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Theories of Information, Communication and Knowledge

A Multidisciplinary Approach

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Chapter 1
Introduction

Thomas M. Dousa and Fidelia Ibekwe-SanJuan

This book addresses some of the key questions that scientists have been asking themselves for centuries: what is knowledge? What is information? How do we know that we know something? How do we construct meaning from the perceptions of things? And how do we communicate this meaning to others—that is to say, inform them? Although no consensus exists on a common definition of the concepts of information and communication, few can reject the hypothesis that information—whether perceived as an "object" or as a "process"—is a precondition for knowledge. Epistemology can be defined as the study of how we know things in general—this is its primary signification in the anglophone world—or, more specifically, as the study of how scientific knowledge is attained and validated—this is how it is conceived in the francophone world. To adopt an epistemological stance is to commit oneself to render an account of what constitutes knowledge or, in procedural terms, to render an account of when one can claim to know something. An epistemological theory imposes constraints on the interpretation of human cognitive interaction with the world. It goes without saying that different epistemological theories will have more or less restrictive criteria for distinguishing what constitutes knowledge from what is not. If information is a precondition for knowledge acquisition, giving an account of how knowledge is acquired should affect our understanding of information and communication as concepts.

While much has been written on the definition of these concepts, relatively few researchers have sought to establish explicit links between differing theoretical conceptions of them and the underlying epistemological stances. This is what this volume attempts to do. The idea for this book came about as the result of a project

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funded by the French Institute of Information and Communication Sciences on the epistemology of information and communication and how it affects interdisciplinarity in scientific research. A colloquium was organised within the framework of this project on the 8th of April, 2011 in Lyon, France which gathered some of the leading specialists on the topic. The current book is a multidisciplinary exploration of how information and communication are perceived in different disciplines and how this affects theories of knowledge. As editors of the volume, we have endeavored to elicit viewpoints from a wide spectrum of disciplines and thus offer readers a diverse but complementary set of studies covering a wide range of theories of information, communication, and knowledge. We hope that the diversity of background of the authors makes for a rich dialogue and so contributes to readers' comprehension, and appreciation, of these fundamental phenomena.

1.1 Structure of the Book

The eleven chapters following this introduction naturally divide into three different clusters, each of which represents a different general way of approaching the phenomena of information, communication, and theories of knowledge:

– Four chapters, written by Søren Brier, Luciano Floridi, Wolfgang Hofkirchner, and Winfried Nöth, offer what can broadly be called a transdisciplinary or even "metadisciplinary" approach to the analysis of information, communication, and knowledge—that is to say, they seek to set forth general models of these phenomena that, in principle, hold good across different disciplinary contexts or, more broadly, across different areas of human life. The studies of Brier and Hofkirchner are explicitly transdisciplinary in their aims: the former sets forth a general theory of information rooted in the author's theory of cybersemiotics (Brier 2008), while the latter builds upon its author's development of a unified theory of information (Hofkirchner 2013). The other two studies provide accounts of knowledge and communication that hold for human activity in the world as such: Floridi provides a general model of the transition from information to knowledge within the framework of the philosophy of information that he has developed over the last decade and a half (e.g., Floridi 2011a), while Nöth gives an analytic overview of the development of semiotic models of human communication over the course of the twentieth century.
– Another set of four chapters, authored by Lyn Robinson and David Bawden, Ian Cornelius, Jonathan Furner, and Birger Hjørland, focuses on conceptions of information and knowledge in relation to a particular discipline that has long had a particular interest in these questions—Information Science (IS). Bawden and Robinson provide a panoramic overview of conceptions of information from a wide range of disciplines and ask both how these theories can inform the theorization of information within IS and how, in turn, theories of information developed within the field of Library and Information Science (LIS) might inform

accounts of information in other disciplines. Furner takes a comparable, but somewhat different, approach that takes the ontology of information as a point of departure: after considering the different possibilities for understanding what information is, he passes in review several representative theories of information from areas outside of IS and asks how theories of information from within the field could enrich these. Cornelius, on the other hand, proposes a theory of information specially to guide information-related practices in IS. Finally, Hjørland considers the implications that taking information as a core concept of IS has for the self-definition of the field: he asks whether one can speak of information science as a single field or a number of closely related fields and raises the question whether, to the extent that one can speak of a unitary field of IS, its primary focus should be on information as such or whether its self-identification should be widened by supplementing the notion of information with that of document.

– The third, and final, cluster of chapters has a more applied flavour, consisting of three papers that detail how the concept of information can be operationalized for the purpose of interpreting the informational contents, in the widest sense of the term, of visual or textual documents in particular contexts. Deploying the notion of information as a process involving the recognition of perceptual differences and the active articulation of these differences into interpretable patterns, Sylvie Leleu-Merviel gives an account of how persons viewing bistable images—i.e., images the form of which can be interpreted in two or more equally valid ways—and pieces of abstract art come to construct meaning from such objects. In a similar vein, Michel Labour demonstrates how viewers' perceptions of the relationships among characters depicted in a short film sequence can be documented by means of a research instrument operationalizing the notion of "informational constructs"—patterns of similarity and difference obtaining between three objects: viewers' reactions to these constructs provide a basis for assessing their perspectives on the film. Finally, Thomas Dousa examines the concept of information underlying the method of "systematic indexing" developed by Julius Otto Kaiser in the early twentieth-century. Positing that textual documents could be decomposed into smaller units of information, Kaiser developed a system of language-based analysis to identify and isolate such information units in a manner that both respected the objective linguistic features of texts and gave indexers scope to exercise interpretative discretion in deciding which elements of a text to foreground in their indexing work.

Although each of these clusters has its own particular thematic emphasis, the demarcation between them is neither hard nor fast. Indeed, there are many links, at different levels, between chapters from different clusters, for different authors frequently invoke the same models to serve as points of reference for the concepts under study within a given context. In other words, the connections between chapters are multilayered so that one can profitably juxtapose chapters from different clusters as well as read together those belonging to a single one. Rather than set forth a review of how the different concepts of information and communication set forth in the individual chapters have been addressed by different authors over time, we shall here take a closer look at the main points of the chapters and give our own analysis of some of the commonalities and differences in the approaches, or perspectives, taken by the different contributors to the volume, in the hope that this will provide a point of entry to readers not familiar with some of the work done in the different areas of specialization represented here.

1.2 Transdisciplinary or Metadisciplinary Approaches to Information, Communication, and Knowledge

We begin with the chapters embodying general, transdisciplinary, or metadisciplinary approaches to information, communication, and knowledge.

As already noted, **Søren Brier** outlines the bases for a transdisciplinary theory of information rooted in the general framework of cybersemiotics. The main thrust of his chapter is that, ultimately, any truly adequate transdisciplinary theory of information must account for human experience—individual and collective—as well as the properties of the physico-chemical and biological world within which this experience unfolds. Passing in review a number of what he characterizes as syntactic and semantic theories of information based on classical information theory, first-order cybernetics, and pan-computationalism, he finds them wanting because they ultimately cannot account for such "phenomenological" elements of human experience as first-person consciousness or the ability to formulate and communicate interpretations of phenomena in the world. He also considers systems-theoretical accounts of information that have attempted to integrate socio-cultural phenomena more fully into their framework, above all Luhmann's ambitious systemic theory of communication: these, he argues, falter because they do not provide a sufficient ontological grounding for the phenomenology of individual experience. Ultimately, he argues, one must take recourse to the semiotic pragmaticism of the nineteenth-century American philosopher Charles S. Peirce, which, he contends, provides the foundation for such a phenomenology: integrated with elements of Luhman's theory, it forms the basis for cybersemiotics. On this view, we must take "our daily, lived semiotic, social and linguistic practice"—the product of "a communicative and semiotic mind"—as a point of departure and combine it with a semiotically oriented theory of information that connects it to other levels of existence.

To this end, Brier discusses Peirce's own theory of information, which has recently received extensive treatment by Nöth (2012). Peirce viewed information within the logical framework of the proposition. He held that symbols conveyed information and that the information conveyed by any given symbol was "the sum of synthetical propositions in which the symbol is subject or predicate", each symbol in the propositions having its own logical "breadth" (i.e., extension) and "depth" (i.e., intension). Important is the fact that, if a symbol was to be informative, the propositions in question had to be "synthetical" in nature. That is to say, the symbol was brought into relation with other symbols that did not simply recapitulate parts of its semantic content in the manner of analytical propositions, but represented something new to the semiotic mind, or interpreter, to which they were presented. This meant that the prior knowledge of interpreter confronted with a given symbol determined, to a degree, its informativeness of the symbol. For Peirce, information was thus both objective (in that it had to do with that which is real) and interpreter-dependent and thus provided a link between a semiotic mind and the world as such; Brier argues that, updated and incorporated into a broader cybersemiotic framework, such an information concept can account for all the different aspects—physico-chemical, biological, cognitive-phenomenological, and socio-cultural—of the world that must be integrated into a truly transdisciplinary framework.

In a vein similar to that of Brier, **Wolfgang Hofkirchner** seeks to develop a holistic, transdisciplinary account of information spanning the physical, biological, and social domains. In his contribution to this volume, however, he focuses his attention primarily on "social information", that is to say, any informational phenomenon involving human beings. His concern is both to characterize social information and to set forth methodological criteria for studying it within the framework of a Unified Theory of Information (UTI). With regard to methodology, Hofkirchner argues that the study of social information should base itself on what he terms a praxio-onto-epistemology (POE). On this view, epistemology foregrounds the subject's knowledge of the world and ontology, the things existing in the world: onto-epistemology represents a combination of these two approaches that combines epistemological constructivism with ontological realism. Praxiology, in turn, represents the study of human action, or co-action, upon the reality posited by onto-epistemology. For Hofkirchner, then, praxiology builds upon ontology, which itself builds upon epistemology. In addition to adopting a POE framework, the study of social information must adopt what Hofkirchner terms "integrative thinking", so-called because it "integrates the epistemological third-person view of "hard" science with the first-person view of "soft" science" and, by the same token, considers information to have both a material and an ideational component—a position that is compatible with the further view that information is an emergent phenomenon that evolves over time. In Hofkirchner's view, the adoption of "integrative thinking" and the assumptions that it involves is a *sine qua non* for a truly transdisciplinary theory of information.

Social information builds upon self-organizing processes already immanent in non- or, if one will, pre-human, systems : however, its *propria* are the functions of cognition, communication, and co-operation. In terms of cognition, it involves a movement from percepts, through knowledge, or the interpretation of percepts, to wisdom, or the relation of knowledge to goals in the world. In terms of communication, it features the use of symbols to convey knowledge about the world within human systems. Like Brier, then, Hofkirchner considers semiosis to be an indispensable feature of social information, although he arguably accords it a less central place within the overall structure of UTI than is the case for cybersemiotics. Co-operation, on the other hand, involves the generation or use of social information to adjust the *Umwelt* to human needs in accordance with expectations of efficiency, the support of human life, and the encouragement of human flourishing : here, then, information becomes the basis for joint action on a societal level. All in all, Hofkirchner's highly systematic account of social information and how to study it links this mode of information to the realm of human purpose and action, while finding continuities between social information and its physico-chemical and biological substrates.

Whereas Brier's and Hofkirchner's essays draw upon the traditions of cybernetics and systems theory to construct proposals for explicitly transdisciplinary theories of information, **Luciano Floridi's** chapter forms part of a project to develop a philosophical account of semantic information. Its goal is not to serve as a stepping-stone to a theory of information reconciling the diversity of information theories in the various disciplines forming sectors of human knowledge but rather to furnish an element of a philosophically satisfying account of the relation of information to knowledge in general: in this sense, it is "metadisciplinary". Taking as his point of departure the view that "information—understood as well-formed, meaningful, and truthful data—upgrades to knowledge if and only if it is correctly accounted for", Floridi considers two related questions. First, he asks, if knowledge is accounted information, then does knowledge obtained through perception of things in the world or knowledge by testimony about them constitute knowledge in the strict sense of the word, as is often assumed? He argues that they do not, on the grounds that acquiring data directly by one's senses (i.e., perception) or at second hand (i.e., testimony) does not entail an ability to interpret it so as to generate a meaningful account of it or, in other words, to understand it: insofar as understanding is requisite for considering an epistemic state to be one of knowledge, perception and testimony are best characterized as processes of data acquisition or provision that are necessary to, but not sufficient for, the generation of knowledge.

Floridi's second question builds on the notion of perception and testimony as data providers: if one accepts that, by themselves, perception and testimony lead to the acquisition of data but not knowledge as such, then how can one account for the conversion of the data so acquired into knowledge on the part of an epistemic agent? Or, to put it in simpler terms, how does one get from data to full-blown empirical knowledge? Taking perception as the more fundamental of the means of data provision, Floridi presents an elaborate model of how the transition takes place. Taking as a premise that, to be exploitable as information, data must be encoded in some way and processed by an epistemic agent, he draws upon Shannon's information-theoretical model of communication as a framework for viewing "data as signals … elicited by the nomic interactions between types of systems and types of agents". Such a data-processing model, he shows, can account for an epistemic agent's interpretation of the natural meaning of signals—i.e., the "objective" meaning of signals emitted by natural objects—but does not offer adequate explanation for how epistemic agents come to generate non-natural meaning—that is to say, the conventional meaning that is attributed to objects within the framework of human culture—from their perception of these signals. Non-natural, or conventional, meanings, Floridi argues, come about through human repurposing of natural meanings or, as he arrestingly puts it, “human beings are natural-born data hackers”. The repurposing of natural data, however, is not an arbitrary process. Data are “constraining affordances” in that they set limits (constraints) based on the objective natural state of the world that they represent and yet are “affordances” in that they are open to human interpretation and manipulation, which leads to the formulation of non-natural meanings. In short, the movement from perceptual data and data derived from testimony to information and, ultimately, knowledge involves the articulation of the inputs from the world in an manner that does not simply recapitulate them but transforms them in an inventive and creative manner. For Floridi, then, knowledge is the product of creative, yet constrained, construction of meaning that both decouples and recouples human beings from and to the world that they inhabit.

Unlike the preceding chapters, the focus of which are theories of information, **Winfried Nöth’s** contribution takes as its primary theme the phenomenon of communication, which he considers within the framework of the field of semiotics—that is to say, the study of signs. Distinguishing between the semiotics of signification (i.e., the study of natural signs occurring without communicative intent) and the semiotics of communication (i.e., the study of conventional signs used intentionally to mediate meanings among human beings), Nöth offers the reader a wide-ranging overview of modern semiotic theories of human communication. After discussing the classical communications models of the two “founding fathers” of semiotics, the Swiss linguist Ferdinand de Saussure (1857–1913) and the American philosopher and logician Charles S. Peirce (1839–1914), he examines, in turn, functional models of communication that elaborate the distinction between communication and signification and, as the name of the category implies, seek to identify the different functions of the former process; models of communication rooted in cybernetics and information theory, including code models, which frame communication as the transmission of a message, encoded in signals, from a sender to a receiver, and cultural semiotic models that go beyond code models by accounting for the social background to the differences between the senders’ and receivers’ interpretation of a signs; and, finally, the Franco-Lithuanian semiotician Algirdas Greimas’s (1917–1992) view of communication as social action on the part of an addresser (i.e., sender) *vis-à-vis* an addressee (i.e., receiver), in which he foregrounded the intention of the addresser and the different discursive roles that the latter might take in conveying knowledge to others.

Nöth draws two broad conclusions from his examination of the foregoing theories. First, he notes that semiotic models of communication represent a number of diverse approaches to their object, some of which intersect or complement one another, but many of which are, ultimately, incompatible : in view of the divergence among them, it would be “inappropriate” to imagine that one could isolate a single common denominator to create a single grand, unified semiotic theory of communication. Second, he discerns a general tendency among semioticians over the last half-century to move away from models rooted in Shannon and Weaver’s mechanistic view of communication, according to which a sender encodes a message into a series of signals that are transmitted across a channel and then, ideally, decoded by a receiver, to ones that downplay the autonomy of the sender, place greater stress on that of the receiver, and attribute agency to the signs that constitute the objects of communication. In other words, there has been increasing recognition of the full complexity of communication as a process in which the sender, the receiver, and the sign itself all take an active role in shaping what, precisely, gets communicated.

Despite the fact that Brier's, Hofkirchner's, Floridi's, and Nöth's chapters reflect different research programs, derive from different disciplinary discourses, and approach their chosen themes from different theoretical perspectives, there are points of convergence between them. One theme that runs through all four essays is that, whereas the classical information-theoretical model of communication developed by Shannon and popularized by Weaver (Shannon and Weaver 1998 [1949]) has been historically influential and, *mutatis mutandis*, remains useful for thinking about information in certain theoretical contexts, it does not provide adequate resources for understanding how human beings derive meaning from, employ, and communicate information: any account of how epistemic agents convert information into knowledge and of the mechanisms by which they impart it to their fellows must take into consideration the intentional interpretative dimensions of these acts. It is unsurprising, then, that all four authors endorse, in one way or another, a view of information and/or communication that allows for the active construction of meaning. On the other hand, each, in his own way, acknowledges that there are certain limits to this construction—namely, those aspects of the external world, communicable and construable as signs or, if one will, data, upon which interpretation works. On this view, both "objective" and "subjective" factors enter into the communication of information and the constitution of knowledge.

Yet if these authors are in general agreement as to some of the basic parameters of an adequate theory of information and/or communication, they manifest less consensus regarding how to deal with the plethora of different theoretical accounts of these phenomena that are on offer today: for example, Brier and Hofkirchner both posit that it is desirable to develop a single, overarching theoretical framework capable of covering the full spectrum of informational phenomena in a non-reductive way, while Nöth argues that, at least within the context of semiotics, the diversity of available models of communication is such that no single theory can fully reconcile them. This tension between the one and the many is one that recurs in other chapters of this volume, especially those belonging to our second thematic cluster, to which we now turn.

1.3 Theories of Information and Information Science

As its very name suggests, Information Science (IS) is a field in which the concept of information occupies a central place. It is unsurprising, then, that, over the last half-century, a number of different theoretical accounts of information have been proposed within the discourse of IS and researchers within the field have taken a vivid interest in the accounts of information in disciplines outside of their own (for representative overviews, see Bates 2010; Case 2008, 39–67; Capurro and Hjørland 2003, 377–396; Cornelius 2002; Furner 2010; Ibekwe-SanJuan 2012, 1–57). While this theoretical pluralism has undoubtedly enriched the intellectual space of IS and motivated a diverse range of research programs, it has also led scholars of IS to consider such issues as the theoretical adequacy of the field's information concepts, the epistemological bases underwriting its research, and, more generally, its self-identity as a discipline. The chapters by Lyn Robinson and David Bawden, Jonathan Furner, Ian Cornelius, and Birger Hjørland address, each in its own way, questions of how information can be conceptualized within the framework of IS and how IS is to relate to concepts of information developed in other fields.

Robinson and Bawden engage the question of theoretical pluralism by means of a high-level review of information concepts from five different domains—information and communications technology, the physical sciences, the biological sciences, social and human sciences, and philosophy. Noting that the currently regnant accounts of information in IS tend to emphasize the social dimensions of the phenomenon, they pay special attention to those concepts from domains less represented in the discourse of IS, in particular information physics and information biology, as well as the historically significant information theory of Shannon and Weaver, which they characterize as "the closest approach yet available to a universal formal account of information". Comparison of information concepts drawn from these different sectors of human intellectual endeavor leads Robinson and Bawden to identify a general pattern of differences, or gaps, between them. They distinguish between domains in which "information is treated a something objective, quantitative, and mainly associated with data" and those in which information is "treated as subjective, qualitative, and mainly associated with knowledge, meaning, and understanding": physics and information communications technology stand at the former pole and social and human sciences at the latter, while biology lies between the two, though with a propensity towards the former, and philosophy harbors conceptions of information derived from both. The discontinuity between the objective/quantitative/physical and subjective/qualitative/semantic families of information concepts inspires Robinson and Bawden to ask whether it is possible to bridge the gaps between them and whether it is worth the while of information scientists to try and do so, especially in a disciplinary context in which the subjective/qualitative/semantic accounts of information occupy pride of place. Although the first question, in their view, remains *sub iudice*, they give an affirmative answer to the second: in particular, they encourage information scientists to pay greater heed to the information concepts developed in the physical and biological sciences, in the hope that consideration of these may lead to new and fruitful developments in thinking about information within IS.

Robinson and Bawden's contrast between objective/quantitative/physical and subjective/qualitative/semantic concepts of information echoes similar distinctions made by Brier, Hofkirchner, and Floridi in their accounts of information and, much like Brier, they associate these different families of concepts with different disciplinary formations. However, unlike Brier and Hofkirchner, Robinson and Bawden are not sanguine about the prospects of developing a single, transdisciplinary theory of information covering the physical, biological, psychic, and social levels of existence: they consider it more likely that confrontation of various conceptions of information can lead to cross-fertilization among different theories and so accept theoretical pluralism as an inevitable condition of research within IS. Robinson and Bawden's acceptance of theoretical pluralism is connected to another aspect of their chapter that provides an interesting counterpoint to Brier's—namely, the kinds of emphasis they place upon different kinds of information concepts: Robinson and Bawden urge IS researchers to pay greater attention to physical and biological accounts of information, whereas, as we seen, Brier places greater emphasis on the "phenomenological" side of information, on the grounds that the kinds of approaches to information developed in the physical and biological sciences are not sufficient to develop a unified, comprehensive account of information.

Furner also takes theoretical pluralism as the theme of his chapter, which he develops in two distinct but related ways. First, he argues that different concepts of information found within and without IS can be usefully characterized by the kinds of claims that they make, explicitly or implicitly, about the ontological status of information—that is to say, about what kind of entity they take information to be. Adopting philosopher Jonathan Lowe's (2006) four-category ontology—which operates along the two-fold distinction between substance and property on one hand and type and instance on the other—as a framework, he suggests that different accounts of information could conceivably understand it as a kind, or type of substance; as an object, or instance of a substance; an attribute, or type of property; or a mode, or instance of a property. Applying this ontological framework to a close and searching analysis of a single, well-known family of information concepts, namely probability-theoretical concepts, Furner demonstrates that making a distinction between information and informativeness—that is to say, something being information and something being informative—can aid in differentiating between conceptions of information *qua* substance or object on the one hand and information *qua* property or mode on the other: if informativeness is viewed as a property of information (i.e., if information *has* informativeness), then information must be a kind of entity or a concrete instance of that kind; however, if being information is equated with being informative (i.e., if information *is* informativeness), then information must be a property or a concrete instance thereof.

Having developed a framework for categorizing concepts of information on the basis of ontology, Furner goes on to undertake a selective survey of some representative theories of information developed beyond the ambit of IS, choosing as examples a version of the information-theoretical account of information developed by the mathematician Anatoly Rapoport (1955); the view of information developed within a theory of "information physics" by the biologist Tom Stonier (1986), and a hitherto little-discussed semiotic account of information by the philosopher Agnès Lagache (1997), as well as two recent reviews of information concepts by scholars operating outside of the field of IS. The theories considered are drawn from the two poles of information concepts—"objective/quantitative" and "subjective/qualitative"—

identified by Robinson and Bawden: Rapoport set forth a probability-theoretic—that is to say, quantitative—theory of information and Stonier viewed information as a basic constituent of the physical world alongside mass and energy, while Lagace treated it as the product of the interaction between material signs and their human interpreters, thus placing herself within the camp of those for whom information is qualitative and relational. Yet, interestingly, if one applies Furner's ontological grid of analysis to these quite disparate theories, unexpected convergences occur: for example, he shows that, despite the profound theoretical differences between them, Rapoport's notion of information as a quantity and Lagache's as the product of interpretative activity are each based on the underlying ontological presupposition that, in any concrete informational situation, information is informativeness: that is to say that, within the framework of Lowe's ontology, both would fall under the heading of information as a mode. An ontologically-informed approach to categorizing concepts of information, then, provides a new and original way through which to make sense of the multiple theories of information on offer across the disciplines.

Furner closes his chapter with some general considerations about the implications of ontology as a tool for thinking about information theories within the discourse of IS. Noting the wide range of information concepts invoked in this field, he suggests that this reflects a diversity of ontological commitments, as well as epistemological perspectives, among IS researchers, who often draw heavily upon notions of information generated in other disciplines. He also observes that, by contrast, relatively few scholars working outside of IS make use of the theories of information that have been developed within it. The relatively low profile of IS-derived theories of information beyond the field deprives scholars in other disciplines of the opportunity to benefit from the ontological diversity of its information concepts. One of the challenges facing theorists of information in IS, Furner concludes, is "to specify with precision whatever it might be that is distinctive, and distinctively useful" about the conceptions of information that have been developed within their field and to make this visible to those non-IS scholars interested in the phenomenon of information.

Furner's chapter, like that of Robinson and Bawden, examines how scholars in different fields have sought to answer the question "What is information?". Both chapters also consider the implications of theoretical pluralism for IS, though with somewhat different emphases. Robinson and Bawden are interested primarily in the question of how practitioners of information science can best utilize concepts of information derived from other disciplines, whereas Furner discusses the possibility of raising the profile of information concepts developed within IS so that they can inform work of scholars in other disciplines.

Cornelius takes a substantially different approach to the question of information concepts and IS. In his view, the primary goal of a theory of information should be to provide foundations for IS as the discipline that sets the theoretical tone for the practices of information professionals such as librarians, archivists, and other managers of information resources. The information professions, he contends, specialize in distinct practices having to do with the provision of access to (sources of) information. Such practices require a theory of action and, insofar as action is based on knowledge, a theory of action presupposes a theory of knowledge or, if one will, information. For Cornelius, then, it is less important to define what information *as such* is—in other words, to answer the question “What is information?”—than it is to construct a conception of information that can define the scope and justify the function of IS as a field having to do with supporting information work. Within the context of information seeking, that which counts as “information” is relative to the particular kind of social practice within the framework of which it is sought and used: as he puts it, “[t]he ‘information’ that we seek is not just something ‘out there’ which we have to uncover, it is something that happens to match the conditions of our request ... It is the context of the practice that makes something information”. In this colloquial sense, information is, so to speak, a role that is assigned to a given object in the course of an inquiry that a searcher has undertaken with a particular purpose in mind. However, Cornelius goes on to argue, information can be understood in another, more processual sense that finds expression in what he calls a normative theory of information. On this view, information is construed not as “the final retrieved objects in any enquiry” but rather as “the logic that determines what type of statement would constitute an answer to the enquiry” in question. Finding aids created and deployed by information professionals, such as indexes, catalogs, classifications, etc., serve as mechanisms that indicate “what if anything matches the normative standard we develop in any inquiry”: as such, they anchor the activities of information professionals within the logic of inquiry and so provide a *raison d’être* for the information professions. In this way, according to Cornelius, a normative theory of information can support a theory of action specific to information work and so serve as a basis for defining the scope and nature of IS *qua* discipline.

Cornelius’s conception of information as a standard for determining what constitutes an ideal outcome for a given search after informative objects is based on the axiom that information is constructed within the context of a given social practice. It is unsurprising, then, that, unlike Robinson and Bawden, he does not believe that objective, quantitative, or physical models of information have much to contribute to IS: indeed, his thoroughgoingly constructivist account of information conditioned by social practice encourages a conception of IS as a discipline much more closely aligned to the model of the social and human sciences. This is not to say that adopting a normative theory of information as a general framework for IS need preclude efforts to define information as a phenomenon in itself: as Cornelius himself puts it, “[t]here is still the possibility of finding a definition of information “out there” in the world”. However, he maintains that, insofar as “‘the world’ is itself a constructed concept”, any such definition is bound to be “procedurally rather than substantially effective”: ultimately, in his view, a theory of information should support action rather than account for information as such.

Unlike the transdisciplinary accounts of information set forth by Brier and Hofkirchner, Cornelius’s normative theory of information is ineluctably bound up with a particular discipline—IS—and is designed to undergird the self-identity of that discipline. The theme of disciplinary self-identity also looms large in

Hjørland's contribution to this volume. Hjørland, however, approaches the issue from a different angle. Rather than seeking to develop a concept of information that might underwrite IS as a discipline, he considers the implications of identifying IS as a science of information in the first place. To this end, he reviews various conceptualizations of the field as revealed by the names that it and closely cognate domains have historically borne. Hjørland shows that the notion of the field known today as IS as a science of information is a relatively recent one, which came to the fore only the 1960s. IS—or, in its hybrid form, LIS (Library and Information Science)—emerged from a confluence of traditions of theory and practice conceptualized as Library Science (itself a development from Library Economy), Bibliography, and Documentation. Over the last 40 years, as computer-based technologies have become increasingly pervasive and management—already implicit in such earlier notions of the field as that of Library Economy—has re-emerged as a key conceptual marker, the idea of a field devoted to the study of information and techniques for handling, or managing, it has given rise to a host of information-related disciplinary concepts such as those of Informatics, Information and Communication Technology, Information Systems, Information Management, and Informing Science, in which information is frequently conceptualized as a kind of processable entity. Hjørland, who otherwise favors a "subjective/situational" account of information (Hjørland 2007), finds the focus on information as a processable entity to be disquieting, for, in his estimation, it encourages an uncritical privileging of practicalist, technological-driven, and systems-oriented approaches to dealing with informational problems at the expense of the human, social, and cultural concerns that, in his estimation, have traditionally been an ineluctable part of the bibliographical and documentalist traditions—a perspective that clearly converges with that of Cornelius. Accordingly, he argues that the field known today as IS would be better characterized as "Library, Information, and Documentation Science".

The different names associated with IS over the course of its history reflect what Hjørland terms a "level of disagreement" over the self-identity of the field. In his view, it is perhaps the most visible manifestation of a number of other points of disagreement as to how an academic discipline devoted to information should be constituted. Among these, the most fundamental is at the level of disciplinary "paradigms" or "metatheories"—that is to say, the sets of epistemological assumptions and presuppositions about what information is and how informational problems are best approached—where, he notes, a number of different options are currently on offer. Hjørland worries that metatheoretical heterogeneity, which reflects the historically multidisciplinary nature of IS and, of course, goes hand-in-hand with theoretical pluralism, threatens the intellectual coherence of the discipline: in his view, "the basic problem for LIS seems at the moment to be a lack of sufficiently strong centripetal forces keeping the field together". Accordingly, he calls upon students of IS to consider anew the goals of their field and to specify more explicitly, within its different research traditions, "what difference it makes whether one or the other paradigm and philosophical position is taken as the point of departure". An integrative, centripetal approach to IS that takes the full measure of both its epistemological bases and its documentalist and bibliographical roots, he argues, can strengthen it overall as a field within the cosmography of academic disciplines: the alternative, he warns, citing Cronin (2012), is "epistemological promiscuity", which, in his estimation, can only weaken IS as a whole.

The authors of the four preceding chapters, take markedly different views towards the question of (meta)theoretical pluralism *vis-à-vis* the conceptualization of information in IS. Hjørland and Cornelius represent what the former would term a centripetal approach to the issue. Both maintain that IS will benefit from developing a unitary (meta)theoretical framework within which researchers can develop their conceptualizations of information: Cornelius believes that his proposal for a normative theory of information provides such a framework, while Hjørland argues in more general terms for greater attention to the social and epistemological dimensions of information work. On the other hand, Robinson and Bawden, as well as Furner, tend to regard the pluralism of information concepts, both within and without IS, in a more favorable light: in their eyes, different accounts of information offer researchers a greater variety of resources with which to stimulate the theoretical imagination as they seek to make sense of the spectrum of informational phenomena confronting members of the information professions today.

1.4 Information Operationalized: The Concept of Information in Action

According to Cornelius, a theory of information ideally serves as the basis for some sort of activity in the world. In his chapter, he deals primarily with the kind of activity that has traditionally been the concern of information professionals: namely, the discovery and retrieval of informative objects or resources. However, his insight can easily be extended to cover other kinds of activity as well: for example, properly operationalized, a theory of information can provide the foundation for research on how people come to make sense of the various kinds of informative objects that they encounter in the world. The final three chapters, written by Sylvie Leleu-Merviel, Michel Labour, and Thomas Dousa, are case studies in how the general concepts of information can be operationalized and applied either to research on human understanding of particular kinds of documents (Leleu-Merviel, Labour) or to the constitution of practical tools to support information retrieval (Dousa).

Leleu-Merviel, deploys a theory of information to explicate how people come to make sense of visual images, especially when these are ambiguous and can be interpreted in different ways. She takes as her point of departure Floridi's (2011b) general definition of information, according to which information consists of well-formed and meaningful data. The basis for data are pre-epistemic *dedomena*—that is to say, "ruptures in the fabric of being", that give rise to signals, which, in turn, provide the conditions of possibility for symbols. Drawing also on Bates's (2005) account of information as "a pattern of organization of matter and energy that has been given meaning by a living being", Leleu-Merviel posits that once the signals and symbols that arise from differences in the environment are sensed and observed by a "cogitative agent", they assume the status of data. Now the cogitative agent—in the case at hand, a human being—does not passively take in the signals or symbols with which it is confronted, but forms higher-level patterns from them on the basis of its particular subjectivity, spatial position, temporal situation, social location, and experiential background: in other words, data are constructions selectively derived from the sets of signals of which a person becomes aware and observes in his or her interaction with the world. On this view, then, information is "the raw material of a meaning-making process that provokes a response to the external world". Data represent aspects of the world which can be articulated by the human mind into different relational configurations that Leleu-Merviel names "lictions". Lictions, in her view, are the "result of the creation of tension between different aspects; they lead to a combination of representations created at a higher level and so help to bring about innovative understanding". In short, meaning is constructed from data through a process of interpretation that imposes a pattern upon them. In this respect, Leleu-Merviel's account of how meaning is constructed irresistibly reminds one of the Floridi's thesis that human beings are "natural-born data hackers".

Leleu-Merviel exemplifies this model by means of the famous image of the "duck-rabbit", a single set of lines and dots that can be alternatively interpreted as representing the head of a duck or that of a rabbit. In this case, the visual elements of this bistable image form two separate lictional patterns, either of which is an appropriate interpretation of the image because the patterns are visually compatible and so "coalesce". On the basis of her analysis of the duck-rabbit as well as other bistable paintings, Leleu-Merviel argues that, in the case of visual images, a human being assumes that the image is a sign and seeks to interpret it: he or she captures data and relates the various aspects of the image until the lictional pattern results in a pattern that credibly fits the context of interpretation. The process of making sense of a bistable image in this way is constrained by an individual's "horizon of relevance" which involves both individual perspective and knowledge as well as socio-cultural background and experience. While Leleu-Merviel posits that making sense of visual images is an irreducibly individual and, in many ways, incommunicable experience, she also points out that the semiotic properties of images can serve as a basis for the development of socially shared meanings regarding their attributes: in her view, such meanings represent a normalized form of sense-making by which certain interpretations of images (or aspects thereof) become shareable and communicable within a given socio-cultural community. The understanding of visual images thus constitutes an informational process that has a collective, as well as an individual, dimension.

Like Leleu-Merviel, **Labour** deploys a concept of information to analyze the process of sense-making with regard to visual images, albeit ones of a different type—namely, motion pictures. His chapter reports on part of a research project the purpose of which was to examine how persons watching a snippet of a film they had not seen previously came to decide whether, on the basis of the preview, they wanted to see the entire film or not. To this end, Labour developed an operationalization of sense-making based on the notion of "informational constructs". Like Leleu-Merviel, he took Floridi's (2011b) general definition of information, with its emphasis on data as based on the observation of differences in the world, as a starting point. According to Labour, such differences can be captured by means of "informational constructs", an epistemological concept adapted from a theory of "construing" originally developed by the cognitive psychologist George Kelly (1955/1963). According to Kelly, construing involves "abstractive sense-making", wherein a person isolates three salient reference points with respect to a perceived phenomenon and notes the way in which two of these reference points share a similarity that differentiates them from a third (pp. 50, 59, 111). This configuration of two reference points *vis-à-vis* a third, constitutes what Labour calls an informational construct, of which he presents a detailed formal model.

In his study, Labour applied the notion of informational constructs to an analysis of certain scenic elements within a snippet of film depicting a car chase in a busy city centre, a scenario that featured three primary kinds of character types—pursuers in one car, the pursued in another car, and passers-by. Using these character types as reference points, he created an interview template for persons watching the snippet on which to document their information constructs: the triadic grid. This grid, which listed the three character types in question served as a mechanism by which viewers of the film snippet could record (1) the ways in which they construed the character types—that is to say articulated them into informational constructs in each of which two of the types formed a dyad sharing an attribute that the third didn't possess—and (2) their subjective reactions ("likes/dislikes") to the attribute-based configuration of dyad vs. the third. Although we cannot undertake here a full description of how the triadic grid "worked", its essential features are clear: it served as an instrument for capturing both the objective structural elements of the film snippet's scenario and the viewer's interpretation of, and reaction to, these elements. In this respect, it embodied "the guiding assumption" of Labour's study—namely, that "a decisional sense-making process consists of a user's ability to interrelate a series of informational constructs construed from what the person considers as salient data".

The filling out in the triadic grid formed one element in the sense-making process of the viewer of the film. The other major element was an interview, in which viewer and researcher conducted a dialogue about why the former had filled out the triadic grid in the manner that he or she had. Such a dialogue, Labour argues, added a social dimension to the sense-making process and allowed for a dialectic "fusion of horizons" in which the viewer sought to articulate his or her rationale for the informational constructs and his or her affective rationale for liking or disliking the component elements of these constructs. Taken together, the triadic grid and interview offered insight into what individual viewers liked or didn't like about the film snippet as they interpreted it and why: in this way, it contributed to the ultimate project of tracing the formation of the viewpoint on the basis of which they decided whether they wanted to see the rest of the film or not. All in all, Labour's development of the notion of informational constructs and his deployment of them in the formulation of the triadic grids is an especially potent example of how a given conceptualization of information—*in casu*, as a pattern of salient data perceived and constructed by human beings—can be effectively operationalized for the purposes of social-scientific research.

Whereas Leleu-Merviel's and Labour's studies both deploy the concept of information to examine how people make sense of visual documents, **Dousa's** chapter offers a historical case study of how presuppositions about textual information can shape the design of a highly traditional mechanism for the retrieval of information: the subject indexing system. Historically, many such systems have taken the form of documentary languages—that is to say, more-or-less artificial languages consisting of a finite, (typically) controlled vocabulary of terms and sets of syntactic rules for combining these into more complex expressions. Most such documentary languages have been applied to the retrieval of documentary units, such as books or journal articles. However, in the late nineteenth and early twentieth centuries, well before the category of "information" became a theoretical watchword, some workers in the then nascent fields of documentation and special librarianship, operating on the assumption that documents represented recorded information, began to develop techniques for conceptually decomposing textual documents into smaller units of information and characterizing the informational content of these units by means of documentary languages, an approach that can be designated as information analysis. Dousa examines the method of information analysis elaborated by the special librarian and indexer Julius Otto Kaiser (1868–1927), who called his technique "systematic indexing" (Kaiser 1911).

Like most indexers, Kaiser was interested primarily in textual information: spending most of his working career as a librarian for business organizations, he developed his system to deal primarily with what he called business literature. Dousa argues that Kaiser considered textual information to have both an epistemological and an ontological component. On one hand, he believed that "[r]ecords represent knowledge and give information" (Kaiser 1911, § 53): that is to say, information was derived from textual representations of a writer's knowledge about a given subject. On the other, he held that insofar as information was "conveyed by written language" (§ 297), it could be treated as a kind of processable thing. Kaiser's view of knowledge was essentially empiricist and perspectivist in tenor. He believed that all knowledge ultimately derived from human observation of things in the world; at the same time, he also maintained that "observation is individual" (§ 57) and that any description of things in the world resulting from observation would thus be inevitably colored by the perspective of the observer. Furthermore, he considered the textual representations of information to consist primarily of what he called "facts and opinions" (§§ 79, 115)—more precisely, statements of fact and expressions of opinion: in other words, the information conveyed by business literature was composed of statements evaluable in terms of truth and falsity with some having greater claim to truth than others. Finally, he believed that, whereas written language represented information, that it was an inherently imprecise and semantically labile medium for communicating knowledge: in his view, there was no assurance that the creator of a written document would express his thoughts exactly in the text that he produced nor that his readers would interpret the text in the manner that the author intended. In short, characterizing the informational contents of a text for the purpose of information analysis required an act of interpretation on the part of the indexer.

Kaiser's method of information analysis reflected his general view of textual information as a representation of human knowledge conveyed by what he saw as the semantically imprecise medium of language. He believed that any given text could be decomposed into smaller information units on the basis of the subjects of which it treated. He sought to minimize the possibility of misinterpretation by stipulating that indexing terms were to be derived, whenever possible, directly from the text being indexed: which terms were chosen was left to the discretion of the indexer. All selected terms were to be assigned to one, and only one, of three categories—terms for concretes (i.e., self-subsistent things in the world), terms for countries, and terms for processes (i.e., the activities or conditions attaching to a given concrete). These three categories of terms formed the building blocks for what Kaiser called "statements", or compound index terms formulated according to strict syntactic rules that combined terms for concretes and/or countries with those for processes. Such statements defined the semantic limits of a unit of information and served as the basis for the creation of "index items" containing extracts from, or abstracts of, portions of a document dealing with the subjects so defined: in other words, Kaiser made use of a documentary language as a means of demarcating pieces of information within any given text. Dousa shows that, ultimately, Kaiser's method of information analysis both made allowances both for the objective linguistic features of texts and gave indexers a degree of interpretative freedom in establishing the boundaries of information units conveyed by those texts.

Although Kaiser developed his method of systematic indexing at the beginning of the twentieth century, the manner in which his conceptualization of information shaped his analysis of the informational content of texts bears some broad similarities with the operationalization of information concepts by present-day researchers. For example, much as Labour used the concept of informational constructs in his study as a structural principle with which to create units of analysis with regard to salient features of visual documents (*in casu*, film), so did Kaiser use the statement as a structural principle by means of which to generate units of analysis with regard to salient features of textual documents. Another point of convergence is that both Labour and Kaiser acknowledge—each within his own particular theoretical frame—the importance of interpretation in the construction of these units; both use formal structures in an essentially hermeneutical manner to make sense of the informational contents of the documents with which they are concerned. In this, they recapitulate the by now familiar scenario of interaction between data ultimately derived from features of the world (whether these latter be the *dedomena* characterizing concrete things in the world, the elements of a visual image, or the linguistic signs in a text) and the mind of a human interpreter that, *mutatis mutandis*, underlies the concepts of information in Brier's, Hofkirchner's, Floridi's, and Leleu-Merviel's chapters.

1.5 Envoi

As our overview of the contributions to this volume shows, there is a wide range of views among scholars interested in informational phenomena regarding the nature of information, its relationship to knowledge and communication, and the most appropriate ways or frameworks within which to conceptualize it. The 11 studies presented here represent only a small *sondage* from an extensive and ever-increasing literature, much of which can be pursued through the bibliographies given at the end of the chapters. Yet even a small sample such as this is sufficient to indicate some of the major themes that are dominating current thought about information as an epistemological phenomenon and how it should be approached. Two such themes are especially prominent and worth singling out.

One touches on the scope that a theory of information should take. We have seen that some scholars seek to create a single, integrated theory of information that can account for manifestations of the phenomenon across all levels of being and applicable to all disciplines (e.g., Brier, Hofkirchner), whereas others endorse discipline-, domain-, or practice-bound theories of information (e.g., Cornelius): the latter, as the example of Kaiser shows, have a long history. A somewhat different version of the tension between unicity and pluralism is also evident at the level of the discipline arguably most closely bound up with the study of information: IS. As we have already noted, some scholars prefer what Hjørland has characterized as a "centripetal" approach to (meta)theories of information (e.g., Cornelius, Hjørland), others expect and even welcome the plurality of information concepts on offer within that and other fields (e.g., Furner, Robinson and Bawden).

The other has to do with the nature of information as such. Although different commentators include different phenomena under the rubric of "information" and conceptualize it in different ways, the authors of most of the chapters in this volume accept the premise that both data derived from observation of things in the world and the mind of the cognitive agent who operates upon these data contribute to the constitution of information. On this view, information is neither simply a representation of the world as it is *in se* nor is it a pure construction on the part of the cognitive agent operating within it: rather it is a synthesis of data grounded in human interaction with the world and creative interpretation of the meaning of that data on the part of a cognitive agent *qua* individual and social being. The general tendency to take a moderately constructionist view of information as the result of interpretative activity upon data naturally suggests that the next great frontier in the study of information may lie in narrowing the gaps between "objective" and "subjective" conceptions of information, as Robinson and Bawden suggest and as Brier, Hofkirchner, and Floridi seek to do, within their respective theories of information.

Needless to say, these two themes—that of the one and the many and that of the composite nature of information *qua* onto-epistemological phenomenon—do not exhaust the links tying together the studies in this volume: the attentive reader will discover further points of convergence or, as the case may be, disagreement among them. We leave him or her to explore the following chapters at his or her leisure, with the hope that he or she will find the experience intellectually pleasurable, profitable, and, above all, *informative*.

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[2] See EPICIC's website for more details: http://www.epicic.org/en/node/16.

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Chapter 2
The Transdisciplinary View of Information Theory from a Cybersemiotic Perspective

Søren Brier

At present, there is a general trend towards creating a transdisciplinary scientific theory of information, computing, semiotics, cognition, and communication[1] because these seem to be the most foundational disciplines in a knowledge society (Brier 2008, 2009a, b; Floridi 2004; Davies and Gregersen 2009; Dodig-Crnkovic and Burgin 2010; Hofkirchner 1999, 2010). But there are so many ways to define the concepts of information and information science (Floridi 2004; Qvortrup 1993). These include ways related to mathematics, physics, computer science, biology, communication science, information and system sciences, and human linguistic communication. Discussion of this issue is currently ongoing within the Foundation of Information Science (FIS)[2] as well as multiple conferences, journals and books still proliferating. When we look at the various information concepts available, we discover that they often have almost incommensurable theoretical foundations – some are rooted in the hard sciences, some in the life sciences, some in the

[1]For lack of a better word, that is what I will call what we are aiming for. The concept of *transdisciplinary science* is supposed to cover the natural and life sciences, as well as the humanities and social sciences. In an anglophone context, this may seem like a contradiction in terms, since "science" most often is applied only to the natural sciences. However, in European contexts, the situation is different: concepts like the German word '*Wissenschaft*' and the Danish word '*videnskab*' include the natural, life, and social sciences as well as the humanities without assuming a positivistic unified science. For this reason, I will use the German concept of *Wissenschaft*.

[2]FIS is an international interdisciplinary group. It has been an attempt to rescue the *information* concept from its classical controversies and use it as a central scientific tool, so as to serve as a basis for a new, fundamental disciplinary development –*Information Science*. Home page http://infoscience-fis.unizar.es/. Journal *TripleC* http://www.triple-c.at/index.php/tripleC

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social sciences, and some in the humanities. How, then, can we help create some meta-order in this complex and fast developing research area? First I will try to sort out some major theories from this meta-view. One way of overcoming the incommensurability between paradigms and knowledge areas with different foundations is to produce transdisciplinary frameworks where interdisciplinary connections are made possible by a meta-reframing, which posits that signs, meaning, and interpretation are the foundational concepts within which information and associated concepts have to function. Thus I will argue for the necessity of going beyond the idea held by some current commentators (Chaitin 2010; Dodig-Crnkovic 2010) that the universe is a computer or even a quantum computer running on qubits.[3] I will argue that a pan-informational approach, based on a pan-computational ontology, precludes the development of a proper phenomenological theory of subjective consciousness and meaningful interpretation. Furthermore, I will argue that C.S. Peirce's semiosis creates a new paradigmatic transdisciplinary framework into which autopoietic-based cybernetic information can fit as an important aspect. I call this transdisciplinary frame Cybersemiotics. From a semiotic, linguistic, and language philosophy platform perspective, it makes sense to order information theories into syntactic, semantic, and pragmatic probability theories (Nöth 2012). So that is the way I will proceed.

2.1 The Syntactical Probabilistic Theory of Information

The syntactic theory calculates information according to the probabilities of the occurrence of signs in their respective contexts. This theory ultimately derives from Claude Shannon and Warren Weaver's theory of communication. Claude Shannon (1916–2001) was an AT&T researcher who was primarily interested in ascertaining the limitations of a channel in transferring signals and the cost of information transfer via a telephone line. He developed *The Mathematical Theory of Communication* (Shannon and Weaver 1963/1948). Shannon defines information as a

[3]A qubit is a quantum bit. It is a unit of information or the counterpart thereof in quantum computing. It is the quantum analogue of the classical bit if you want. A qubit is the basic unit of information in a quantum computer. The Turing machine is a theoretical device that consists of tape of unlimited length that is divided into little squares. Each of these squares can either hold a symbol say 1 or 0 or be left blank. A read-write device reads these symbols and blanks, which gives the machine its instructions to perform a certain program. The difference between bits and qubits is that whereas a bit *must be* either 0 or 1, a qubit *can be* 0, 1, or a superposition of the two and so can be involved in entanglement. Quantum computers use superposition to run all the calculations of a normal computer simultaneously. Taken together, quantum superposition and entanglement create an enormously enhanced computing power. While a normal Turing machine can only perform one calculation at a time, a quantum Turing machine can perform many calculations in parallel at once.

purely quantitative measure of communicative exchange. His theory of information as entropy is based on pure probability and influenced psychologists such as George Miller, who made his information concept the foundation of a new science of mind (Miller 1951; Miller and Frick 1949). Shannon's information was also used in neuroscience (MacKay and McCulloch 1952). Recognized philosophical theories of information like that of Dretske (1981) have been inspired by Shannon's theory, which has also been used in attempts to naturalize mental content. Probabilistic entropy information is dimensionless and measured in bits. Weaver linked Shannon's mathematical theory to the second law of thermodynamics and stated that it is the entropy of the underlying stochastic process in the information source that determines the rate of information generation (Shannon and Weaver 1963/1948).

Shannon defined the amount of information as the negative of the logarithm of a sum of probabilities. The minus sign is there because, according to Shannon, the amount of information is equal to entropy. According to Weaver's interpretation and explanation of Shannon's theory, information is a measure of one's freedom of choice in selecting a message. The greater this freedom of choice, then the greater the uncertainty that the message actually selected is a particular one and the greater the amount of information. Greater freedom of choice, greater uncertainty, and greater information go hand in hand. One of the conclusions from Shannon's theory is that entropy contains more information than structure.[4] Information, according to Shannon, must not be confused with meaning. His information relates not so much to what you do say as to what you could say (or do not say). The problems of interpreting signals in a "message" are left outside the theoretical space within which Shannon's definition is formed. It is tempting to see Shannon's signals as "data" and the meaning of the signals as "information", but this would be wrong as it is not how he defined them.

Contrary to the assumptions of many system theorists, Shannon's information cannot be transmitted only by signals that "carry" it. The problem is that although the concepts of information theory cover only the technical level of communication, they were later applied to the sphere of human communication. Certain forms of early first-order cybernetic theory especially make claims regarding similarity to how the human brain works (McCulloch and Pitts 1943; Pickering 2010). But, humans do not communicate through electric signals from brain to brain. They communicate with meaningful signs between embodied minds. Qualia and meaning are unlikely to emerge from the Shannon information extracted from electrical signals between nervous cells *per se*. Thus, information has to be connected to embodied meaningful language in a culture or to the physical world of material objectivity.

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[4]Thus, whereas Norbert Wiener's later theory, which is the next one we will comment on below, sees information as negative entropy, i.e. a "structured piece of the world", information in Shannon's theory is the same as (positive) entropy. From this angle at least, Shannon's "information" is the opposite of Wiener's "information".

2.1.1 The Thermodynamic-Cybernetic Type of Theory of Information

This type of theory is most prominently associated with the work of Norbert Wiener (1948) and Erwin Schrödinger (1967). Here information is defined as neg-entropy in phase-space, an idea that contributed to the creation of cybernetics as a transdisciplinary paradigm of a technologically instrumentalist and utilitarian knowledge system. Wiener (1948) focused on the role of information in the control of both mechanical and biological systems. His first order cybernetics united thermodynamics in Boltzmann's probability interpretation with the ideas contained in Shannon's work. Thermodynamic entropy is measured in Joules/Kelvins. In contradistinction to Shannon's theory of information, Wiener reversed his definition of information from entropy to neg-entropy, from disorder to organization, which Schrödinger integrated into his theory of life. Wiener's concept of information relates both to man-made systems and to living subsystems like the liver or even the brain as a tissue of neurons. These systems use signals in a way that cybernetic theory seems to explain through control theory. Differences in perception or thinking became the food of the cybernetic mind, as this was defined by Wiener and later conceptually developed by Bateson (1973, 1980). Cybernetics sees mind as a circular system encompassing both the physical and the living as well as technological and organizational systems (Brier 2008). This information theory got its ecologically developed and proto-semiotic version through Gregory Bateson, who conceptualized information as a "difference that makes a difference".

To get to meaning, Wiener's "information" must presume an observer with a meaning of his/her own outside the system, who determines the goal of the system. The observer in cybernetics unfortunately may be another machine, but in the end (or perhaps beginning) there must be a human being somewhere with an embodied and social intention or purpose. But the primacy of first-person experience *vis-à-vis* the whole concept of observer in cybernetics is never really contemplated in Wienerian first order cybernetics. It only starts in Gregory Bateson's theory of the informational mind and Heinz von Foerster's second order cybernetics (Brier 2008; Foerster 1984). It should be noted that both Bateson and von Foerster participated in the Macy Conferences that were so foundational for the cybernetic paradigm.

The observer's meaning in this view is interrelated with the system's meaning. But, in my view, Bateson, as well as von Foerster, merely delivered a cybernetic theory of mind, which provided no theoretical foundation for an account of the phenomenological and qualia[5]-based experimental aspects of mind

[5] According to the *Stanford Encyclopedia of Philosophy*, "[p]hilosophers often use the term 'qualia' (singular 'quale') to refer to the introspectively accessible, phenomenal aspects of our mental lives. In this standard, broad sense of the term, it is difficult to deny that there are qualia. Disagreement typically centers on which mental states have qualia, whether qualia are intrinsic qualities of their bearers, and how qualia relate to the physical world both inside and outside the head. The status of qualia is hotly debated in philosophy largely because it is central to a proper understanding of

(Brier 1992a, b, 2008, 2009a, b, 2011; Brier and Joslyn 2013a, b). Before we address this issue, we will dig deeper into the physicalistic attempt to ground information and meaning on the quantum level.

2.1.2 The Quantum Mechanical Physicalist Information Theory

John Archibald Wheeler's "It from Bit" is the most prominent foundational theory of physical information. It is based on an interpretation of quantum physics and thus relies on the concept of qubits (Wheeler 1994, 1998; Barrow et al. 2004). Physical information is a concept that is well established within physics, and is basically just *a way to model material form and physical patterns*. Physicists can quantify material form with techniques deriving from Shannon or Wiener. This mathematical and physical foundation is the historically scientific background of *the non-semantic use of the word* "*information*".

Quantum states are the key mathematical objects in quantum theory. It is therefore surprising that physicists have been unable to agree on what a quantum state truly represents. One possibility is that a pure quantum state corresponds directly to reality. Pusey et al. (2012) argue against the long history of suggestions that a quantum state (even a pure state) represents only knowledge or information about some probable aspect of reality. They show that any model in which a quantum state represents mere information about an underlying physical state of the system and in which systems are prepared independently as having independent physical states, must make predictions that contradict those of quantum theory. This means that physics and information science have to build on two different ontological assumptions, a difference that can only be solved through developing a pan-computational ontology, as we shall see. In his paper on the unavoidable cost of computation, Ball (2012) shows that forgetting is equal to the undoing of Maxwell's demon. The existence of pure informational states with no physical cost is not possible in nature.

Still a straight road from a theory based on physical states to a theory of meaningful conscious linguistic communication in a cultural setting seems almost impossible to conceive, as no convincing theories of qualitative emergence have been produced. The positivist 'unity of science' idea and its modern version in Wilson's (1999) *Consilience* theory are very idealistic and reductionist attempts to establish a subject-free 'objective' theory of universal scientific knowledge, which assumes that observation statements can be connected to experience unambiguously. This served as the foundation for the verificationist theory of logical positivism. However, this belief has been so thoroughly criticized that it has been abandoned

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the nature of consciousness. Qualia are at the very heart of the mind-body problem." http://plato.stanford.edu/entries/qualia/.

by scientists and philosophers of science and the physicalist unity of paradigm of unified science built on it has fallen into desuetude. But perhaps a new version thereof can be constructed on a pan-information or pan-computational paradigm. That is at least one way to explain the growth of this paradigm over the last 20 years.

2.2 The Pan-Computational and Pan-Information Science View

The basic notion that cognition essentially is *computation* and *information processing* has led to the idea of connecting human consciousness with the world through an enlarged vision of computation integrated with a computational information theory. On this view, all processes in the world are informational and computational—ideas that underpin the techno-science paradigms called pan-computationalism and pan-informationalism. The two views are often combined in various ways (e.g., Chaitin 2010; Dodig-Crnkovic 2010). Pan-computationalism is an attempt to answer the question of what the minimum ontological prerequisites are for us to simulate natural systems including our own mind and its intelligence in a convincing way. This is viewed as possible if the world's ontology – including our brains – is like a big computer.

But, such a machine would not be like the Turing computers we have made so far, as closed axiomatic systems are not able to learn. The Turing Machine is a machine that embodies a closed formal system. Thus, present-day computers represent only a restricted simulation of *natural computation*. The artificial languages controlling Turing and von Neumann machines are formal algorithms in which syntax determines meaning independently of context. These limits have to be breached in the further development of natural computation, as nature possesses more expressive means than those used by Turing Machines – for instance, those found in living systems.[6]

Thus a pan-computationalist sees whatever nature does as computational. All that remains to be learned is how those computations are really carried out in the organic world. The downside of this simple formula is that the phenomenological view of human consciousness seems incompatible with computationalism. Everything is

[6]The formal languages that code machine programs are not compatible with that of the genetic code. Gene expression depends on environmental context and so genetic configurations cannot be treated in the same way as the formal languages humans have created. DNA is a product of the evolution of living systems with agency. Syntax in DNA may convey different and even contradictory meanings, depending on the cellular agents that exploit the genome for interpretations. Protein folding can be viewed as the first level of interpretation where information controls an energy- and rate-dependent physical activity that has a function for the cell as agent. This pragmatic aspect of semiosis is largely ignored by many researchers defining a "sign", a "code", or "information" as "pure relationship" in a dualistic ontology, which then makes the code function as a sort of pure objective "correspondence". It is confusing because their concept fails to refer to those agents who developed these relationships.

fine if one proceeds with Dennett's (1991) functionalistic view regarding the inconsistency of the concept of qualia.[7] Dennett proposed replacing the Cartesian Theater model, with its privileged place in the brain where all the processes of the brain integrate and produce subjective experiences, with the idea that human consciousness is the mental software that reorganizes the functional architecture of the brain. But, as we mentioned above, Ball (2012) has shown that informational transactions cannot be separated from the entropy debt that, according to thermodynamics, is produced by all physical processes. On this view, informational processes, are also physical and may be viewed as the structuring of energy. Thus, it seems that we rather need to find theories that take their point of departure from real-life semantics instead.

2.3 A Semantic Probability Information Theory

A semantic probability information theory seeks to calculate the amount of content conveyed by a message. The most influential semantic theory of information is based on the work of Bar-Hillel and Carnap (1953). They imagine a formal language consisting of all sentences that might be true in a given possible universe (cf. Bar-Hillel 1964: 224). This is a problematic view, for, as Chomsky (1957) has pointed out, natural language has the intrinsic capacity to generate an infinite number of well-formed sentences and, thus, no natural language has a finite determinable number of sentences that could serve as a basis for determining all true sentences.

Nevertheless, Bar-Hillel proposes to determine the information values of actual sentences according to the probability of occurrence in reference to this formal knowledge base, measured from the number of sentences *excluded.* Of course, as in Shannon's theory, one has to determine actual real probability (in the given situation and language); clearly, this is not really possible in the sphere of natural language. Thus, meaning and probability measures seem very difficult to synthesize or combine.

It becomes even more difficult if one implements a pragmatic theory that seeks to study how the sender's message influences and increases the receiver's knowledge, as Dretske (1981) does in *Knowledge and the Flow of Information*. Dretske defines information as the content of new, true, meaningful, and understandable knowledge. Gibberish, by contrast, is both meaningless and uninformative, and sentences uttered or written in a foreign language that we have not mastered fail to convey information; furthermore, telling a person something s/he knows already does not count either as real information in this theory, nor do false statements. An informative message for Dretske must convey *new* and comprehensive knowledge.

Thus, information in this theory is not 'objective', but relativized in relation to the receiver's knowledge. This makes the theory more acceptable, perhaps, but

[7] Qualia are first person subjective experiences that each one of us is immediately aware of, such as the taste of sweetness or the smell of roses or feeling hot. For further discussion, see note 5 above.

it also makes it difficult to operationalize the idea of probability in reality. It is difficult to produce a quantitative statement that is more reliable than a qualitative analysis based on some sort of relation to the human condition such as, for example, ethics, aesthetics, truth, and rationality. One alternative, then, is to build information theories from the basic context of human meaningful communication.

2.4 Information Theory Founded in Intersubjective Linguistic Communication Among Humans in a Culture

This is what Machlup's (1983) famous analysis of information promotes (Brier 2008). Beginning from a traditional humanistic viewpoint, Machlup suggests that only people can send and receive information, which is a very different perspective from that of information science and its further development into pan-informationalism. In his analysis of the concept of information, Machlup (1983: 657) posits that the creation of a concept and a theory of information should take its starting point from the human communicative situation. He thereby develops a critique, from a position within the humanities, of the objective concept of information on which cognitive science is based. This critique takes its point of departure from exactly that aspect of information most weakly represented in the information-processing paradigm, namely the socio-phenomenological and hermeneutical aspect of signification in human communication. Machlup points out that, lexically, the word "information" means to inform: *to give form* to something, especially mind, consciousness or character, through learning or instruction, and to pass on knowledge about facts or events. The essential historical meanings of the concept of information are: (1) To tell something to someone. (2) That which one is told.

Note that this is a definition with a starting point in natural language communication between embodied and conscious persons living within a social and cultural context. Machlup (1983) concludes, in contradistinction to Dretske, that, in his paradigm, the correct conceptions of information and knowledge are based on the following tenets:

- Neither knowledge nor information needs to be correct or universally true.
- New knowledge can be achieved without the addition of new data through thought/insight/sense making.
- Empirically-based cognition is not the reception of information.[8]
- Data are that which is given to the receiver or the researcher for the extraction of information.

[8]On this subject Popper and Kuhn, as well as Peirce, hold that there is no direct semantic or logical-syntactic connection between observation and knowledge. Thus there seems to be no easy way for science to avoid the gatekeeping of interpretation. We can measure how many bits the senses "take in", but unless you believe in a primitive form of pan-computationalism, the world is not constructed out of bits that are then "channeled" into the mind through the senses. This critical view opposes pan-informationalism.

Data are not necessarily numbers. In most contexts, data are not different from information, except in computer languages, where they are the information (input) that is to be treated in the system. Used generally in this way, the concept of data is a relative one. What are data for one person may be information for another.[9] From Machlup's point of view, the use of the information concept in neurophysiology, brain research, and genetics must therefore be considered an analogy or a metaphor. But Machlup wants not only to delimit the concept of information against "downward" reductionism through the natural and technical sciences; he also wants to delimit it against "upwards" expansion to social entities in the social sciences. Thus he considers it to be a metaphoric use if one claims that institutions or societies as such receive or give information. It is always individual human subjects who exchange, induce, and produce meaning among themselves. According to Machlup, to speak of information within the framework of Shannon and Weaver's technical and statistically grounded theory of communication is to push the analogy too far, for that theory concerns itself with impulses and the transmission of signals, but is not about any form of meaning. In this view, one should always attach a prefix to such theories of information such as 'technical', 'statistical', etc. if one uses the concept in these contexts.

All of these negatives point toward the conclusion that the creation and communication of information demands some basic characteristics associated with individual, embodied, conscious minds. But the well-established fact – which Gadamer's (2004) hermeneutics always underlines – that all understanding and interpretation happen within a social-historical background seems not to be an essential part of Machlup's theory of information. Thus we must conclude that it seems that neither the information-processing paradigm nor a pure phenomenological paradigm based solely on the lifeworld of human persons is able to establish a transdisciplinary unifying principle that ties together the qualitative differences in communication that arise in a setting that involves humans, documents, institutions, societies, and computers. A generalized system theory view may then be a way to find a common denominator between these different kinds of entities.

2.5 Information as Part of General System Theory

This view is mostly inspired by Ludwig von Bertalanffy. Today many researchers seem to adhere to an organicist philosophy based on complexity science or the theory of complex adaptive systems (CAS). Hofkirchner (1999, 2010) has been one of the main developers of these kinds of theories. One can here seemingly still adhere to a kind of physicalist basic ontology, by assuming that the increase of complexity drives the emergence of new levels of being with new qualities such

[9] This is contrary to a physicalist empiricist position that believes in quantitative data as the origin of all true knowledge.

as life, as well as cognition and consciousness, qualia and feelings. But, I do not find that the present theories of emergence and downward causation offer us any accepted mechanism for understanding the emergence of life—not to mention the mind as a locus of experience—from matter. This is especially true if our basic understanding of matter is that it is something dead and inert. As Emmeche (1991) shows, none of the accepted forms of emergence deal with how experiences arise from matter through self-organization, if one believes in the reality of qualia and subjective experience. Emmeche (2004) realizes that a broader idea of ontology is necessary and describes qualitative organicism as one way of breaking out of physicalism and making a broader ontological stipulation that experience is a part of objective reality. He writes:

> **Qualitative organicism**. This is a more radical position differing from mainstream organicism in its appraisal of teleology and phenomenal qualities. It emphasizes not only the ontological reality of biological higher level entities (such as self-reproducing organisms being parts of historical lineages) but also the existence of qualitative experiential aspects of cognitive behavior. When sensing light or colors, an organism is not merely performing a detection of external signals which then get processed internally (described in terms of neurochemistry or information processing); something more is to be told if we want the full story, namely about the organism's own experience of the light. This experience is seen as real. It may be said to have a subjective mode of existence, yet it is an objectively real phenomenon (Emmeche 2004: 117).

Thus there is a real problem in making ontological assumptions that can support a transdisciplinary framework, especially if such a framework is primarily based in the natural and technical sciences or, alternatively, in traditional humanities. A third possibility, therefore, is a systems theory rooted, not only in biological but also in psychic and communicative autopoietic systems.

2.6 Information as Part of a System-Theoretical Autopoietic View of Communication

It is primarily Niklas Luhmann's unique and complex system theory that attempts to achieve this three-leveled transdisciplinarity. In his systemic theory of communication, information is viewed as an intrinsic part of a message, which consists of *utterance, information, and interpretation.* Thus, for Luhmann, information is *explicitly always a part of a message* in an autopoietic communication system. In his words:

> If one conceptualizes communication as the synthesis of three selections, as the unity of information, utterance, and understanding, then communication is realized if and to the extent that understanding comes about. Everything else happens "outside" the unity of an elemental communication and presupposes it. This is especially true for a fourth type of selection: for the acceptance or rejection of the specific meaning that was communicated (Luhmann 1995: 47).

Luhmann (1995) explicitly states that his whole epistemology derives from the fact that all kinds of rational knowing are based on making a difference between the observing system and the environment. This epistemological foundation is derived in turn from Spencer-Brown's (1979) *Laws of Form* as well as the work of Gregory Bateson and Heinz von Foerster.[10] There is a biological system in Luhmann's systems theory that seems to be equivalent to Maturana and Varela's biological autopoiesis (Maturana and Varela 1980, 1986).[11] Luhmann's revolutionary idea is to generalize the concept of autopoiesis in a sort of meta-biology and then distinguish between biological, psychological, and social autopoiesis. Biological autopoiesis works in the medium of life; but psychological and communicational autopoiesis' operational closure creates a 'meaningful world' of its own that, while it does not exclude external influences, nevertheless selects them in such a way as to have influence according to the system's own inner world of meaning and survival. According to Luhmann, the deep meanings of an individual's psychic world should re-emerge in the ontological basis of communication as an independent system:

> ...communication is a completely independent, autonomous, self-referentially closed selection, a mode of constantly changing the forms of meaning material, of reshaping freedom into freedom under changing conditions, whereby (given the premise that the environment is complex enough and not ordered as pure randomness) experiences of reliability gradually accrue and are then re-included in the process. Thus a meaning world emerges through epigenetic evolution that makes possible communication that is less probable (Luhmann 1995: 149).

Luhmann essentially identifies two autonomous worlds of meaning based on the psychic and the socio-communicative autopoietic operations. He defines them as both operating in the medium of meaning, which is not culture because he also has a view of this term that differs from the received sociological version. Thus, psychic systems – which, as also Habermas argues, are not the same as classical subjects of the humanities – face competition from the social system, which has the ability to cognize through communication. In Habermas's view:

> ... the "self" of the system is distinguished from that of the subject because it does not consolidate the "I" of the apperceptive "I think" that, according to Kant's formulation, has to be able to accompany all my representations (Habermas 1987: 369).

This latter ability is not available to the psychic system in Luhmann's theory. The psyche does not communicate *per se*, but is limited to its own closed world of meaning, thoughts, and feelings. Thus it is not the source of communication as in Machlup's humanistic conception of information communication. Teubner writes:

[10]It is not clear if an observer needs to have feelings, free will, and qualia as minimum requirements in Spencer-Brown's theory. Spencer-Brown works in a logical framework and does not systematically discuss the ontology necessary to support the epistemology of differences and form that he promotes in *that* work. But he discusses it in another of his less scientific works, written under the name James Keys, *It takes Two to Play This Game*; there, he promotes a Buddhist inspired "living emptiness" philosophy (Brier 2007, 2009a).

[11]Which, as with all other cybernetic theories, does not have an explicit theoretical position for quale consciousness and its subject-derived agency.

> Social autopoiesis argues for the modern contract to be seen as being primarily about inter-discursivity, not the inter-personal relations between two actors with their own goals and resources. This means giving up the idea of the dominance of the psychic inner worlds of the actors and their subjective meanings and individual resources. ... The interests that people think they are realizing or exchanging through a contract are therefore not their personal interests, but are social or discursive products (Teubner 1997).[12]

Habermas is well aware of the significance of the shift in the concept of information and in socio-communicative meaning wrought by the Luhmanian paradigm. He writes:

> In this way, subject-centered reason is replaced by systems rationality. As a result, the critique of reason carried out as a critique of metaphysics and a critique of power, which we have considered in these lectures, is deprived of its object. To the degree that systems theory does not merely make its specific disciplinary contribution with the system of the sciences but also penetrates the lifeworld with its claim to universality, it replaces metaphysical background convictions with metabiological ones. Hence, the conflict between objectivists and subjectivists loses its point (Habermas 1987: 385).

I agree with Habermas' very precise philosophical diagnosis. Luhmann (1990, 1995) accepts the psyche as an autopoietic system, but makes no attempt to explain its creation or ontological status. He seems to find some compatibility between Husserl's phenomenology and system theory. Whereas many biologists take the spontaneous development of life as a given, Luhmann tends to treat the development of meaning as a culturally given phenomenon. The processing of meaning precedes and controls communication as an independent variable in Luhmann's theory. This metabiological perspective posits that meaning is processed without intentionality (Leydesdorff 2007). Luhmann apparently wanted to dispense with an ontology of the subject grounded in phenomenological intentionality in favor of systems theory, which did not really have a phenomenological foundation. He thus understood information in Bateson's terms as a difference that makes a difference and integrated Bateson's cybernetic theory with some aspects of Husserl's phenomenology. The epistemology in Luhmann's paradigm is partly based on an interpretation of Spencer Brown's *Laws of Form*, without, however, adopting the latter's ontology of mystical unity where the observer is basic in making the first distinction (Brier 2007, 2013). Consciousness is accepted in an open ontology,[13] but the unification of the various frameworks of Wiener, Bateson, Maturana, Spencer Brown, Bertalanffy's general system theory, and Husserl's phenomenology do not seem to be carried through in a manner that is philosophically consistent. I do not think Luhmann manages to produce an ontology for, and a definition of, experientially-based meaning. He is a systemic sociologist, not a philosopher (Brier 2007; Thyssen 2006).

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[12] Electronic document without page numbers.

[13] Meaning that this ontology is not specified or even delimited.

Thus, this communicational foundation of information has produced a novelty in the form of a quantitative probabilistic view of information integrated within an autopoietic systems framework, combined with a semantic and pragmatic framework. But I find the claimed integration with the Husserlian phenomenology questionable and see a better possibility of integrating it into the evolutionary triadic phaneroscopic foundation of Peirce's semiotics. This would bring us closer to a transdisciplinary foundation for a universal theory of information, cognition, and communication.

There are only two non-reductionistic attempts to transdisciplinary approaches that stand out. One is Luhmann's, with his three levels of autopoiesis: the biological, the psychological, and the socio-communicative. But it does not really include a first person perspective and quale consciousness and is weakly connected to a realistic natural scientific worldview.[14]

Another non-reductionist transdisciplinarity framework that does not have the shortcomings of Luhmann's is the semiotic-logical paradigm of C.S. Peirce's transdisciplinary triadic pragmaticism which, through the semiotics of logic, attempted to connect logic, empirical research, and meaningful cognition. Peirce defines the word "interpretation" generally as the action of symbols (as information vehicles) on physical, living, and other systems (such as matter and energy). This brings us back to the idea of how to combine the understandings of information we have described so far into a common framework. My suggestion is Cybersemiotics (Brier 2008), which is an attempt to combine the best aspects of Peirce's and Luhmann's work.

2.6.1 Cybersemiotics as a New Way of Combining the Natural, Technical, Life and Social Sciences with Humanities

A transdisciplinary paradigm of information, cognition, and communication encompassing the natural, life, technical, and social sciences, as well as the humanities, within its theory needs to engage the role of first-person conscious embodied perception as well as intersubjective social awareness in producing signification from all sorts of verbal communication combined with pictorial, cinematic, and bodily types of non-verbal communications.

We thus have to embrace what C.S. Peirce (1931–1958) called *cenoscopic science* or, to use Cantwell Smith's (1998) modern phrase, *intentional sciences* (further discussed in Brier 2010a, b). This means that we need to integratively reflect our phenomenological point of departure for knowledge creation in the

[14]Luhmann's operational constructivism lacks, in my opinion, a clear view of the type of deep ontological work towards uncovering deep intransitive structures in reality, which is also the aim of the natural, life, social, and human sciences to which Roy Bhaskar (1997/75, 1998/1979) and C.S. Peirce (1931–1958) are devoted.

sciences. If our transdisciplinary efforts do not do so, but base themselves on physicalism or informationalism, it is going to be difficult to make any real progress in the understanding of the relation between human consciousness, nature, computation, and cultural meaning simply because no theory of consciousness of qualities and meaning can be built from that foundation (Brier 2013).[15] In the famous book *Chance and Necessity* (1971), Jacques Monod highlighted the apparent epistemological contradiction between the teleonomy of living organisms and the principle of objectivity in science based on the ontological assumption of the natural sciences that there are no intentions or meaning in inanimate nature. Consciousness is not only a product of culture but also a product of the natural evolution of living bodies. Furthermore, we should not view culture as part of a reality outside nature (dualism), but as a special developed part of nature in a broadened naturalism (Brier 2013; Fink 2006). I agree with Bateson (1973) and Maturana (1988a, b) that we must commence our understanding of information with the process of knowing. Bateson's definition of information as a difference that makes a difference is very fruitful. His theoretical problem is that he makes nearly every cybernetic system a communicator and a knower, be it a homeostatic machine, an organism, or an ecosystem or organisation. But the big difference between computers and humans is this embodied field of meaning in which human communication operates. Computers can only provide pragmatic meaning within a system like chess, for instance, if that meaning is modelled in the computer's own memory.[16] This is why the type of unpersonalized, unembodied logical and mathematical reasoning that has been the foundation of the mechanical paradigm of classical science cannot be the sole support of a transdisciplinary foundation for rationality. The paradox is that the sciences think this domain of conscious sense experiences, meaning, and rationality emerges later in evolution than energy, matter, and information, but we have also shown that it is the prerequisite for the intersubjective knowing process from which the whole idea of science springs.

Like Fink (2006), I object to the use of the term "nature" to mean only what the physico-chemical sciences can describe. What we can measure intersubjectively is a part of the reality we call nature. Thus the meaning of a sign, a word, or a sentence has some kind of existence more or less independent of the individual human being. The natural sciences see humans primarily as connected to all other entities and processes in the world by being made of the same "stuff".[17] However

[15]This is where Dennett and I part ways. I do not believe that the road he takes leads to a transdisciplinary solution.

[16]I think of the meaning of taking a pawn measured in points and in strategic probabilities of winning, but not personal anger at having overlooked the possibility. I think of the meaning of arriving at checkmate within the frame of the game, but not the personal feeling of humiliation and loss of social position.

[17]Few realize how much debate and development preceded the construction of the conceptions of basic "matter" underlining the realism of physicalism.

I see no reason to assume that physics has a special privilege to explain what this universal “stuff” is. Rather I agree with biosemiotics (Kull et al. 2009) that signs are real relational processes, which connect all living beings with each other and with the environment. With Peirce, I prefer the concept of *hylé* to characterize the basic “stuff” the world is made of as it – in contrast to the modern physical concept of matter – does not carry the indication of matter being completely inert and dead. This concept was fundamental to Aristotle’s philosophy but has been moved, in Peirce’s semiotic philosophy, into an evolutionary process-oriented paradigm and further developed along semiotic lines.

As a consequence of the widely shared perspective that human beings are embodied, feeling, knowing, and enculturated beings participating in semiosis and language processes, our analysis so far points to the fact that they can be seen as living simultaneously in four different worlds. One way to describe and classify these worlds – as much as possible in accordance with the currently received view of the many sciences mentioned – is:

1. The physico-chemical part of the natural world that also constitutes the pure material-energetic aspect of our body.
2. Our embodiedness as the source of life, which we share with other living species. It is a product of ecology and evolution; but also formed by cultural practices.
3. Our inner world of feeling, will, drives, affects, and thoughts, manifested as mind, consciousness, and self-consciousness. We think it is partly produced by our embodied nervous system and formed by culture most strongly through our childhood.
4. The cultural world of language, meaning, power, and technology, such as the informational machines we call computers. Language, pragmatically viewed, connects our perception with our thinking, communication, and acting in the social world.

Each of the four worlds has historically developed its own type of narrative, with its own fundamentalist and reductionist versions vitiating the project of transdisciplinarity. Physicists and chemists tend to view the universe as consisting of matter, forces, and energy. Mechanistically oriented biologists extend this view into their subject area. But non-mechanistically oriented biologists tend to perceive living systems as the basic organizers of reality, possessing self-organizing, self-protecting, self-promoting, and reflective properties as well as perception, instincts, and communication that physics and chemistry cannot (yet?) explain. This view of life as a foundational quality is why I insist that the natural and the life sciences are not the same.

The social and cultural sciences, especially dialectical and historic materialistic perspectives, as well as the radical social constructivist ones, tend to see the world as constructed from social, human, and linguistic interpretations, unless they are dualistic, accepting that nature is just as science describes it (Brier 2008). Thus, energy-matter-information,life, consciousness, and meaning become separated in different domains or worlds. But this is in conflict with our everyday lifeworld experience. Here they are not in any way absolutely separated. Thus we lack a transdisciplinary *wissenschaftlich* explanation of how they are integrated.

One of the reasons for the separatist tendencies of the received views of natural and social science as well as the humanities may be that the traditions of science and the humanities were established before the theory of evolution became broadly recognized. Thus, the incompatibility of these four dominant views in the Western world's systematization of knowledge is a deep paradox in the modern worldview's attempt to build a "unified narrative" of the world. This is especially the case since it has been broadly accepted in all four worlds that the 'unity of science' idea of the logical positivists failed because it was predicated on the excessively narrow epistemological foundation of verificationism. Karl Popper's (1960, 1976) critical analysis and argumentation for a falsificationist view of scientific knowledge has been accepted as a turning point in the break with the positivist unity of science, but not as providing any final solution to the problem. Thomas Kuhn's (1970) work on paradigms and their incommensurability has been generally accepted by philosophers of science and many scientists, changing the revolutionary mono-paradigmatic view based on the history of the natural sciences into an acceptance of parallel co-existing paradigms especially in the realm of the social sciences and humanities. I have extended this view to include the social and the life sciences here in order to put all forms of *Wissenschaft* on an equal standing, because I find it true in an absolute naturalism and a necessary prerequisite for establishing a non-reductionist transdisciplinary view.

My suggestion for finding a transdisciplinary commensurable framework for all *Wissenschaften* is to start in the middle, with our daily lived semiotic, social, and linguistic practice. I view the communicative and semiotic mind, in combination with a concept of information, as that which binds all four worlds together. The view that all thought uses signs as vehicles and all objects of experience are comprised of signs constitutes the foundation of a unified theory of signs and sciences among the foundations of which we include phenomenology. Like Luhmann and Peirce, I cannot see how we can avoid it when we ask from what or where comes the ability of the observer to produce knowledge and furthermore to reflect consciously on how knowledge is produced in language.

This semiotic view integrates the sciences' view of reality as well as the cybernetic, informational, and systems views of reality into a single model in an attempt to avoid the inner inconsistencies described earlier. I have combined some of the core aspects of this framework into a visual and simplified model called the Cybersemiotic star for those readers who – like me – get a special kind of insight by looking at such visual representations. Those I encourage to consult Fig. 2.1, the rest to stay with the text.

Peirce simply viewed man as a growing, living symbol summarizing all his experience. I want to use this daring interdisciplinary way of understanding the relation between man, language, and reality as a point of departure. Therefore

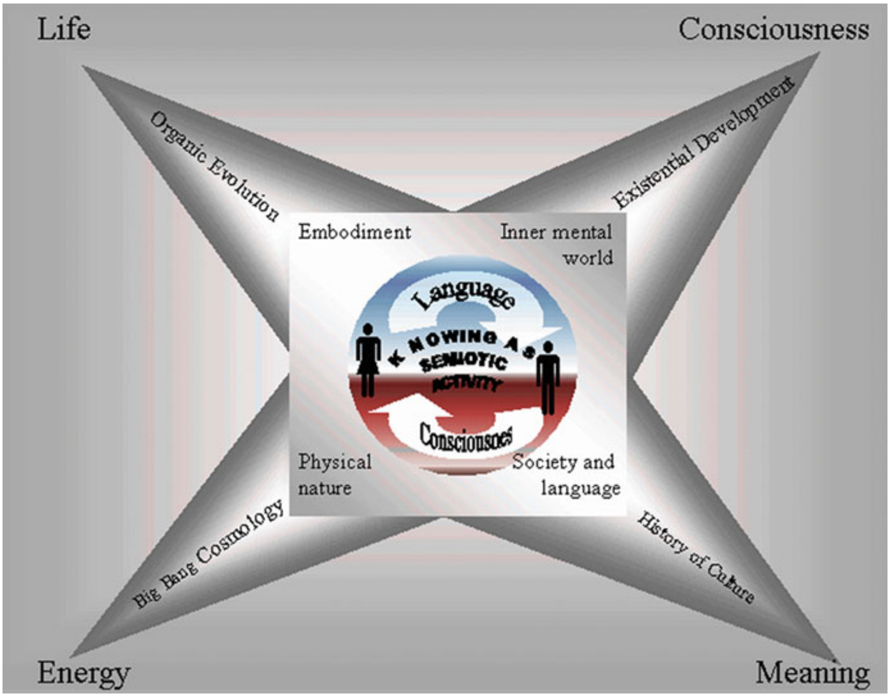

Fig. 2.1 The Cybersemiotic star: A model of how the communicative social system of the embodied mind produces four main areas of knowledge that can also understood to be prerequisites for interpersonal observation and knowing. Physical nature is usually explained as originating in energy and matter, living systems as emerging from the development of semiotic life processes (for the production of special proteins from DNA in the first cell). Social culture is explained as founded on the development of meaning in language and practical habits, and, finally, our inner mental world is explained as deriving from the development of our individual life world and self-consciousness. All these types of knowledge are seen as having their origin in our primary semiotic intersubjective lifeworld of observing as well as social communication and action (Brier 2008).

Cybersemiotics is built on the idea of Peircean evolutionary, pragmaticist semiotics as well as his phaneroscopy, his three basic categories,[18] his sign typology, and his synechism, tychism, and agapism.[19]

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[18]These categories are “Firstness”, “Secondness”, and “Thirdness”. Firstness stands for the aspects of reality that include possibility, the may-bes, the vague, spontaneity, pure feeling, the present. Secondness stands for actuality, the determinate/singular, fact, and the past. Thirdness stands for mediating between Firstness and Secondness, conditional necessity, the would-be, the tendency to take habits, the general, law, and the future. Through Thirdness, the meaning of signs emerges as a movement from may-bes to would-bes. (CP 5.469, 1907).

[19]Peirce writes that *tychism* is “... absolute chance – pure tychism ...” (CP 6.322, c. 1909). So Tychism is connected to Firstness as real objective chance in the universe. But it has to be integrated with the Secondness of resistance, facts, and individuality to create Thirdness to mediate connections between the two categories. It is connected to his pragmatism: “It is that

The other important problem is that ontologies and epistemologies usually follow the various conceptions of the four cardinal aspects of the world and the paradigms developed within them. Thus, if we – for instance, for the sake of medicine – want to create a transdisciplinary theory of information, cognition, consciousness, and meaningful communication (see Cowley et al. 2010, for the initiation of such an attempt), then it is necessary to adjust the ontologies of the different subject areas that we wish to integrate into our transdisciplinary[20] paradigm so as to make them compatible in a larger context.

2.6.2 Peirce's Transdisciplinary Semiotically-Based Information Theory

Similarly to Luhmann's view, Peirce holds that signs grow in information through the development of their interpretants[21] (CP 3.608, 1908).[22] This binds up information with the interpretations of signs, which is an ongoing personal and social process. Human communication – which occupies the central position in our model – involves a very complex interpretation by the "receiver". The meaning of a text or a sign does not exist independently of the receiver as a fixed state. It enters as a percept through our senses and clashes with our mind. A percept is the result of our interaction with what seems exterior to consciousness. Regarding percepts, Peirce writes:

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synthesis of tychism and of pragmatism for which I long ago proposed the name, *Synechism*" (CP 4.584, 1906). Synechism is "... that tendency of philosophical thought which insists upon the idea of continuity as of prime importance in philosophy and, in particular, upon the necessity of hypotheses involving true continuity" (CP 6.169, 1902). It thus constitutes the deep continuity between everything, including mind and matter as well as the three categories: "... I chiefly insist upon continuity, or Thirdness, ... " (CP 6.202, 1898). As for agapism, Peirce writes in his famous article 'Evolutionary Love' that "The *agapastic* development of thought should ... be distinguished by its purposive character, this purpose being the development of an idea. We should have a direct agapic or sympathetic comprehension and recognition of it by virtue of the continuity of thought" (CP 6.315, 1893).

[20]Not much has been written about the ontological conditions necessary for transdisciplinarity. But Basarah Nicolescu's (2002) *Manifesto of Transdisciplinarity* is a profound work on the meaning and consequences of transdisciplinarity.

[21]Peirce explains the concept of interpretant thus: "The Sign creates something in the Mind of the Interpreter, which something, in that it has been so created by the sign, has been, in a mediate and relative way, also created by the Object of the Sign, although the Object is essentially other than the Sign. And this creature of the sign is called the Interpretant" (EP 2: 493–94, 1909). In Peirce scholarship, the siglum "EP" stands for the two-volume University of Indiana edition of *The Essential Peirce* (Peirce 1992, 1998).

[22]Note that, in Peirce scholarship, "CP" is the customary way of referring to the Harvard edition of Peirce's *Collected Papers* (= Peirce 1931–1958). Citations give volume and paragraph number, separated by a period (e.g., Peirce CP 5.89 refers to volume 5, paragraph 89), and can be followed by the date of the manuscript or publication in question.

> The direct percept [. . .] has no generality; [. . .] it appears under a physical guise [. . .] it does not appear as psychical. The psychical, then, is not contained in the percept (Peirce CP 1.253, 1902).

According to Peirce's three categories—Firstness, Secondness, and Thirdness[23] —, the process of the percept is a pure 'Second': a clash between two different phenomena. Thus, it includes Firstness, but not Thirdness, as there is no interpretation of any kind of regularity or meaning yet. Thus, to Peirce, Thirdness in perception emerges with the construction of an perceptual fact or a cognition, which is the intellect's fallible generation of meaning through a generalization operated upon a series of percepts and concepts, i.e., what he calls abduction. The perceptual judgment constitutes an irresistible hypothesis for consciousness with regards to making sense through interpretation. According to Peirce, then, percepts are not, strictly speaking, objects of experience. Though the percept makes knowledge possible, it offers no information, as it does not contain any Thirdness in its immediateness. Experience, understood as the knowing process imposed upon us in the course of living, is "perfused" with Thirdness. Thirdness takes the form of generality and continuity within a fallible account of percepts. "Meaning" must somehow be constructed by the receiver from the information gathered by the interpretation of signs, within certain frames that reality imposes on us for survival. Peirce writes:

> At any moment, we are in possession of certain information, that is, of cognitions which have been logically derived by induction and hypothesis[24] from previous cognitions which are less general, less distinct, and of which we have a less lively consciousness (Peirce CP 5.311, 1868).

Peirce develops an information theory that starts with a physical event hitting the perceptual organs – i.e., Secondness – but he does not construct a probability-based theory of information as do Shannon or Wiener. Instead, Peirce develops a theory based on the logical quantities of extension and intension associated with the concept of symbol that is so vital for his semiotics.[25] Peirce defines his concept of information directly from his semiotics and its most important species of sign, namely, the symbol. From this basis, he introduces a new way of calculating the value of information conveyed by new propositions. He explains this in a passage worth quoting *in extenso*:

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[23] Peirce writes about the categories: "Careful analysis shows that to the three grades of valency of indecomposable concepts correspond three classes of characters or predicates. Firstly come "firstnesses," or positive internal characters of the subject in itself; secondly come "secondnesses," or brute actions of one subject or substance on another, regardless of law or of any third subject; thirdly comes "thirdnesses," or the mental or quasi-mental influence of one subject on another relatively to a third." (CP 5.469, 1907)

[24] An early concept of what he came to call abduction.

[25] The seminal paper by Nöth (2012) is my main source on Peirce's theory of information.

> In a paper ... I endeavored to show that the three conceptions of reference to a ground,[26] reference to a correlate, and references to an interpretant, are those of which logic must principally make use. I there also introduced the term "symbol," to include both concept and word. Logic treats of the reference of symbols in general to their objects. A symbol, in its reference to its object, has a triple reference:
>
> First, Its direct reference to its object, or the real things which it represents;
> Second, Its reference to its ground through its object, or the common characters of those objects;
> Third, Its reference to its interpretant through its object, or all the facts known about its object.
>
> What are thus referred to, so far as they are known, are:
>
> First, The informed *breadth o*f the symbol[27];
> Second, The informed *depth o*f the symbol;
> Third, The sum of synthetical propositions in which the symbol is subject or predicate, or the *information* concerning the symbol.
>
> By breadth and depth, without an adjective, I shall hereafter mean the informed breadth and depth.
>
> It is plain that the breadth and depth of a symbol, so far as they are not essential, measure the *information* concerning it, that is, the synthetical propositions of which it is subject or predicate. This follows directly from the definitions of breadth, depth, and information. Hence it follows:
>
> First, That, as long as the information remains constant, the greater the breadth, the less the depth;
> Second, That every increase of information is accompanied by an increase in depth or breadth, independent of the other quantity;
> Third, That, when there is no information, there is either no depth or no breadth, and conversely.
>
> These are the true and obvious relations of breadth and depth. They will be naturally suggested if we term the information the area, and write – Breadth X Depth = *Area* (CP 2.418–419, 1868).

Here Peirce suggests measuring the amount of information that symbols acquire through their individual and cultural history of use; or what Peirce calls the "growth of symbols". This is also augmented by the combination of terms in propositions as they then interact and change each other's meaning. "No proposition is supposed to leave its terms as it finds them. ...; and there are three objects of symbols the connotative, denotative, informative; it follows that there will be three kinds of propositions, ..." says Peirce (W1: 277).[28] Thus, propositions are a further source of the growth of symbols and, in the sciences, synthetic propositions are a

[26]Peirce writes in (CP 2.228): "[A sign] stands for [its] object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the [sign]". Peirce defined the sign's ground as the pure abstraction of the quality in respect of which the sign refers to its object.

[27]"Informed breadth" is equivalent to extension under a certain state of information.

[28]In Peirce scholarship, W customarily stands for the *Writings of C.S. Peirce*, the chronological edition of his entire corpus of writings published by the Indiana University Press. It can be found in the reference list under Peirce (1982–).

source of the acquisition of new knowledge. When an adjective precedes a noun, the logical content of the noun is modified by the adjective. If the noun, "information" is modified by the adjective "physical", then the logical content of the abstract concept of information is modified by what the author understands the term "physical" to mean. Nöth (2012: 139) writes further on this subject:

> Symbols have both extension, since they denote classes of objects, and they have intension, since the objects they denote must have certain characters in common. There are even reasons to argue that all signs, that is, symbols, indices, and icons, have both extension and intension, … With this assumption, Peirce differs from logicians who argue that proper names (*indices* for Peirce) have only extension (reference) and no intension (sense), whereas fictional names, such as *unicorn*, and signs of mere qualities (icons) have no extension but only intension.

Although Peirce's information theory is built not only on denotative formal signs but also on a vast array of meaningful signs, it is still a realistic information theory. One needs to have empirical reference[29] in order to produce real information. Peirce writes:

> If there be anything that conveys information and yet has absolutely no relation nor reference to anything with which the person to whom it conveys the information has, when he comprehends that information, the slightest acquaintance, direct or indirect—and a very strange sort of information that would be—the vehicle of that sort of information is not, in this volume, called a Sign (CP 2.231, 1910).

In other words, analytical statements lack informativity. The more synthetic a proposition is (i.e., the greater the empirical reference that it has), the more informative it is. *Quantity* is a measure of the extension of a symbol. It refers to the fact that different symbols "may denote more or fewer possible things; in this regard they are said to have extension." (W1: 187). Thus, the extension of the symbol *fish* is larger than the one of *sharks* since *fish* is applicable to more animals than *Sharks*. *Quality*, on the other hand, is dependent on the intension of a symbol, which is the number of characters attributed to a term. That is a *logical quantity.* This is a quantity very different from the probability theory underlying Shannon's and Wiener's objective information theories. Nöth (2012: 144) explains:

> *Information* is thus a third logical quantity between depth and breadth. Peirce calls it the "implication" of a symbol (W1: 465). The word *man* has no more than one meaning, but it has many biological, religious, political and other implications which go beyond the mere lexical definition of the word (W1: 465–466). In this sense, informational implication takes into account all available knowledge and not only the defining characters from which lexical definitions are made up.

This view is also our transdisciplinary key interlinking the various arms of the Cybersemiotic star. Peirce is aware of the fact that the amount of information transferred in communication is dependent on the knowledge horizon of the receiver or, rather, interpreter. He writes "If you inform me of any truth, and I know it

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[29] Empirical reference would also be to social-cultural phenomena like "Unicorn".

already, there is no information" (MS 463: 13, 1903).[30] Thus information has to be able to combine with what you already know. "Actual information extends the knowledge horizon of the interpreter. Information is the measure of how much a symbol involves more or less real knowledge" (W1: 187). Thus 'objective' does not means 'interpreter-independent'! Peirce writes,

> I do not call the knowledge that a person known to be a woman is an adult, nor the knowledge that a corpse is not a woman, by the name 'information,' because the word 'woman' *means* a living adult human being having female sexuality. Knowledge that is not informational may be termed 'verbal' (MS 664: 20, 1910).

Precisely here is where "analyticity" comes in. Peirce is saying that the concept of *adult* is contained in *Woman*: thus, to say "A woman is an adult" is to make an analytic statement. Thus information is a process in which the symbol of *shark*, for instance, as a concept with a content that I know, is constantly undergoing development. When I see a documentary showing me many different species of sharks, that I did not know before, like *hammerheads*, then my symbol of sharks grows, because I have added information to my conception of the species *shark* by increasing the quantities of extension or intension of the symbol connected to it, which now include *hammerheads* within their scope. Peirce writes:

> An ordinary proposition ingeniously contrives to convey novel information through signs whose significance depends entirely on the interpreter's familiarity with them; and this it does by means of a 'predicate,' i.e., a term explicitly indefinite in breadth, and defining its breadth by means of 'Subjects,' or terms whose breadths are somewhat definite, but whose informative depth (i.e., all the depth except an essential superficies) is indefinite, while conversely the depth of the Subjects is in a measure defined by the Predicate (CP 4.543, 1905).

So it is not the lexical definition of "shark" that carries the information, but all the other things I know about sharks' behavior, size, colors, way of movement, prey, and how many of them we catch each day and eat in shark fin soup. Peirce underlines that "the information of a term is the measure of its superfluous comprehension" (W1: 467), which is all the extraneous world knowledge I have about sharks, including if I have been bitten by one. In other words, information is all the knowledge "outside" the lexical definitions! Indeed, Johansen (1993: 148) has suggested that "One way to define *information* is this: the set of characters which can be predicated of a symbol minus the characters contained in its verbal definition."

But, what if one of my students includes something undetermined living underwater looking like a fish and which might possibly be a whale in her symbol or conceptualization of fish – is there then no information? Peirce would conclude that, in this case, we are dealing with the possible, which he considers to be real but having to do with propensities rather than certainties: "that is possible which, in a certain state of information, is not known to be false" (CP 3.442, 1896). Moreover,

[30] MS customarily stands for manuscripts written by Peirce not found in the CP. Many of them can be found on *Arisbe: the Peirce Gateway* home page (http://www.cspeirce.com), but also other places on the Internet. Sooner or later they will appear in the *Writings*.

"the Possible, in its primary meaning, is that which may be true for aught we know, that whose falsity we do not know" (CP 3.374, 1885). As Peirce holds a fallibilist view of science combined with a pragmaticist and realistic view of knowledge, he must conclude:

> The cognitions which ... reach us ... are of two kinds, the true and the untrue, or cognitions whose objects are real and those whose objects are unreal. And what do we mean by the real? ... The real, then, is that which, sooner or later, information and reasoning would finally result in, and which is therefore independent of the vagaries of me and you (CP 5.311, 1868).

Thus Peirce produces a new transdisciplinary theory of information connected to his semiotic theory of cognition and communication, which differs substantially from the usual conceptions. Nöth (2012: 139) explains:

> In modern linguistics, the intensions of words are described in the form of semantic features, whereas their extension is studied in a reference semantic framework. For Peirce, however, extension and intension cannot be separated from each other since the extension or denotation of a symbol "is created by its connotation" (W1: 287), that is, through the predicates attributed to a subject term. We can only determine the referent (denotatum or extension) of a word if we know its meaning (intension or connotation) and vice versa: we must know the referent if we want to specify its semantic features ...

Thus, Peirce's theory combines the concepts of meaning and information within a framework of pragmatic realism established on a semiotic understanding of cognition and communication. In this way, he builds bridges between the four different and often incommensurable worlds we mapped in Fig. 2.1. Peirce's theory can be modernized by combining it with Luhmann's communicative systems theory, which introduces autopoiesis at the level of biology, psychology, and social communication (Brier 2008, 2011). Luhmann and Peirce both share the idea of form as the essential component in communication. Peirce (MS 793:1–3) writes:

> [...] a Sign may be defined as a Medium for the communication of a Form. [...]. As a medium, the Sign is essentially in a triadic relation, to its Object which determines it, and to its Interpretant which it determines. [...]. That which is communicated from the Object through the Sign to the Interpretant is a Form; that is to say, it is nothing like an existent, but is a power, is the fact that something would happen under certain conditions.

In Peirce's dynamic process semiotics, a form is something that is embodied in an object as a habit. Thus, form acts as a constraining factor on interpretative behavior or what he calls a real possibility in the form of a 'would-be'. Thus *the form is embodied in the object as a sort of disposition to act* (Nöth 2012).

2.7 Conclusion

When scientific methods are applied to information, cognition, and communication, we are only left with codes, grammar, phonetics, programs, formal language, copy machines, adaptors, and the analysis of meaningful relations is lost amidst all the formal technicalities. Contrary to reductionist loss of meaning, Cybersemiotics follows in the footsteps of Peirce, whose semiotics allows us theoretically to distinguish between the information the sender intended to be in the sign, the (possible) information in the sign itself and the information the interpreter gets out of the sign. The knowledge in the sign must be interpreted for a full semiosis[31] to happen and for the receiver – for example, a party in a conversation – to acquire the information imparted by his or her interlocutor.

Thus, in this transdisciplinary frame for interdisciplinarity the sign process is viewed as transcending the division between nature and culture, between the natural sciences, the life sciences, the social sciences, and the humanities and between phenomena that are exterior and those that are interior to human consciousness. As such, it is central to any conception of knowledge and information. Through the development of Peirce's semiotics into a biosemiotics combined with Luhmann's three levels of autopoiesis, the subjective, the natural, and the social are integrated into one framework because signs are relations and not objects (Brier 2008). As such, they are able to bring all the things of the world into a contextual and historical web of culture, a family, a lineage, a species, and the experiential embodied lifewords, be they the sedimentation of the experience of an individual or of a group of people. Signs have the "active power to establish connections between different objects, especially between objects in different Universes" (CP 6.455, 1908).

We must accept that experience and meaning are just as real as matter. This does not mean that what physicists call the "world" or "reality" as such is imbued with meaning. It means that their concept of "world" and "reality" is unable to reflexively encompass the embodied psychological and social foundation of knowledge. Thus their idea of reality does not take our full measure as conscious, linguistic, and social creatures. It lacks an embodied phenomenological foundation in the understanding of *Wissenschaft*. From a semiotic viewpoint, we can see man as a parasite of symbols (Nöth 2012), because we use them to create our perceived selves as self-conscious, cultural communicative beings. Peirce points out that self-reproduction and self-replication are not only characteristics of organisms and chromosomes, but also of symbols. Signs replicate through and in their tokens. Replicas of symbols in their acoustic or written form are indeed dead things (phenomena of Secondness), but symbols as genuine Thirdness live on as self-replicative beings. It is within that wider reality of life connecting subjects in language and social actions to nature and technology that information is created.

[31]Peirce defines semiosis the following way: "It is important to understand what I mean by semiosis. All dynamical action, or action of brute force, physical or psychical, either takes place between two subjects (whether they react equally upon each other, or one is agent and the other patient, entirely or partially) or at any rate is a resultant of such actions between pairs. But by "semiosis" I mean, on the contrary, an action, or influence, which is, or involves, a coöperation of three subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into actions between pairs." (EP 2:411, 1907)

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Chapter 3
Epistemology and the Study of Social Information Within the Perspective of a Unified Theory of Information

Wolfgang Hofkirchner

3.1 Introduction

Approaching any object of investigation has its implications – that is, it implies, whether one is aware of it or not, general assumptions regarding how objects of investigation can and should be approached. The general approach leads to specific findings which, in turn, can and should feed back to the general assumptions, thus assuring reciprocal compatibility between the general and the specific in methodology. Usually, the general part of methodology is considered to be part of the philosophy of science – that is to say, the epistemology of scientific knowledge – whereas the specific part of methodology is considered as part of the discipline in question.

Methodology, however, gives an epistemological twist to theory. That is, knowledge about a certain object of investigation is not only knowledge about the particular features of the specific object but also implies knowledge about the general features that a larger set of objects of inquiry display. As with methodology, again, the latter knowledge pertains to philosophy, while the former pertains to the discipline. The general theory is part of ontology; the more specialised theories are lower-range theories of the disciplines.

In short, each disciplinary approach is based upon philosophy – upon epistemological and, through them ontological assumptions.

Approaching social information as an object of study is no exception to the rule. "Social information" shall denote here any phenomenon that is an information process, a result of an information process, or related to such a process in the social, that is, human, realm – i.e., data, knowledge, wisdom, meaning,

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message, communication, understanding, human language, human intelligence, human percepts, concepts, thought, human consciousness, conscience, etc. Social information research is based upon epistemological foundations as well; findings relating to specific features of social information stand in a certain relation to the general assumptions of epistemology. A Unified Theory of Information (UTI) as proposed by the author (Hofkirchner 2013b) is set up in a way that reflects that relation.

3.2 Epistemological Foundations

First of all, epistemology is the starting point for scientific investigations of social information, since epistemology is the starting point for every scientific investigation. However, epistemology is also very much about the general features of (the methods of) social information itself: this means that, in this case, philosophy directly addresses the general features of the object and the disciplinary findings in social information directly address philosophy. That is, epistemology should both provide heuristics for social information research and recast its assumptions to fit the findings of studies on social information.

In what follows some aspects of epistemology and its applications are dealt with:

- the embeddedness of epistemology in ontology and praxiology;
- transdisciplinarity;
- explanation and understanding;
- semiosis.

3.2.1 Praxiology and Ontology Added to Epistemology

The phenomenon of social information has to do with individuals joining groups from small enclaves up to the level of society as a whole, exchanging with each other, and reflecting social life and nature. These individuals ask questions like "How should humans act?", "How can humans intervene in the world?", and "How can humans comprehend the world?". The study of social information needs more than mere epistemology, which only answers the last of the above questions. Epistemology is intertwined with the philosophical discussion of the other two questions too.

Since theory and methodology are closely interlinked – the former tells you how the object is and the latter tells you how the fact that the object is as it is determines how you can get knowledge of the object as well as the other way around; the latter makes assumptions about how you can get knowledge of the object and the former results from applying those assumptions to your activity of getting knowledge of it –, epistemology and ontology are also tightly tied together. Hence the rise of radical-constructivist standpoints that often seem to end up in mere solipsism and of Onto-Epistemology, a rather moderate stance in German philosophy combining realism with constructivism introduced by the Marxist thinker Sandkühler (1990; 1991: 34–37, 353–369) and later modified by Zimmermann (2002: 147–167).

The actual philosophical foundation of UTI draws upon the latter strand and tries to complement epistemology and ontology with "praxiology" – that is to say, with a philosophical theory of praxis comprising ethics, aesthetics, and axiology (Hofkirchner 2013b: 47). Praxis means the process of co-action of human actors upon reality; reality means the field of interaction of human actors with the environment mediated by method; and method means the mode of action of those human actors.

A certain practical interest defines the spheres of intervention as realities made up of objects of concern to human actors and any given sphere of intervention defines the scope of instruments as methods useful for intervening within it. And, in turn, a definite methodical instrument excludes a range of definite realities and a definite reality excludes the pursuit of a range of definite practices.

Accordingly, "praxis builds upon reality and reality builds upon method" (Hofkirchner 2013b: 47) and praxiology builds upon ontology, which, in turn, builds upon epistemology. Hence, we can speak of "Praxio-Onto-Epistemology" (POE).

However, the point here is that this hierarchy should not be interpreted in a deterministic way. "This relationship of encapsulation of domains of philosophical disciplines, and of the philosophical disciplines themselves, does not model a one-way process of causal influence or linear inferences. Rather, both bottom-up as well as top-down processes have to be recognised. There is relative autonomy of each of the domains (praxis may shape reality but reality provides the scope of possible practices; reality may shape method but method provides the scope of possible realities) and of each of the disciplines (praxiology does not fully determine ontology and ontology does not fully determine epistemology, and *vice versa*)" (Hofkirchner 2013b: 47–48).

To sum up, the methodology of social information studies needs to be viewed in a POE context.

3.2.2 A New Way of Thinking Adopted for Reasons of Transdisciplinary Research

Social information is not only a social phenomenon. It is at the same time a natural phenomenon, for humans and societies originate from prehuman and presocietal existents and continue natural evolution with social means that are, at the same time, specified natural means. (For example, technology is one of these social-and-natural means). Methodology should provide the grounds for transdisciplinary approaches toward social information.

Ways of thinking are decisive for whether or not transdisciplinarity can be achieved.

UTI follows a new way of thinking. By doing so, it offers a creative resolution to a basic quandary faced when analysing possible conceptualisations of information (not only in the social realm). This quandary is known as Capurro's Trilemma (Hofkirchner 2011b). It is a trilemma since, at a first glance, there seem to be three possibilities of understanding information, none of which is satisfying.

- One possibility is the "hard" science perspective that opts for "information" as having a single, univocal meaning.
- A second possibility belongs to the "soft" science perspective and consists in seeing analogical meanings when taking social information as a point of departure.
- A third possibility gives up on looking for identity and affirms a plurality of different, largely incommensurable, equivocal meanings. This possibility too belongs to the "soft" science perspective.

The trilemma is dissolved, once the three possibilities above are recognised as being due to applications of three ways of thinking – the reductionistic one, the projectivistic one and the disjunctivist one[1] – and the omission of a fourth way of thinking. The fourth way of thinking is integrativistic: it integrates lower with higher complexity while differentiating them and yields, in a dialectical manner, a unity of identity and difference (Hofkirchner 2011b).

Integrativism applies Aristotle's specification hierarchy in the context of evolutionary theory. "Aristotle paved the way for a dialectics of the universal and the particular by establishing specification hierarchies via *genus proximum* and *differentia specifica*. The whole tree can be considered to represent the concrete-universal, and each ramification to specify one particular instantiation of the universal by making the abstract concrete.

Hierarchies that specify the being are the logical way of grasping the history and genesis of becoming (unity of being and becoming). According to that conceptualisation approach, which is logical and historical at the same time, a UTI seeks a concrete-universal concept of information rather than an abstract one" (Hofkirchner 2013b: 155).

Integrative thinking integrates unity and diversity while doing justice to differentiations. It integrates the epistemological third-person view of "hard" science with the first-person view of "soft" science by positing that information can be, and needs to be, perceived both from outside and from inside. The rationale for this epistemological assumption is that it is embedded in an ontological assumption regarding information. According to this assumption, information is an existent that is material, but never exclusively material– for in the course of evolution, it has become more and more ideational. The upshot of this is that the materialistic ontological perspective of "hard" science and the idealistic one of "soft" science are

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[1] Reductionism reduces higher complexity to lower complexity; projectivism – often subsumed under reductionism because it is another attempt at unification – projects higher complexity onto lower complexity; disjunctivism – a more precise term than dualism – disjoins higher complexity from lower complexity and leads to difference without identity.

integrated; and this ontology is backed by positing information as an ingredient of practice that demonstrates objective and subjective features as well, thereby integrating the objectivist praxiological information perspective of "hard" science with the subjectivist perspective taken by "soft" science (Hofkirchner 2011b).

To sum up, the methodology of social information studies needs to be integrative in order to enable a truly transdisciplinary approach to social information.

3.2.3 Abilities to Explain Revisited

Social information is not only redundant, it is creative, unexpected, surprising, unpredictable, and novel.

A basic problem that methodology needs to confront is how scientific understanding can be assured, given cases in which explanation does not seem to work, in particular, in the case of social information.

The epistemological foundation of UTI implies a fresh perspective on comprehension, that is, the relation of explanation and understanding.

Explanation is the way in which why-questions are said to be answered in the "hard" science perspective. It is said to be true when, according to the deductive-nomological scheme elaborated by Popper (1935) and Hempel and Oppenheim (1948), a formal logical inference from premises to a conclusion can be drawn in such a way that the premises express that which is expected to do the explaining – i.e., the "*explanans*" – and the conclusion describes what is to be explained – i.e., the "*explanandum*". This inference is compelling. By way of deduction, truth is transferred from the premises to the conclusion. The conclusion is given and proper premises are hypothesised. Hypotheses remain hypothetical as long as they are not falsified. Hypotheses boil down to describing sufficient conditions. Sufficient conditions are formalisable as antecedents in implications. Implications form part of the premises.

Social sciences like economics, behavioural science, or psychology treated as "natural" sciences and, in particular, cognitive science are, on the whole, inclined to make use of this scheme. However, they can be criticised for encouraging reductive thinking – reduction either of collective phenomena in society to individual ones or of ideational phenomena to material ones.

The way why-questions are approached in the "soft" science perspective in the narrower sense is known by the name "understanding", as understood in phenomenological and hermeneutic traditions. On this view, explanation is said not to work in fields like history or, again, psychology. Thus, events or entities are described and interpreted in order to yield understanding instead of giving an explanation. Interpretation needs no deduction. Since interpretations could be of any type, this perspective can be criticised for lacking rational substantiation of its background ideas.

UTI epistemology accepts the criticism of deductivism typical of the natural science approach, as well as the nondeductivism characteristic of the "soft" science approach.

Deductivism in epistemology goes hand in hand with strict determinism in ontology and an expensive interventionism in praxiology: compelling epistemological inferences can be drawn only if strictly determined causal relationships are at work on the level to which ontology refers; and strictly determined causal relationships can be presumed ontologically only if controllability holds for the level of praxis – the possibility of proper instrumentalisation of cause-effect-relationships for practical reasons (Hofkirchner 2011a). But neither is the world under the efficacious, effective, and efficient control of humans nor are causes strict determinants.

On the other hand, nondeductivism should not open the door to the arbitrariness of the methodological anarchism of "anything goes" (Feyerabend 1975). With regard to ontological assumptions, this would not preclude any event or entity from being possible at all. And with regard to praxiological assumptions, no action could successfully be oriented toward a goal.

What is needed is neither sufficient conditions nor no conditions at all. What is needed is necessary conditions – conditions without which an event could not happen or an entity could not be. And the search is after the (most) proximate necessary condition for a phenomenon to take the form it does. This condition is called the "adjacent necessary", by which Stuart Kauffman's thesis of the "adjacent possible" is paraphrased – Kauffman's thesis is predictive, whereas the one presented here is retrodictive (Hofkirchner 2013b: 133).

The closer the necessary condition is to that which is conditioned, the better the understanding of the conditioned event or entity. If there is no conditioning condition available, then there is no understanding at all. Sufficient conditions can be detected in areas where agents are levelled down to patients having no more than one option. And these areas are rather rare. Thus explanations in the deductive sense are a subgroup of understandings only.

Methodology can recognise the fact that leaps in quality need not be explained – and cannot be explained in the deductive sense – but can be understood when identifying that necessary condition that is the point of departure for the qualitative leap, be it diachronic change over time or a change of layers in synchronic hierarchies.

To sum up, the methodology of social information studies needs a proper directive for how to cope with qualitative leaps.

3.2.4 Semiotics Reconfigured

Social information is semiosis, sign processes, the generation and usage of signs.

The philosophical architecture of praxiology, ontology, and epistemology can be used to restructure semiotics as an architecture of pragmatics, semantics, and syntactics. Sign use is a kind of praxis, sign referents are a kind of reality, and sign production is a kind of method. "Pragmatics deals with the use of signs, semantics is about the signs' relation to their referents, and syntactics refer to signs themselves and how their components fit together. If a sign is something that is produced and/or used by someone with the purpose of referring to something else in order to express its meaning to someone else, then it makes sense to consider the pragmatic aspect as the uppermost level, the semantic aspect as the intermediate level and the syntactic aspect as the bottom level" (Hofkirchner 2013b: 50). This is so because – as in the interrelations of praxis–reality–method – "the usage defines the reference and the reference defines the production of signs, whereas the production gives rise to a certain scope of possible references which, in turn, gives rise to a certain scope of possible usages" (Hofkirchner 2013b: 50). Accordingly, semantics is a subset of pragmatics and syntactics a subset of semantics.

To sum up, the methodology of social information studies needs to embrace the different semiotic aspects of syntactics, semantics, and pragmatics to give a unified account of semiosis and not a syntactic, semantic, or pragmatic account in isolation.

3.3 Studying Social Information

The foregoing discussion of epistemological foundations for studying social information in a UTI perspective has resulted in some methodological consequences: what should be considered is the relationship of method with reality and praxis, the transdisciplinary specification hierarchy, emergence as an essential feature of information, and all semiotic contexts together.

What follows describes how UTI takes these consequences into consideration. First, a general account of the information concept in a UTI perspective will be given; second, consideration of the social information concept will show that social information is a particular – and, in evolutionary terms, the most particular – manifestation of information.

3.3.1 Generic Information

The methodology of social information studies demands the application of a specification hierarchy.

Accordingly, UTI defines social information in a first step as information in social, or human, systems. Social, or human, systems are self-organising, or evolutionary, systems. Presocial, or prehuman, systems are self-organising too. Living systems are self-organising as are material systems, if they are not mechanical.

A self-organising or evolutionary system s_e is defined as "a collection of

(1) elements E that interact such that
(2) relations R emerge that ... dominate their interaction in
(3) a dynamics D" (Hofkirchner 2013b: 105 – italics removed, W.H.).

Information is then, in a second step, assumed to be co-extensive with self-organisation. This is the case because self-organisation occurs whenever an event or an entity in the inner or outer environment of a system perturbs that system. Information can then be defined as a "relation such that

(1) the order O built up spontaneously . . .
(2) reflects some perturbation P . . .
(3) in the negentropic perspective of an Evolutionary System s_e" (Hofkirchner 2013b: 171 – italics removed, W.H.).

Negentropy refers to the fact that – in physical terms (and every real-world system is a physical system) – entropy needs to be exported by a system, if it is to organise itself. The build-up of order is a negentropic process. The higher the order, the more negentropic is the process and the more important is information for the system's organisation (Morin 1992: 350 and 368).

In other words, information is defined as a "relation by which, from the perspective of a self-organising system (that maintains itself *vis-à-vis* its environment), a spontaneous build-up of order corresponds to a perturbation in the environment. Information is generated if self-organising systems relate to some external perturbation by the spontaneous build-up of order they execute when exposed to this perturbation" (Hofkirchner 2013b: 9).

Information mediates the interaction of the system with its environment – hence the subjective and the objective aspect of information. Information is the process of building up the order (a process that is often held to be nonmaterial) and the result of this process – the order itself, which is material and stands for some perturbation in reference to the maintenance conditions or other goals of the system. The perspective of information research shifts back and forth between the emergence of information (the interior) and information as emergent (an external observable) which is an emergent structure, state, or behaviour of the system.

According to Bateson, information is "a difference which makes a difference" (Bateson 1972: 453). The substance of this famous definition of information is fully compatible with the UTI view. As has been argued elsewhere (Hofkirchner 2013a: 9), "we can speak of information if there is a difference in the environment of a self-organising system that makes a difference to that very system; a difference in the environment may be instantiated by an event or an entity, and the difference made to the system might manifest itself as a change in its structure, state or behaviour . . . . Information is a tripartite relation such that

(1) Bateson's 'making a difference' is the build-up of the self-organised order;
(2) Bateson's 'difference' that makes the difference is the perturbation that triggers the build-up;
(3) Bateson's difference that is made is made to the system because the perturbation serves a function for the system's self-organisation."

The methodology of social information studies requires the inclusion of semiosis and the anticipation of method–reality–praxis in presocial information. In semiotic terms, UTI equates the self-organised order of a system of any kind with the sign, the perturbing event or entity with that which is (to be) signified, and the system itself with the sign-maker. The whole process is equated with the making (and the usage) of the sign, the sign process (Hofkirchner 2013b: 155–166). Here syntactics refers to the sign which plays the role of a primordial method; semantics relates to the signified which plays the part of a forerunner of later reality; and pragmatics applies to the agency of the sign-maker which assumes the role of what in social systems is known as praxis.

The methodology of social information studies calls for a proper conception of qualitative leaps. It is worth noting that the generation of information (as well as the usage of information) is a creative activity of the system in the course of which novelty is produced. This presupposes that self-organisation is emergent – i.e., not mechanical. That is to say, the input the system takes in is not transformed in a mechanical way: rather, self-organising systems are active in the context of undeniable degrees of freedom, and their activity of discrimination, distinction, and differentiation is an information process.

3.3.2 Social Information

The methodology of social information studies requires that the information concept be properly unfolded along the specification hierarchy in a manner that takes into account the phenomena of semiosis, method–reality–praxis, and novelty. Let us consider how UTI does this.

Information varies from system to system. According to the framework of UTI, evolutionary types of information are associated with evolutionary types of self-organisation. Material, living, and social systems differ with regard to their mode of self-organisation.

Social self-organisation is characterised by so-called "re-creation". Social systems and processes change their form in a directed way and transcend themselves, re-invent themselves, create themselves – that is what the Austrian philosopher Jantsch (1987) meant by the term "re-creation". Social self-organisation goes beyond biotic self-organisation, which, in turn, goes beyond physico-chemical self-organisation.

- All material self-organising systems are dissipative systems, for they dissipate the entropy that comes about when they produce order (Prigogine 1980); in doing so, they are self-referential and teleomatic in that they show an inner circular causality that lets them tend towards an attractor;
- all living systems are material self-organising systems that, in addition, are self-reproductive and teleonomic (Mayr 1974) in that they can influence the conditions they require to maintain themselves; Maturana and Varela (1980) coined the neologism "autopoiesis" to describe this;

- social systems are, in addition, self-productive and full-fledgedly teleological in that they are able to set new kinds of goals through which they practically change themselves.

Evolutionary systems form a series of stages in which each new layer of self-organisation is added on top of the previous layers.

Social information is connected to re-creation. Re-creation consists of three evolutionary layers of self-organisation. So does social information, which brings about the constitution of sense. The constitution of sense works along the three concatenated cycles of self-organisation in that it starts with means, proceeds via ways, and, eventually, ends up in goals. Means, ways, and goals are steps that represent syntactic, semantic, and pragmatic signs; each sign is a structure that fulfills a function for the next sign. Sense is something that reworks the whole chain of lower levels of sign production from the goals to the ways to the means. At the social level, full-fledged semiosis is unfolded as the outcome of evolution. It leaves behind the two-levelled architecture of code-making as a type of information in less complex autopoietic systems, which features structure as a quasi-syntactic sign and function as a quasi-semanto-pragmatic sign, and the one-levelled architecture of pattern formation in yet simpler dissipative systems, which consists purely of undifferentiated, proto-semiosic signs[2] (Hofkirchner 2013b: 173–184).

According to the Triple-C Model (Hofkirchner 2013b: 184–196), social information involves three systemic functions: cognition, communication, and co-operation. Cognitive, communicative, and co-operative functions appear in systems at every self-organising stage.

- Cognitive processes are information processes in one system only.
- Communicative processes are coupled information processes of at least two co-systems.
- Co-operative processes are information processes between a multitude of co-systems and their supra-system which channel their coupled information processes.

These functions form a hierarchy. “Hierarchy always means that the higher level shapes the lower one, although the higher depends on the lower. Therefore, cognition is a necessary condition for communication, and communication is a necessary condition for co-operation. Given a system of systems, co-operation of these very systems shapes their communication. This, in turn, shapes the cognition in each of them. In this way, cognition, communication and co-operation are mutually conditioned” (Hofkirchner 2013b: 186).

[2]The term “proto – semiosic” is used here to refer to semiosis as well as signs in a seminal state. System structure, system state, and system behaviour cannot be distinguished, and, thus, there is no distinction between semiosic levels. However, pattern formation is semiosis and pattern is a sign because the pattern relates the system to the perturbation.

3.4 Human Cognition

Reflexivity – a term borrowed from Archer (2007, 2012) that here signifies human consciousness – is the cognitive dimension of the sense-constituting ability; accordingly, reflexion is the actualisation of the ability to cognise in the constitution of sense.[3]

If cognition is "that informational process, or the result of that process, in which an evolutionary system relates

(1) by carrying out a certain activity of building up order
(2) to a certain perturbation
(3) so as to realise a certain end" (Hofkirchner 2013b: 201 – italics removed, W.H.),

then reflexion is "that cognitive process, or the result of that process, in which a human system (which is labelled the 'subject of recognition' or 'cognitive subject'), generates or utilises information

(1) by a certain means (which is labelled 'method of recognition' or 'cognitive method')
(2) and by a certain way of signifying something (which is labeled the 'object of recognition' or 'cognitive object')
(3) for certain goals (which is labelled the 'interest in recognition' or 'cognitive interest')" (Hofkirchner 2013b: 205–206 – italics removed, W.H.).

Reflexion comes in three varieties along the levels of means, ways and goals: percepts, knowledge, and wisdom (see Fig. 3.1).

If one thinks in terms of evolution, the lowest level goes back to the one-leveled architecture of dissipative systems which provided responsiveness as ability to cognise. The second level goes back to that second level that is disposed of by autopoietic systems. This level was added to responsiveness and provided the ability to cognise for systems that were adaptive. Only the third level is genuinely human. It provides the reflexivity that disentangles motives from the representations with which they coincide in prehuman cognitive systems. With each leap in quality, the lower levels are modified so as to suit the new quality (see Fig. 3.2).

Fig. 3.1 Cognitive social information

[3]"Reflexion" here denotes human cognition. It comprises emotive aspects as well.

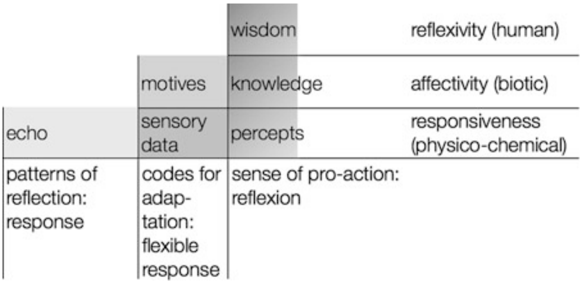

Fig. 3.2 Evolution of cognitive information

3.4.1 Percepts

Percepts are the result of perceiving. Perceiving oscillates infinitely between receiving and conceiving. "While the reception process refers to the input side of perceiving, the conception process refers to the downward causation in which concepts already supplied by the system influence how perception is done" (Hofkirchner 2013b: 206). This is so because, as Popper put it (1973), no observation can be made unless the human system avails itself of concepts that guide it. Percepts form the unity of "recepts" and "concepts". It is presumed that, through the interaction of the opposing processes of receiving and conceiving, progress can be made from an ever new abstract to an ever new concrete.

If percepts are represented by physical signals outside the human body, they are ready for machine data-processing procedures. That is why percepts might be called data.

The level at which percepts are produced is the syntactic level.

3.4.2 Knowledge

The next level is the semantic one. It is semantic because it refers to what the reflexion is about. It has its basis in the level of percepts, which now acquire a new function: the creation of knowledge takes place when they undergo interpretation. The interpretation process involves two countervailing processes – instruction from below and construction from above. Instruction is influenced by reception, construction influences conception. "Constructive moments are needed because knowledge cannot be inferred from data alone. Instructive moments are required too in order to bind knowledge back to the data" (Hofkirchner 2013b: 207). It may be supposed that this process brings about the accumulation of knowledge: it leads from knowledge of one presumed degree of truth to knowledge of another, presumably higher degree of truth.

3.4.3 Wisdom

The semantic level is a function of the uppermost level, which is the pragmatic one. The pragmatic level relates knowledge to self-set goals. It confers value to knowledge, a process known as evaluation. Evaluation is, again, composed of two opposite processes: describing and prescribing. “The description starts from knowledge but is counterbalanced by prescription that orients action towards the goals (makes action pro-active) and shapes the construction of knowledge. The content of knowledge is, basically, reformulated in prescriptive terms to explicate the relation to the goals” (Hofkirchner 2013b: 208). The outcome of that process is wisdom. Wisdom is expected to be capable of elaborating and yielding subjective goals that are progressively based upon objective knowledge.

The hierarchy of percepts, knowledge, and wisdom together make up the sense of pro-action. They form emergent levels and are not linked in a strictly deterministic sequence but show convergence on top of one another. The sense of pro-action is itself an emergent outcome of the process of sophistication of cognition.

3.5 Human Communication

Human communicability takes on the form of “languageability”[4] (the capacity for language) and human communication, the form of symbolic acts.

Starting from communication as “that informational process, or the result of that process, in which one evolutionary system relates,

(1) by carrying out a certain activity of manifesting order
(2) referring to a certain perturbation having occurred to it previously,
(3) so as to realise a certain end,

to other evolutionary systems and vice versa” (Hofkirchner 2013b: 212 – italics removed, W.H.), human communication can be considered as “that communicative process, or the result of that process, in which one human system (which is labelled ‘communicator’), tries to make intelligible,

(1) by a certain means of demonstrating (which is labelled the ‘method of communication’),
(2) a certain way of information about something (which is labelled the ‘object of communication’)
(3) for certain goals (which is labelled the ‘interest in communication’),

[4]The inspiration for this term is “languaging”, which I first came across in Maturana’s (1995) writings.

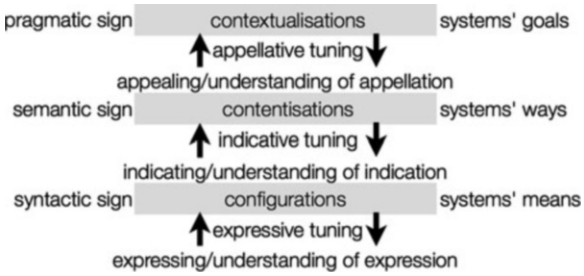

Fig. 3.3 Communicative social information

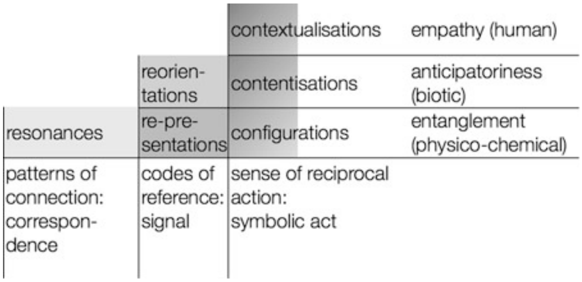

Fig. 3.4 Evolution of communicative information

to other human systems, while the latter (which are labelled 'communicants') try to grasp the configuration, content and context of symbols and engage with the first system on the same line" (Hofkirchner 2013b: 216–217 – italics removed, W.H.).

Symbols are seen as the specific human instrument to convey communication. They are arbitrary language elements agreed upon by convention. They are configured on the syntactic level, endowed with content on the semantic level, and embedded in contexts on the pragmatic level (Fig. 3.3).

Again, these three levels are re-ontologisations of communicative systems in the course of evolution. The third level is the specific human one that ensures human empathy to help understand appeals in contexts. A second level was only reached by autopoietic systems – that level guaranteed the capacity of a system to anticipate orientations of co-biosystems. Simple dissipative systems manifested only one quality – the quality of entanglement of co-systems, which stands at the origin of communicability (Fig. 3.4).

3.5.1 Configuring Expressions

A person engaged in communicating, or communicator, has at his or her disposal a range of means of representing the results of his or her cognition to others, be these linguistic or non-verbal signs. These are configured on the syntactic and methodic level in order to express what the communicator seeks to present to his or her communicants, or those persons receiving the communication. While the communicator expresses, the communicants try to understand these expressions. So there is a process of expression together with a process of understanding the expression, which conjointly form the process of expressive tuning. For, in reiterated feedback loops, both the communicator and the communicants tune in to each other's expressions; this allows for the progressive attainment of reciprocal understanding (Hofkirchner 2002: 183–184).

3.5.2 *Matching the Content*

As it is about the objects of communication, this level is about semantics and reality. Again, there is a process of tuning between the communicator and the communicants – in this case, however, it is tuning with respect to indicating the content and understanding the indication. The whole process of reciprocal matchings of the indications produces a shared content (thus, the process might be called "contentisation"). Indicative tuning consolidates through progress from the indicated to the understood and from something newly indicated to something newly understood (Hofkirchner 2002: 185–186).

3.5.3 *Putting into Context*

The pragmatic level is about the interests in communication the communicator and communicants have according to praxis. These interests take center stage when symbols are put in context. Underlying a communicator's desire to engage with communicants is an intention. He or she displays this intention through appealing to the communicants. And the communicants have intentions that fertilise or block the understanding of the appeal. At any rate, understanding can crystallise during the overall process of appellative tuning (Hofkirchner 2002: 186–187).

Configurations, contentisations, and contextualisations of symbols realise the hierarchy of symbolic acts – the sense of reciprocal action. As in the case of reflexions, they form emergent levels and are not linked in a strictly deterministic manner but show convergence on top of one another. The sense of reciprocal action emerges in the course of constructing common ground through communication.

3.6 Human Co-operation

When harnessed to carrying out co-operative activities, the sense-constituting ability of humans can be called "communitarity" (Hofkirchner 2013b: 197), and the constituted sense can be called association.

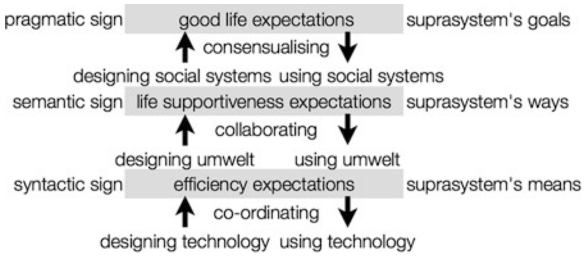

Fig. 3.5 Co-operative social information

Given that co-operative information in general is "that informational process, or the result of that process, in which a number of evolutionary systems relate

(1) by carrying out a certain activity of building up the common order
(2) to a certain perturbation on the part of the meta- or suprasystem they participate in
(3) so as to realise a certain common end" (Hofkirchner 2013b: 223 – italics removed, W.H.),

human co-operative information is "that co-operative process, or the result of that process, in which a number of human systems generate or utilise social information, that is, information on the level of the social system they participate in,

(1) by a certain means of building up a common order (which is labelled the 'method of co-operation')
(2) and by certain ways of relating to a common environment (which is labelled the 'object of co-operation')
(3) for certain common goals (which is labelled the 'interest in co-operation')" (Hofkirchner 2013b: 226–227 – italics removed, W.H.).

Association (Hofkirchner 2013b: 225–226) is multifold: it consists in expectations with regard to three different issues: expectations regarding efficiency, expectations regarding life supportiveness, and expectations regarding the good life, one on the top of the other (Fig. 3.5).

In an evolutionary account, collectivity is the first quality of systems that co-operate. It characterises simple material self-organising systems. When the next great innovation of nature added collective intelligence, living systems emerged as intelligent collectives that assigned needs and distributed roles through downward causation in a two-levelled architecture. With the advent of social systems, collective intelligence is augmented by collective intentionality – that is to say, "the participants have a joint goal in the sense that we (in mutual knowledge) do X together" (Tomasello 2009, 61; Fig. 3.6).

3.6.1 Efficiency Expectations

On this lowest level of association, human co-systems co-ordinate their activities in designing and using technologies (technologies not in the sense of machines only

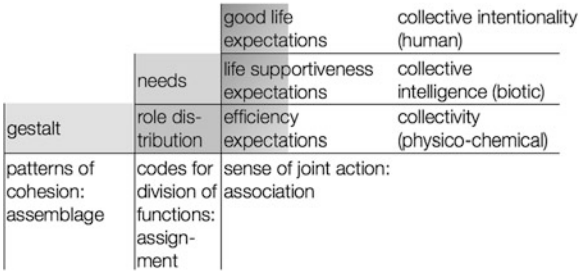

Fig. 3.6 Evolution of co-operative information

but in the sense of any artificially devised way of carrying out an activity). Efficiency is expected to be raised in an infinite cycle of innovations and applications that progress from obsolete instruments to new ones. What is co-constructed here can be named *poiesis*.

This level reflects the level of method in the series of method–reality–praxis and the expectations of efficiency reflect syntactics in the bigger picture.

3.6.2 Life Supportiveness Expectations

Efficiency expectations are demanded by expectations that regard the environment of human co-systems. That environment, in turn, is expected to support life; eco-systems are addressed as life-support systems. Life-support is provided by a process of collaboration among the human co-systems in work. They produce the conditions for their biological survival by using nature and, in order to be able to use nature, they reproduce nature. They constantly change from obsolete life support conditions to new ones. *Oikos* in the sense of a harmonic human ecology is co-constructed.

This level is the semantic level and the level of reality: "the meaning of collaborative work is the object of co-operation" (Hofkirchner 2013b: 228).

3.6.3 Expectations for a Good Life

Designing the *umwelt* for supporting life is required for providing a good life. Providing a good life by designing social systems at all is the essence of human culture. "Here, goals go beyond mere survival or productivity issues; the latter are only part of achieving good life" (Hofkirchner 2013b: 229) in the sense of Aristotle's *eudaimonia*. Expectations of a good life are subject to reaching a consensus on the design and use of social systems that bring about synergy effects: these latter give rise to values that cannot be produced otherwise. In the co-construction of *eudaimonia*, values are produced and consumed and obsolete values are replaced by new ones.

This is the level of pragmatics and praxis.

As in the case of symbolic acts, the associations that expect efficiency, life supportiveness, and a good life form emergent levels and are not nested in a strictly deterministic manner. They show, however, convergence on top of one another. Sense in co-operation is the sense of joint action. Co-operative information in social systems emerges from the co-construction of human expectations.

3.7 Conclusion

In the perspective of UTI, “information” is the generic concept to which other concepts like “knowledge” are related. This chapter has shown where in the universe of information spanned by this theory knowledge is to be located and how it relates to various aspects of social information. This location emerges from the interplay of methodological provisions and disciplinary needs.

Methodology is the application of epistemology to the constitution of scientific knowledge, while social information studies is a discipline that investigates information in the social realm. Scientific knowledge is a part of social information; thus it belongs to the domain of social information studies, which yields disciplinary findings. Social information studies is a scientific discipline and is subject to methodological considerations. This chapter has provided a first glance at the interplay between methodology and disciplinary knowledge. Methodology needs to consider disciplinary particulars and needs to be considered when investigating social information.

This chapter has demonstrated how UTI can do both tasks.

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Chapter 4
Perception and Testimony as Data Providers

Luciano Floridi

4.1 Introduction

What is the relationship between information and knowledge? In Floridi (2010a, 2011a, 2012), I argued that information—understood as well-formed, meaningful and truthful data—upgrades to knowledge if and only if it is correctly accounted for. The basic idea is rather simple. Each piece of factual, propositional information that *p* (e.g., "The dishwasher's yellow light is flashing"), is constituted by a Boolean question and answer ("Is the dishwasher's yellow light flashing?" + "Yes"), which, as a stand-alone item, does not yet constitute knowledge, but poses further questions about itself. Such further questions require the right sort of information flow in order to be answered correctly, through an appropriate network of relations with some informational source. If all Alice can do, when asked by Bob why she holds the information that the dishwasher's yellow light is flashing, is to repeat that this is what the yellow light is actually doing, the fact that the dishwasher's yellow light is indeed flashing only warrants at most the conclusion that Alice is informed about the state of the dishwasher's yellow light, but nothing else. For all Bob knows, Alice might have uttered "The dishwasher's yellow light is flashing" as the only English sentence she can master, or she might have dreamed or guessed correctly the state of that particular light. Indeed, the light that Alice reports to Bob to be flashing might have stopped flashing, but then, when Bob goes to the kitchen to check the

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status of the dishwasher, another dishwasher's light, also yellow but different from the one to which Alice was referring, might have started flashing, making Alice right, yet only accidentally so. This is all very well known. The proposal to resolve such difficulties is to analyse knowledge informationally. The result is a definition of knowledge according to which an epistemic agent *S* knows that *p* if and only if:

(i) *p* qualifies as semantic information, i.e., it is well-formed, meaningful, and truthful data;
(ii) *q* accounts for *p*, that is, A(*q*, *p*);
(iii) *S* is informed that *p*; and
(iv) *S* is informed that A(*q*, *p*).

The articulation of the informational analysis of knowledge, in terms of a network theory of account, and its defence, especially against a potential Gettierization (Floridi 2004b), are explicit tasks with which I have dealt in Floridi (2012), so I shall not rehearse the arguments here. Rather, in the following pages I intend to investigate two important consequences of such an analysis:

(a) if knowledge is accounted information, how are we supposed (to apply this analysis in order) to understand perceptual knowledge and knowledge by testimony?

In the first part of this article (Sects. 4.2, 4.3, 4.4, 4.5, and 4.6), I shall articulate an answer to (a) in terms of a re-interpretation of perception and testimony as data providers rather than full-blown cases of knowledge. This, however, leads to a further question:

(b) if perception and testimony are data providers, how are we supposed (to apply this analysis in order) to understand the semantic value of such data?

In the second part of this article (Sects. 4.7, 4.8, 4.9, and 4.10), I shall argue in favour of a constructionist hypothesis about how data may become meaningful for cognitive agents like Alice. This will build upon the naturalistic, action-based semantics developed in Floridi (2011a) and in Taddeo and Floridi (2005) and (2007), and provide the missing link between that kind of semantics and the richer, more convention-based semantics enjoyed by Alice and Bob when having an ordinary conversation, basically their unique way of generating and managing non-natural meanings.

In the conclusion, I shall outline some of the consequences of the two answers and contextualise them within the wider context of some previous research.

4.2 A First Potential Difficulty

The first question has actually been asked explicitly, by phrasing it in terms of a "potential difficulty" by Tommaso Piazza. In a recent, insightful article discussing my proposal for an informational analysis of knowledge, Piazza wrote:

> No less clearly, however, the considerations above [about the nature of the informational account of knowledge] also face Floridi's account with a *potential difficulty*, as they seem to sustain a reasonable doubt about the very viability of this strategy: if one believes that *knowledge can be acquired through perception, or by testimony*, and one also believes that *in those cases there is no accounting or explaining information which could explain the epistemic status to which it is upgraded*, one could well be tempted to suggest that *knowledge could not, at least not in general, be analysed as accounted information*; for at least in the cases just envisaged, an explanation of it will have to proceed by taking into account the justificatory role which perception and testimony seem to perform (Piazza 2010: 79, italics added).

I believe Piazza to be mostly right, but perhaps in a way that may not entirely satisfy him, for I shall argue that his premises can be accepted, indeed strengthened, without accepting his conclusion. But first, let me clarify the background against which the discussion must be understood.

4.3 Some Background

All the empirical information about the world that we enjoy flows, and keeps flowing, to us through our sensorimotor interactions with the world: *directly*, through our perception of the world, possibly mediated by some technologies; and *indirectly*, through our perception of other (possibly even artificial) epistemic agents' perception of the world. We either saw it or read it somewhere, to put it simply, if slightly incorrectly (for we might have heard it, or tasted it, and reading after all is also a case of seeing etc., but I am sure the point is clear). Thus, Aristotelians and Empiricists of various schools are *largely* correct in holding that *nihil est in intellectu quod non prius fuerit in sensu* ("Nothing is in the understanding that was not earlier in the senses"), if and only if (the biconditional qualifies the "largely" above) what we are talking about is empirical information about the external world.[1]

If we distinguish the *direct* and the *indirect perception* of the world by referring to the former as sensorimotor perception or simply *perception*, the first-hand testimony of our senses, and to the latter as *testimony*, the second-hand perception by proxy, we see immediately that the potential difficulty, highlighted by Piazza in Sect. 4.2, concerns the only two sources of empirical information available to cognitive agents like us. Without any external perception, either direct or indirect, we could not even be brains in a vat, bio-batteries in a *Matrix*-like world, or dreamers in a Cartesian scenario, because, in each of these cases, we could not be fed any data through our senses. Therefore, it is essential to check how far the potential difficulty affects the proposal to analyse knowledge as accounted information.

[1] Of course, Leibniz's qualification "*excipe, nisi ipse intellectus*" ("except the intellect itself") remains correct.

Let me first clear the ground of a potential misunderstanding. Knowledge and information states, as well as epistemic, cognitive, and informational processes, are sufficiently similar for our terminology to be interchangeable in most daily circumstances, without any significant loss either in communication or in pragmatic efficacy. This fact reminds us that some tolerance might be sensibly acceptable, even in our technical language. There is an imprecise but still very reasonable sense in which, if Alice sees that such and such is the case, then Alice holds the information that such and such is the case, and *ipso facto* Alice knows that such and such is the case. Thus, if Alice sees a yellow light flashing, then she may rightly claim to know that there is a yellow light flashing in front of her. The same holds true for testimony: if there was a yellow light flashing, and Alice is told by Bob (where Bob could even be a robot or a parrot, see Sect. 4.5 below), who perceived that yellow light flashing, that there was a yellow light flashing, then Alice knows that there was a yellow light flashing. All this I am very happy to concede as uncontroversial in everyday scenarios and parlance.

The value of such a mundane equation—perceiving, or being provided (through testimony) with well-formed, meaningful, and truthful data amounting to p is equivalent to being informed that p, which is equivalent to knowing that p—is that, by adopting it, we gain much simplicity. The cost is that we lose the possibility of drawing some conceptual distinctions, which become essential once we wish to be precise in our epistemology and philosophy of information. This is partly why some philosophers, including myself, resist the equation's deflationism. "Partly" because the reluctance is due not only to the cost to be paid (i.e., a decrease in our ability to draw finer distinctions), but also to the fact that such cost is philosophically unaffordable once we realise that knowledge that p is a specific kind of information that p, the kind enriched by the capacity for answering relevant questions about p, that about which one is informed, by reference to further information that q, which accounts for p. Perception and testimony may be analysed along the same lines because—in the best (i.e., non-Gettierised, scepticism-free, error-free (Floridi 2004b)) circumstances—they *end up conveying* information about their specific references, but they do not yet represent cases of knowledge: in slightly different ways (to be specified soon) they are our data providers. Let us consider perception first.

4.4 Perception and the *Phaedrus* Test

Epistemologically, our bodies are our cognitive interfaces with the world. Their sensory and kinetic apparatus implements hard-wired levels of abstraction (more technically, we are embodied, cognitive gradients of abstraction (Floridi 2008)), which determine the range and type of data (observables) that can be negotiated, acquired, and processed. Perception is then a general term that refers to the process of data input through which epistemic agents like us acquire first-hand data about their environments, at the levels of abstraction offered by their bodies. Suppose Alice sees a yellow light flashing on the panel of her dishwasher at home. Such a process of data input is fallible, but it can be corrected at least through *redundancy* (e.g., Alice sees the yellow light flashing and hears the noise associated with it), *control* (e.g., Alice double-checks that the yellow light is actually flashing by turning on the light in the kitchen and moving closer to the dishwasher), *reasoning* (e.g., Alice infers that it is time for the yellow light to be flashing), and *social interaction* (e.g., Alice notices that Bob too sees the yellow light flashing). The data input can also be *enhanced* (e.g., through a pair of glasses) and *augmented* (e.g. through a remote monitoring system). By itself, such a first-hand, data-gathering process may be considered a case of knowledge acquisition, but then any elementary signal-processing gadget, like Arduino,[2] would qualify as an epistemic agent, and this seems to be a bullet not worth biting. Let me explain.

In some circumstances, we are not much better off than the aforementioned gadget. Suppose that, when Alice sees a yellow light flashing on the panel of her dishwasher at home, she actually has no clue about what it might mean. At this stage, all she has acquired, through such perception, is at most the information (equivalent to the propositional content) that a yellow light on the dishwasher's panel is flashing. If Alice has further background information—e.g., about the covariance between the yellow light flashing and the dishwasher running out of salt (see footnote 8 below)—then, by perceiving the light flashing, she may also acquire that further information about the low level of salt. All this is uncontroversial. What is notoriously open to debate is whether this yellow-light-flashing-in-front-of-her kind of perception, by itself, may amount to more than just information-gathering at best. I hold that, if we wish to be epistemologically accurate, it does not. It is not enough for Alice to *perceive* a yellow light flashing to *know* that there is a yellow light flashing in front of her, for two sets of reasons. First, because several complex concepts and experiences must already be in place and at play: light; yellow; flashing; the fact that lights can flash; that flashing lights of any colour on the panel of an electro domestic appliance are normally not decorative features (like on a Christmas tree) but signals; that, as signals, lights being off are less perspicuous and hence conventionally less indicative than lights being on; that lights might not work properly but a flashing light on a dishwasher's panel is normally working well and it is meant to be intermittent; etc.. Second, but equally importantly, because the perceptual data input (to simplify: the stream of photons that turns into a there-is-a-yellow-light-flashing-there), plus the conceptual framework (the yellow light flashing there means …) required to formulate and make sense of it, further demand an account (or explanation) in order to graduate from information to the higher status of knowledge. In other words, unless Alice understands and is able to answer (at least potentially, or implicitly) a whole series of "how come" questions—how come that the light is flashing? How

[2] "Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators", see the official website http://www.arduino.cc/

come that it is the yellow light and not another light that it is flashing? How come that the light is yellow? etc.—her epistemic status is no better than Arduino's or indeed the dishwasher manual's, where one can read that "the yellow light flashing indicates that the dishwasher is running out of salt". Call this the *Phaedrus* test[3]: Alice may claim to have more than mere information about the yellow light flashing if she can pass it.

4.5 Testimony and the Parrot Test

Let us now turn to testimony. This is the process through which epistemic agents like us *transfer* information to each other. Note that testimony does not *generate* information: the GIGO (garbage in garbage out) rule applies. If Bob tells Alice that *p*—e.g., that the dishwasher's yellow light was flashing yesterday—then, at most, Alice now holds the information that *p*. Unless we quietly presuppose that Alice, the receiver of *p*, is actually doing more than just receiving and registering *p*—e.g., that Alice is also inferring something that Bob did not, namely that the dishwasher is running out of salt, or that she is evaluating the reliability of Bob as the source of *p*, but then all this "more" is where a theory of account is hiding—all we have, at the end of a testimony process, is at most the transfer of some information from the original source to the final target, through a network of senders and receivers. The best that can happen is that the informational baton is passed through the several nodes that are relaying it without being lost or decreased.

Luckily for us, testimony is not a Boolean process. The network is *resilient*—nodes can implement information correction procedures, as when a later epistemic agent recovers or reconstructs what was the original information and relays it in its corrected, restored format—and there is often plenty of *redundancy*—as when several epistemic agents act as independent sources, conveying the same information about the same event, or repeatedly sending the same information at different times and through different channels (Bob tells Alice that the yellow light was flashing, and so does Carol). Still, this is information *transfer*, not *yet* information (let alone knowledge) *generation*. The expression "knowledge by testimony" is really a shortcut not to be taken literally. Receiving *p* can hardly amount to knowing that *p*, for knowledge requires more than true content (or, what is equivalent, well-formed, meaningful, and truthful data). If this were not the case,

[3][Socrates]: Writing, Phaedrus, has this strange quality, and is very like painting; for the creatures of painting stand like living beings, but if one asks them a question, they preserve a solemn silence. And so it is with written words; you might think they spoke as if they had intelligence, but if you question them, wishing to know about their sayings, they always say only one and the same thing [they are unary devices, in our terminology]. And every word, when [275e] once it is written, is bandied about, alike among those who understand and those who have no interest in it, and it knows not to whom to speak or not to speak; when ill-treated or unjustly reviled it always needs its father to help it; for it has no power to protect or help itself.

any database would be very knowledgeable indeed and all medieval scribes who copied Greek manuscripts without speaking much Greek at all would have been very learned. In other words, we would like Alice to pass the parrot test (Descartes' *Discourse on the Method*)[4]: given that the yellow light was indeed flashing, being told, correctly, by a well-trained source like a parrot that the yellow light was flashing while Alice was not in the kitchen does not yet suffice to ensure that Alice *knows* that the yellow light was flashing. At best, she has now acquired that piece of information. If she does not or cannot do anything else with it, that is all the epistemic dividends she may enjoy.

4.6 Data Providers

Let us now put the two threads together. Perception is the process through which Alice acquires data about the world, which need to be made *meaningful* and properly *interpreted* (i.e., *semanticised*) in order to become information. It does not generate propositional semantic information yet. Testimony is the process through which Bob transfers to Alice propositional information (also but not only) about the world, but does not yet generate propositional knowledge by itself. In both cases, what is missing, in order to gain empirical knowledge of the world in a precise epistemological sense, is the understanding (explanation in a different vocabulary, or account, as I would prefer) of the empirical information acquired. Such understanding (or explanation) is obtained through the intelligent accounting of the available propositional semantic information. This is what I have argued in Floridi (2011a). Time to return to the potential difficulty.

It should now be clear that Piazza is right is stating that (first premise):

P.1) "knowledge can be acquired through perception, or by testimony",

as long as "acquired" in (P.1) is understood, as it should, as stating necessary but not yet sufficient conditions. Compare this to "*x* (a mortgage, a passport, a skill, etc.) can be acquired through *y* (a credit evaluation, a full application, the relevant training, etc.)". Indeed, in this sense, I have argued for a stronger thesis: empirical knowledge can be acquired *only* through perception or by testimony. If one day we are able to implant Wiki-microchips under our skin, it will still be a case of testimony.

Piazza is also right in stating that (second premise):

P.2) "in those cases [perception and testimony] there is no accounting or explaining information which could explain the epistemic status to which it is upgraded",

if we understand by (P.2) that unaccounted perception or testimony do not qualify *yet* as knowledge.

[4]Part V: [. . .] parrots can emit words, as we can, but nonetheless cannot talk the way we can, that is to say, giving evidence that they are thinking about what they are uttering.

Where he seems to be mistaken is in drawing the following conclusion from the previous two premises:

C) "one could well be tempted to suggest that knowledge could not, at least not in general, be analysed as accounted information".

Nobody who understands the previous analysis and the two premises should be tempted to jump to such conclusion. He adds that:

> for at least in the cases just envisaged, an explanation of it will have to proceed by taking into account the justificatory role which perception and testimony seem to perform.

So perhaps the problem lies with the devilish concept of justification. Now, without entering into a discussion of the nature of justification and its role in epistemic processes (Floridi 1996), there are at least two ways in which perceiving that such and such is the case—e.g., seeing that the yellow light is flashing—justifies Alice in holding that such and such is the case. One is by interpreting the justification in terms of causal interactions. Reliabilist theories tended to use this approach. It seems impossible to disagree with this interpretation: it is the perceptual (visual, in the example) process of data-input that causally makes possible the acquisition of the relevant bits of information about the yellow light flashing. Yet causality is not all that is being invoked here, since we are not looking for a mere descriptive account, but for a normative one. So the alternative is to use justification to mean exculpation. This, however, adds nothing to our, or Alice's, understanding of the case in question, even if it does add a note on her epistemic conduct in such circumstances. She did not dream it, nor imagine it, she did not project it out of fear, nor carelessly assume it: she saw a yellow light flashing, eyes wide-open, double-checking, changing angle and perspective, perhaps asking Bob as well. Alice really did her best to make sure that what she actually saw was indeed a yellow light flashing. She did the right thing. The verdict is: causally sound and epistemologically not guilty. Yet all this is irrelevant to Alice's epistemic state. We still cannot tell whether she *knows* or is merely *informed* that *p*. As I have argued above and much more extensively and in detail in Floridi (2011a), being correct about *p* and having done everything reasonably possible to avoid being mistaken about *p* does not yet mean that one knows that *p*. The time has come to turn to the second question.

4.7 A Second Potential Difficulty

Suppose the previous analysis is correct, or at least moves in the right direction. Perception and testimony are both to be understood as data providers. In the case of testimony, the suggestion seems less controversial, as long as one understands that testimony is a data-providing process not in the sense that it transfers raw data about the world (think of the photons in the case of the yellow light flashing), but in the sense that it transmits well-formed and meaningful data from sender to receiver. Ultimately, perception deals with the world, testimony with information about the world: it is the difference between cooking with fresh ingredients (perception) and microwaving a pre-cooked meal (testimony). Testimony that conveys empirical information about the world ultimately depends on perception of the world. It is informative when the well-formed and meaningful data it transmits are also truthful, otherwise it is misinformative (unintentionally false) or disinformative (intentionally false). I shall return to such a crucial role at the end of Sect. 4.10.

Testimony presupposes the occurrence of data already meaningful. This cannot be said of perception, and this raises a second, potential difficulty. For once perception is stripped of its high epistemological status—once perception no longer counts, philosophically, as a full-blown, genuine instance of knowledge, but rather as a necessary condition of possibility of empirical information and hence of knowledge—one may object that we have swung to the other extreme. For now it becomes difficult to explain how perception, so epistemologically impoverished, may progress to generate empirical knowledge at all. Recall the example of Arduino: artificial agents are very proficient at collecting, storing, and manipulating data, and yet they do not go on to produce empirical knowledge, not in the sense in which Alice does. If the previous analysis reduces Alice's epistemic state to Arduino's, we have a new potential difficulty.

This second difficulty can be phrased in terms of a dilemma: either perception is *overinterpreted* informationally, but then this fails to explain how it differs from full-blown empirical knowledge (what is the difference between perceiving that such and such is the case and knowing that such and such is the case?) and why it does not require the ability to (explain, justify, or) account for the information it provides; or perception is *underinterpreted* informationally, as the necessary source of the data that go on to constitute empirical knowledge, but then this fails to explain how such data can become full-blown empirical knowledge. We move from an inflated to a deflated view of perception, when what we need is just the right epistemological evaluation in between. As I argued above, working on the first horn of the dilemma looks unpromising. The alternative is to show that the data-based interpretation of perception is not stuck in the impasse of an underinterpretation. This is the task of the next three sections, for which we need more background.

4.8 More Background

Semantic information is a very slippery topic. If we know the relevant codes, we patently have no difficulty in understanding sentences, maps, formulae, road signs, or other similar instances of well-formed and meaningful data. And yet, scientists and philosophers have struggled to determine what exactly semantic information is and what it means for an agent to elaborate and understand it. One of the sources of the difficulty is known as the "symbol grounding problem" (SGP):

> How can the semantic interpretation of a formal symbol system be made intrinsic to the system, rather than just parasitic on the meanings in our heads? How can the meanings of the meaningless symbol tokens, manipulated solely on the basis of their (arbitrary) shapes, be grounded in anything but other meaningless symbols? (Harnad 1990: 335).

The difficulty in solving the SGP consists in specifying how agents can *begin* to elaborate *autonomously* their own semantics for the data (symbols, signals) that they manipulate, by interacting with their environments and other agents, without begging the question, that is, without relying on more or less hidden forms of *innatism* or *externalism*: semantic resources should be neither presupposed, as already "pre-installed" in the agents in question, nor merely "uploaded" from the outside by some other agents already semantically-proficient. If they are, we are really addressing a different kind of question.

In Chapters 6 and 7 of Floridi (2011a), I argued that all the main strategies proposed so far in order to solve the SGP fail to satisfy the previous conditions (clustered under the expression *zero semantic commitment condition* or Z condition), but they provide several important lessons to be followed by any new alternative. In light of such critical analysis, I elaborated a constructive proposal for a *praxical* solution to the SGP. There is neither space nor need to outline it here. Suffice it to say that the praxical solution is based on two main components: a theory of meaning—called *Action-based Semantics* (AbS)—and an architecture of agents—which models them as being constituted by at least two modules. Thanks to their architecture, agents can implement AbS, and this allows them to ground their symbols semantically as well as to develop some fairly advanced semantic abilities, including forms of semantically grounded communication and of elaboration of semantic information about the environment, and hence to overcome the SGP without violating the Z condition. The reader interested in the details (and viability) of the proposal is invited to read the two chapters. Here, it is important to stress that such a praxical solution points towards a more ambitious and challenging possibility: the elaboration of a theory of meaning that can enable us not to under-interpret perception as data provider but rather account for its role in the elaboration of empirical knowledge. The hypothesis is that the praxical solution of the SGP provides the seeds for an explanation of how advanced semantic and linguistic skills may develop among higher biological agents in more complex environments when perception and, later, testimony are in question. This is what we shall see in the next two sections.

4.9 The Vise Analogy

In trying to show how perception as data provider may lead to the elaboration of a meaningful experience of the world and hence to empirical knowledge of it, two converging strategies may be adopted. They may be quickly introduced as the two jaws of a vise.[5] On the one hand, one may rely on *quantitative* analyses, especially, but not only, through information theory and Shannon information, the algorithmic theory of information and Kolmogorov information, and signalling theory. On the other hand, one may rely on *qualitative* analysis, especially, but not only, through truth-theoretic semantics, inferential role semantics, game-theoretic semantics, and meaning as use.

The limits of such strategies are well known. Quantitative analyses are not meant to deal with semantics, while qualitative analyses offer at most semantic *criteria* (how one can tell whether Alice understands the meaning of *p*), or presuppose meaningful contents (how Alice successfully handles meanings by becoming proficient in a particular perceptual or linguistic game), but are not meant to explain how semantics (including meaningful data) arises in the first place.

When misapplied, both kinds of analyses are a way of cheating. Quantitative analyses do less than they are said (but not meant) to do. When misused, this leads to a *semantics-from-syntax fallacy* so flagrant in the failures of classic AI. Qualitative analyses presuppose (correctly) what they are said (mistakenly) to deliver. When misused, this leads to a *semantics-from-semantics fallacy* and the failures of current solutions to the SGP. Recall the Z condition discussed in Sect. 4.8 above.

The question is whether there is a way to bridge the physical/syntactic side, addressed by quantitative analyses, and the mental/semantic side, addressed by qualitative ones, in order to explain how perception, and later on testimony, as data proving processes, may lead to the generation of meaning. The answer is that pragmatics might help. Here is a quick list of some lessons we have learnt from the two kinds of strategies recalled above:

(a) there is an active component dealing with meanings, this is the semantic engine (*agent*);
(b) *interactions* between the environment (*system*) and the agent elicit the data used by the agent as constraining affordances to create semantic information (*model*) of the system;
(c) *semanticisation* (the generation and attribution of meaning to data/signals) is a functional relation between meaningless input and meaningful output;
(d) evolutionarily, models of the system compete with each other on the basis of two quality requirements: *fit for purpose* and *correct* (right) *first time*;
(e) the agent's interactions with the system provide the competitive context within which the incorrect models are revised or abandoned (Bayesian learning);
(f) ultimately, semantic information is the outcome of the agent's active interpretation of the system that is the referent/source of the relevant data, not of its passive representation.

Let me now show how the elements may be put together with a praxical approach (the pragmatic "bridge" just mentioned) to give rise to a full picture.

[5] In American English, the two-handled tool known in British English as a "vice" is known as a "vise". In order to avoid the potential for unfortunate homonymous associations "vice (tool)" vs. "vice (moral quality)", I use the American spelling "vise" in this section. Thanks to Thomas Mark Dousa for this "wise" suggestion (pun irresistible).

4.10 The Constructionist Interpretation of Perception and Testimony

Imagine a very early time in the universe when there is no difference between agent and system, or sender and receiver, informer and informee. We may assume the presence of only an environment, in which physical structures occur more or less dynamically, that is, there are patterns of physical differences understood as asymmetries or lack of uniformities. There is no specific name for such "data in the wild". One may refer to them as *dedomena*, that is, "data" in Greek (note that our word "data" comes from the Latin translation of a work by Euclid entitled *Dedomena*). Dedomena are not to be confused with *environmental information*. They are pure data, that is, data before they are interpreted or subject to cognitive processing, comparable to Kant's *Dingen an Sich* or *noumena*. They are not experienced directly, but their presence is empirically inferred from, and required by, experience, since they are what has to be there in the world for our information about the world to be possible at all. So dedomena are whatever lack of uniformity in the world is the source of (what looks to an informational agent like Alice) data. Try to imagine the photons that will generate the perception of a yellow light flashing before they are perceived as a yellow light flashing. Such data might be flowing around, but they are not signals yet, as there are no senders or receivers.

This initial stage is where there are environmental data and patterns that might be exploitable as information by the right sort of agents for their purposes, before there is any kind of communication. Therefore, it is also the stage (see Fig. 4.1) where Shannon's classic model of communication may easily be misleading, if applied too early. In the *relata* (that is, sender, receiver) vs. channel and communication process (message), it is the message that comes logically first, in the form of physical data as potentially exploitable constraining affordances.

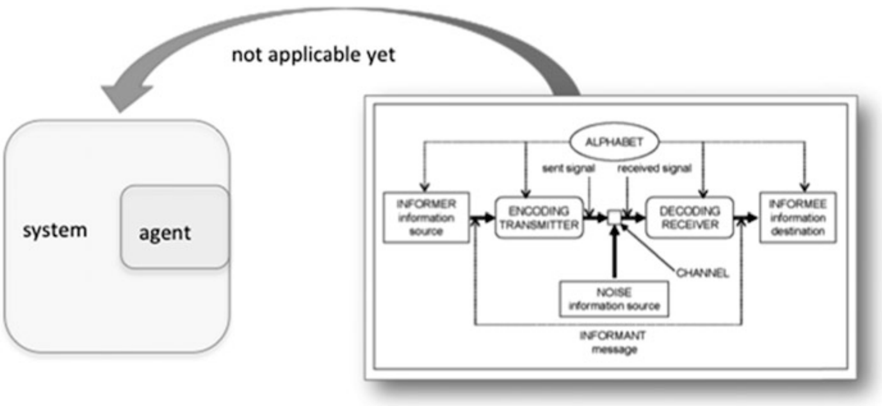

Fig. 4.1 Shannon's model of communication not yet applicable

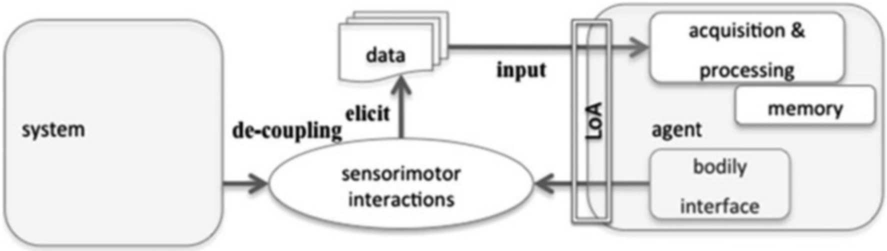

Fig. 4.2 The system-agent interactions elicit data as signals at a bodily LoA

Once some structures in the environment become encapsulated through a *corporeal membrane*, such encapsulation of part of the environment allows the separation of the interior of an agent from the external world. The ontological function of the membrane is to work as a hardwired divide between the inside, the individual structure or agent, and the outside, now the environment *for* the agent. Its negentropic function is to enable the agent to interact with the environment to its own advantage and withstand, evolutionarily, the second law of thermodynamics, for as long and as well as possible. The epistemological function of the membrane is that of being selectively permeable, thus enabling the agent to have some minimal variety of degrees of inputs and outputs with respect to the environment. At this stage, data are *transducible* physical patterns, that is, physical signals now seen as *broadcast* by other structures or agents in the environment, which are captured by the permeable membrane of the agent. The body is a barrier that protects the stability of the agent (physical homeostasis). A good example is a sunflower.

We move from pre-cognitive to post-cognitive agents once data become *encodable* resources, exploitable by agents through some language broadly conceived (sounds, visual patterns, gestures, smells, behaviours, etc.). Patterns and flows of data/differences, which were before quantities without direction (scalars), broadcast by (what it is still improper to interpret as) sources not targeting any particular receiver (e.g. the sun generating heat and light, or the earth generating a magnetic field), acquire a direction, from sender to receiver (become vectors), and an interpretation (e.g., noises become sounds interpreted as alarms), thus being exploitable as signals. From now on, latent Shannon information becomes manifest and Shannon's classic communication model applies. This shift requires a *cognitive membrane*, or *bodily interface*, which allows the encapsulation of data (i.e., some form of memory) for processing and communication. The body as an interface or cognitive membrane is a semi-hardwired (because configurable through learning) divide between the cognitive agent and its environment, that is, a barrier that further detaches the agent from its surroundings, and allows it to exploit data processing and communication in its struggle against entropy.

At this stage (see Fig. 4.2), sensorimotor interactions through bodily interfaces are best understood as interactions at a given set of levels of abstractions or LoAs (gradient of abstractions, (Floridi 2008)), where LoAs are hardwired as sensory

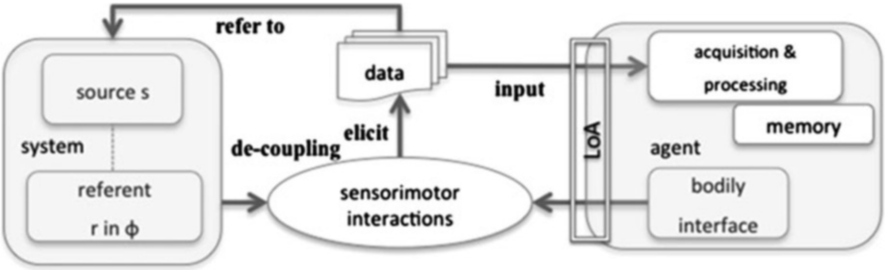

Fig. 4.3 Data source and referent

receptors. Note that, according to this reconstruction, there are no signals (let alone information) in the wild: data as signals are elicited by the nomic interactions between types of systems and types of agents. This is not relativism but *relationism* (if the difference is unclear, consider the concept of food: not everything is food, but food is understandable only relationally, by understanding the nature and role of both the consumed substance and the consuming agent). Agents are further de-coupled from their environments, with different embodiments determining different types of epistemic agents, which are able to interact informationally with their environments and other agents through their bodily interfaces. Thus, each type of agent is a type of LoAs implementation. Same type, same LoAs. Wittgenstein's lion and Nagel's bat are incommensurable LoAs. The stability (cognitive homeostasis) now concerns the internal data within the agent and their codification: memory and language.

The emergence of natural signals as meaningful for an agent is the stage where the praxical solution to the SGP is applicable. To oversimplify, the semantic value (meaning) of the signals is the state in which they put the receiving agent (cf. the adverbial theory of perception and Grice's comments discussed below). A good example is a bird on the sunflower.

The elicited data, in Fig. 4.2, understood now as signals, may have both a source s (a sender) and a referent r that is in some state φ (this is what they are "about"), see Fig. 4.3. Clearly, if there is no referent r, then we have a *virtual system*: the model (the interpreted data) generates its referent, as in a computer game. If there is no source s, then the agent is in a state of complete ignorance, where "complete" means that the state of ignorance itself is unknown. If both r and s are present, then, in most cases of communication, including perception and testimony, $s \neq r$. This simply means that the data come *from* a source interacting with the agent (the photons coming from the yellow light), but they are not *about* the source (the photons are not "about" the yellow light), which is not their referent, not least because they are the outcome of the cognitive interactions and negotiations between agent and data source, although we shall see that there is a plausible sense in which ordinary perception works correctly when it interprets $s = r$. If $s = r$, testimony becomes an unusual case of self-confession. Francis Bacon was perhaps the first to rely on this feature in order to speak metaphorically of the scientific inquiry as a questioning procedure addressed to Nature, an informational interpretation of the logic of discovery that we consider rather common nowadays (Sintonen 1990). However, even conceding that all this, including the praxical solution of the SGP, is correct, it still falls short of providing a full account of Alice's perception of the yellow light flashing as indicating that the dishwasher is running out of salt. For the latter is a conventional meaning, and Grice was right in distinguishing it from natural meaning (Grice 1957), as I shall explain below. At this stage, the best one can do, without begging the question, is to show how Alice may be "put in a yellow state", as it were, by a yellow light flashing. According to the praxical solution of the SGP, there is a plausible sense in which Alice may be said to see "yellowly", but she cannot be said to see "salt-in-the-dishwasher-running-outly", not without presupposing what needs to be accounted for.

Pace Skyrms, the naturalist tradition—which seeks to account for non-natural meanings by reducing them entirely to natural ones through signalling or information theory (Skyrms 2010)—provides the right beginning but seems to be unable to deliver the whole story. Using a different example, it struggles to explain why the same sound is perceived as a song by some and as a national anthem by others. Non-natural (conventional, artificial, synthetic) semantics seems to require more than natural semantics to emerge. If this were not the case, we would have already made at least some successful steps in the realization of classic AI, where the frame problem is just a specific instance of the SGP (Harnad 1993). We have not (Floridi et al. 2009). Indeed, the whole project of information or signals processing as sufficient for the development of a full-blown semantics runs into the semantics-from-syntax fallacy, seen above. The usual reply to such an objection consists in asking for more, indefinitely: more time, more complexity, more processing, more "add your resource". In AI, this has often and conveniently translated into more funding. Yet, in the same way as we are reminded in AI that climbing to the top of a tree is not the first step towards the moon, but the end of the journey, no matter how many more resources may become available, so, in naturalistic theories of meaning and of meaningful perception, accounting for the communication procedure among birds, bees, monkeys, or indeed robots, is not the first but the last chapter in the book of natural semantics. It is where things start becoming interesting if difficult, not where one may accept a "... and so on" clause.

This is hardly news. More than half a century ago, Grice had already identified and exposed the shortcomings of such a naturalism:

> I want first to consider briefly, and reject, what I might term a causal type of answer to the question, "What is non-natural meaning [Grice actually uses the abbreviation meaning$_{NN}$] ?" We might try to say, for instance, more or less with C.L. Stevenson,[6] that for *x* to non-naturally mean [mean$_{NN}$] something, *x* must have (roughly) a tendency to produce in an audience some attitude (cognitive or otherwise) [in the praxical solution this is expressed in terms of putting an agent in the specific, correlated, internal state]

[6]Grice adds here a footnote to Stevenson (1944: ch. iii).

> and a tendency, in the case of a speaker, to be produced by that attitude, these tendencies being dependent on 'an elaborate process of conditioning attending the use of the sign in communication.'[7] This clearly will not do. (Grice 1957: 379).

Grice goes on to give several reasons why such a naturalisation will clearly not do. They were as clear and hardly refutable then as they are now, but if the reader remains unconvinced, let me add a further consideration. The irreducibility of non-natural meanings to natural ones is not just a matter of scientific results and philosophical arguments. The view that just more data or signals processing, without appeal to any further variable, may somehow lead to the development of higher-level, non-natural semantics—what Grice describes as, at best, a circular reasoning ("We might just as well say, 'X has non-natural meaning [meaning$_{NN}$], if it is used in communication,' which, though true, is not helpful"), see the semantics-from-semantics fallacy discussed in Sect. 4.9 above—also runs against a specific result in information theory, one that indicates that natural data input and processing is necessary but insufficient to generate the meaning for perceptions and concepts such as "the dish washer is running out of salt". This is the data processing theorem (DPT).

The DPT concerns the quantity of mutual information between signals, messages, or data. *Mutual information*[8] is, together with the *inverse relation principle*,[9] the *covariance model*,[10] and Shannon's *communication model*, one of the pillars of any information-based project for the full naturalisation of semantics. The DPT states that data processing tends to *decrease* information. Here is an informal summary. Suppose three systems S_1, S_2, and, S_3 are such that X is the output of S_1 and the input of S_2, Y is the output of S_2 and the input of S_3, and Z is the output of S_3, as illustrated in Fig. 4.4, then:

[7] Grice adds here a footnote to Stevenson (1944: 57).

[8] Mutual information, indicated as $I\ (X;\ Y)$, is a measure of how dependent two random variables X and Y are, for example, the dependency between the information $X =$ the dish washer is running out of salt (that is, the average reduction in uncertainty or the expected reduction in yes/no questions needed to guess X) and the information $Y =$ the low salt yellow light indicator is flashing. The higher the dependence is the higher the degree of mutual information is. Mutual information satisfies the properties $I\ (X;\ Y) = I\ (Y;\ X)$; $I\ (X;\ Y) \geq 0$; if X and Y are independent, then $I\ (X;\ Y) = 0$; highest I when X = Y (ideal, noiseless channel).

[9] The principle states that there is an inverse relation between the probability of p—where p may be a proposition, a sentence of a given language, a situation, or a possible world—and the amount of semantic information carried by p. Thus, a biased coin provides increasingly less information the more likely one of its outcomes is. The principle, though very plausible, runs into two problems, the "scandal of deduction" (Hintikka 1973) and the "Bar-Hillel-Carnap Paradox" (Floridi 2004a, 2005b).

[10] The model states that if two systems a and b are coupled in such a way that a's being (of type, or in state) F is correlated to b being (of type, or in state) G, then such correlation carries for the observer of a the information that b is G. For example, the dishwasher's yellow light (a) flashing (F) is triggered by, and hence is informative about, the dishwasher (b) running out of salt (G) for an observer O, like Alice, informed about the correlation. See Barwise and Seligman (1997), Dretske (1999), Floridi (2010b).

Fig. 4.4 The data processing theorem

DPT) if the random variables depend on each other, that is, [$X \Rightarrow Y \Rightarrow Z$]; and
if [$X \Rightarrow Y \Rightarrow Z$] is a Markov chain;
then the mutual information I satisfies the following condition:
$I\,(X; Y) \geq \mathrm{I}\,(X; Z)$.

This means that the average amount of information that Z conveys about X is usually less than, and at most equal to, the average amount of information that Y conveys about X. Of course, larger degrees of mutual information correspond to greater degrees of statistical dependence between a system's input and output, in our example between X and Z. Indeed, we shall see below that such mutual information can reach total equivalence between variables. But the introduction of further n stages of data processing can never increase the statistical dependence between the variables, and is likely to decrease it. In short, if one does not have such and such information at the input, data processing, as formulated above, is not going to generate it. If one obtains it at the end of it, either it was already there since the beginning (see above Grice's comment about the true but unhelpful solution, or the fallacy of semantics-from-semantics), or it has been surreptitiously introduced by something other than the data processing itself. For example, the Markov chain has been broken (for a classic example of such a "break" in human communication consider the "crying wolf" scenario).[11]

Intuitively, the reader may recall the game of Chinese Whispers, in which a first player in a line whispers a message to the player next in line, who whispers it as accurately as possible to the next player, and so on, until the last player communicates the message to the whole group. The players are the equivalent of S_1, S_2, S_3, and so forth, and their whispered messages are X, Y, Z, and so forth. The longer the chain of speakers is, the less likely it becomes that the final message will resemble the initial one. With a slogan more memorable but less accurate: data processing tends to destroy information, it certainly cannot increase it. Asking for more signal processing is not going to solve the problem of escalating natural semantics to a non-natural one. At best, it can only deliver more natural semantics. Some other factor must be at play.

[11]This has been suggested as a solution to the problem of enriching the semantic value of computer visualizations, in Chen and Floridi submitted. For a simple and balanced introduction to the limits of Markov Chains in animal communication, see Bregman and Gentner (2010: 370–371).

Let us take stock. We saw that, if perception is a data providing process, then we need to be able to explain how such data become meaningful and hence suitable for generating information (i.e., well-formed, meaningful, and truthful data) and then knowledge (i.e., accounted information). There are ways, such as the praxical solution to the SGP, to show how the meaning of some perceptual data may be naturalised. However, many, if not most, of our perceptions, deal with non-natural meanings. There was a time when Alice saw a piece of cloth with some coloured patterns on it, but it is now impossible for her not to see the Union Jack, or Old Glory, or the Tricolore, etc. In this case, signalling, the agent's data processing and internal states, and the memory of such states are necessary but insufficient conditions to account for the emergence of non-natural semantics. We also saw that the development of cognitive agents should be interpreted in terms of an increasing distance from their environment. Despite this—and despite the fact that data as signals are elicited by the interactions between the agent and the system, and hence should be taken as negotiations with, rather than representations of, the system—we usually correctly assume that, in the best (but also very common) circumstances, even when non-natural meanings are in question, the end-product of the agent's perception of the system is a faithful grasp of the state of the system by that agent. When Alice sees the yellow light flashing and perceives that the dishwasher is running out of salt, that is normally the case: she is correct and the dishwasher is indeed running out of salt. The same holds true for her perception of the national anthem, the flag of her country, the red traffic light at the crossroads, and so forth. Mistakes are the exception in Alice's cognitive life. She wouldn't be here as a species, if they were the rule. In order to solve this strange predicament, according to which perception as data provider both decouples the agent from her environment through more and more non-natural meanings and couples her to it successfully and indeed in a way that is cognitively superior to any other species, we need to adopt a different perspective and move from a naturalistic to a constructionist view (Floridi 2011c). Here is how we may do it.

It seems incontrovertible that human agents do not merely use natural meanings but constantly *repurpose* them for other epistemic, communicative, and semanticising goals. Alice not only sees the yellow light flashing, she also repurposes it to mean, in the kitchen appliance context, that the dishwasher is running out of salt. Conventional or non-natural meanings are the outcome of such repurposing. The cognitive strategy of using, converting, or modifying data/signals for a purpose or function other than their original, natural one, to fit a new use—think of Peirce's distinction between icon, index, and symbol—is very cost-effective and can be reiterated endlessly: a cloth becomes a flag, which becomes a country, which becomes a foe to burn, or something to be proud of and wear as qualifying one's identity, and so forth. By repurposing perceptual data, human agents like Alice actually use them as resources to interact with the world, with themselves (see narrative theories of the self, (Floridi 2011b)) and among themselves more richly, innovatively, inventively, indeed more intelligently, than any other kind of agents we know, which are unable to go beyond natural semantics. And since "repurposing" is just another word for "hacking", a simple way of putting the previous point is by saying that *humans are natural-born data hackers* (see Fig. 4.5).

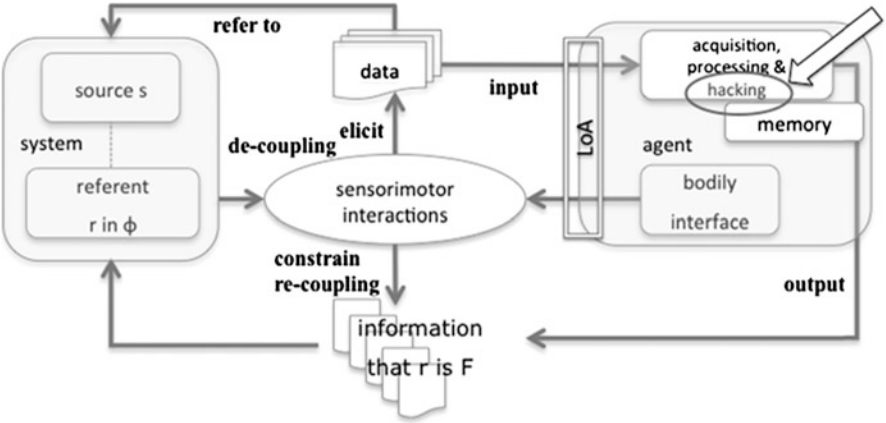

Fig. 4.5 Non-natural meanings as data hacking

A conception of Alice as a cognitive mirror or a representationalist mechanism is simply wrong. It is certainly inconsistent with our best neuroscience:

> Increasingly, the brain reveals itself proactive in its interface with external reality. In the past, our conception of the brain changed from that of a mirror to that of an interpreter. Several current lines of research—in fields such as memory, motivation and attentional orienting—now begin to cast the brain as a predictor. The results of experience are integrated over various timescales in order to anticipate events relevant to the current task goals and motivational state of the individual and to tune the relevant perceptual and motor machinery accordingly. In particular, research on attentional orienting has shown how signals coding predictions about the location, identity or simple features of relevant events can influence several stages of neural processing. Recent evidence shows that these predictions are not restricted simply to the contents of events but also extend to their anticipated timing (Nobre et al. 2007, 465).

The philosophical hypothesis about repurposing—the view that humans are natural-born data hackers—may be scientifically plausible and conceptually convincing, but there is a final problem. For unless Alice's repurposing of natural data and signals is somehow successfully constrained, its outcome could be indistinguishable from the delusions or hallucinations of a mentally ill person. Alice could start repurposing a piece of cloth as a ghost, for example. The similarity between semantic repurposing and mental disorder is an important point to which I shall return in the conclusion. At the moment, it is clear that, while the hypothesis of a data hacking process may solve the problem of understanding how the data acquired through perception may move from natural to non-natural meanings, it does not, in itself, say anything about the fact that through perception human agents interact very successfully with each other and their environments and are re-coupled to the world in the most realistic, indubitable, "what you see is what you get" kind of way. What does re-couple Alice to the world, once she is decoupled from it by her data hacking? Recall that, normally, outside Hume's studio, Alice has no doubts whatsoever about the fact that the yellow light flashing is exactly what

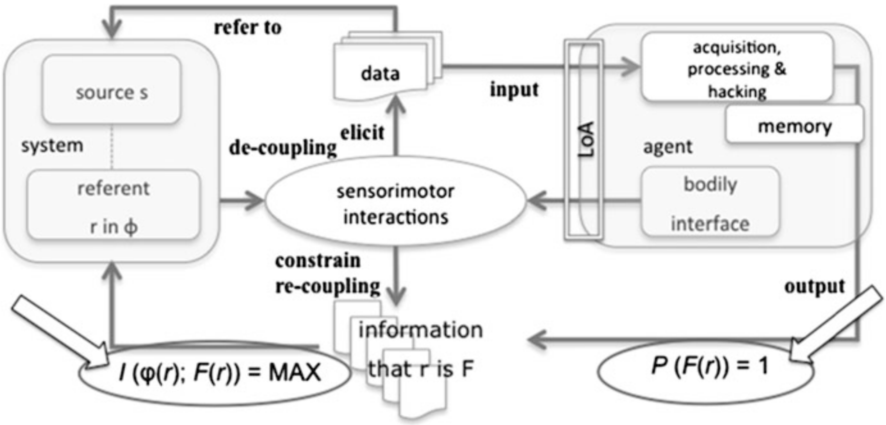

Fig. 4.6 The construction of perceptual information

the world is like, and that the world is such that it now contains her dishwasher running out of salt. She is right, and her successful interactions with the world show her to be right, but this is a problem because, at the moment, the creativity offered by data hacking fails to explain the cognitive and pragmatic success of her naïve and commonsensical realism. Indeed it works counter to it. What seems to be required is a re-interpretation of the representational correspondence between Alice's perception of the world and the way the world is as *retro-fitness*, in the following sense. In normal and common circumstances, say in Alice's kitchen, data/signals (the yellow light flashing) referring to system r (the dishwasher) in state φ (running out of salt) become the information (model) that r is F (the dishwasher is running out of salt) by being processed in such a way that the mutual information $I\ (\varphi(r); F(r)) = \text{MAX}$. This ensures complete correspondence between the perception and the perceived, which Alice enjoys cognitively and on which her actions are successfully based practically. However, this is possible only if

(a) either $s = r$, $F(r)$ is a faithful representation of $\varphi(r)$, and there is a noiseless ideal channel between the system-referent and the agent;
(b) or $F(r)$ constitutes $\varphi(r)$, in the Kantian, constructionist sense that $\varphi(r)$ depends on Alice processing the relevant data (i.e., constraining affordances) to perceive r as F.

None of the three conditions in (a) seems really satisfiable, so (b) remains the only option, but this means that perceptual information is the *output* of the perceptual data processing/hacking, not the input (see Fig. 4.6).

Such output—the models of the world that the data (constraining affordances) hacking generates—competes for success on the basis of *fit for purpose* and *correct* (right) *first time*. Given her constraining affordances (data), Alice generates an endless amount of interpretations of the world: some of them are correct because they respect and make the most of her data and are evolutionarily selected to

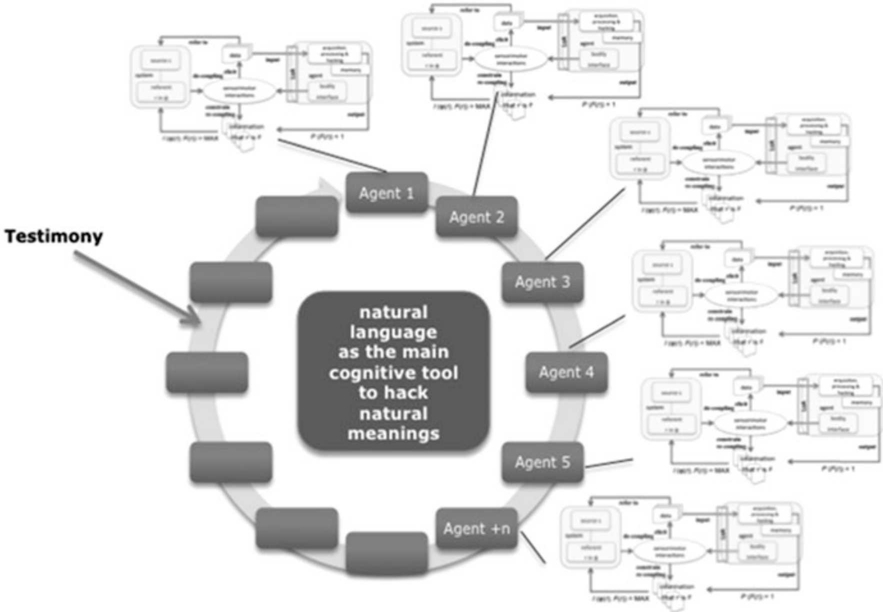

Fig. 4.7 Perception, testimony, and language

ground and improve her interactions with her environment and other agents ("the dishwasher needs more salt"), some are simply mistaken ("the dishwasher is not getting enough water"), many are simply innocuous and unrestrained by the available data ("the yellow light flashing means I will not get the job"). Following the inverse relation principle, Alice will be in no state of surprisal (Shannon's term) with regard to her perceptions: she cannot be informed *about* them (mind, not *by* them) because to her the probability P of her perception ($F(r)$) is 1. New information, of the kind exemplified by the yellow light flashing, is the exception, certainly not the norm. To put it in Kantian terms, perceptual information about the world is the world, and the world-information by default has probability 1 for those who perceive it. The system is the source/referent of the data, but the interpreted data, properly understood as semanticised constraining affordances, do not represent the system, no more than radio signals represent the radio sending it.

In all this, testimony as information transmission, not yet generation, and as a by-product of perception, which allows further semantic hacking, plays a final and crucial role. So far, the analysis has been developed by considering only a single agent. Of course, this is an untenable simplification. Alice is part of a community of speakers. Most of the semantics she enjoys and controls is inherited. She read in the manual that the yellow light flashing non-naturally means (or, to put it *à la* Grice means$_{NN}$) that the dishwasher is running out of salt. It is here that testimony, understood as the main mechanism through which agents learn and share a language and hence are able to constitute a multiagent system (i.e., a community of speakers), plays a fundamental role (see Fig. 4.7). For testimony is what enables the development of language as the main cognitive tool to hack natural meanings, thus allowing the Lamarckian evolution of hacked data through generations (i.e., cumulative learning).

4.11 Conclusion: The Beautiful Mistake

Much more could and should be said about the previous two answers to the questions outlined in Sect. 4.1. The data hacking hypothesis is only the beginning. In order to facilitate further steps ahead, in this conclusion I shall only summarise a few salient points.

We saw that perception is a complex process through which constraining affordances (data) are negotiated, acquired, elaborated, and repurposed by agents like Alice and Bob in order to make sense of their environments both naturally and non-naturally. The interpretation of perception as a decoupling and then re-coupling process of the cognitive agent is coherent with the development of language, through testimony, as mainly a cognitive tool (Deacon 1997; Schilhab et al. 2012) rather than just a communication medium, and with the emergence of *consciousness* (Floridi 2005a) and the construction of a sense of *personal identity* (Floridi 2011b) as part of a progressive detachment of the agent from the world. Mentally healthy humans are different from animals because they are non-naturally de-coupled from the here-and-now by their data hacking, and they are different from the mentally ill because the same data hacking re-couples them to the here-and-now inventively and successfully. From an evolutionary perspective, we are uniquely different from, and more successful than, other species not because of a plus but because of a minus; namely the (both perceptual and linguistic) semantic *incapacity* of being absolutely and inseparably present, cognitively, where we are located, bodily. We cannot help experiencing the world *as*. This gap, this detachment or decoupling, this initial incapacity of being thoroughly absorbed by the world—which our intelligence and mental life then has to bridge through the development of language and our knowledge of the world—is what makes us special. Looking for our semantic, linguistic, mental, conscious *quid* is looking for an absence, for a gap, for a fissure. Indeed, it has been controversially argued in psychiatry[12] that the same evolutionary causes lie behind our capacities to develop both language and mental illness. It seems that the price to be paid to be *Home sapiens sapiens* is that of being potentially the schizophrenic species as well. The fissure is double-edged, as it were.

[12] The theory that schizophrenia might be a consequence of the human evolution of language is scientifically associated to the research of Tim Crow, a professor of psychiatry at Oxford University. A close view, according to which schizophrenia contributed to the evolution of *Homo sapiens*, was popularised rather controversially, by David Horrobin (Horrobin 2001). More recently, the publication of Faulks (2005), a novel in which the theory is presented in a fictional scenario, "sparked an academic feud" (Thorpe 2005).

Some 50,000 years ago, the *Homo* species finally snapped and began regularly, widespreadly, and consistently to distance itself from its environment through the development of a culture of tool- and weapon-making, art (sculpture, cave painting, body ornaments), travelling, long-distance trade, and burial rituals (Diamond 2006). We are not evolution's finest moment, the peak of the process, some kind of *Über*-animal, but nature's beautiful mistake. It is because we are a bit less that we are so much more. And in the same way as a broken mechanism that manages to survive and evolve by repurposing itself is perfectly natural, and yet unlikely to be reproducible, it remains an open question whether we might ever be able to "break" our syntactic machines in such a way as to make them intelligent like us. Real, old-fashioned AI may remain unachievable not because it is physically impossible—Nature managed the trick with us—but because some mistakes may be perfectly natural and yet be forever unique. The beautiful mistake may well be Nature's *hapax legomenon.*

Philosophically, the accidental and yet resilient balance between informational decoupling and re-coupling, detachment and engagement, is better understood from a constructionist and non-representationalist perspective, than from a naturalistic and representationalist one. This means understanding our informational, linguistic, and cognitive activities as part of our creative manipulation of the data/signals (the cognitive constraining affordances) negotiated with the world. Epistemologically, this leads to the acknowledgment that knowledge by acquaintance is more fundamental than know-how, and this, in turn, is more fundamental than knowledge-that, to rely on a useful but slightly inadequate Russellian terminology. It also means that we should be able to find a middle ground between naïve realism (which is not a philosophical position but really the final outcome of a complex process of successful construction) and relativism, reinforcing the relational analysis of many of our key informational concepts. Only by strengthening our understanding of such a third way, Plato's *metaxy*, shall we be able to escape the usual dichotomies that haunt our philosophy (think of the naïve question whether colours are in the perceived or in the perceiver).

The world as we consciously experience it is the totality of its models as we unconsciously design them. It is the outcome of a constant construction and amendment of a stable interpretation. We are cognitive amphibians: as embodied and embedded physical agents, we live in, and interact with the world in itself, Kant's *noumena*. We eat and drink, handle and build, avoid and crash into *noumena*. But as informational organisms, we experience and inhabit the world as a semantic reality both afforded and constrained by the world in itself. Our ontology is entirely semantic, so we know the world when we are informed about it and are able to account for such information. For a knower is "the man who knows how to ask and answer questions" (Plato, *Cratylus*, 390c), giving an account, that is, about the information that he holds.

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Chapter 5
Human Communication from the Semiotic Perspective

Winfried Nöth

5.1 Communication Studies and Semiotics

If semiotics is the study of sign processes (semioses) in nature and culture, it necessarily includes the study of communication since communication is undoubtedly a sign process, but is the reverse also true? Are all processes of semiosis processes of communication? Thinking, for example, is a semiotic process if we accept with Peirce that all thoughts are signs, but is thinking communication? The same question arises when we consider the interpretation of natural signs (cf. Nöth 2008). Is there anyone who communicates?

In order to demarcate the research field, semiotics has been divided into the two subdomains of *semiotics of communication* and *semiotics of signification*. The *semiotics of signification* goes beyond the study of communication insofar as it is concerned with the study of signs not used for communicative purposes, for example, unintentional signs or so-called natural signs, such as symptoms of disease, trails in the wild, or indices of physical causes. Nevertheless, the dividing line between these two fields of semiotic research remains fuzzy. Are pieces of music, paintings, or sculptures, hairstyles, body odor, or clothes used to communicate, or do they only signify without serving any communicative purpose? Furthermore, semiotics also studies how animals, plants, and machines communicate, phenomena which are usually excluded from communication studies proper.

The present paper is restricted to *human communication*. Its purpose is to draw attention to the major approaches to the study of communication adopted in the framework of modern semiotics, to show that semiotics and communication studies are by no means two clearly separate fields of study (see also Jensen 1995), and that

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the semiotic models of communication developed during the last century, despite their heterogeneity or perhaps better because of their plurality, have certainly rather original elements to contribute to the general theory of communication (cf. Santaella and Nöth 2004).

The process of communication has often been defined by means of *communication models*, which are nothing but graphic representations of the principal elements and relations between them. In the typology of signs outlined by Charles S. Peirce, models are *diagrams*. Diagrams are abstract *icons*, that is, signs which evince some similarity to what they represent. Modeling communication is thus an instance of the more general "diagrammatic method of embodying ideas in an outward form" (MS 787, 1897).

5.2 Saussure's Communication Model

The founding father of twentieth century structuralist semiotics, Ferdinand de Saussure (1857–1913), not only reflected on signs but also on the process of communication. Saussure's model of the *speech circuit* is a diagrammatic representation of the mental processing of speech sounds in a dialogue between a speaker A and a hearer B (Fig. 5.1). Harris (1987: 22–27) interprets it as "a general model of communication" (cf. Linda 2001).

Saussure (1959: 11–12) distinguishes five stages of communication within the speech circuit: (1) Some "mental fact (concept)" is associated in A's brain with "representations of the linguistic sounds (sound-images) that are used for their expression". (2) A given concept "unlocks a corresponding sound-image in the brain", which is a "purely psychological phenomenon". (3) The brain, in a "physiological process", transmits an impulse corresponding to this sound image to the speech organs. (4) Next, the sound waves "travel from the mouth of A to the ear of B" in a purely physical process. (5) Finally, this circuit continues in B, in the same phases in a reversed order. In a more abstract model, reduced to "the elements thought to be essential" (Fig. 5.2), Saussure (1959: 12) focuses on three phases of verbal communication to represent "the distinction between the physical (sound waves), physiological (phonation and audition), and psychological parts (word-images and concepts)".

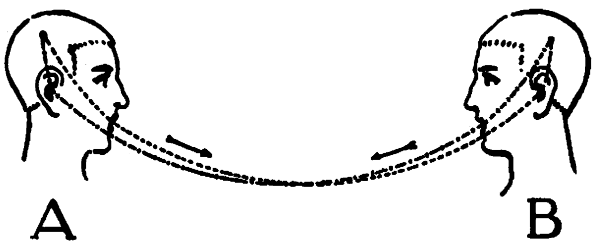


Fig. 5.1 Saussure's general model of the speech circuit (Saussure (1959 [1916]): 11)

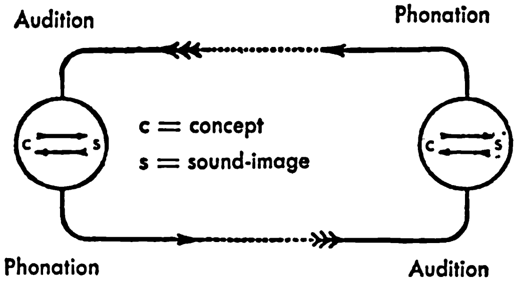


Fig. 5.2 Saussure's abstract model of the speech circuit of Fig. 5.1 (1959: 12)

The term *sound image* is a key concept of this model, which testifies to its mentalist character: the mental aspect of communicating, the "outer part that includes the vibrations of the sounds which travel from the mouth to the ear" (1959: 12), is of interest, "not the material sound, a purely physical thing, but the psychological imprint of the sound, the impression that it makes on our senses" (1959: 66). Other features which distinguish Saussure's model from the canonical models of twentieth century communication theory are its circularity and symmetry (cf. Nöth 2011a). Concerning the symmetry in the diagrammatic representation of the mental processes (Fig. 5.2), Saussure writes: "Everything that goes from the associative center of the speaker to the ear of the listener is active, and everything that goes from the ear of the listener to his associative center is passive" (1959: 13). This description reveals that the graphic symmetry of diagrams 5.1 and 5.2 conceals an underlying asymmetry: the speech production phase ($c \rightarrow s$ in Fig. 5.2) is conceived as a phase of *activity*, whereas the speech reception phase ($s \rightarrow c$) is described as a phase of *passivity*.

5.3 Peirce's Communication Model

The second founding father of modern semiotics, Charles S. Peirce (1839–1914), has a model of communication based on very different principles (cf. Nöth 2011b). Communication, according to Peirce, is a particular process of *semiosis*, that is, a sign process. What communication has in common with signification is the following:

> The action of a sign generally takes place between two parties, the *utterer* and the *interpreter*. They need not be persons; for a chameleon and many kinds of insects and even plants make their livings by uttering signs, and lying signs at that. Who is the utterer of signs of weather, which are not remarkably veracious, always? However, every sign certainly conveys something of the general nature of thought, if not from a mind, yet from some repository of ideas, or significant forms, and if not to a person, yet to something capable of some how "catching on". (MS 318, S. 17, 1907)

Peirce's concept of sign corresponds roughly to the one of *message* in communication theory. The sign functions as a *medium*, but not in the sense of a conveyor of signals from a sender to a receiver. Instead of mediating between an addresser and an addressee the sign mediates between the object, which the sign represents, and the so-called interpretant, the interpretative effect which it creates. The sign is determined by its object to create this interpretant in a sense to be specified below.

5.3.1 The Three Agents in Communication

Peirce describes the communicative interaction of a speaker and a hearer as follows: "Signs mostly function between two minds, or theatres of consciousness, of which one is the agent that *utters* the sign (whether acoustically, optically, or otherwise) while the other is the *patient* mind that *interprets* the sign" (EP 2: 403, 1907). The description of communicating minds as "theaters of consciousness" is more than a mere metaphor. Actors on stage act on behalf of third agents, who determine their performance, the playwright and the character they represent, to whose fictive reality their performance must conform. In the scenario of communication, the third agent co-determining what is being said is the sign. The sign acts with the purpose to represent its object and to create an interpretant to the mind of an interpreter. The object, in turn, is "in a sense the cause, or determinant" of the sign (CP 6.347, 1909).

Evidence of this determination is to be found in the way communicators are restricted as to their choice of signs, the ways of structuring them, and the options of communicating by means of them. Two modes of determination may be distinguished, a syntactic and a semantic one. The *syntactic determination* of the sign is the one which the rules of grammar, morphology, style, or orthography exert on the choice of words. Other syntactic determinants have their roots in the evolutionary history of language, which has shaped language according to the biological constraints of the perceptual and articulatory organs of humans (cf. Deacon 1997: 116). Although individuals do disregard these rules when they make mistakes, they cannot disregard them permanently nor can they violate these rules too seriously if they want to make themselves understood.

The *semantic* determination of the sign (or message) consists in its long-term tendency to correspond to the facts it represents. It is not the sender who decides whether the message is right or wrong, credible or incredible, etc. It is the reality represented by the sign that does so. Thus, reality determines the signs which represent it. The object of the sign thus turns out to be a semiotic co-agent in communication. The events reported in the news story determine what the reporters eventually write; for, despite all possibilities of choosing among alternative words and sentences, the reporters can only choose those signs which are capable of representing what they want to write about. Again, this is a general tendency which does not preclude the possibility of distortion, error, lies, ignorance, and other short-term misrepresentations, but in the long run, truth tends to reveal itself, or, as Peirce put it, although truth needs its defenders to become apparent, it is an agent in communication which also "*creates* its defenders and gives them strength" (CP 2.272, 1902, italics added).

A related kind of semantic determination of the sign by its object is derived from the laws of logic. It is not the sender of a message who decides whether his or her argument is logically valid or not. Instead, the rules of logic determine which conclusions can be drawn from which given premises. This is what Peirce means when he says that "The purpose of signs — which is the purpose of thought — is to bring truth to expression" (CP 2.444, fn., ca. 1893).

These are the reasons why signs are not merely *instruments* but have a semiotic agency of their own (cf. Nöth 2009). Still further evidence of the sign's agency is the continuity of its potential to signify in the absence of the sign producer. This semiotic potential is another aspect of the sign's purpose, which is "the purpose to be interpreted in another sign" (MS 1476, 1904). It is this agency of the sign which Derrida has in mind when he uses the metaphor of the text as a machine which continues to act after it has been produced. In Derrida's (1988: 8) words, "to write is to produce a mark that will constitute a sort of machine which is productive in turn, and which my future disappearance will not, in principle, hinder in its functioning, offering things and itself to be read and to be rewritten".

5.3.2 Congruence, Commonage, and the Inscrutability of the Communicator's Mind

When I. A. Richards (1928: 177) states that "communication [. . .] takes place when one mind so acts upon its environment that another mind is influenced, and in that other mind an experience occurs which is like the experience in the first mind, and is caused in part by that experience", he refers to an element of communication described in communication theory as *congruence* or *consensus* (cf. Nöth 2000: 237–38; 1990: 172–78). This refers to the assumption that communication is guided by the goals of consensus, cooperation, mutual understanding, and compliance with the sender's intentions. For some authors this is a desirable goal of communication; others emphasize the impossibility of achieving it.

Peirce discusses both the possibility and the impossibility of reaching mutual consensus in communication. As to the former, he writes: "Honest people, when not joking, intend to make the meaning of their words determinate, so that there shall be no latitude of interpretation at all. That is to say: the character of their meaning consists in the implications and non-implications of their words; and they intend to fix what is implied and what is not implied" (CP 5.447, 1905).

The very concept of communication contains, at its root, the idea of 'making common'. Charles Morris (1946: 195) introduced the term *commonage* to describe this normative goal of communicative interaction. For Peirce, it is both a presupposition and a goal of communication. It is a prerequisite insofar as the sign can only be known if both the utterer and the interpreter have *collateral experience* of its object since in order to know what a sign represents we need to have "previous acquaintance with what the sign denotes" (CP 8.179, s. d.). The sign itself cannot express its object, "it can only *indicate* and leave the interpreter to find out by *collateral experience*" what it represents (EP 2: 198, 1909). In addition to the code which both communicators must share, commonage is the presupposed common horizon of world knowledge: "No man can communicate the smallest item of information to his brother-man unless they have [. . .] common familiar knowledge [. . .] such that each knower knows that every other familiarly knows it, and familiarly knows that every other one of the knowers has a familiar knowledge of all this" (MS 614: 1–2, 1908). To make clear that no *circulus vitiosus* is involved in this endless reciprocity, Peirce underlined that this infinite regress is a logical and not a psychological one: "Of course, two endless series of knowings are involved; but knowing is not an action but a habit, which may remain passive for an indefinite time" (MS 614: 1–2: cf. Pietarinen 2006: 438).

As a regulative ideal, "commonage" is Peirce's *cominterpretant*, that is, that "into which the minds of utterer and interpreter have to be fused in order that any communication should take place" (EP 2: 478, 1906). The cominterpretant "consists of all that is, and must be, well understood between utterer and interpreter at the outset, in order that the sign in question should fulfill its function" (ibid.). In actual situations, this goal can hardly be reached. Commonage between a speaker and a hearer may perhaps be achieved when the topic of conversation is something like the theory of numbers, but "the further the topics are from such [. . .] 'abstract' subjects, the less possibility is there of [. . .] precision of speech. In so far as the implication is not determinate, it is usually left vague" (CP 5.447, 1905).

Furthermore, despite all efforts at collaboration, dialogues also evince a fundamental divergence of interests between the participants, which makes them "opponents" (MS 515: 25, s. d.; cf. Hilpinen 1995: 293). Peirce even evokes the image of communication as war: "The utterer is essentially a defender of his own proposition and wishes to interpret it so that it will be defensible. The interpreter, not being so interested, and being unable to interpret it fully without considering to what extreme it may reach, is relatively in a hostile attitude, and looks for the interpretation least defensible" (MS 9: 3–4, c.1903). Vagueness, however, is not only an impediment to communication; it is also a necessary source of creativity, for if we were always precise in what we say, nothing would be left to communicate (cf. Nöth and Santaella 2011).

Another reason why commonage is hard to achieve is that the communicators have no direct access to each others' minds. Knowledge about what the other means is always fragmentary, and the pieces of evidence of what is meant are mere "copies of a scrap torn out of another's life". The interpreters can only try to supplement these fragments with ideas of their own (MS 318: 194, 1907; cf. Johansen 1993: 198–202), can only try to match those fragments with their own "panorama of universal life" to find out where these scraps can be "inserted or recopied" within the horizon of their own life (MS 318: 194, 1907). Understanding is in this sense re-cognition, an echo of something with which we must be familiar, or in the words of Jantsch (1980: 203): "The verbal description of a colorful sunset transmits nothing of the real experience, if not by way of remembering a comparable experience of one's own."

5.4 Semiotics of Communication: Functional Models

To distinguish *communication* from *signification* which is not communicated is one of the aims of *functional semiology*, a trend in twentieth century semiotics whose major representatives are Eric Buyssens (1900–2000) and Luís Prieto (1926–1996). In the somewhat different tradition of the Prague School of functional semiotics, Roman Jakobson (1896–1982) has proposed a model of communication of his own.

5.4.1 Buyssens's Functional Model of Communication

Buyssens (1967 [1943]: 22) defines semiology as a "science of communication" and communication as a means by which an agent A influences an agent B who, in turn, is aware of A's intention. For Buyssens, communication is a means of obtaining the collaboration of others (1967 [1943]: 27). "The semiological point of view obliges us to go back to the primordial function of language, which is to exert an influence on somebody else" (ibid.: 22).

Buyssens's first criterion of communication is intentionality. Signification can be found in signs not intended by a sender, but these signs do not constitute acts of communication. In an act of communication, "an individual who knows that a given perception is associated with a certain state of mind becomes aware that another individual understands the objective [...] and reconstructs [...] that which has taken place in the former individual's mind. The signification of this act consists in the influence aimed at" (1967 [1943]: 32).

Since the sender's purpose to communicate must be accompanied by the receiver's awareness of it, intentionality is only a necessary but not a sufficient criterion of communication. A message fails to constitute an act of communication if the sender A conveys a message with the intention to influence the receiver B, but B remains unaware of A's intention. It also fails to serve communicatively if A acts without the intention to communicate, but B interprets A's behavior as being intended as an act of communication. Buyssens defines signs emitted without the intention to communicate as *indices*. What indices and signs have in common is that there is an interpreter who interprets "one fact as revealing another fact" Buyssens (1967 [1943]: 32); what distinguishes them is that the interpreter of a sign needs to know the convention which makes it a sign, whereas indices are not based on conventions.

5.4.2 Prieto's Instrumental Theory of Communication

Prieto's semiology of communication deals with verbal and nonverbal communication, language, traffic signs, numerical codes, maritime flag codes, and alphabets of sign languages. In this framework, Prieto proposes an instrumental model of communication, which is a variant of the functional model. In general, instruments are *useful* for the purpose of "acting on the external world" (Prieto 1966: 8). In communication, *signals* are the instruments, and their utility or function is that they serve to convey *messages*. Both instruments and signals are signifiers associated with signifieds. The signifier of an instrument is the class of objects serving one and the same utility; their signified is the utility they have. The signifier of a signal is its spoken or written form; its signified is its meaning. Signals have signification, whereas ordinary instruments have a practical utility (Prieto 1973: 156–57, 1975a: 59–63).

All signals contain an *index*, which relates them to their universe of meanings. Signification is a relation between an *index* and whatever it indicates (Prieto 1975b: 129), but there are indices which constitute signals, messages, and acts of communication and there are indices without signification (1975b: 128), for example, *natural*, *spontaneous*, *falsely spontaneous*, and *conventional indices*. *Falsely spontaneous* indices are the product of the intention of a sender, who pretends that the index is spontaneous and hence unintentional, for example, the rouge of a lady's make-up (Prieto 1975a: 15–16). Conventional indices have acquired signification although they originally only served some practical utility (Prieto 1975b: 59–68), for example, clothes worn because they express a *life style*. The study of such phenomena is the domain of the semiology of connotation (1975a) or semiology of signification (1975b), which is complementary to the study of communication proper.

Any act of communication presupposes the intention of a sender and it needs an interpreter. Prieto (1966: 32–38) postulates two kinds of intention. There is the intention to convey a *significative indication*, by which a signal indicates whatever it means (that is, its signification), and there is the one to convey a *notificative indication*, by means of which the message indicates that its signals are being communicated with the sender's intention. The content of a notificative indication is, so to speak, "Attention! This sign is intended to convey a message to you!" (cf. Hervey 1982: 71). The act of communication in which a speakers says "It's raining", does not only have the purpose of informing a receiver about a meteorological fact, for if it were so, there would be no difference between a message and the indication of a natural fact. In contrast to the natural indices of the rainfall, the message that informs about it also indicates (by its notificative index) that the speaker wants the hearer to know that it is raining (Prieto 1975b: 127). This is why only signals and not natural indices can be used to lie. The imitation of a natural index for the purpose of deceiving a receiver is a *falsely spontaneous* index.

5.4.3 Jakobson's Functional Model of Communication

Jakobson proposed a model to determine the factors and functions of communication. Inspired by Karl Bühler's (1934) *organon model* of language functions which distinguishes the three functions of *representation*, *expression*, and *appeal*, Jakobson's model is as follows (Fig. 5.3): An *addresser* sends a *message* to an

Fig. 5.3 The model of the constitutive factors (capital letters) and functions (in brackets) of communication proposed by Roman Jakobson (1960: 123, 129)

CONTEXT
(referential)

MESSAGE
(poetic)

ADDRESSER --------------------------------------- ADDRESSEE
(emotive) (conative)

CONTACT
(phatic)

CODE
(metalinguistic)

addressee. This message refers to a *context* (the "referent" of the verbal message) "seizable by the addressee". Addresser and addressee have a common *code*, such as the vocabulary and grammar of the language in which they communicate, and finally, there is a *contact*, which serves as "a physical channel and psychological connection between the addresser and the addressee, enabling both of them to enter and stay in communication" (Jakobson 1960: 353).

Each of the six factors is the determinant of a specific communicative function; one and the same message may have several functions, but one of them is usually predominant. Messages which focus on the referent (context), such as informative, descriptive, or narrative texts, have a predominantly *referential* function. The *emotive* or *expressive* function is predominant when the focus is on the speaker's attitude in relation to the meaning of the message. The use of interjections, a trembling voice, or the frequent use of the pronouns *I* or *me* are examples of signs of an utterance in which the emotive function of language is predominant. The *conative* function is oriented toward the addressee; its most typical grammatical expressions are the vocative and the imperative. The *phatic* function predominates in messages which, without necessarily conveying any particular meaning at all, serve "to establish, to prolong, or to discontinue communication, to check whether the channel works ('Hello, do you hear me?'), to attract the attention of the interlocutor or to confirm his continued attention ('Are you listening?')" (Jakobson 1960: 355). The *metalinguistic* function predominates when language is used to refer to language and verbal communication; metalanguage is language about language, for example, as in grammar books or in the discussion of questions of terminology. Finally, the *poetic* function predominates when the focus of verbal communication is on the qualities of the verbal message irrespective of its contents, for example, on the sound pattern, rhythm, or meter of a text.

5.5 Semiotic Code Models of Communication

The *code* model of communication was adopted by structuralist semioticians and became a predominant paradigm of semiotic communication theory during the decades of the 1960s and 1970s. Its origins are not in the writings of the founding fathers of semiotics but in the models of telecommunications engineering and cybernetics of the 1950s. The founder of semiotic code theory is Jakobson. Its most prominent representative is Umberto Eco.

5.5.1 Jakobson and the Two Paradigms of the Code Model

Jakobson was one of the first semioticians to adopt the terminology of communication theory. In a paper of 1953 in which he declared "that there are indeed many stimuli to be gained for linguists from the theory of communication", he justified the loan of the term *code* as follows: "The most essential problem for speech analysis is that of the code common to both sender and receiver and underlying the exchange of messages. No communication is feasible without a certain stock of what engineers [. . .] call preconceived possibilities and prefabricated representations" (Jakobson 1953: 258–59).

The term *code*, as Jakobson adopts it here, is in its essence a synonym of Saussure's *langue* (language as a *system*) in contrast to *parole* (language in *use*), but the advantage which Jakobson (1953: 259) sees in adopting the new term is "that the *Code-Message* concepts of communication theory are much clearer, much less ambiguous, and much more operational than the traditional presentation of this dichotomy in the theory of language". Jakobson was also inspired by the notions of coding and decoding as a model of the communicative process:

> A normal communication process operates with an encoder and a decoder. The message is new to him, but, by virtue of his code, he interprets the message. [. . .] The receiver understands the message thanks to his knowledge of the code. The position of the linguist who deciphers a language he doesn't know is different. He tries to deduce the code from the message: thus, he is not a decoder; he is what is called a cryptanalyst. The decoder is a virtual addressee of the message. The American cryptanalysts, who, during the war, read the Japanese secret messages, were not the addressees of the secret messages. (Jakobson 1953: 259–260)

The term *code*, as used in semiotic communication theories, evinces a fundamental ambiguity inherited from the lexical meaning of the word (cf. Eco 1984: 165). On the one hand, *code* is a legal term. A *Civil Code*, for example, is a book of rules, laws, and principles that instruct people how to behave in social life. The extension (or restriction) of this sense leads to expressions such as *code of etiquette*, *chivalric code*, *code of ethics*, and the definition of *language* as a code with several *subcodes*. The advantage of the term over its alternative, *language*, is that it is also applicable to nonverbal cultural phenomena. In the semiotic literature, one finds discussions of visual codes, musical codes, gestural codes, fashion codes, culinary codes, etc.

On the other hand, a code is a system which correlates the signals of one sign repertoire with equivalent signals from another sign repertoire. The *Morse code*, the binary digital codes of computer languages, and the codes of cryptography are examples of this type of code. A code in this sense is not a complete sign system. It does not consist of an expression plane and a content plane. Instead, it is a pairing mechanism used to translate the elements of the expression plane of one sign system (such as the letters of the alphabet) by elements of another form (such as electrical impulses). Codes in this sense are artificially constructed systems on the principle of a one-to-one correspondence between the expression elements of one sign system and the signals of an artificial sign repertoire without a content plane of its own.

5.5.2 Eco on Culture, Codes, and Communication

Communication and code are key terms of Umberto Eco's cultural semiotics. On the one hand, semiotics "studies all cultural processes as processes of communication" (Eco 1976: 8); on the other, a code is "a system of rules given by a culture" (1968: 130, 134). Eco's research field comprises codes from zoosemiotics, tactile communication, paralinguistics, medical semiotics, kinesics, music, languages, visual communication, including architecture and paintings, systems of objects, narrativity and other branches of text semiotics, cultural codes such as systems of etiquette and primitive religions, aesthetics, mass communication, and rhetoric. In contrast to narrower definitions of codes, Eco (1973: 171) includes *vague* codes, *weak* codes (changing rapidly), *incomplete* codes (with few signifiers associated with large complexes of content), *preliminary* codes ("soon to be replaced") and even *contradictory* codes. The fashion code, for example, is an imprecise, weak, incomplete, and preliminary code.

According to Eco (1976: 129), "the mobility of semantic space makes codes change transiently and processually". The interpretation of messages therefore requires a continuous *extra-coding,* the challenging and hypothetical modification of existing codes. Eco distinguishes two modes of extra-coding in text interpretation, *overcoding* and *undercoding* (ibid.: 133–36, 155). Overcoding is the interpretative process of modifying a preestablished code by proposing a new rule which governs a rarer application of the previous rule. Stylistic and ideological conventions are examples of such rules used in overcoding. Undercoding is a kind of rough, imprecise, and hypothetical coding, a "movement from unknown texts to codes" (ibid.: 135–136). The discovery of meanings in the acquisition of a foreign language or culture is an example: "So undercoding may be defined as the operation by means of which in the absence of reliable preestablished rules, certain macroscopic portions of certain texts are provisionally assumed to be pertinent units of a code in formation, even though the combinatorial rules governing the more basic compositional items of the expression, along with the corresponding content-units, remain unknown. [. . .] Thus, overcoding proceeds *from existing codes to more analytic subcodes* while undercoding proceeds from *non-existent codes to potential codes*" (ibid.).

5.6 Models of Communication Rooted in Cybernetics and Information Theory

The influence of cybernetics is most apparent in the communications models proposed in the framework of Umberto Eco's theory of semiotics and in the writings of Yuri M. Lotman (1922–1993), the founder of the Estonian Tartu School of Semiotics.

5.6.1 Eco's Cybernetic Communication Model

Eco (1968: 5, 1976: 8–9) proposes a model of the "elementary structure of communication" which is the one of signal transmission in machines. In contrast to human communication, where senders convey meanings by means of signs, machine communication takes place when *information* is transmitted by means of *signals*. Whereas communicated signs are intended by minds, signals are links in chains of mechanical causes triggering certain effects. This is why Eco postulates that the model of the most elementary communication process is the one which characterizes the path taken by the signals in a cybernetic control circuit of a machine. Its stations are: *Source* → *Transmitter* → *Signal* → *Channel* → *Signal* → *Receptor* → *Message* → *Destination*. *Noise* may disturb this process, and a *Code* is necessary as a repertoire of signals and their interpretation. The code in a control system can be a very rudimentary one, restricted to a repertoire of two signals only, such as +A (giving a positive impulse to react or not) − or A (giving a negative impulse to react or not).

For example, in order to regulate the water level in a water reservoir automatically, one needs to measure it by a float (*source*), which *transmits* a *signal* via radio waves (*channel*) to a *receptor* that interprets the information conveyed by it as a *message*, which is then received by a *destination* which reacts by opening a sluice or not. This communication process can take place fully automatically with no human operator interpreting the signal. In parenthesis, it must be added that the use of the term *communication* for signal processing of this kind is not accepted by all authors. For Prieto and Buyssens, for example, communication is a synonym of *human* communication, which excludes mechanical signal processing. Eco justifies his terminology by arguing that whenever there is a code, there is communication.

The difference which Eco sees between machine and human communication is that the codes on which the latter are based do not connect causes with effects but *signs* with *significations*. The process of human communication is coupled with a process of signification, and the *semiotics of communication* includes a *semiotics of signification*. The difference is the following:

> In a machine-to-machine process, the signal has no power to signify in so far as it may determine the destination *sub specie stimuli*. In this case we have no signification, but we do have the passage of some information.

> When the destination is a human being or 'addressee' (it is not necessary that the source or transmitter be human, provided that they emit the signals following a system of rules known by the human addressee), we are on the contrary witnessing a process of signification – provided that the signal is not merely a stimulus but arouses an interpretative response in the addressee. This process is made possible by the existence of a code. (Eco 1976: 8)

A process of signification is not the only distinction which Eco makes between machine and human communication. All elements of the model of the elementary structure of communication need to be redefined to be applicable to communication between humans. Since signal transmission can be neglected, his model of human communication is reduced to a chain consisting of the elements *Source* → *Emitter* → *Channel* → *Message* → *Destination* (Eco 1973: 25). What Eco means by these terms can best be understood by his interpretation of a news report of an earthquake in the Philippines about which a reporter transmits the story by telex to his newspaper: "What happened in the Philippines is the *source*, the reporter is the *emitter*, the radio waves are the *channel*, the news story is the *message*, and the editor who receives it is the *destination*" (ibid.).

An important difference between Eco's cybernetic and human models of communication concerns the two instances of the *source* and the *emitter*. Eco (1968: 41, 1973: 25–26) explains that in human communication both instances are usually localized in the person of the human *sender* of the message, where, in the case of a speaker, the brain is the source and the vocal apparatus the emitter (or transmitter). Now, if the *source* of the reporter's *message* is the earthquake and the *emitter* is the reporter, we are faced with a situation in which the source of the *message* is not the sender but an uncoded and nonintentional nonhuman real-world event. Although Eco does not elaborate it further, what he says is indeed rather Peircean: the source of an object is ultimately the dynamical object of the sign, which is the reality outside the human brain (cf. Nöth 2009, 2011b). What Peirce calls the *immediate object* of the sign is localized in the reporter's mind; it is his or her incomplete perspective of that event. The *message* is the *sign*, and the effect of the message on its readers, its *destination*, is the *interpretant*. This is where the message is interpreted as to its *signification* concerning which Eco (1968: 19) concludes that when we pass from the universe of machines to the universe of human communication, we pass "from the universe of signals to the universe of *sense*".

5.6.2 Lotman: Communication and Information

In Lotman's cultural semiotics, communication is defined in its relation to languages, signs, and signals not used for communicative purposes. In contrast to communication theorists who postulate that there is only communication when a sender is distinct from a receiver, Lotman (1990: 20–22) introduces the concept of *autocommunication*, defined as the transmission of a message from a present to a future I reinterpreting the same message in a new context. It takes place in an "I-I system" with the result that the information in the message from the former context is qualitatively transformed into a new message, with the results of a "restructuring of the actual 'I' itself" (ibid.: 22).

Excursus on autocommunication: Communication theorists who postulate that communication is only communication if it takes place between a sender and a receiver, both of whom need to be two different individuals, must find the concept of autocommunication (see also Schorno 2004) a contradiction in terms, but in semiotics it can be found in at least two other variants besides the one proposed by Lotman. One is Peirce's theory of autocommunication as the inner dialogue of the self (see above), the other is Kristeva's theory of autocommunication, whose background is Jacques Lacan's semiotic psychoanalysis. Kristeva defines her concept of autocommunication as follows:

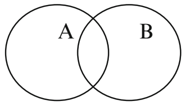
> Language is the process of communicating a message between at least two speaking subjects, one of whom is the addresser, the other, the receiver. [. . .] However, each speaking subject is both the addresser and the addressee of his own message since he is capable of emitting a message and deciphering it at the same time and in principle does not emit anything he cannot decipher. In this way, the message intended for the other is, in a sense, first intended for the one who is speaking: whence it follows that to speak is to speak to oneself. (Kristeva 1969: 7–8)

Returning to Lotman's communication model: a *language* is a system of communication consisting of "structured signs" (Lotman 1970: 21), which are either signs of primary systems, such as natural and artificial languages, or secondary systems, such as the ones of art, rituals, and myths. The purpose of communication is to "store and transmit information" (ibid.). Whereas structured signs (languages) are always used to communicate, there are three other ways in which human communication may be related to them: (1) communication may take place but by means of "extra-semiotic" signs, that is, primitive signals beyond the control of the human intellect, for example, because they occur within the body of an organism; (2) (structured) signs may play a secondary role only, as in nonverbal communication; (3) signs may *not* be used for communicative but for other purposes than to store and transmit information (Lotman 1970: 21–22).

The system of *language* and its use in *speech* have their counterpart in the dichotomy of *code* and *message*, but, for Lotman, the term *code* is less all-encompassing than for Eco: "The term 'code' carries with it the idea of an artificial, newly created structure, introduced by instantaneous agreement" (Lotman 2009: 4). While a *language* is a code *with* a history, a *code* is a system without memory. Culture is not based on codes in general but on languages: "If we assume an addresser and an addressee processing identical codes and fully devoid of memory, then the understanding between them will be ideal, but the value of the transferred information will be minimal. [. . .] The ideal of information of this type is found in the transfer of commands", but in "normal human communication" the "nonidentity" of speaker and hearer must be presupposed (Lotman 2009: 4–5).

Shannon and Weaver's classical model of communication is therefore not applicable to human communication since it interprets differences between the message as encoded by a sender and decoded by a hearer as the result of undesirable *noise* which the system must eliminate by introducing redundancies (Lotman 1970: 43).

Fig. 5.4 Lotman's (2009: 5) model of the nonidentity of codes



Natural communication, by contrast, thrives on such differences, without which communication would be "insipid" (Lotman 2009: 5): "For a fairly complex message to be received with absolute identity, conditions are required which in naturally occurring situations are practically unobtainable: addressee and addresser have to have wholly identical codes, that is, to be in fact semiotically speaking a bifurcation of one and the same personality" (1990: 12–13).

Due to the nonidentity of the addresser (A) and the addressee (B) and the differences in their cultural memories, the "lingual spaces" of A and B are never congruent but only overlap, like the following two intersecting circles a and B (Fig. 5.4):

This difference between the semiotic spaces of A and B is not only a distinctive feature of human communication in general but also the source of a permanent tension and conflict between two opposing forces (Lotman 2009: 5). On the one hand there is a "struggle to facilitate understanding" which results in the attempt to extend the area of intersection between A and B; on the other there is "the struggle to amplify the value of the communication", which results in an effort to amplify the semiotic spaces in which A and B do not intersect (ibid.). We are therefore faced with the following paradox: communication is only possible within the semiotic domain of intersection between A and B, but it is only informative if transfers take place between the nonintersecting domains. Hence,

> we are interested in communication in the very sphere which complicates communication and, in actual fact, renders it impossible. Moreover, the more difficult and inadequate the translation of one nonintersecting part of the space into the language of the other, the more valuable [. . .] this paradoxical communication becomes. You could say that the translation of the untranslatable may in turn become the carrier of information of the highest degree. (Lotman 2009: 5–6)

The asymmetry between the semiotic domains of A and B is only a particular manifestation of the asymmetry within the more general semiotic sphere of culture, the *semiosphere*, outside of which there is no communication (Lotman 1990: 124–27). Its main characteristic is a "semiotic asymmetry" which is the creative source of information in a permanent process of translation between heterogeneous languages. Since immersion within the cultural semiosphere is a prerequisite of communication but communication is not possible without its semiotic space, we are faced with another paradox: "All participants in the communicative act must have some experience of communication, be familiar with semiosis before they can communicate. [. . .] The semiotic space necessary for the existence and functioning of languages [. . .] has prior existence and is in constant interaction with languages" (ibid.: 123). Hence, the semiosphere must have been created by communication, but at the same time, communication presupposes it.

Because of these determinants, communication is not the collaboration of fully autonomous agents. The addresser and the addressee of the message have the semiosphere as their co-agents in communication. The semiosphere collaborates in the form of its cultural memory whose ideas are distributed in the cultural semiosphere, for:

> Thought is within us, but we are within thought, just as language is something engendered by our minds [. . .] and we are with language. [. . .] We are both part and likeness of a vast intellectual mechanism. [. . .] We are at the same time [. . .] participants in an endless number of dialogues, and the likeness of *everything*, and 'the other' both for other people and for ourselves; we are both a planet in the intellectual galaxy, and the image of its universum (Lotman 1990: 273).

5.7 Greimas on Communication as Semiotic Action and Enunciation

Algirdas Greimas (1917–1992) rejects all linear models of communication of the type "*sender* → *message/code* → *receiver*" in the Shannon/Weaver tradition (Greimas 1976: 36–37) and defines communication instead from the point of view of the *discursive subject* as an action and process of *enunciation*. Greimas has not presented a coherent theory of communication himself, but the elements of such a theory can be reconstructed from dispersed articles in his alphabetical *Dictionary* (Greimas and Courtés 1979/1982). Whenever reference is made to one of its articles in this subchapter, italics are used (instead of page number references).

5.7.1 Communication as Action and Its Modalities

At the root of Greimas's semiotic theory of human *action* is the fundamental distinction between *production* vs. *communication* or more specifically between *operation* and *manipulation*. Whereas *to operate* means 'to act on things' or more abstractly 'to make (or cause to) be', *to manipulate*, in a sense without negative connotations, means to 'make (or cause) to do'. Manipulative action involves a *sender*-manipulator (the *addresser*) and a *receiver*-subject (the *addressee*). The purpose of the former is to influence the *receiver*-subject's *wanting-to-do* or *having-to-do* in order to make her or him do something. *Communication* is a *cognitive* as well as a *manipulative* activity, whose purpose is information, persuasion, or interpretation. *Informative doing* concerns the transfer of some knowledge from the addresser to the addressee. It is a *make-known* (or *causing-to-know*, Greimas's general definition of communicative doing), whose goal it is to convey some knowledge to a receiver-subject. Its *mode* of enunciation is *affirmative*.

Persuasive doing is the act of an addresser who aims at making the receiver accept a proposal. *Interpretive doing* pertains to the role of the *addressee*. While *information* conveys knowledge in a neutral and affirmative way, persuasion and interpretation modalize the content of the message. The propositional content of a *persuasive doing* is modalized with the purpose of making the addressee *believe* in what its states. The addressee's *interpretive doing*, in turn, involves *veridictory modalities* in the form of beliefs or judgments evaluating the propositional content as true or false, likely, credible, possible, impossible, desirable or undesirable.

In its deep structure, any *enunciative* act presupposes a *phatic act*, by which an implicit contract between the subjects of enunciation is established and the status of the *actants* involved is modified. On the one hand, it situates the subjects of enunciation between the two opposed forces of an open potential of communicating and acting; on the other it has the effect of a coercion limiting the possibilities of *action* of the agents involved. Thus, communication takes place within a conflictual field of tension created by the ambivalence between a benevolent or mistrustful *addressee* and its release when the addressee complies with or defies the addresser's proposal.

5.7.2 *The Multiple Identities of the Communicating Agents*

In his revision of the roles of the *addresser* and the *addressee* in communication, Greimas redefines the *subjects of enunciation* as the *enunciator* and the *enunciatee*, who are not the empirical subjects of some specific enunciation but abstractions of a discursive logic according to which communication has its cause in an enunciator-sender logically presupposed by the enunciation and a presupposed addressee.

Greimas rejects the presupposition of the unicity of the communicating subjects, the assumption that addressers are solely responsible for their enunciations and addressees alone determine their interpretation. Instead, discursive semiotics is based on the axiom of enunciative *heterogeneity*: enunciators speak in several voices and they attribute authorship to imaginary co-present speakers. Discursive semiotics also calls into question the assumption of intentionally communicating subjects whose purpose is to influence other subjects in a determinate way. Greimas and Courtés criticize this assumption as psychologically reductionist and naively monocausal. *Intention* manifests itself in a transitive relation between a subject and an object, in which the subject constructs his or her world, endowing it with meaning.

In its surface structure, the *enunciation* is marked by indices revealing a *phatic intention* underlying the act of communication in the form of deictic words identifying the subjects of enunciation through the first and second person pronouns *I* and *you*. However, the roles thus identified are mere simulacra, according to Greimas and Courtés, who argue that the subject of *enunciation* really remains only implicit and presupposed so that there is only a semblance of enunciation in a merely reported enunciation. The I of the subject of enunciation cannot be the I that leaves its marks in the *enunciation*, for the I of the former needs to differ from the I of the latter to be able to project the self as a non-I into the enunciation.

What manifests itself in the pronouns *I* and *you* are mere instances to which the subjects of enunciation delegate or transfer their enunciative *competence*. They identify themselves with the message or establish a critical distance from it by letting others speak instead of themselves. Instead of the voice of the I we hear this other in a tone of irony, self-criticism, partiality, objectivity, subjectivity, or engagement.

One of the typical modes of the delegation of enunciative competence is letting a *narrator* speak instead of the I so that the you becomes transformed into a *narratee*, a "dear reader". Another simulacrum is a secondary delegation of the enunciative *competence* from the enunciating subject to the pair *interlocutor/interlocutee* representing a dialogue between two subjects within the discourse. A model representing the polyphony of voices resulting from a twofold delegation of the enunciator's competence, first to a narrator and then to the interlocutor of the narration, is the following:

Enunciator – {Narrator – [Interlocutor – (Enunciation) – Interlocutee] – Narratee} – Enunciatee

In other words, the *enunciator* (presupposing an *enunciatee*) delegates the responsibility for the enunciation first to a *narrator* (presupposing a *narratee*), who then takes the floor as if he or she were the enunciator him or herself. The narrator then lets an *interlocutor* speak in a dialogue with still another person, the *interlocutee*. In this chain of delegations of enunciative *competence*, each of the new subjects speaking instead of the enunciating subject is a simulacrum of the voice from which his or her enunciative competence is borrowed.

5.7.3 Symmetry and Asymmetry of the Communication Situation

The above diagram of the chain of enunciative competences reflects a fundamental symmetry of the agents involved in communication. Evidence of this symmetry is the complementarity of the roles to the left and to the right of the enunciation in the middle of this model. In contrast to linear models of communication which circumscribe the role of the addressee with the passive metaphor of a "sink" (in which the substance emitted by the "source" disappears), Greimas and Courtés describe the *addressee's* role not as merely passive but as the one of an actively productive *subject of enunciation*, arguing that the act of *interpretation* is a speech act just like the addresser's utterance is. However, there are also logical asymmetries and asymmetries related to the asymmetry of *knowledge* and *power*. The former consist in a presuppositional unilaterality between the two enunciative subjects since there is no addressee without an addresser because the addressee is the presupposed term, whereas the addresser is the presupposing term.

The most important communicative asymmetry results from the transitivity of *manipulation* and the addresser's *factitiveness* as a manipulator aiming at transforming the addressee's competence. *Manipulation*, defined as a *causing-to-do* or *-be*, presupposes an addresser-manipulator putting the manipulated addressee in a role of lack of freedom *not-to-be-able-not-to-do*. In this scenario of a process whose source is a powerful manipulator, the role of the *addressee* is inscribed into the modalities of enunciation. If the addressee's *not-being-able-not-to-do* is combined with a *having-to-do*, the addressee will interpret it as a provocation or warning; if it is combined with a *wanting-to-do*, the enunciation will be interpreted as a seduction or temptation.

5.8 Diversity and Complementarity – Construction and Deconstruction of Communication

Our panorama of diverse models of communication within semiotic frameworks since Saussure and Peirce has shown considerable divergences. Some of the models are clearly incompatible, whereas others may be interpreted as being complementary. A syncretistic synthesis of the various models with the ambitious goal of finding a common denominator of semiotic theories of communication would be inappropriate. It could only distort the undeniable divergences among the different approaches.

However, the diversity and plurality does not gainsay the validity of the semiotic framework of communication and the originality of some of its models. Most notably, the diversity of the semiotic models of communication is by no means greater than the diversity which prevails in the field of communication theory in general. Considering the breadth of the spectrum of communication theory in general from its so-called "classical" Shannon/Weaver paradigm to the constructivists and deconstructivists (Chang 1996), it becomes apparent that there is no less diversity and incompatibility in these approaches.

Diversity and even paradox are in fact inscribed into the very word *communication* in whose Latin root we can find such opposed notions as commonality and reciprocity (*communis*, *mutuus*) on the one hand and separation or even segregation (*cum moenus* 'with defense walls') on the other (see Nöth 2011a). This paradox inscribed in the etymology of the word becomes once more apparent in contemporary theories of communication, raising the paradoxical question whether communication is possible at all (see Nöth 2013). Incompatibilities are equally inherent in the metaphors of communication in everyday language, whose recently much investigated scope is known to reach from the rhetorics of sharing and get-togethers to the ones of war and defense.

Despite the word of warning against any attempt at finding a common denominator of the diverse semiotic approaches to communication, we will nevertheless dare to conclude with the attempt of a rough sketch of a general line of development in the semiotic theory of communication since the mid-twentieth century, a line which cannot be called straight, not even representative, and certainly not one which can claim to serve as a common denominator of the development of semiotic communication theories of the last century, but it is a line able to characterize a general trend.

The line of development which characterizes a general trend in the semiotics of communication since the 1960s is the line *away from* the Shannon/Weaver model of communication and its precursor in the Saussurean speech circuit (Figs. 5.1 and 5.2) towards its deconstruction and total rejection (see especially Sect. 5.7). The ambition of the "classical" model was to represent communication in terms of an optimum flow of messages from a sender to a receiver, both in an idealized relation of mirror symmetry endangered only by the undesirable impediment of *noise* to be remedied by the technical means of *feedback* and control. Although the Shannon/Weaver model has no semiotic foundations of its own, it was adopted and at least partially incorporated into the early semiotic models of communication by Roman Jakobson, Umberto Eco, and Yuri Lotman (see Sect. 5.6).

However, the additional component of the code in these semiotic models (Sect. 5.5) meant a first distancing from Shannon and Weaver's model of communicational symmetry insofar as it postulated two codes, the sender's and the receiver's code, which are only partially congruent so that the ideal of the symmetry between the sender and receiver can never be reached (cf. Fig. 5.4). With the ensuing development of the semiotic theory of codes in the 1960s and 1970s, it became apparent that the possibilities of congruence between the senders' and the receivers' codes diminished to the degree that more and more cultural codes were taken into account as determinants of communication.

Finally, for the poststructuralist Derrida, models of communication which postulate ideas such as commonage and congruence need to be entirely abandoned because, as Jensen (1995: 9) aptly summarizes his views, our messages "are mere chains of signifiers initiating a play of differences that constantly put meaning into question", and discourse can never mean what it seems to mean since it is "only the trace of an absent meaning" so that, in the end, "all communication is miscommunication".

Derrida's radically deconstructivist model of communication ends up reverting Shannon and Weaver's classical model to its opposite. The semiotic about-turn in communication theory does not only culminate in a theory of the impossibility of communication per se, but also in an amazing reinterpretation of Shannon and Weaver's classical model in which the message becomes the noise. This is the radically postructuralist thesis proposed by Roland Barthes. He declared that the goal of communication is not congruence or the unimpeded transmission of a message, but rather the conveyance of a message which *is* the very noise which Shannon and Weaver had wanted to eradicate. In a summary of Barthes' ideas on communication noise, Nelson (1985: 9) writes:

> In poststructuralism [. . .], noise *is* the message. Noise is the sender; noise is the receiver. Noise is not outside the message, nor is it an internal supplement to the truth of the message. Noise is the semiotic process that constitutes messages; it is their substance; it is irreducible. This is a radical extension of Saussure's argument: there are only differences; there are no positive terms.

Thus conceived, communication conveys putative messages as noise. Communication is not the purification of the message from noise. If messages are nothing but noise, the total negation of the possibility (or at least probability) of communication, as postulated by Derrida and Luhmann, must be the logical consequence (cf. Nöth 2013).

The line which led from Shannon and Weaver's model to its deconstruction has a parallel in another line whose point of departure is Peirce. Peirce's ideas on communication deconstruct the classical model as to its assumptions concerning communicative agency. His deconstruction is concerned with the classical role of the sender as an autonomous agent in communication whose mirror symmetrical inversion is the receiver. There have been other tendencies in communication theory questioning the sender's autonomy in communication. Reception theory aims at strengthening the receiver's role in the communicative process, Greimas deconstructs the sender's autonomy by postulating multiple identities for all communicating agents (see Sect. 5.7.2), and Lotman postulates that communication includes the mode of autocommunication (see Sect. 5.6.2).

Peirce sets a different focus, the one on the sign. The sign is no longer an instrument used by the sender but a third autonomous agent in communication (cf. Nöth 2009). Communication does not only begin when the sender finds his or her counterpart in a dialogue with a receiver. The sign is dialogic and communicative in itself. Communication begins in the inner dialogue of the self and is only continued in communication with others.

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Chapter 6
Mind the Gap: Transitions Between Concepts of Information in Varied Domains

Lyn Robinson and David Bawden

> It is hardly to be expected that a single concept of information would satisfactorily account for the numerous possible applications of this general field.
> (Claude Shannon)

> Information is information, not matter or energy.
> (Norbert Wiener)

> Shannon and Wiener and I
> Have found it confusing to try
> To measure sagacity
> And channel capacity
> By $\sum p_i \log p$.
> (Anonymous, Behavioural Science, 1962, 7(July issue), p. 395)

> Life, language, human beings, society, culture – all owe their existence to the intrinsic ability of matter and energy to process information.
> (Seth Lloyd)

6.1 Introduction

'Information' is a notoriously slippery and multifaceted concept. Not only has the word had many different meanings over the years – its entry in the full Oxford English Dictionary of 2010, which shows its usage over time, runs to nearly 10,000 words – but it is used with different connotations in various domains. For overviews of the mutability and diversity of the information concept, see Belkin (1978), Machlup and Mansfield (1983), Qvortrup (1993), Bawden (2001), Capurro and Hjørland (2003), Gleick (2011), Ma (2012), and Bawden and Robinson (2012).

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In this chapter, we will focus on usage in different domains and disciplines. As Capurro and Hjørland (2003: 356, 396) say: “almost every scientific discipline uses the concept of information within its own context and with regard to specific phenomena .... There are many concepts of information, and they are embedded in more or less explicit theoretical structures”. Our concern will be to examine these different concepts of information, and in particular the ‘gaps’ between them. By ‘gap’, we mean the discontinuities in understanding which make it difficult to understand whether the ‘information’ being spoken of in different contexts is in any way ‘the same thing’, or at least ‘the same sort of thing’; and if not, in what way – if any – the different meanings of information relate to one another. Given the current enthusiasm for ‘information physics’, exemplified by writings of Zurek, Vedral, Lloyd and others cited in Sect. 6.2.2, we place particular stress on the information concept in the physical sciences. We have also tried to emphasise the historical perspective of these ideas.

We will focus particularly on the implications of these considerations for the idea of information in the field of library/information science. Perhaps because information is at its centre, there has been particular debate about the issue in this discipline; see Belkin and Robertson (1976) for an early account and Cornelius (2002), Bates (2005), and the reviews cited above, for overviews of the on-going debate. A Delphi study carried out by Zins (2007) presents many definitions of information for information science, typically relating information to data and/or knowledge.

Indeed, it is the relationship between these concepts that is a constant concern, perhaps even an obsession, within the information sciences. This has led to two main classes of model (Bawden and Robinson 2012; Ma 2012). The first, based in Karl Popper’s ‘objective epistemology’ uses ‘knowledge’ to denote Popper’s ‘World 2’, the subjective knowledge within an individual person’s mind. ‘Information’ is used to denote communicable knowledge, recorded or directly exchanged between people; this is Popper’s ‘World 3’ of objective knowledge, necessarily encoded in a ‘World 1’ document, or physical communication. Information, in this model, is ‘knowledge in transit’. The second regards information and knowledge as the same kind of entity, with knowledge viewed as ‘refined’ information, set into some form of larger structure. This is typically presented as a linear progression, or a pyramid, from ‘data’, or ‘capta’ – data in which we are interested – through ‘information’ to ‘knowledge’, perhaps with ‘wisdom’ or ‘action’ at the far end of the spectrum or the apex of the pyramid; see, for example, Checkland and Holwell (1998), Frické (2009), Rowley (2011), and Ma (2012).

The debate on the nature of information within the information sciences, somewhat limited in scope, has been widened by some wider visions, such as those of Buckland and of Bates, which will be discussed below. The purpose of this chapter is to attempt to widen perspectives still further; to attempt, in effect, to begin to answer John Wheeler’s question ‘What makes meaning?’, by considering conceptions of meaning-free and meaningful information, and the relations between them.

We begin with a brief consideration of the way in which information is viewed in several diverse domains.

6.2 Information in Various Domains

We will examine the concept of information in five domains, in each of which information has come to be regarded, at least by some, as a central concept: technological, physical, biological, social and philosophical. For reasons of space, the discussion must be cursory, and the reader is referred for more extensive treatments (at an accessible level in the case of the scientific perspective) to Gleick (2011), Greene (2011), Deutsch (2011), Floridi (2010a), Davies and Gregersen (2010), Vedral (2010, 2012), Lloyd (2006, 2010), von Baeyer (2004), Smolin (2000) and Leff and Rex (1990, 2002).

6.2.1 Information and Communication Technology

We begin with technology rather than the sciences, since the closest approach yet available to a universal formal account of information is 'information theory', originated by Claude Shannon and properly referred to as the Shannon-Weaver-Hartley theory in recognition of those who added to it and gave it its current form. Gleick (2011) gives a detailed account of these developments, which all occurred in Bell Laboratories, and which focused on communication network engineering issues.

The initial steps were taken by Harry Nyquist (1924), who showed how to estimate the amount of information that could be transmitted in a channel of given bandwidth – in his case, the telegraph. His ideas were developed by Ralph Hartley (1928), who established a quantitative measure of information, so as to compare the transmission capacities of different systems. Hartley (1928: 535) emphasised that this measure was "based on physical as contrasted with psychological considerations". The meaning of the messages was not to be considered; information was regarded as being communicated successfully when the receiver could distinguish between sets of symbols sent by the originator. His measure of information, understood in this way, was the logarithm of the number of possible symbol sequences. For a single selection, the associated information, H, is the logarithm of the number of symbols:

$$\mathrm{H} = \log \mathrm{s}$$

This in turn was generalised in (1948) by Claude Shannon into a fuller theory of communication, which was later republished in book form (Shannon and Weaver 1949). This volume included a contribution by Warren Weaver that expounded the ideas in a non-mathematical and more wide-ranging manner. Weaver's presentation arguably had greater influence in promoting information theory than any of its originators' writings.

Following Nyquist and Hartley, Shannon defined the fundamental problem of communication as the accurate reproduction at one point of a message selected from another point. Meaning was to be ignored: as Weaver noted, “these semantic aspects of communication are irrelevant to the engineering problem” (Shannon and Weaver 1949: 3). The message in each case is one selected from the set of possible messages, and the system must cope with any selection. If the number of possible messages is finite, then the information associated with any message is a function of the number of possible messages.

Shannon derived his well-known formula for H, the measure of information

$$\mathrm{H} = -\mathrm{K} \sum \mathrm{p_i} \log \mathrm{p_i}$$

where $\mathrm{p_i}$ is the probability of each symbol, and K is a constant defining the units. The minus sign is included to make the quantity of information, H, positive; this is necessary as a probability will be a positive number less than 1, and the log of such a number is negative.

Shannon pointed out that formulae of the general form $\mathrm{H} = -\sum \mathrm{p_i} \log \mathrm{p_i}$ appear very often in information theory as measures of information, choice, and uncertainty; the three concepts seem almost synonymous for his purposes. Shannon then gave the name ‘entropy’ to his quantity H, since the form of its equation was that of entropy as defined in thermodynamics. It is usually said that the idea of using this name was suggested to him by John von Neumann. The original source for this story seems to be Myron Tribus who, citing a private discussion between himself and Shannon in Cambridge, Massachusetts, on March 30th 1961, gives the following account:

> When Shannon discovered this function he was faced with the need to name it, for it occurred quite often in the theory of communication he was developing. He considered naming it ‘information’ but felt that this word had unfortunate popular interpretations that would interfere with his intended uses of it in his new theory. He was inclined towards naming it ‘uncertainty’, and discussed the matter with John Von Neumann. Von Neumann suggested that the function ought to be called ‘entropy’ since it was already in use in some treatises on statistical thermodynamics. Von Neumann, Shannon reports, suggested that there were two good reasons for calling the function ‘entropy’. ‘It is already in use under that name’, he is reported to have said, ‘and besides, it will give you a great edge in debates because nobody really knows what entropy is anyway’. Shannon called his function ‘entropy’ and used it as a measure of ‘uncertainty’, interchanging between the two words in his writings without discrimination (Tribus 1964: 354).

Whatever the truth of this, Shannon’s equating of information to entropy was controversial from the first. Specialists in thermodynamics, in particular, suggested that ‘uncertainty’, ‘spread’, or ‘dispersion’ were better terms, without the implications of ‘entropy’ (see, for example, Denbigh 1981). A particularly caustic view is expressed by Müller (2007: 124, 126): “No doubt Shannon and von Neumann thought that this was funny joke, but it is not – it merely exposes Shannon and von Neumann as intellectual snobs . . . . If von Neumann had a problem with entropy, he had no right to compound that problem for others . . . by suggesting that entropy has anything to do with information ... [Entropy] is nothing by itself. It has to be seen and discussed in conjunction with temperature and heat, and energy and work. And, if there is to be an extrapolation of entropy to a foreign field, it must be accompanied by the appropriate extrapolations of temperature and heat and work". This reminds us that, when we see later that there have been criticisms of the use of objective measures of information in the library/information sciences, these have been matched by criticisms regarding the arguably uncritical use of information concepts in the sciences.

Shannon's was not the only attempt to derive a mathematical theory of information, based on ideas of probability and uncertainty. The British statistician R.A. Fisher derived such a measure, as did the American mathematician Norbert Wiener, the originator of cybernetics. The latter seems to have been irritated that the credit for the development was given mainly to Shannon; less than 10 years later, he was referring to "the Shannon-Wiener definition of quantity of information" and insisting that "it belongs to the two of us equally" (Wiener 1956: 63) His mathematical formalism was the same as Shannon's but, significantly, he treated information as the negative of physical entropy, associating it with structure and order, the opposite of Shannon's equating of information with entropy and disorder:

> The notion of the amount of information attaches itself very naturally to a classical notion in statistical mechanics: that of *entropy*. Just as the amount of information in a system is a measure of its degree of organization, so the entropy of a system is a measure of its degree of disorganization; and the one is simply the negative of the other (Wiener 1948: 18).

Shannon's information is, in effect, the opposite of Wiener's, which has caused confusion ever since for those who seek to understand the meaning of the mathematics, as Qvortrup (1993) makes plain.

In Shannon's sense, information, like physical entropy, is associated with lack of order. A set of index cards, ordered alphabetically, has low entropy, and little information; if we know the order of the alphabet, we know all there is to know about the ordering of the cards, and we can explain it to someone very briefly. If they are disordered, however, they contain, in Shannon's sense, much more information, since we would need a much more lengthy statement to describe their arrangement.

By contrast, there is a long-standing idea that information should be associated with order and pattern, rather than its opposite; in essence, this view follows Wiener's conception. Even Warren Weaver, arguing in support of Shannon, wrote that "the concept of information developed in this theory at first seems disappointing and bizarre – disappointing because it has nothing to do with meaning, and bizarre .... in these statistical terms the two words *information* and *uncertainty* find themselves to be partners" (Shannon and Weaver 1949: 116). Leon Brillouin, who pioneered the introduction of Shannon's ideas into the sciences, in effect took Wiener's stance, renaming Shannon's entropy formulation as 'negentropy' (Brillouin 1962). As we shall see later, Tom Stonier took the same approach, proposing a framework for a unified understanding of information in various domains.

Marcia Bates (2005) noted that the idea of 'information as pattern/organisation' was 'endemic' during the 1970s, and identified Parker (1974: 10) as the first to state explicitly in a library/information context that "information is the pattern or organization of matter and energy". While this concept has gained some popularity, it is by no means universally accepted: Birger Hjørland (2008) speaks for those who doubt it, saying that such patterns are nothing more than patterns until they inform somebody about something. Reading (2011) exemplifies those who take a middle course, positing that such patterns are information, but 'meaningless information', in contrast to the 'meaningful information' encountered in social, and, arguably, in biological, systems.

We now consider how these ideas were applied to bring information as an entity into the physical sciences.

6.2.2 Information Physics

The idea of information as a feature of the physical world arose through studies of the thermodynamic property known as entropy. Usually understood as a measure of the disorder of a physical system, entropy has also come to be associated with the extent of our knowledge of it; the more disordered a system, the less detailed knowledge we have of where its components are or what they are doing. This idea was formalised by Zurek (1989), though it builds on earlier insights of scientists such as Ludwig Boltzmann and Leo Szilard who introduced information as a fundamental concept in science, though it was not named by them as such.

Boltzmann related the entropy of gases to their degree of disorder, measured in probability terms, showing that entropy was related to the probability of collisions between gas particles with different velocities. Hence it could be equated to the probability distribution of the states of a system, expressed by the formula

$$S = k \log W$$

where k is Boltzmann's constant, and W is a measure of the number of states of a system; i.e., the ways that molecules can be arranged, given a known total energy. This equation is certainly reminiscent of later information theory formalisms, but – although it is carved on his tombstone in the Vienna cemetery (actually using an Ω symbol instead of the more modern W) – Boltzmann never wrote it in this form, which is due to Max Planck (Atkins 2007). To suggest, as does von Baeyer (2003: 98), that "by identifying entropy with missing information, Boltzmann hurled the concept of information into the realm of physics" seems to be anachronistic, as well as over-dramatic.

Szilard (1929) analysed the well-worked thermodynamic problem of 'Maxwell's Demon' (Leff and Rex 1990, 2002), in what was subsequently assessed as "the earliest known paper in the field of information theory" (Hargatti 2006: 46), though information is again not specifically mentioned. As Szilard himself later recalled:

> … I wrote a little paper which was on a rather closely related subject [to a paper on the second law of thermodynamics]. It dealt with the problem of what is essential in the operations of the so-called Maxwell's Demon, who guesses right and then does

> something, and by guessing right and doing something he can violate the second law of thermodynamics. This paper was a radical departure in thinking, because I said that the essential thing here is that the demon utilizes information – to be precise, information which is not really in his possession until he guesses it. I said that there is a relationship between information and entropy, and I computed what that relationship was. No one paid any attention to this paper until, after the war, information theory became fashionable. Then the paper was rediscovered. Now this old paper, to which for over 35 years nobody paid any attention, is a cornerstone of modern information theory (Weart and Szilard 1978: 11).

True information physics began decades later when the ideas of information theory were introduced into science, by pioneers such as Leon Brillouin (1962). In essence, this amounted to recognising a formal mathematical link between entropy and information, when information is defined in the way required by Shannon's theory (although it should be noted that it was Wiener's interpretation that was generally adopted) or, indeed, by other formalisms for defining information in objective and quantitative terms, such as Fisher information (Frieden 1999), a quantitative measure of information used most often in statistical analysis.

Subsequent analysis of the relation between information and physical entropy led Landauer (1991) to propose his well-known aphorism 'information is physical'. Information must always be instantiated in some physical system; that is to say, in some kind of document, in the broadest sense. Information is subject to physical laws, and these laws can, in turn, be cast in information terms. The physical nature of information, and, in particular, its relation to entropy, continues to arouse debate; for early discussions, see Avramescu (1980) and Shaw and Davis (1983), and for recent contributions, see Duncan and Semura (2007) and Karnani, Pääkkönen, and Annila (2009).

The idea of information as a fundamental physical entity has received increasing attention in recent decades, inspired particularly by an association of information with complexity; see Zurek (1990) for papers from a seminal meeting which effectively launched this approach. Information has been proposed as a fundamental aspect of the physical universe, on a par with – or even more fundamental than – matter and energy. The American physicist John Wheeler is generally recognised as the originator of this approach, stemming from his focus on the foundations of physics, leading him to formulate what he termed his 'Really Big Questions', such as 'How come existence?' and 'Why the quantum?'. Two of his questions involved information and meaning. In asking 'It from bit?', Wheeler queried whether information was a concept playing a significant role at the foundations of physics; whether it was a fundamental physical entity akin to, say, energy. Indeed, he divided his own intellectual career into three phases: from a starting belief that 'Everything is particles', he moved through a view that 'Everything is fields', to finally conclude that 'Everything is information', focusing on the idea that logic and information form the bedrock of physical theory (MacPherson 2008). In asking 'What makes meaning?', he invoked the idea of a 'participatory universe', in which conscious beings may play an active role in determining the nature of the physical universe. Wheeler's views are surveyed, critiqued, and extended in papers in Barrow et al. (2004).

Other well-known contributors to the information physics approach are: Lee Smolin (2000), who has suggested that the idea of space itself may be replaceable by a 'network of relations' or a 'web of information'; Seth Lloyd (2006, 2010), who argues that 'the universe computes' (specifically in the form of a quantum computer); and David Deutsch, who proposes that information flow determines the nature of everything that is. "The physical world is a multiverse", writes Deutsch (2011: 304), "and its structure is determined by how information flows in it. In many regions of the multiverse, information flows in quasi-autonomous streams called histories, one of which we call our universe". 'Information flow', in this account, may be (simplistically) regarded as what changes occur in what order. Finally, having mentioned the multiverse, we should note that the increasingly influential 'many worlds' interpretation of quantum mechanics is inextricably linked with information concepts (Byrne 2010; Saunders et al. 2010; Wallace 2012).

'Information' in the physical realm is invariably defined in an objective, meaning-free way. However, there has been a realisation that information content, as assessed by any of the formalisms, with randomness giving the highest information content by Shannon's measure, is not an intuitively sensible measure. Interest has focused on ideas of complexity, and on the idea that it is from an interaction of order and randomness that complex systems, embodying 'interesting' information, emerge. This has led to alternative measures of complexity and order (Gell-Mann and Lloyd 1998; Lloyd 2001; 2006). Examples, with very informal explanations are: algorithmic information content (related to the length of the shortest algorithm which recreates the state; ordered systems need only short algorithms); logical depth (related to the running time of the simplest algorithm which recreates the state); and thermodynamic depth (related to the number of possible ways that a system may arrive at its present state; 'deep' systems are hard to create). These offer the promise of quantifying physical information in ways which, by contrast with the Shannon formalism, account for emergent properties, and lead to 'interesting' informational structures of potential relevance to biological and social domains, as well as providing powerful tools for explaining the physical world; for popular accounts see Gell-Mann (1995) and Barrow (2007).

At about the same time, in the 1940s, as the groundwork for an information perspective on the physical sciences was being developed, the same was happening in biology, and it is to that domain we now turn.

6.2.3 Information Biology

In biology, the discovery of the genetic code and the statement of the so-called 'central dogma' of molecular biology – that information flows from DNA to proteins – have led to the ideas that information is a fundamental biological property, and that the ability to process information may be a characteristic of living things as fundamental as, or more fundamental than, metabolism, reproduction, and other signifiers of life. Dartnell (2007) describes this as the Darwinian definition: life as information transmission. For this reason, it is sometimes stated that biology is now an information science; see, for example, Baltimore (2002), Maynard Smith (2010), and Terzis and Arp (2011).

Concepts of information in the biology domain are varied, and we make no attempt to summarise a complex area. Information may manifest in many contexts: the transmission of genetic information through the DNA code, the transmission of neural information, and the many and varied forms of communication and signalling between living things are just three examples. One vexed, and undecided, question is at what stage 'meaning' can be said to appear; some authors argue that it is sensible to speak of the meaning of a segment of DNA, while others allege that meaning is an accompaniment of consciousness. And there are those who suggest that consciousness itself is explicable in information terms; see, for instance, Tononi's (2008) ideas of consciousness as integrated information.

The analysis of living systems in information terms has been typically associated with a reductionist approach, with enthusiastic adoption of Shannon's 'meaning-free' formulae to assess the information content of living things; see, for example Gatlin (1972). An idea similar to Wiener's conception of information as an opposite of entropy had been proposed at an early stage by the German physicist Erwin Schrödinger (1944), one of the pioneers of quantum mechanics, who had suggested that living organisms fed upon such negative entropy. Later, the idea of information as the opposite of entropy was popularised, under the name of 'negentropy', by Brillouin (1962), and was adopted by researchers in several areas of biology, including ecology; for examples, see Patten (1961), Kier (1980), and Jaffe (1984).

However, such approaches, with their generally reductionist overtones, have not been particularly fruitful, leading some biologists to favour an approach focusing more on the emergence of complexity and, in various senses, meaning; see, for example, Hazen, Griffin, Carothers and Szostak (2007). Several authors have considered the ways in which information may both influence and be influenced by evolutionary processes relating this to the evolution of exosomatic meaningful information in the human realm; see, for example, Goonatilake (1994), Madden (2004), Auletta (2011), and Reading (2011).

Meaningful information, though not yet accepted as a central concept in biology, is certainly so in the realm of human, social, communicable information, to which we now turn.

6.2.4 Social Information

The social, or human, conception of information is, of course, prominent in library/information science. As such, it is likely to be most familiar to this book's readers, and, accordingly, this section is relatively short. But information is also a significant concept in other human-centred disciplines, including psychology, semiotics, communication studies, and sociology. While the exact conceptions, and to a degree the terminology differ, all take a subjective and context-dependent view of information; one which is associated with knowledge and meaning. Information is regarded as something which is always and inevitably associated with human beings being informed about, and therefore knowing, something, and that information having a meaning to them. There are, of course, a variety of ways in which human-centred information may be conceptualised; some of these are discussed later in this chapter.

There have been attempts to bridge the gap between this conception of information and the scientific and technical perspective. A variety of means have been adopted to try to extend the kind of information theory pioneered by Shannon and by Wiener to deal with meaningful semantic information, and to develop mathematical models for information flow: see Dretske (1981) and Barwise and Seligman (1997) as examples, and see Cornelius (2002) and Floridi (2011a) for reviews. Some authors, such as Qvortrup (1993), have argued that the information theory formalisms in themselves are not as objective, external, and impersonal as suggested, but this view has not been generally accepted.

The ‘negentropy’ concept has been applied, some would argue unwisely, to such areas as economics, sociology, psychology, and theology. Müller (2007: 73), a scientist in the field of chemical thermodynamics, warns against “a lack of intellectual thoroughness in such extrapolations. Each one ought to be examined properly for mere shallow analogies”. The same is surely true for applications in the library/information sciences.

Finally, in this brief survey of information concepts in different domains, we consider philosophy. Although the sub-discipline of epistemology has studied the nature of knowledge for many centuries, information *per se* has not until recently been of major concern to philosophers.

6.2.5 Philosophy of Information

Before Luciano Floridi proposed his ‘philosophy of information’ in the late 1990s (as he recounts in Floridi 2010b), relatively few philosophers took any interest in information, at least in a way likely to be of value for library/information science; see Furner (2010) for an insightful overview. Knowledge, of course, is another matter; that has been studied for many centuries, as the subject matter of *epistemology*. The usual view in that context is that knowledge is to be understood as ‘justified, true belief’; that is to say, for something to count as knowledge, it must be believed by someone, for rational reasons, and it must be true. Information fits into epistemology in the form of *testimony*. This is a kind of evidence in which philosophers are becoming increasingly interested; see, for example, Audi (1997) and Adler (2010).

Apart from this, there have been a number of developments in philosophical thought which provide ways of viewing the relations between information and knowledge which offer different insights to the Popperian Three Worlds ‘objective knowledge’ model and the data-information-knowledge hierarchy, both of which were mentioned in Sect. 6.1, above. One is the work of philosophers such as

Dretske (1981), who have attempted to extend Shannon theory into the area of semantic information. Another, and certainly the most ambitious to date, is that within Floridi's 'philosophy of information', which will be discussed in detail later. We may also mention three other interesting ideas: David Deutsch's (2011) concept of 'explanatory knowledge', which comprises our best rational explanations for the way the world is, with the understanding that such knowledge is inevitably fallible and imperfect, and our task is to improve it, not to justify it; Jonathan Kvanvig's (2003) idea of knowledge as 'understanding', which allows for contradictions and inconsistencies; and Michael Polanyi's (1962) ideas of 'personal knowledge' (somewhat similar to Popper's World 2), which have been further developed within the context of library/information science; see, for example, Day (2005).

This concludes our cursory examination of information in different domains, and we now move to look specifically at the gaps between them.

6.3 Identifying the Gaps

We have noted the various ways in which the information concept can be used in five domains, and some of the attempts made to transfer concepts and formalisms between domains. We could add others, not least library/information science, but five is more than sufficient.

In principle, we could seek to describe the gap between the information concepts between each pair of domains, but a simpler and more sensible alternative is to hand. Consideration of the ways in which information is understood in the various domains leads us to two alternatives, both of which have been espoused in the literature.

The first is to consider a binary divide between those domains in which information is treated as something objective, quantitative, and mainly associated with data, and those in which it is treated as subjective, qualitative, and mainly associated with knowledge, meaning, and understanding. The former include physics and technology; the latter include the social realm. The biological treatment of information is ambiguous, lying somewhere between the two, though tending to the former the more information-centred the biological approach is, especially in the more reductive areas of genetics, genomics, and bioinformatics. The philosophical treatment depends on the philosopher; as we have seen, different philosophers and schools of philosophy take radically different views of the concept of information.

The second alternative is slightly more complex, and envisages a three-way demarcation, with the biological treatment of information occupying a distinct position between the other two extremes, physical and social.

Whichever of these alternatives is preferred, the basic question is the same: to what extent, if at all, are objective, quantitative, and 'meaning-free' notions of information 'the same as', emergent into, or at least in some way related to, subjective, qualitative, and 'meaningful' notions. This, we suggest, is in essence the same question as Wheeler framed when he asked 'What makes meaning?'.

6.4 Bridging the Gaps

There have been a number of contributions to the literature suggesting, in general terms, that 'gap bridging' may be feasible and desirable, without giving any very definite suggestions as to how this may be done. One of the authors of this chapter has put forward a proposal of this vague nature, suggesting that information in human, biological, and physical realms is related through emergent properties in complex systems (Bawden 2007a, b). In this view, physical information is associated with *pattern*, biological information with *meaning*, and social information with *understanding*.

In an influential paper from 1991, Buckland (1991) distinguished three uses of the term 'information':

- Information-as-thing, where the information is associated with a document;
- Information-as-process, where the information is that which changes a person's knowledge state;
- Information-as-knowledge, where the information is equated with the knowledge which it imparts.

From the information-as-thing viewpoint, information is regarded as physical and objective, or at least as being 'contained within' physical documents and essentially equivalent to them. The other two meanings treat information as abstract and intangible. Buckland gives arguments in favour of the information-as-thing approach, as being very directly relevant to information science, since it deals primarily with information in the form of documents. Information-as-process underlies theories of information behaviour which have a focus on the experience of individuals, such as those of Dervin and Kuhlthau (Bawden and Robinson 2012). Information-as-knowledge invokes the idea, well-trodden in the library/information area, as noted above, that information and knowledge are closely related. The exact relation, however, is not an obvious one. How is knowledge to be understood here? As a 'refined', summarised, and evaluated form of information?; as a structured and contextualised form of information?; or information embedded within an individual's knowledge structure? These, and other, ideas all have their supporters.

We will now look at three approaches to this kind of gap bridging which offer more concrete proposals: those of Tom Stonier, Marcia Bates, and Luciano Floridi.

Stonier, in a series of three books, advanced a model of information as an abstract force promoting organisation in systems of all kinds: physical, biological, mental, and social, including recorded information (Stonier 1990, 1992, 1997). This is a model envisaging the bridging of two distinct gaps, in the terms discussed above. Stonier regards information, in its most fundamental form, as a physical entity analogous to energy; whereas energy, in his view, is defined as the capacity to perform work, information is the capacity to organise a system, or to maintain it in a state of organisation. He regards a high-information state as one that is organised and of low physical entropy. This, he points out is the opposite of Shannon's relation between information and entropy, which Stonier regards as an unfortunate metaphor. He links this concept of information to biological and human information, or as he prefers intelligence, and to meaning, through an evolutionary process. Salthe (2011) presents a somewhat similar viewpoint linking thermodynamic entropy and Shannon information through to meaning and semiotics.

Bates (2005, 2006) has advanced a similar all-encompassing model, which she characterises as ‘evolutionary’. It relies on identifying and interrelating a number of ‘information-like’ entities:

- Information 1 – the pattern of organization of matter and energy
- Information 2 – some pattern of organization of matter and energy given meaning by a living being
- Data 1 – that portion of the entire information environment available to a sensing organism that is taken in, or processed, by that organism
- Data 2 – information selected or generated by human beings for social purposes
- Knowledge – information given meaning and integrated with other contents of understanding

This model, while all-encompassing and one of the more ambitious attempts at integrating information in all its contexts, remains at a conceptual and qualitative level, and introduces a potentially confusing multiplicity of forms of information and similar entities. In particular, the distinction between Information 1 and Information 2, without any clear indication of their relation, seems to perpetuate a gap, rather than bridge one. Bates describes her approach as evolutionary, and relates it to the approaches of Goonatilake (1991) and Madden (2004), mentioned earlier, though these latter start with information in the biological realm, rather than the (arguably more basic) physical world. She argues that the different forms of information are emergent, as animals – not just humans – can recognise patterns of physical information in their environment. Animals can assign meaning to such recognition, though not in a conscious act of labelling; this is reserved for the human realm. In contrast to Stonier, she argues that information *is* the order in the system, rather than its capacity to *create* order (both of which, we may remind ourselves, are the opposite of the Shannon conception). For Bates, knowing the degree of order of a system tells us how much information it contains; for Stonier, knowing how much information is in it tells us how it may be ordered.

Floridi (2010a, 2011b) has presented a General Definition of Information (GDI) as part of his Philosophy of Information, analysing the ways in which information may be understood, and opting to regard it from the semantic viewpoint, as “well-formed, meaningful and truthful data”. Data is understood here as simply a lack of uniformity; a noticeable difference or distinction in something. To count as information, individual data elements must be compiled into a collection which must be well-formed (put together correctly according to relevant syntax), meaningful (complying with relevant semantics), and truthful; the latter requires a detailed analysis of the nature of true information, as distinct from misinformation, pseudo-information and false information. Although Floridi takes account of Shannon’s formalism in the development of his conception of information, and argues that it "provides the necessary ground to understand other kinds of information" (Floridi 2010a, 78), he moves beyond it in discussing human, semantic information. His analysis also includes biological information in detail; noting that it is complex and multifaceted, he treats, for example, genetic and neural information separately. Meaningful information and knowledge are part of the same conceptual family. Information is converted to knowledge by being inter-related, a process that may be expressed through network theory. Informally, "what [knowledge] enjoys and [information] lacks … is the web of mutual relations that allow one part of it to account for another. Shatter that, and you are left with a pile of truths or a random list of bits of information that cannot help to make sense of the reality that they seek to address" (Floridi 2011b, 288). Furthermore, information that is meaningful must also be relevant in order to qualify as knowledge, and this aspect may be formally modelled, as also the distinction between 'knowing', 'believing', and 'being informed'.

This is therefore a formalism – the only one of its kind thus far – which begins with a treatment of information in Shannon's objective sense, and goes on, apparently seamlessly, to include subjectivity, meaning, and relevance. It provides a formal framework for understanding a variety of forms of information, and, while in itself an exercise in philosophical analysis, it may serve as a basis for other forms of consideration of information in various domains. It also, happily, includes and systematises library/information science's pragmatic approaches to the information-knowledge relation, discussed earlier.

While undoubtedly valuable as a framework for understanding, Floridi's conceptualisation does not of itself answer our basic question: which, if any, conceptions, and laws and principles, of information in one domain can be meaningfully applied in another? We will go on to consider this, but first we must ask: why bother?

6.5 Why Attempt to Bridge the Gaps?

The question then inevitably arises as to whether these various ideas of information have any relevance for the library/information sciences, whether it just happens that the English word 'information' is used to mean quite different things in different contexts, or whether any connections which there may be are so vague and limited as to be of little interest or value.

We believe that this is a question well worth investigating, and not just for the sake of having a neat and all-encompassing framework. If the gaps between different understandings of information can be bridged in some way, then there is a possibility for helpful interactions and synergies between the different conceptualisations. In particular, if it is correct that the principles of physics and of biology can be, to a significant extent, cast in information terms, then there should be the possibility, at the least, for analogies helpful to human-centred disciplines, including library/information science to be identified. This need not be in any sense a reductionist enterprise, attempting to 'explain away' social and human factors in physical and biological terms. Nor need it be just one way. If it is true, as some authors suggest, that there are some general principles, involving information, complexity, meaning, and similar entities and concepts, which operate very widely, beyond the scope of individual disciplines, then it is not beyond the bounds of possibility that insights from the library/information sciences could 'feed back' to inform physical and biological conceptions. No such examples have yet been reported, though one might envisages them coming from areas such as infometrics, information behaviour, and information organisation. This kind of feedback is, of course, in the opposite direction to the common reductive approach, by which physics informs chemistry, which informs biology, which in turn informs the social sciences. If it ever proved fruitful, it would have the potential to change the standing of the library/information sciences within the academic spectrum, giving it a place as a more fundamental discipline.

Let us, at the risk of seriously annoying those readers who will think this approach too naïve to be worth dignifying in print, give some examples of physical laws which could have 'information analogies'; for a popular account of these laws, see Pickover (2008).

To begin with perhaps the simplest possible example, Ohm's law states that the strength of an electric current, I, is proportional to the applied voltage, V, and inversely proportional to the resistance, R, of the material carrying the current; in appropriate units, $I = V/R$. We can easily envisage an information analogy, with information flow equating to current, the strength of the need for information equating to voltage, and a measure of difficulty of obtaining the necessary information equating to resistance. So, if we consider the situation of a doctor treating a seriously ill patient, and needing to know the appropriate drug treatment, we have a high value of V. If the doctor has in their pocket a mobile device giving immediate access to well-structured drug information, then we might say that R was low.

Too simple? How about Poiseille's Law, which governs the rate of flow, Q, of a fluid with viscosity μ through a pipe of length L and internal radius r, when there is a pressure difference P. The formula, assuming that the flow is smooth, without any turbulence, and that the density of the fluid never changes, is $Q = \pi r^4 \Delta P/8\ \mu L$. Again, we may amuse ourselves looking for information equivalents: the length of the pipe equates to the number of steps in a communication chain; its internal radius equates the amount of information which can be transferred; the viscosity equates to the difficulty in understanding the information; and so on. This is not such an odd idea: Qvortrup (1993) reminds us that Shannon's theories are firmly based on the metaphor of information as water flowing through a pipe.

Another example is the use of the various scientific diffusion laws, which offer clear analogies with information dissemination. Avramescu (1980) gave an early example of this, using laws for the diffusion of heat in solids, equating temperature to the extent of interest in the information; Liu and Rousseau (2012) review this and other examples. Le Coadic (1987) mentions this, and similar attempts to use diffusion and transfer models drawn for both the physical and biological sciences, while cautioning against the uncritical use of such analogies. However, provided they are treated with due caution, such analogies with physical laws, even if it be accepted that there is no underlying common ‘meta-law’, may be of value as aids to teaching and learning, and to the early stages of the planning of research.

We must also mention quantum mechanics, the most fundamental scientific advance of the last century, of which both the mathematical formalism (directly) and concepts (by analogy) have been applied in a library/information science context; see, for example, Piwowarski et al. (2010, 2012) and Budd (2013).

It may be objected that this is too simplistic an approach. Physical laws are physical laws, and are too specific to their context to be adapted for human information, and do not take account of its dynamic nature, nor of the ability of humans to be more than passive recipients.

What, then, about a more general principle? In the physical sciences, the principle of least action occupies a central place, as does Zipf’s principle of least effort in the social, including library/information, sciences. Is it unreasonable to ask if there may be a reason for this, which would involve some common aspects of information in the two realms?

Or perhaps we should look rather at statistical regularities, whether these be called laws or not, and consider whether there may be some underlying reasons, if similar regularities are found in different realms. One example may be the fractal, or self-similar, nature of many physical systems, which, it is hypothesised, may also be found in technical and social information; see, for example, Ottaviani (1994) and Berners-Lee and Kagal (2008). Similarly the power law relationships underlying the main bibliometric laws (Egghe 2005) have their equivalents in power laws in the physical and biological sciences.

The important question is not which of these ideas or approaches is ‘right’. It is simply whether it is rational and appropriate to look at ideas of information in different domains, seeking for causal links, emergent properties, analogies, or perhaps just helpful metaphors. It is by no means certain that this is so. We have seen that some scientists, such as Müller, object to the use of information concepts in thermodynamics. And, conversely, many in the library/information sciences are concerned about the application of the term ‘information’ to objective, meaningless patterns. Le Coadic (1987), Cole (1994), Hjørland (2007, 2008), and Ma (2012), for example, argue in various ways against any equating of the idea of information as an objective and measurable ‘thing’ to the kind of information of interest in library and information science; this kind of information, such commentators argue, is subjective in nature, having meaning for a person in a particular context, and cannot be reduced to a single objective, still less quantifiable, definition. However, this perhaps overlooks some recent trends in the physical and biological sciences themselves: not merely the increased focus on information noted above, but a tendency towards conceptualisations involving non-linearity, systems thinking, complexity, and reflexivity. All these tend to make current scientific thinking a more amenable source of analogy for the library/information sciences, than heretofore.

It may also be objected that the physical, and to a degree the biological, sciences are necessarily mathematical in nature, whereas the library/information sciences are largely qualitative. While qualitative analysis is certainly necessary, and indeed arguably the best way of achieving understanding in this field (Bawden 2012), this is no reason not to seek for mathematical formalisms to increase and deepen such understanding. Over 30 years ago, Brookes (1980) argued that information science needed a different kind of mathematics; perhaps the library/information sciences still do.

Our view is that the questions are so intriguing that it is worth the attempt to bridge these gaps. And we believe that the valuable insights already gained from the kinds of approaches discussed above justifies this position. Wheeler's Big Questions have not been answered yet, and it may be that studies of the relation between information as understood in the library/information sciences and as understood in other domains, may contribute to their solution.

6.6 Conclusions

We are faced with two kinds of gaps: the gaps between the concepts of information in different domains; and the gap between those who believe that it is worth trying to bridge such gaps and those who believe that such attempts are, for the most part at least, doomed to fail.

The authors of this chapter consider themselves in the first group. But we wish to be realistic about what can be attempted: as Jonathan Furner (2010, 174) puts it, "the outlook for those who would hold out for a 'one size fits all' transdisciplinary definition of information is not promising". We should not look for, nor expect to find, direct and simplistic equivalences; rather we can hope to uncover more subtle linkages, perhaps to be found through the use of concepts such as complexity and emergence.

We would also do well to note Bates' (2005) reminder that there are swings of fashion in this area, as in many other academic areas. The recent favouring of subjective and qualitative conceptions of information is perhaps a reaction to the strong objectivity of information science in preceding decades, which was itself a reaction to the perceived limitations of traditional subjectivist methods of library/information science (Bates 2005). Perhaps the time has come for something of a swing back, to allow a merging of views, and a place for different viewpoints in a holistic framework. A bridging of gaps, in fact. A number of authors have advocated this, though so far it has not happened.

At a time when other disciplines, particularly in the physical and biological sciences, are embracing information as a vital concept, it seems unwise for the library/information sciences to ignore potentially valuable insights, though we certainly wish to avoid the shallow analogies mentioned above.

Mind the gaps, certainly, but be aware of the insights that may be found within them.

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Chapter 7
Information Without Information Studies

Jonathan Furner

7.1 Introduction

Several options suggest themselves as approaches to answering questions like "What is information?"

- We could do some *empirical science*. We could find some information, observe it, determine what it's made out of, how it comes into existence and what effects it has, measure its quantifiable properties and its distribution across space–time, and report on our findings.
- We could do some *history*, maybe mixed with a little *sociology*. We could study the development, over time and across cultures and disciplines, of the use of the term "information," and explain how different conceptions reached different levels of prominence in different contexts.
- We could do some *conceptual analysis*. We could identify the conditions that must be met if we are to accept any given candidate as an instance of the category that we label "information" in ordinary language (or in whatever technical language our community uses). In other words, we could clarify the meaning that the term "information" has for us.
- We could do some *ontology*—"proper" ontology, in the terminology of Jonathan Lowe (2011). We could start by asking, not what information *is*, but what information *could* be. Proper ontology in this sense is not a matter of analyzing concepts, but a matter of "envisag[ing], in a very general way, what sorts of things there *could be* in the world, at its most fundamental level of organization or structure, and then ... develop[ing] arguments for or against the existence of things of this or that general sort" (Lowe 2011: 104).

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If we turn to the literature (without limiting ourselves to any particular discipline), we find that the post-1950 discourse on the nature of information is replete with examples of at least the first three of these approaches. We also find that individual contributions have had purposes of several distinct kinds:

A. to present, and/or to advocate for, a *single* conception of information that was first formulated elsewhere;
B. to review, and/or to classify, a *range* of existing conceptions of information; and
C. to present, and/or to advocate for, a *new* conception of information.

These three categories of purpose suggest a second way of classifying individual contributions. Each of these categories may be further subdivided into those contributions that present at least one *general*, discipline-independent conception capable of universal application, and those that present at least one *special*, discipline-dependent conception intended for application in a context with specifiable boundaries. Contributions in category B—i.e., reviews—may be evaluated against criteria that include exhaustiveness (over conceptions, and across disciplines), validity (of the authors' choice of the dimensions on which conceptions are classified), and utility (of the results of the review).

A third way to classify contributions would be to distinguish the *disciplinary* affiliation(s) of their author(s): Some scholars self-identify with fields (such as "information science," "library and information science" [LIS], and "information studies") whose roots lie in earlier explorations of bibliography, librarianship, and documentation; others approach the study of information from the perspectives of scientific and technical disciplines such as computer science, physics, and biology; others still are embedded in various other social sciences and humanities.

With this chapter, it is not my intention to provide a contribution in any of the three categories of purpose (A, B, or C) identified above. Instead, I would like to suggest (by example) a way of conducting a meta-analysis of contributions, with the following goals:

- to introduce a fourth way of classifying contributions to the literature on the nature of information—one that involves identification of authors' ontological commitments;
- to propose a framework for defining the range of ontological possibilities for things that have been called "information";
- to examine the ontological commitments of some of those whose work may be less familiar to an LIS audience; and
- along the way, to clear up some residual confusion about the nature of the relationships among different conceptions of information.

In Sect. 7.2 following this introduction, the way in which we might take an ontological approach to the analysis of information concepts is described in a little more detail. In Sect. 7.3, I begin an investigation of "what information could be," by constructing a preliminary list of candidates, classified by ontological category. In Sect. 7.4, I look to probability theory for some additional candidates that have assumed considerable weight outside LIS, and explore the significance of a basic distinction that may be drawn between conceptions of information-as-informativeness, and conceptions of information-as-informative. In Sect. 7.5, I examine the ontological commitments of three authors writing about information from perspectives outside LIS. In Sect. 7.6, I focus on the work of two representatives of a recently-emerging community of scholars that, while dedicated to establishing "the foundations of information science," has not (yet?) formed strong ties to LIS. Lastly, in Sect. 7.7, I tentatively conclude that any approach to conceptualizing information that downplays the contributions of LIS—i.e., information without information studies—is needlessly impoverished, not least on account of the range of ontological possibilities that it misses.

7.2 An Ontological Approach to the Analysis of Information Concepts

Ontology is the branch of metaphysics that is concerned with identifying and understanding the fundamental categories or kinds of things that exist in the world.[1] For any information-related phenomenon, we may ask, What *kind* of thing is it? A *concrete* thing (existing in space–time as a "datable and locatable" object or event that is capable of undergoing change and/or of causing effects), or an *abstract* thing? A *universal* (that is instantiable or exemplifiable), or a *particular*? A *substance* (that is characterizable), or a *property*? An object or an event? A set or an element? One of the tasks of ontology is to identify, characterize, and relate these different categories in a coherent framework. The main structural features of one such framework—Jonathan Lowe's "four-category ontology" (Lowe 2006), whose antecedents may be traced at least as far back as Aristotle—are depicted in Fig. 7.1.[2] Lowe distinguishes *kinds* (substance-types), *objects* (substance-instances), *attributes* (property-types), and *modes* (property-instances). In this scheme, types are universals, and instances are particulars; and the only entities that are concrete are some objects.

Different thinkers have different views on the existence (i.e., the reality) or otherwise of entities in various categories—in other words, they have different ontological commitments, and may be regarded as realists or anti-realists with respect to the entities in any given category. In the philosophical literature, authors typically make their ontological assumptions well known, especially if those assumptions form the foundations on which are built understandings of the concepts under analysis. In LIS, on the other hand, such views are not frequently made explicit, notwithstanding their equal importance for the development of cohesive and powerful conceptual frameworks. Nevertheless, if we are successfully to specify

[1] See, e.g., Loux (2002) for an authoritative introduction to this field.

[2] Figure 7.1 is adapted from Figure 1.2, The four-category ontology, in Lowe (2006: 18).

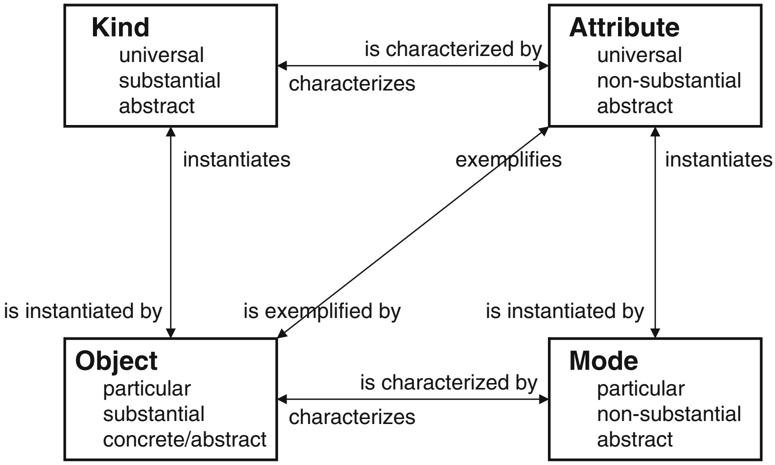

Fig. 7.1 Lowe's four-category ontology

the distinctive nature of various conceptions of information, it is essential that the ontological commitments underlying their authors' theories, arguments, and knowledge-claims be revealed.

Lowe has argued that "proper" ontology involves *a priori* reflection and argument about the *possibility* of sorts of things, as "an indispensable prerequisite for the acquisition of any empirical knowledge of actuality" (Lowe 2011: 100). Were we to proceed with an inquiry into the nature of information along these lines, one specific strategy would be to begin with one of the existing frameworks that purport to catalog the various fundamental sorts of things that there are, to exhaust the various possibilities by which information may be related to each of the existing categories, and to consider whatever additional possibilities there might be for revising the framework in the light of information's distinctiveness. Lowe's (2006) own framework (as partially depicted in Fig. 7.1) gives us the motivation to consider the possibilities of information-as-*kind*, information-as-*object*, information-as-*attribute*, and information-as-*mode*. How far might that project get us? To find out, let's start at the beginning.

7.3 What Information Could Be

You flip a coin. It comes up Heads. You write down "It came up Heads" as a note to yourself; but (for reasons unknown) you tell me "It came up Tails." In this scenario, where, precisely, is there information?

If being true (i.e., correspondent with reality; accurately representative of the facts) is a necessary condition of being information, then whatever it is I get out of this exchange, it isn't information. If being productive of a change in a recipient's state of knowledge is a necessary condition of being information, then (according to most definitions of knowledge, which include truthfulness as a necessary condition thereof) I'm not receiving information in this case, either. Maybe a change in a recipient's state of belief is what we should be looking for? Any exploration of that route will lead us to one of the versions of what has often been called a "subjectivist" concept of information, whereby whether something counts as information or not depends on the nature of the effects it has on the observer. Alternatively, we might decide that we need to pay closer attention to your intentions. Maybe the necessary condition we seek is the motivation of the sender to represent reality, to express themselves, to influence people, to get things done with words, to communicate ... Is information the "content"—i.e., the meanings—of speech acts, and that's that?

But to stop there would be to have opened only one or two compartments of an expansive toolbox. Information as what generates changes in human knowledge/belief states; information as what is produced by human acts of representation; information as signal, as sign, as evidence; information as difference; information as everything—the list of distinct conceptions is long, and may be organized in many more-or-less helpful ways, several of which are well-known in LIS. Furner (2010, 174–175), for example, provides a conceptual framework that differentiates between (i) a *semiotic* family in which distinctions are drawn among real-world situations, mental representations of those situations, and linguistic expressions of those representations; (ii) a *socio-cognitive family* in which the emphasis is on action and process, and especially processes by which people become informed or inform others; and (iii) an *epistemic* family in which conceptions are developed with the aim of providing an account of the properties that an information resource must have if the beliefs that are generated upon interpreting the content of that resource are seen to be justified. The origins of these conceptions may be traced to various cognate disciplines, including cognitive psychology, linguistics, philosophy of language, semiotics, computer science, physics, and biology, and it is these communities to which authors typically look when they embark on analyses of the nature of information.

An undoubtedly incomplete list of the phenomena that are involved in the coin-flip scenario, categorized according to Lowe's ontology, is presented in Table 7.1. In order to make progress with our exploration of the range of ontological possibilities, we might consider each of the entries in the list as a candidate for satisfying the conditions for informationhood.

One of the obvious ways in which, as it stands, this list is far from complete is in its omission of a number of categories of property-instances that have great significance within conceptions of information derived from probability theory. Despite their widespread acceptance in applications of Shannon's mathematical theory of communication (Shannon 1948) in the natural sciences and in engineering, these conceptions are typically not as sympathetically addressed in the LIS literature, and a quick review might be helpful.

Table 7.1 Information-related phenomena in the coin-flip scenario

Kinds (substance-types)
The concept of a coin-flip; the concept of a coin's coming up Heads; the concept of a coin's being in a state of having come up Heads
The concept of your writing down the outcome of a coin-flip; the concept of your telling me the outcome of a coin-flip
The sentence "It came up Heads" (or "It came up Tails")
The value-type, word-type, or category-label "Heads" (or "Tails")
Objects (substance-instances)
Concrete objects
The event of your flipping the coin; the event of its coming up Heads; the event of its being in a state of having come up Heads; the event of your observing the coin coming up Heads
The event of your deciding to write down "It came up Heads"; the event of your deciding to tell me "It came up Tails"
The event of your writing down "It came up Heads"; the event of your telling me "It came up Tails"; your inscription of the sentence "It came up Heads"; your utterance of the sentence "It came up Tails"; your message to me "It came up Tails"
The event of my receiving the message "It came up Tails"; the event of my interpreting the meaning of the message "It came up Tails"
The piece of paper on which you write down "It came up Heads"
The marks on the paper spelling out "It came up Heads"
The value-token "Heads" (or "Tails")
Your state of knowledge before the coin was flipped; your state of knowledge after it came up Heads; my state of knowledge before you told me the coin came up Tails; my state of knowledge after you told me it came up Tails
The change in your state of knowledge produced by you observing it coming up Heads; the change in my state of knowledge caused by you telling me it came up Tails
Abstract objects
The fact that this coin came up Heads
The fact that you told me that this coin came up Tails
The proposition that this coin came up Heads
The proposition that it came up Tails
The series of related events to which this coin-flip belongs
The series of related events to which your message belongs
The subseries of events of coin-flips coming up Heads
The subseries of events of your telling me that a coin-flip came up Tails
The set of instances of the property of a coin-flip coming up Heads
The set of instances of the property of meaning that a coin-flip came up Tails
The set of properties of a coin-flip
The set of properties of a message about a coin-flip
The set of possible values of a coin-flip
The set of possible values of a message about a coin-flip

(continued)

Table 7.1 (continued)

Attributes (property-types)
The property of (a coin-flip's) coming up Heads;
the state of having come up Heads
The property of (an inscription's or utterance's) meaning that a coin-flip came up Heads (or Tails)
Modes (property-instances)
The instance in this particular case of the property of coming up Heads;
the state of this coin having come up Heads
The instance in this particular case of the property of meaning that this coin came up Heads (or Tails)
The truth-value of the proposition that this coin came up Heads (or Tails)

7.4 Probability-Theoretic Conceptions of Information

Suppose you flip a coin a large number of times, and, after each flip, you record the result—Heads or Tails—and keep a tally of the cumulative frequency of each of the two kinds of outcome. If it is a fair coin, then after a while, you will start to see a simple pattern. The running total in the Heads column will be roughly equal to the one in the Tails column. In fact, the definition of a fair coin is a coin that is equally likely to land Heads or Tails. Over time, as you keep flipping, both tallies will tend towards the same proportion (50 %) of the total number of flips.

Using the terminology of probability theory,[3] we can say that the probability p of random variable X (the flip of a fair coin) having the value x_1 (Heads) is $p(X = x_1) = 0.5$. A variable is a series of events or observations, each of which can take on any of the values specified in a set known as the domain of the variable. With a random variable, the value of any given future event cannot be predicted with certainty: all we can do is give our best estimate of the probability (i.e., the likelihood) that the next event will have one or other of the values in the domain. In the case of the fair coin-flip, the domain has two members (x_1:Heads, x_2:Tails), and the probability distribution—the plot of values of the variable X against the probabilities p with which those values occur—is uniform, in the sense that all the values of p are equal.

The value of $p(X = x_i)$ can be found by calculating the ratio of $f(X = x_i)$, the frequency of events in which variable X has the value x_i, to n, the total frequency of events. Values of p always range from 0 to 1. When $p(X = x_i) = 1$, we are in a position of absolute certainty: there is no doubt that the next event in X will take on the value x_i. Similarly, when $p(X = x_i) = 0$, we can be certain that the next event in X will not take on the value x_i. All values of p between 0 and 1 indicate varying degrees of uncertainty. We might describe the case of the fair coin-flip, with its

[3]See, e.g., Cover and Thomas (1991) for an authoritative presentation of the mathematical material in this section.

uniform probability distribution, as one where the level of uncertainty is maximized: we have no grounds for choosing either of the two options ahead of the other as our prediction for the outcome of the next coin-flip.

Now, suppose you flip another coin a large number of times; you keep a tally of frequency of occurrence of heads and of tails as before; and, this time, instead of a 50:50 split, you see a 60:40 split. This uneven split indicates that the coin you have been flipping is not a fair coin, but a biased one, with $p(X = x_1) = 0.6$ and $p(X = x_2) = 0.4$.

7.4.1 *Informativeness as Surprisal*

The simplest concepts of information to be drawn from probability theory are those that result from (a) defining a measure of improbability (a.k.a. *surprisal*, or unexpectedness) as the reciprocal of p (i.e., $1/p$), (b) equating informativeness with surprisal, and (c) clarifying the nature of the relationship between the property of surprisal and the entity to which it may be attributed. In the case of the fair coin, instead of saying that Heads has a probability of 0.5 (on a scale of 0–1), we could say that Heads has a surprisal of 2 (on a scale of 0 to infinity), given that $1/p(X = x_1) = 2$. The surprisal of Tails is the same. In the case of the biased coin, the surprisal of Heads is 1.67, and that of Tails is 2.50.

It is common for surprisal to be measured in bits,[4] whereby values of improbability are expressed on a logarithmic scale, specifically as binary logarithms (where the binary logarithm of a value n, written as lb n, is the power to which 2 must be raised to obtain n). When $p = 0.5$, the value of $-\mathrm{lb}\, p$ (which is equivalent to $\mathrm{lb}\, 1/p$) is 1. When $p = 0.6$, $-\mathrm{lb}\, p = 0.74$; when $p = 0.4$, $-\mathrm{lb}\, p = 1.32$.

One upshot would then be that (assuming we are already in a position of knowledge about the probability distribution of the values of the variable) we could give "0.74 bits" as an answer to any of these questions: "How improbable is it that the next flip of our second coin will come up Heads?" "If the next flip comes up Heads, how unexpected will that be? How surprising? How informative?" "How much information is provided by a flip of Heads?" In any given situation, the value of our answer to any of these questions will vary in inverse proportion to the probability of occurrence of the value of the variable specified in the question. In the case of the biased coin described above, a flip of Tails is more informative than a flip of Heads because it is more improbable. In the case of a variable whose probability distribution is uniform, our answer will vary in direct proportion to the size of the domain: Any roll of a fair die (where the domain consists of six values, all equally likely) is more improbable, unexpected, surprising, and therefore informative, than any flip of our fair coin.

[4]It should be noted that the use here of "bit" as a unit of measurement is distinct from its other regular use as the name for a type of data.

There are at least four different ways of moving from such an account (of informativeness as surprisal) to an account of information.

1. One way would be to think of information as if it were *the same* property of events as surprisal. On this account, information *is* informativeness. Just as we might talk about the date or location of an event, we might talk about its information. If we were to ask, "What is the information (i.e., the informativeness) of event e_X?"—a question to which the answer would be something like "0.74 bits"—then (on this account) it is the particular surprisal of event e_X that we would be treating as information. In Lowe's terms, it would be a mode.
2. Another group of options emerge from thinking of information as whatever it is that is informative. On this account, information *has* informativeness. If we were to ask, "How informative is event e_X?"—another question to which the answer would be something like "0.74 bits"—then (on this account) there are several candidates for the thing that we would be treating as information, as follows:
   (a) It could be the outcome of event e_X—i.e., either
      (i) the category of the value produced by event e_X, such as x_1: Heads (in Lowe's terms: an attribute); or
      (ii) the particular instance of the value produced by event e_X (in Lowe's terms: a different mode).
   (b) Alternatively, it could be event e_X itself—i.e., the actual flip of the coin (in Lowe's terms: a concrete object).

7.4.2 Mean Informativeness as Entropy

A second cluster of concepts of information to be drawn from probability theory consists of those that result from (a) treating whole *variables* (i.e., series of events), rather than individual events, as the entities that have properties of interest, (b) defining a measure of *mean* improbability (a.k.a. *entropy*, or uncertainty), (c) equating mean informativeness with entropy, and (d) clarifying the nature of the relationship between the property of mean informativeness and the entity to which it may be attributed. We can calculate the entropy $H(X)$ of any random variable X by weighting the improbability (measured in bits) of every distinct outcome of an event by that outcome's probability of occurrence, and summing the weighted values. In other words, $H(X) = -\sum p(X = x_i)\ \mathrm{lb}\ p(X = x_i)$. A fair coin has an entropy of 1 bit; the biased coin in our example has an entropy of 0.97 bits.

We might wonder: What does it really mean to say that the entropy of a fair coin is greater than the entropy of a biased coin? Entropy is maximized when all the probabilities of occurrence of the possible outcomes of an event are equal: i.e., when the probability distribution is uniform. So entropy is an indicator of the extent to which those probabilities tend towards uniformity, evenness, or equality. The more unequal the probabilities, the closer the value of $H(X)$ to 0. Entropy reaches this minimal value when one of the possible outcomes has a probability of 1 (and every one of the other outcomes has a probability of 0). Consequently, entropy is often characterized as a measure of uncertainty: the more equal the probabilities of possible outcomes, the more uncertain any prediction of the outcome of the next event. The fact that the entropy of our biased coin is slightly less than the entropy of the fair coin reflects the slightly lower level of uncertainty (i.e., the slightly higher level of certainty or confidence) we would have in any prediction we might make of the outcome of the next event.

Again, there are at least four different ways of moving from such an account (of mean informativeness as entropy) to an account of information.

1. One way would be to think of information as if it were *the same* property of variables as entropy. On this account, information *is* mean informativeness. Just as we might talk about the frequency or range of a variable, we might talk about its information. If we were to ask, "What is the information (i.e., the mean informativeness) of variable *X*?"—a question to which the answer would be something like "0.97 bits"—then (on this account) it is the particular entropy of variable *X* that we would be treating as information. In Lowe's terms, it would be a mode.
2. Another group of options emerge from thinking of information as whatever it is that is informative. On this account, information *has* mean informativeness. If we were to ask, "How informative is variable *X*?"—another question to which the answer would be something like "0.97 bits"—then (on this account) there are several candidates for the thing that we would be treating as information, as follows.
   (a) It could be the set of outcomes produced by the events comprising variable *X*—i.e., either
      (i) the set of categories of the values produced by the events comprising variable *X* (in Lowe's terms: an abstract object); or
      (ii) the set of particular instances of the values produced by the events comprising variable *X* (in Lowe's terms: a different abstract object).
   (b) Alternatively, it could be variable *X* itself—i.e., the actual series of coin flips (in Lowe's terms: yet a different abstract object).

7.4.3 Mean Informativeness as Conditional Entropy

Suppose we now introduce a new element to the coin-flipping scenario. This time, instead of repeatedly flipping just one coin, we take two different coins. We flip one, record the outcome (Heads or Tails), then flip the other, and record the outcome (Heads or Tails). We do this dual-flip operation a large number of times, and end up with a tally indicating that each of the four possible combinations (Heads, Heads; Heads, Tails; Tails, Heads; and Tails, Tails) occurs on 25 % of occasions. We can say that the joint probability of the co-occurrence of the values x_1 (Heads of the first coin) and y_1 (Heads of the second coin) is $p(X = x_1, Y = y_1) = 0.25$. This result gives us good reason to believe that we have two fair coins. The joint probability distribution—the plot of the four pairs of x_i, y_i values against the probabilities p with which those values occur—is uniform.

Of course, we could do the dual-flip experiment with our two original coins, the fair one and the biased one, instead of two fair ones. In that case, the joint probability distribution is no longer uniform: the probability of two Heads, for instance, is 0.3, while the probability of one Head then one Tail is 0.2.

Armed with the probabilities of the four outcomes in either case, we can calculate a value in bits for the improbability of each outcome, i.e., –lb $p\big(X = x_i, Y = y_j\big)$; and we can calculate a value for the entropy of the joint distribution, i.e., $H(X, Y) = -\sum\sum p\big(X = x_i, Y = y_j\big)$ lb $p\big(X = x_i, Y = y_j\big)$. In the case of the two fair coins, $H(X, Y) = 2$; in the case of the one fair and one biased coin, $H(X, Y) = 1.97$. As in the earlier examples with the single coins, we may consider these values of entropy as indicators of the uniformity of the probabilities of occurrence of the possible outcomes of the events in question (i.e., pairs of coin-flips), or as measures of the uncertainty of any predictions of the outcome of the next pair of flips. The fact that the joint entropy in the fair–biased case is slightly less than the entropy in the fair–fair case reflects the slightly lower level of such uniformity and uncertainty.

So far, we have been considering variables that are independent of each other. We have been assuming that the outcome of the second in each pair of coin-flips is completely uninfluenced by the outcome of the first. The next case we might consider is one where we have no reason to make such an assumption—e.g., a case in which the second variable is not a second series of coin-flips, but a reporter of the outcomes of the first series of coin-flips. Suppose we have a fair coin and a wholly reliable reporter, who always reports every outcome correctly, 100 % of the time. In other words, the conditional probability $p(Y = y_j|X = x_i)$—i.e., the probability that $Y = y_j$ given that $X = x_i$—is 1 when $y_j = x_i$, and 0 otherwise. While the probability distribution of values of Y in this case is exactly the same as that of values of Y in the case of the two fair coins, the joint distribution is quite different. For example, in the present case, $p(X = x_1, Y = y_1) = 0.5$ and $p(X = x_1, Y = y_2) = 0$. Moreover, we find that $H(X, Y) = 1$, a lower value than that found either in the fair–fair case or in the fair–biased case, indicating less uniformity in the probability distribution, and less uncertainty in any prediction that might be made of the outcome of the next flip–report pair.

Finally, suppose we have a fair coin and an unreliable reporter, who does not always report every outcome correctly. Let's say that the relevant conditional probabilities are as follows: on 90 % of the occasions when the flip is Heads, the reporter says it was Heads; on 80 % of the occasions when the flip is Tails, the reporter says it was Tails. Here we find that $H(X, Y) = 1.60$, somewhat higher than in the previous fair–reliable case, but still lower than in the fair–fair or fair–biased cases.

It is possible to interpret values of *joint* entropy as measurements of informativeness in just the same way in which values of entropy are interpretable in the cases that each involve a single variable. But it is important to appreciate that our attention would thereby be on the distribution of probabilities of *pairs* of outcomes. Values of joint entropy tell us nothing, for example, about the level of uncertainty we would have about the outcome of a report given the outcome of the corresponding flip (or about the outcome of a flip given the outcome of the corresponding report). To measure that kind of uncertainty, we can turn instead to calculating values of *conditional* entropy—either $H(Y|X)$ in the case where the outcome of the flip is known, or $H(X|Y)$ in the case where the outcome of the report is known. For example: A value for the conditional entropy of the report, given knowledge of the flip, would be calculated by weighting the conditional improbability $\left(-\text{lb}\ p\left(Y = y_j | X = x_i\right)\right)$ of every distinct flip–report outcome-pair by that outcome-pair's probability of occurrence $\left(p\left(X = x_i, Y = y_j\right)\right)$, and summing the weighted values. In other words, $H(Y|X) = -\sum\sum p\left(X = x_i, Y = y_j\right)\ \text{lb}\ \left(p\left(Y = y_j|X = x_i\right)\right)$.

In the fair–fair case, the value of $H(Y|X)$ is 1 bit, reflecting the uniformity of the distribution of conditional probabilities; in our fair–biased case, it is slightly lower (0.97 bits), reflecting the slight reduction in uniformity. In the fair–reliable case, in contrast, it is zero, reflecting the situation of minimum uncertainty; while in our fair–unreliable case, it is back up to 0.60 bits.

7.4.4 Mean Informativeness as Mutual Information

What implications does this demonstration of a method of characterizing the uniformity of a joint or conditional probability distribution have for conceptions of information? Well, just as in the case of the single coin-flip, we might choose to equate mean informativeness with conditional entropy, and move from there to a clear specification of information either (a) as something that *is* informativeness, or (b) as something that *has* informativeness. In the case of a pair of variables, however, there is yet a further possibility, which is to equate informativeness with a quantity that has indeed generally come to be known as *mutual information*. Mutual information is given by the formula $I\,(X;Y) = \sum\sum p\left(X = x_i, Y = y_j\right)\ \text{lb}\ \left(p\left(X = x_i, Y = y_j\right) / \left(p(X = x_i)\, p\left(Y = y_j\right)\right)\right)$, and can be interpreted as a measure of the extent to which each variable is dependent on the other, of the extent to which knowledge of the values of one reduces uncertainty in predictions of the values of the other, and of the extent to which each variable tells us about the other. The relationships among entropy, joint entropy, conditional entropy, and mutual information—including the fact that $I\,(X;Y) = H(X) + H(Y) - H(X,Y)$—are indicated diagrammatically in Fig. 7.2.

In both the fair–fair and the fair–biased case, $I(X;Y) = 0$, since the two variables are independent, and knowledge of the value of one is of no help in predicting the value of the other. But in the fair–unreliable case, $I(X;Y) = 0.40$, and in the fair–reliable case, $I(X;Y) = 1.00$, indicating successively greater degrees of dependence, and greater amounts of reduction in our uncertainty when we base our predictions of values of one on knowledge of values of the other. Indeed, in the fair–reliable case, mutual information is maximized, as uncertainty (expressed in the form of

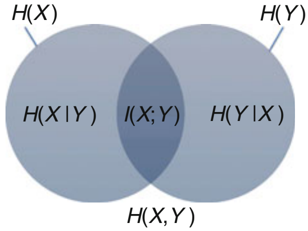

Fig. 7.2 $I(X;Y) = H(X) + H(Y) - H(X, Y)$

Table 7.2 Conceptions of informativeness

Conception of informativeness	Formula
Surprisal	$-\text{lb}\ p(X = x_i)$
Entropy, $H(X)$	$-\sum p(X = x_i)\ \text{lb}\ p(X = x_i)$
Conditional entropy, $H(X\|Y)$ or $H(Y\|X)$	$-\sum\sum p(X = x_i, Y = y_j)\ \text{lb}\ \left(p(X = x_i \| Y = y_j)\right)$ or $-\sum\sum p(X = x_i, Y = y_j)\ \text{lb}\ \left(p(Y = y_j \| X = x_i)\right)$
Mutual information, $I(X;Y)$	$\sum\sum p(X = x_i, Y = y_j)\ \text{lb}\ \left(p(X = x_i, Y = y_j)/\left(p(X = x_i)\, p(Y = y_j)\right)\right)$

values of conditional entropy, $H(X|Y)$ and $H(Y|X)$) is reduced to zero. The inverse relationship between entropy (as a measure of uncertainty) and mutual information (as a measure of reduction in uncertainty) is reflected in the "difference in sign" in the formulae of each—negative in the former, and positive in the latter.

A third cluster of concepts of information to be drawn from probability theory, then, consists of those that result from (a) treating *pairs* of variables, rather than single variables, as the entities that have properties of interest, (b) defining a measure either of mean conditional improbability (a.k.a. *conditional entropy*) or co-dependency (a.k.a. *mutual information*), (c) equating mean informativeness with either of those measures, and (d) clarifying the nature of the relationship between the property of mean informativeness and the entity to which it may be attributed.

7.4.5 Informativeness and Information

We now have four distinct conceptions of informativeness, summarized in Table 7.2.

Using *surprisal*, we can measure the unexpectedness of the value of a given event. If we chose to equate informativeness with surprisal, we would be proposing that the more unexpected a value, the more informative it is. Using *entropy*, we can measure the uniformity of the distribution of probabilities of occurrence of the possible outcomes of a given variable. If we chose to equate mean informativeness with entropy, we would be proposing that the more uniform such a distribution, the more informative it is. Using *conditional entropy*, we can measure the uniformity of the distribution of conditional probabilities of occurrence of the possible outcome-pairs of a given variable-pair. If we chose to equate mean informativeness with

Table 7.3 Additional phenomena of interest in the coin-flip scenario

The probability of the coin's coming up Heads; the unexpectedness of it coming up Heads
Your uncertainty as to whether it would come up Heads, or Tails
The fraction of messages you send that are true (i.e., accurate representations of fact)
The fraction of messages I receive that are true
Your reliability in accurately representing facts in general, and/or coin-flips in particular
The fraction of content of messages sent that is not received
The fraction of content of messages received that is not sent
The reliability of the channel across which messages are sent
The probability of your telling me this coin came up Tails; the unexpectedness of your telling me it came up Tails
My uncertainty as to whether you would tell me it came up Heads, or Tails
My uncertainty as to whether it came up Heads, or Tails

conditional entropy, we would be proposing that the more uniform such a distribution, the more informative it is. Using *mutual information*, we can measure the co-dependency of two variables. If we chose to equate mean informativeness with mutual information, we would be proposing that the more co-dependent a pair of variables, the more informative each is.

In each of these cases, as we have seen, there are several different ways of moving from the account of informativeness that each provides to an account of information. For example, if we equate informativeness with information, then we might conclude that instances of information are property-instances (i.e., modes in Lowe's ontology) such as the particular surprisal of a particular event. If we decide instead that informativeness is a property of information, then we might conclude (by choosing among various possibilities) that instances of information are substance-instances (i.e., concrete objects in Lowe's ontology).

Returning to the list of phenomena involved in our original coin-flip scenario, some of the entries that should now be added to the "Modes" category are identified in Table 7.3.

7.5 The Ontological Commitments of Information Theorists, I

A comprehensive review of the literature on the nature of information would fill a book. Others (see, e.g., Bates 2010; Capurro and Hjørland 2003; Case 2012; Floridi 2003) have provided excellent shorter overviews. I do not intend to take either of these routes here. Instead, I am going to focus on a sample of convenience that I will simply assume (whilst I am aware of the risks of doing so) to be representative of the larger population. If you type "What is information?" (complete with the opening and closing quotation marks) into Google Scholar, you find a lot of good stuff. The highlights are summarized in Table 7.4: 18 papers, published between 1955 and 2012, with the title "What is information?"

Table 7.4 Contributions to the literature on "What is information?," 1955–2012

Rapoport, A. 1955. What is information? *Synthese* 9(1): 157–173.

Contribution type:	A (single existing: Shannon information)
Author's discipline:	Mathematics
Source's discipline:	Epistemology
LIS authors cited:	–

Drum, D.D. 1956. What is information? *The Speech Teacher* 5(3): 174–178.

Contribution type:	A (single existing: Shannon information)
Author's discipline:	Speech communication
Source's discipline:	Speech communication
LIS authors cited:	–

Stonier, T. 1986. What *is* information? In *Research and development in expert systems, III: Proceedings of expert systems '86: The sixth annual technical conference of the British Computer Society Specialist Group on expert systems, Brighton, 15–18 December 1986*, ed. M. Bramer, 217–230. Cambridge: Cambridge University Press.

Contribution type:	C (new)
Author's discipline:	Biology
Source's discipline:	Computer science
LIS authors cited:	–

Israel, D., and J. Perry. 1990. What is information? In *Information, language, and cognition*, ed. P.P. Hanson, 1–19. Vancouver: University of British Columbia Press.

Contribution type:	C (new)
Authors' discipline:	Philosophy of language
Source's discipline:	Cognitive science
LIS authors cited:	–

Sveiby, K.-E. 1994. *What is information?* Sveiby Knowledge Associates. http://www.sveiby.com/articles/Information.html. Accessed 1 Aug 2012.

Contribution type:	B (review)
Author's discipline:	Knowledge management
Source's discipline:	–
LIS authors cited:	–

Hillman, C. 1995. *What is information?* Seattle: Department of Mathematics, University of Washington. http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.51.8223. Accessed 1 Aug 2012.

Contribution type:	C (new)
Author's discipline:	Mathematics
Source's discipline:	–
LIS authors cited:	–

Lagache, A. 1997. What is information? In *Signals and images: Selected papers from the 7th and 8th GIRI meeting, held in Montpellier, France, November 20–21, 1993, and Jerusalem, Israel, December 10–11, 1994*, ed. M. Bastide, 279–292. Dordrecht: Kluwer Academic.

Contribution type:	A (single existing: information as signification)
Author's discipline:	Philosophy
Source's discipline:	Homeopathy
LIS authors cited:	–

(continued)

Table 7.4 (continued)

Rowley, J. 1998. What is information? *Information Services and Use* 18(4): 243–254.
- Contribution type: B (review)
- Author's discipline: LIS
- Source's discipline: LIS
- LIS authors cited: Bawden, Brier, Brookes, Buckland, Capurro, Cronin, Davenport, Eaton, Fairthorne, Hannabuss, Hayes, Ingwersen, Kaye, Kuhlthau, Rowley, Ruben, etc.

Chmielecki, A. 1998. What is information? An ontological approach. In *Proceedings of the twentieth world congress of philosophy, Boston, August 10–15, 1998*, ed. A.M. Olson. http://www.ifsid.ug.edu.pl/filozofia/pracownicy/a_chmielecki/doc/teksty_w%20_jezyku_angielskim/what%20is%20information.pdf. Accessed 1 Aug 2012.
- Contribution type: C (new)
- Author's discipline: Ontology
- Source's discipline: Philosophy
- LIS authors cited: –

Sholle, D. 1999. What is information? The flow of bits and the control of chaos. Paper presented at the media in transition conference, Cambridge, MA, October 8, 1999. http://web.mit.edu/m-i-t/articles/sholle.html. Accessed 1 Aug 2012.
- Contribution type: B (review)
- Author's discipline: Mass communication
- Source's discipline: Media studies
- LIS authors cited: –

Lombardi, O. 2004. What is information? *Foundations of Science* 9(2): 105–134.
- Contribution type: B (review)
- Author's discipline: Philosophy of science
- Source's discipline: Philosophy of science
- LIS authors cited: –

Harms, W.F. 2006. What is information? Three concepts. *Biological Theory: Integrating Development, Evolution, and Cognition* 1(3): 230–242.
- Contribution type: B (review)
- Author's discipline: Philosophy
- Source's discipline: Biology
- LIS authors cited: –

Konorski, J., and W. Szpankowski. 2008. What is information? Paper presented at ITW'08: The IEEE information theory workshop, Porto, May 5–9, 2008. http://www.cs.purdue.edu/homes/spa/papers/info08.pdf. Accessed 1 Aug 2012.
- Contribution type: C (new)
- Authors' disciplines: Telecommunications/Computer science
- Source's discipline: Information theory
- LIS authors cited: –

Díaz Nafría, J.M. 2010. What is information? A multidimensional concern. *TripleC: Cognition, Communication, Co-operation* 8(1): 77–108. http://www.triple-c.at/index.php/tripleC/article/view/76. Accessed 1 Aug 2012.
- Contribution type: B (review)
- Author's discipline: Computer science/Philosophy of science
- Source's discipline: Information society studies
- LIS authors cited: Brier, Capurro

(continued)

Table 7.4 (continued)

Rocchi, P. 2011. What is information? Beyond the jungle of information theories. *Ubiquity*, March 2011, article no. 1. http://dx.doi.org/10.1145/1959016.1959017. Accessed 1 Aug 2012.	
Contribution type:	B (review)
Author's discipline:	Computer science
Source's discipline:	Computer science
LIS authors cited:	–
Yapp, C. 2011. What is information? *ITNOW* 53(2): 18.	
Contribution type:	Short paper
Author's discipline:	Information technology
Source's discipline:	Information technology
LIS authors cited:	–
Logan, R.K. 2012. What is information? Why is it relativistic and what is its relationship to materiality, meaning and organization. *Information* 3(1): 68–91. http://www.mdpi.com/2078-2489/3/1/68. Accessed 1 Aug 2012.	
Contribution type:	B (review)
Author's discipline:	Physics
Source's discipline:	Information science and technology
LIS authors cited:	Losee
Barbieri, M. 2012. What is information? *Biosemiotics* 5(2): 147–152.	
Contribution type:	A (single existing: biological information)
Author's discipline:	Embrylogy
Source's discipline:	Biosemiotics
LIS authors cited:	–

The LIS student, perhaps raised on a diet of Bates, Bawden, and Buckland, with substantial helpings of Belkin, Briet, and Brookes, might be forgiven for failing to recognize not just the names of the authors represented in Table 7.4, but even the titles of the journals and conferences. With the single exception of Rowley's 1998 article in *Information Services and Use*, it is difficult to imagine any of these papers being routinely treated as contributions to the LIS literature. Few have been cited to any great extent by LIS authors; and similarly few contain citations to LIS sources. Yet, just as we might expect, every one is an intriguing and provocative contribution to the literature on the nature of information. My intention in this section and the next is to examine the conceptions of information that are developed in a small, purposive sample of these papers, with the aims of clarifying the nature of the relationships among these conceptions, and demonstrating the potential value of the ontological approach outlined above.

Before we focus on a couple of the most recent articles from the set listed in Table 7.4, it is worth taking a look at a few of the older contributions in a little more detail: one from the 1950s (Rapoport's) that introduces its readers to the theory (Shannon's) that has had by far the greatest impact on the development of conceptions of information in the world beyond LIS; one from the 1980s (Stonier's) in which the author develops one of the first serious accounts of information as a physical entity; and another from the 1990s (Lagache's) that presents a compelling version of the semiotic theory of information that is widely admired in LIS.

7.5.1 *Rapoport (1955)*

The conception of information that Shannon (1948) developed as a core element in his mathematical theory of communication (and whose origins have been traced to precursors such as Hartley (1928)) is effectively summarized in the first "What is information?" (WII) in our list, written more than half a century before the most recent contributions such as Logan's (2012).[5]

Anatol Rapoport (Russian-born American; 1911–2007) was a mathematician who made important contributions to game theory, decision theory, social network analysis, and general systems theory. In his paper (Rapoport 1955), Shannonian information theory is introduced from the outset as a branch of probability theory, and information is defined as "the improvement of one's chances of making the right guess" (p. 158) in situations of a certain kind—viz those in which the probability of one's correctly predicting the value of one random variable is affected by one's already knowing the value of another random variable. This probability can be calculated by analyzing the properties of the joint probability distribution of the two variables. The amount of information shared by the two variables—i.e., the *mutual information* of the joint distribution—is defined as the extent to which each tells about (or depends on) the other.[6]

Rapoport (1955) considers the potential for applying this conception of information to the solution of problems in several scientific fields—communications engineering, linguistics, physics, and biology—claiming that Shannon's information theory provides "an altogether new way of measuring the amount of information in a message" (p. 158). The idea is that the sources (senders) and targets (receivers) of messages are to be treated as random variables, and that the probability distribution of the values of the signals comprising the messages received by a given target is to be compared with the probability distribution of the values of the signals comprising the messages sent by a given source. The amount of information (on average) in a message sent by source X to target Y is defined as the mutual information of the joint distribution—i.e., the extent to which the two variables depend on each other, or (another way of describing the same quantity) the extent to which our uncertainty about the values of the signals received would be reduced by prior knowledge of the signals sent.

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[5]Rapoport was by no means the first to articulate the value of Shannon's theory in this way. Among other summarizations, Warren Weaver's (1949) introduction to a volume in which Shannon's 1948 paper was reprinted has been especially influential.

[6]See the discussion of mutual information in Sect. 7.4.4 above.

This technical definition of information is contrasted by Rapoport (1955) with that implicit in the old way of measuring the amount of information in a message, "known ever since messages were invented" (p. 158), whereby a message is assumed to carry "more or less information in it depending on the state of knowledge of the recipients" (p. 158). Instead of comparing the contents of individual messages with the contents of individual persons' minds, the new suggestion (i.e., Shannon's) is that we compare probability distributions of the values of signals sent and signals received.

Following Weaver (1949) and others, Rapoport (1955) notes the opportunity provided by information theory to extend the notion of mutual information so that we may talk not only about the average amount of information per message sent by a given source to a given target, but also the amount of information in a single message. All other things being equal, the amount of such "self-information" in a message—i.e., the message's *surprisal*—increases as the size of the repertoire from which the message is selected increases.[7] The more messages you (as a prospective sender of a message) have to choose from, the less chance a receiver has of accurately predicting what message you will choose to send, and your "information giving capacity" increases (p. 159).

In its application to communications engineering, information theory provides ways of (for example) estimating the effects of noise on the accurate reception of signals, and calculating the limits at which communication channels may be expected to perform. In linguistics, information theory may be used to measure the amount of redundancy in a natural or coded language. Turning his attention to applications in physics, Rapoport (1955) notes that "the formula for the amount of information ... looks exactly like the formula for *entropy* in statistical mechanics" (p. 168), and insists on the significance of this mathematical (rather than merely metaphorical) analogy: "Such analogy is evidence of similar *structure* in two or more classes of events, and a great deal can be deduced from such similarity" (p. 168).

An explanation of the relationship between information and entropy requires some familiarity with related concepts in thermodynamics, i.e., the study of the physical laws that govern the conversion of energy from one form to another and the flow of energy from one object to another.[8] These laws are expressed in terms of quantitative relationships among amounts of work, energy, heat, temperature, and entropy. *Work* is the action of a force on an object, and *energy* is the ability of an object to do work. Both are measured in joules. Energy has two forms: potential energy, which an object has as a consequence of its position, shape, or state; and kinetic energy, which an object has as a consequence of its motion. *Heat* is the flow of energy from one object to another as a result of difference in *temperature*: when heat flows, the object from which heat flows is said to be at a higher temperature; when no heat flows between two objects, their temperatures are equal. In the latter

[7] See the discussion of surprisal in Sect. 7.4.1 above.

[8] See, e.g., Pitzer (1995) for an authoritative presentation of the principles of thermodynamics.

case, the objects' energy is said to be unavailable for doing work. *Entropy* is the unavailability of energy in a system, measured in joules per kelvin, and is maximized when the temperatures of all objects in the system are equal. The second law of thermodynamics specifies that the entropy of any closed system—i.e., the degree to which the temperatures of objects in the system are uniform—increases over time.

The concept of entropy was introduced in 1865 by Rudolf Clausius (German physicist; 1822–1888), who had already formulated the second law of thermodynamics in 1850. One formula for calculating entropy—$S = k \ln W$—is named after Ludwig Boltzmann (Austrian physicist; 1844–1906). Here k is the Boltzmann constant, equal to 1.38062×10^{-23} J/K, and W is the number of distinct ways in which the atoms and molecules comprising the system may be arranged while preserving the system's temperature, i.e., the number of possible microstates of the system that are consistent with its current macrostate. This formula assumes that each microstate is equally probable. A generalization of Boltzmann entropy is due to J. Willard Gibbs (American scientist, 1839–1903): $S = -k \sum p \ln p$, where p is the probability of occurrence of a microstate. The similarity in form of this formula to that introduced in Sect. 7.4.2 above (and contrasted with surprisal and mutual information in Table 7.2 above) should be noted.

It is often argued—as Rapoport (1955) does in his WII—that entropy may be viewed as a measure of the *disorder* of a system, in the sense that a higher value of entropy indicates a greater number of possible configurations of the system at the microscopic level. But this characterization of entropy can be confusing, especially when it is considered that, at the macroscopic level, higher entropy indicates greater uniformity, homogeneity, and equilibrium.

In summary: In Rapoport's (1955) presentation, readers are introduced to the concepts (if not the precise terms) of surprisal, entropy, and mutual information; and we are invited to consider these as measures of *amounts* of information, with the implication that information is thus to be equated with informativeness. On this view, information is not something that *has* informativeness: it *is* the informativeness of something. In Lowe's (2006) terms, instances of Rapoport's information are modes.

7.5.2 Stonier (1986)

Our second WII (what is information?) of interest is Tom Stonier's (1986). Stonier (1927–1999) was a German-born biologist, active in the U.S. and in the U.K., who made celebrated contributions to STS (science, technology, and society) and peace studies. He wrote a trilogy of books (Stonier 1990, 1992, 1997) developing a "general theory of information" based on the somewhat controversial idea that entropy can be negative.

Stonier (1986) begins his WII by talking about information in a rather conventional sense, as something that people "absorb" every time they talk or read, that can be stored outside the human brain, and (as "raw data") is processed not just by human brains but by "information machines" (i.e., computers). He notes that the science of thermodynamics emerged only when we had experience with "energy machines" (i.e., steam engines), and expresses frustration that, in his view, we still don't have an equivalent "science of information" that allows us to understand the "actual properties of information such as function, structure, dynamic behaviour and statistical features ..." (Stonier 1986: 220, quoting Scarrott 1986). It then becomes clear that Stonier is seeking to treat information as "a property of the universe"—i.e., a physical entity in its own right, analogous to matter and energy, and perhaps even present in particulate form as infons.

Stonier's (1986) conception of information is of a quantity I whose values can be calculated using the formula $I = 1/W$, where W has the same meaning as it does in Boltzmann's formula for entropy. In other words, Stonier's information is the *reciprocal* of the number of possible microstates of the system that are consistent with its current macrostate, and the relationship between entropy and Stonier's information is given by $S = k \ln c/I$, where c is a constant that may vary between systems of different types.

Stonier (1986) is very clear about the difference between his conception of information and the one he attributes to Shannon: The two concepts are "diametrically opposed" (p. 222). A system in a high-entropy state, i.e., one characterized by a uniformity of temperature (at the macroscopic level) and a high level of atomic and molecular disorder or randomness (at the microscopic level), is one that exhibits a large amount of (what Stonier characterizes as) Shannon information, but a small amount of Stonier information. Conversely, if a system is highly ordered, highly organized, highly differentiated, highly complex, and highly improbable—like organic molecules and living cells are—then its Stonier information content is high.[9] Indeed, Stonier suggests that it is possible for the most complex (and thus informative) systems to be characterized by values of entropy that descend below 0, i.e., values of negative entropy. A case such as this, however, would require a value for W lower than 1, and Stonier leaves it quite unclear how such a value could be generated. It is important to recognize, moreover, that Stonier's characterization of Shannon's "information" as equivalent to entropy is a narrow view in which other concepts of information derivable from probability theory (mutual information in particular; see Fig. 7.2 and Table 7.2) are ignored.

Stonier's (1986) conception of information is the centerpiece of his proposal for a new "information physics" in which matter, energy, and information are recognized as the three basic components of the universe. Any system that is nonrandom in its structure—i.e., any system that is ordered in some way—contains information: "What mass is to the manifestation of matter, and momentum is to energy, organization is to information" (p. 224). Just as different forms of matter (i.e., solid, liquid, gas) contain different amounts of energy, different forms of energy (e.g., mechanical energy, chemical energy, electrical energy) contain

[9]The idea that information is a quantity equivalent to the reciprocal of entropy is due to Norbert Wiener (1948), whom Stonier does not cite.

different amounts of information: "[J]ust as ice, liquid water, and steam represent matter whose form is determined by the amount of energy contained within it, so may the various forms of energy reflect the nature and amount of information contained within them." (p. 224).

One of the implications of Stonier's (1986) inclusion of information in the list of the universe's basic entities implies that "... every existing equation describing the interaction between matter and energy ... needs to be re-examined ..." (p. 225). Work is to be reconceptualized as a process that may result in a change in a system's information content, as well as (or instead of) a change in a system's energy content. "Other things being equal, the information content of a system is determined by the amount of work required to produce the information or organisation exhibited by the system" (p. 224). Stonier goes so far as to propose that light contains information, and that a photon is not itself an elementary particle; rather, it is made up of two elementary components: an energon (i.e., a quantum of pure energy), and an infon (i.e., a quantum of pure information). "[Infons] would not show up in any traditional physics experiment since such particles would possess neither mass nor energy—they would, however, manifest their effect by changes in organisation" (p. 227).

The postulation of the existence of quantum phenomena of any kinds raises some tricky issues for ontologists.[10] Certainly it is not immediately obvious where, in Lowe's (2006) four-category ontology, particles of pure information lacking mass and energy should be placed; but the categories of mode and object are two possibilities. Clarifying the ontological status of information is a live issue for those contemporary theorists who, following Stonier and others, advocate for conceptions of information as some sort of structuring or organizing principle exercised upon matter and energy.[11]

7.5.3 Lagache (1997)

Our third WII of interest is by Agnès Lagache (d. 1999), who was a philosophy professor at the Lycée Carnot in Paris, and frequent collaborator with immunology professor Madeleine Bastide on projects relating to the theoretical foundations of homeopathy. Her WII (Lagache 1997), a paper presented at the 8th meeting of the Groupe International de Recherches sur l'Infinitésimal (GIRI; the International Research Group on Very Low Dose and High Dilution Effects) in 1994, gives a

[10] See, e.g., French and Krause (2006).

[11] Marcia Bates (2005, 2006), for example, grapples with this issue; see Furner (2010: 178–181) for a discussion. I am grateful to Tom Dousa for the insight that conceptions like Stonier's are somewhat comparable to the "forms" of Aristotelian and Scholastic philosophy, which likewise give structure to otherwise unformed matter; see Capurro (1978) for a review of such ideas.

compelling account of information as the meanings of signs—in virtue of which her conception finds its natural habitat among the *semiotic* family (identified in Sect. 7.2 above) that is well-established in the LIS community.[12]

Lagache (1997) begins her discussion (p. 284) with a statement of Gregory Bateson's "general principle" of information as "a difference which makes a difference" (Bateson 1972), and proceeds to reconcile this definition with a semiological view of the central role of information in the process of signification or representation. The main elements of this conception are as follows (Lagache 1997):

- Signs are those phenomena that are informative, i.e., those "differences" (i.e., distinctions between an "element" and the "structure" in which it appears) that "make a difference" by becoming "significant" (i.e., literally, signifying or representing).
- Signs exist on two levels, one material and one interpretive: "The semantic object [has] a double nature: it belongs to the level of things as drawing, voice, written letters ..., but it [also] belongs to the level of interpretation ..." (p. 290).
- Material objects exist as signs only when they are being interpreted. "Sartre said that paintings in an art gallery don't exist during the night and closure: at these moments, they are only canvas, oil and such stuff. They exist as paintings when they are watched. In the same way, ideograms or letters don't exist as signs without a reader" (p. 289).[13]
- Information occurs when representation does, and specifically when the products of representation are interpreted. "The world of information begins when dealing not with the thing, but with a representation of things" (p. 285).
- Information is both a process and the result of that process: "... [Information] is [the] very event which happens between levels, which goes from things to reading, the very passage itself. Sense is an emigrant: process and result are the same" (p. 290).
- Information is not material. "... [A] piece of information is not an object, though having generally a medium." (p. 284). "... [N]othing is information by itself; information is not an object, and doesn't *subsist in itself and for itself*, according to the classical definition of substance" (p. 289, emphasis in original). "... [A]lthough it does exist, information is not a substance" (p. 290).

[12]See, e.g., Qvortrup (1993).

[13]The similarity of this argument to Suzanne Briet's (1951) explanation of the distinction that should be made between the documentary status of an antelope in the wild and that of an antelope in a zoo (an explanation that is well-known in LIS thanks to the glosses provided by Michael Buckland and others; see, e.g., Buckland 1991) is striking, especially given Briet's characterization of documents as signs (*indices*). However, it should be noted that Sartre's paintings take on a sign-role only when they are being regarded; whereas, once it enters the zoo's collection, Briet's antelope remains a document even when nobody is looking at it.

- Information is subjective, in the sense that the meaning of any given sign is dependent on its interpreter. "Information is in the receiver. ... The receiver is necessarily active: information arises from his reading. He creates it." (p. 289).[14]
- The interpretation of a given sign is influenced by context: "... [T]he world of information is the determinism of context: the original role that a given element plays according to the structure in which it appears. ... A lost jigsaw-piece in a children's room has no meaning ... Putting it in its jigsaw's frame with the other pieces makes arise a new meaning ... Sense is an emigrant, the new and impalpable dimension which arises not from objects, but from the network of woven relations around objects" (p. 284).
- Information by itself is not observable. "What we actually observe is the informative effect on a receiver" (p. 289).
- The more informative a sign, the better: "... [A] criterion of good art would be its informative effect on art lovers" (p. 288).
- Other conceptions of information miss the target completely and disastrously. "[The] fantastic semantic capacity of living beings cannot remain for ever relegated out of science" (p. 290).

Lagache (1997) identifies several kinds of signs:

(a) At "the most primary level" of representation, there are *images*, which are "similar to the thing, but maintaining a constitutive difference with things" (p. 286), e.g., the representation of a man's hand formed by the man's dipping his hand in paint and then pressing that hand on a wall: "... [I]mages ... are signifiers, that is a concrete sign of the thing, but stand for an equivalent of the thing; there is no transformation, just ... an *alleviation* of the presence of the thing. We see this hand, and we just know that a man dropped in there" (p. 285).

    The interpretation of an image depends on the viewer's previous experience. "... [T]he informative ability of such an image is dependent upon a previous and already known lexical register: the receiver, the reader of the image must have a referent to understand it. Each image is different, and does not inform about anything else than itself; the receiver must already have encountered the thing, or must have a memorized referent to be able to read it" (p. 285).

(b) Then there are *tracks*, e.g., the representation of a man's hand formed by the man's laying his hand on a wall, spreading powder all around it, and then removing the hand: "... [T]he original informative power of tracks comes from the function of absence, included into the signifier. ... We don't see a hand, we *see an absent hand*, that is the mere genius of semantic objects" (p. 287, emphasis in original).

(c) There are *analogic signs*, i.e., voiced names for things: "... [B]efore becoming an alphabet, written signs went through an intermediary state of syllabication.

[14] Lagache (1997: 284) also quotes Merleau-Ponty, from his *Phenomenology of perception* (1945): "The mere presence of a living being transforms the physical world, makes appear here foods, there hiding places, and imparts to the stimuli a meaning they had not."

The ideogram, noun of a thing, has been taken as a sound, which refers not to the thing but to the vocalization of its noun. There is an analogical transfer from the reference to the thing, to the corporal event of vocalizing its noun" (p. 288).

(d) And finally there are *symbolic signs*, i.e., written words, where the "break-up between signified and signifier" is complete: "Letters are completely symbolic: they are no more images; they refer to the register of verbal language as supporting the whole necessary referents" (p. 287).[15]

Strictly speaking, what Lagache calls mere signals (e.g., "a pheromone amongst butterflies," p. 285) are not informative, because they do not have a representational function, and are not interpretable. As material objects, signals play only a "determinist" (i.e., causal) role.

For Lagache, then, signs are what are informative: informativeness is a property of signs. But signs are not themselves information, since information is not what has informativeness: information *is* informativeness. The information (i.e., the informativeness) of a sign is its meaning. In Lowe's (2006) terms, instances of Lagache's information are modes. While the two are quite different from each other in their content, the Shannonian conception (based on probability theory) and the Lagachian conception (based on semiotics) are nevertheless surprisingly similar in the ontological status they assign to information.

7.6 The Ontological Commitments of Information Theorists, II

In the context of the issues raised thus far, two of the journals represented in the list in Table 7.4 are of particular interest. Given their relative lack of visibility in LIS at the present time, it might be useful to provide a few contextual details, before we take a look at two more WIIs appearing very recently in their pages.

Information is the straightforward title of a relatively new[16] online, open-access, peer-reviewed journal published quarterly by MDPI[17] out of Basel, Switzerland. It is

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[15]Because Lagache does not use the standard semiotic terminology (due to Peirce; see, e.g., Atkin 2010) of icon, index, and symbol, it is not immediately clear how the first three of her four kinds of signs should be mapped to a Peircean framework. For example, is the handprint an icon (referring to its object through similarity), or an index (referring to its object through a physical connection)?

[16]Its first volume was published in 2010.

[17]From MDPI's website at http://www.mdpi.com/about/history, we learn that, at the time of its founding in 1996 as a non-profit institute for "the promotion and preservation of the diversity of chemical compounds" and as the publisher of the electronic journal *Molecules*, MDPI originally stood for "Molecular Diversity Preservation International"; that it now stands for "Multidisciplinary Digital Publishing Institute"; and that the organization now publishes more than 70 open-access journals in a variety of (mainly) scientific fields, many of which are financed by collecting "article processing charges" from journal articles' authors.

described on its website[18] as a journal of "information science and technology, data, knowledge and communication," and further specifics of its scope are indicated by the following list of subject areas: "information technology (IT) and science; quantum information; information theory, systems theory, cybernetics; communication theory and communication technology; information security; information society; data management, information systems; data mining, data, knowledge; languages, semiotics; information processing systems; information and computation; information and artificial intelligence; information in society and social development; information and intelligent agents; problems of information security; information in organizations and knowledge management; information processes and systems in nature."

Information's founding editor-in-chief is Mark Burgin,[19] formerly of Kiev State University and since 1998 a visiting scholar in the mathematics department at UCLA.[20] Its editorial board includes a mix of, on the one hand, scholars working in fields that are somewhat related to library and information science (LIS), such as information use, scientometrics, and information ethics, and on the other, researchers whose names may be less familiar to an LIS audience, including computer scientists and physicists.[21] *Information* has published several "special issues"—i.e., virtual issues made up of articles that are focused on a common theme but that may be scattered across different regular issues. One special issue on "What is information?," edited by Burgin, comprised ten papers published in 2010–11; another collected fourteen "Selected papers from FIS 2010 Beijing,"[22] edited by Pedro C. Marijuán in 2011–12; a third brought together eight papers on "Information and energy/matter," edited by Gordana Dodig-Crnkovic in 2011–12; and a fourth on "Information: Its different modes and its relation to meaning," edited by Robert Logan, was (at the time of writing, in July 2012) still open to submissions.

In a related vein, *TripleC: Cognition, Communication, Co-operation* is a transdisciplinary, peer-reviewed, open-access journal "for a global sustainable information society,"[23] founded in 2003 by systems scientist Wolfgang Hofkirchner (Unified Theory of Information [UTI] Research Group, Vienna, Austria) and currently edited

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[18] See http://www.mdpi.com/journal/information/about/

[19] See http://www.mdpi.com/journal/information/editors

[20] See http://www.math.ucla.edu/~mburgin/fl/cv.htm

[21] Information use: Suzie Allard and Kizer Walker; scientometrics: Loet Leydesdorff and Lokman Meho; information ethics: Rafael Capurro, Luciano Floridi, and Herman Tavani; computer science: Gordana Dodig-Crnkovic, Lorenz Hilty, and Paul Vitányi; physics: Giorgio Kaniadakis, Andrei Khrennikov, and Robert Logan; see http://www.mdpi.com/journal/information/editors

[22] FIS 2010: Towards a New Science of Information (Beijing, China, August 20–23, 2010), co-chaired by Hua-Can He, Pedro Marijuán, and Wolfgang Hofkirchner, with Burgin, Floridi, and Logan among the members of its international advisory board, was the Fourth International Conference on the Foundations of Information Science; see http://bitrumagora.wordpress.com/2010/03/17/2010fis-conference/

[23] See http://www.triple-c.at/index.php/tripleC/index

by media theorist Christian Fuchs (Uppsala University, Sweden).[24] It provides a forum for the discussion of "the challenges humanity is facing in the information society today," and its scope is defined by the following list of thematic areas: "information society studies, media and communication studies, internet research, new media studies, social informatics, information and communication technologies & society; science and technology studies (STS), technology assessment, design science; social sciences, economics, political economy, communication studies; science of information, information studies, cognitive science, semiotics; philosophy, humanities, arts; with a special interest in critical studies ..." Submissions to the journal are required to show how findings contribute to "the illumination of conditions that foster or hinder the advancement of a global sustainable and participatory information society."[25]

TripleC's editorial board includes several scholars of information studies; several who also sit on *Information*'s board; several members of the UTI Research Group; and several who served on the advisory board for FIS 2010.[26] In other words, there is much overlap among the memberships of these bodies, indicating the existence of a relatively small but well-defined and cohesive research community. *TripleC* has published many papers in which the question "What is information?" is a central topic, including articles by Burgin, Marijuán, Brenner, Collier, and (in a 2009 special issue on "What is really information? An interdisciplinary approach") Capurro, Floridi, Fleissner, Fuchs, Díaz Nafría, and Hofkirchner. A 2011 special issue on "Towards a new science of information" collected 31 further contributions to FIS 2010, adding to the 14 published in *Information*.

Few of the papers published in the special issues of *Information* and *TripleC* cite the LIS literature or (as yet) attract citations from LIS. Why might this be? Is there a sense in either camp that the other has little to offer? Or a lack of awareness of each other's existence? One way to address this issue would be to conduct a comprehensive review of the kinds of answers to the "What is information?" question that are provided in the *Information*–*TripleC*–UTI–FIS community, and to determine how different they are from those that are routinely gathered up in the surveys that are read and cited by LIS scholars. It is not my intention to do that

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[24]Hofkirchner is current president of the UTI Research Group; Fuchs is a member of its executive board. UTI Research Group focuses on "the role of information, communication, media, technology, and culture in society," contributing to "information science, communication and media studies, and science and technology studies"; see http://uti.at/

[25]See http://www.triple-c.at/index.php/tripleC/about/editorialPolicies

[26]Information studies: Ron Day, Michel Menou, Alice Robbin, and Dan Schiller; *Information* editorial board: Burgin, Capurro, Dodig-Crnkovic, Hilty, Leydesdorff, and Logan; UTI Research Group: José María Díaz Nafría, Peter Fleissner, Francisco Salto, and Rainer Zimmermann, as well as Hofkirchner, and Burgin again; FIS 2010 advisory board: Søren Brier, John Collier, Charles Ess, Pedro Marijuán, Michel Petitjean, and Tom Ziemke, as well as Díaz Nafría, Fleissner, Hofkirchner, Logan, Zimmermann, and Burgin once again; see http://www.triple-c.at/index.php/tripleC/about/editorialTeam

here, but a flavor of the kinds of results that we might obtain from such a study can be given by an examination of the two WIIs in our list that have been produced by members of the newly emergent group.

7.6.1 Logan (2012)

Robert K. Logan is a media ecologist, a former collaborator with Marshall McLuhan, an emeritus professor of physics at the University of Toronto, and a central figure in the *Information–TripleC*–UTI–FIS group.[27] His very recent WII (Logan 2012), published in the journal *Information*, is a relatively informal review that critiques the applicability of the Shannon conception to bioinformatics. In the course of doing so, he provides distinctive answers to two versions of the "What is information?" question that have been much discussed down the years and across the disciplines: 1. What kinds of information are there? 2. What sort of thing is information?

What Kinds of Information Are There?

Much like the authors of other review articles, Logan advocates for a pluralistic approach to conceptions of information. He reviews various conceptions, and argues that each individual conception is appropriate only for a different limited context. He pays greatest attention to four kinds of information, three explicitly (Shannon information, structural information, and biotic information) and one slightly less so, in that he does not label it other than as a Wienerian variant of Shannon information.

(a) *Shannon information*. Logan (2012) asserts that, despite the claims made for the other kinds of information he identifies, it is Shannon information that "has been accepted as the canonical definition of information by all except for a small band of critics" (p. 75). (This may be true for Logan's own discipline of physics but is not obviously so in LIS, for example, nor in philosophy—notwithstanding Logan's accompanying claim that, "[i]f ever pressed on the issue, most contemporary IT experts or philosophers will revert back to Shannon's definition of information" (p. 80).) Logan presents his paper as a timely antidote to what he sees as an uncritical acceptance of the Shannonian paradigm, in which he demonstrates the inapplicability of Shannon information beyond telecommunications engineering, and in particular to bioinformatics.
(b) *Wiener information*. The motivation for Logan's presentation of the Wienerian variant of Shannon information is his conviction that, whatever else information is, it is not entropy. Like "many physicists before" him, Logan (2012) is

[27] As previously indicated, Logan is a member of the editorial boards of both journals, and was on the advisory board for FIS 2010. Logan is also on the board of directors of the Science of Information Institute (SoII; see Sect. 7.6.2 below).

concerned to demonstrate that "information and entropy are opposites and not parallel as suggested by Shannon" (p. 69). In the published version of Logan's paper, the negative sign (as well as the summation symbol) is unfortunately dropped from the quotation of Shannon's formula for entropy (from Shannon 1948), which thus appears as $H = p_i \log p_i$ (Logan 2012, 71) rather than as $H = -\sum p_i \log p_i$. In any other context, the typographical error would be trivial, but in this particular case, it serves only to muddy the waters of Logan's ensuing discussion of the relationship between information and entropy, where he highlights the "difference in sign" between Shannon's formula and Boltzmann's ($S = k \ln W$, where, as we saw in Sect. 7.5 above, W is the number of different ways of arranging the components of a system while producing the same temperature, and k is the Boltzmann constant). The confusion is compounded by Logan's assertion, in the context of showing how Shannon equates information and entropy, that "Shannon uses a positive sign" (p. 73). Logan's comments about the formulae's signs are misleading for two reasons: (a) Shannon's formula for entropy does not, in fact, use a positive sign; and (b) Shannon's and Boltzmann's formulae are usually considered to be analogous.

The real issue, which Logan does go on to raise, is not that Shannon is somehow mistaken in his representation of entropy, but rather that we would be mistaken if we were to use Shannon's entropy formula to measure information. Logan's position is that, to the extent that information is conceivable as a quantity, it is one that is *inversely* (rather than directly) proportional to entropy. In this sense, Logan's conception is analogous to Stonier's (1986), discussed above in Sect. 7.5.2. Whereas entropy is a measure of disorder, information (for Logan) is a measure of order. Logan (2012) credits Norbert Wiener as the source of this insight: "Just as the amount of information in a system is a measure of its degree of organization, so the entropy of a system is a measure of its degree of disorganization." (p. 86, quoting Wiener 1948). The Wienerian conception of information which Logan advocates is one according to which information is maximized in the case of a maximally *ordered* or organized system, rather than (as Logan interprets Shannon as suggesting) in the case of a maximally disordered, disorganized, randomized, or chaotic system.

(c) *Structural information*. Following Hayles, Logan identifies Donald MacKay as the originator in 1951 of a rival conception of information—"structural information," defined as the "change in a receiver's mind-set" (Logan 2012: 74; quoting Hayles 1999). For Logan, structural information is "concerned with the effect … of the information on the mind of the receiver …" and essentially with meaning—not just "the literal meaning of a sentence," but also the meaning "that the speaker or writer intended," and "the possible interpretations of the receiver" (p. 76).

(d) *Biotic information*. Logan (2012) then turns his attention to conceptions of information applicable in biological contexts, and presents an account of (what he and his colleagues have called) biotic or instructional information, defined as "the organization of [the] exchange of energy and matter" that living organisms (i.e., biotic agents) "propagate" through replication (pp. 78–79) and as the "constraints or boundary conditions" that "partially direct or cause" the processes by which energy is turned into work and by which living organisms reproduce (p. 79).

What Kind of Thing Is Information?

(a) *Shannon information*. At the same time as he characterizes Shannon information as a "measure of the degree of uncertainty for a receiver," Logan (2012) states that Shannon "defined" information as "a message sent by a sender to a receiver" (p. 71), and refers to Shannon's "suggest[ion]" that "information in the form of a message often contains meaning" (p. 74). Set in the context of Logan's goal to distinguish between one conception of information (Shannon's) in which meaning is ignored and another conception (MacKay's) in which meaning is central, the reference to information-as-message is understandable. It should be appreciated, nevertheless, that information-as-message is a conception that is ontologically quite different from Shannon's. On a stricter reading of Shannon's work, neither the semantic content of a message (i.e., its meaning) *nor its form* (i.e., the signals that comprise it) is to be treated as its information: rather, information is that which is measured by Shannon's formula—viz the informativeness, or reduction in uncertainty, produced by a message.

This latter reading is consistent with Hayles' assessment, of which Logan writes approvingly, that "although [Shannon] information is ... instantiated in material things, [it] is not itself material" (Logan 2012: 81), but rather is "a quantity" (p. 81), "a pattern" (p. 81, quoting Hayles 1999), and "an abstraction" (p. 82). The idea here is that, ontologically speaking, instances of Shannon information are to be regarded as properties of material things—i.e., in Lowe's (2006) terms, as modes. For Logan, it is precisely this immateriality or insubstantiality of Shannon information that weighs most heavily against its applicability in biological contexts.

(b) *Structural information*. Are we to think of structural information in a Shannonian way, i.e., as a measure of the *amount* of change occurring in a recipient's state of knowledge as a result of receiving a message? Or as the semantic content or meaning of the message, or even as the message itself—the *cause* of, or catalyst for, the change? When he initially introduces the idea of structural information, Logan (2012) is ambiguous on this point; but, a little further on in his paper, he cites approvingly a version of the DIKW (Document–Information–Knowledge–Wisdom) pyramid[28] in which data is defined as "pure and simple facts without any particular structure or organization ...," and information as "structured data, which adds more meaning to the data ..." (p. 83, quoting Logan and Stokes 2004). Here Logan clearly equates data with "the signals transmitted between Shannon's sender and receiver" (p. 83), and

[28] See, e.g., Frické (2009).

information with "data ... that ... has meaning" (p. 83). On this account, the intention seems to be that information and meaning are to be treated as things of different ontological kinds: i.e., that meaning (a property) is something that may be ascribed to information (a substance). This conception of instances of information as (in Lowe's (2006) terms) concrete objects that *have* meaning stands in contrast to those in the semiotic family (e.g., Lagache's (1997), discussed in Sect. 7.5.3 above) in which information *is* meaning.

(c) *Biotic information*. One way in which Logan's conception of biotic information is similar to his conception of structural information is in virtue of the distinction that he makes between biotic information itself, and the meaning or effect that biotic information has. Furthermore, Logan (2012) is even clearer about the materiality of biotic information than he is about the materiality of structural information: "biotic information is very much tied to its material instantiation in the nucleic acids and proteins of which it is composed" (p. 84), he writes, adding, "[a] biological system is both an information pattern and a material object or more accurately information patterns instantiated in a material presence" (p. 84). Indeed, it is the material nature of nucleic acids and proteins that allows them to participate in chemical interactions with other biomolecules. Logan contrasts the *symbolic* nature of Shannon information (and, by implication, of structural information) with the *chemical* nature of biotic information: in the former case, the medium of the message, the message itself, and the message's content (i.e., its information) are all "quite separate" and "independent" of one another, whereas in the latter case, "[t]he medium is both the message and the content" (p. 85).

However, Logan stops short of arguing, as some other physicists and proponents of artificial life have done, that organic matter itself can be reduced to information—that human beings, for instance, are ultimately constructed of information and nothing else. The "mistake" that these others make, according to Logan (2012), is to fail to appreciate what Bateson (1972) and others have clearly articulated—i.e., that the true nature of information is "the *organization* of the molecules of which we are composed" (p. 87, emphasis added) rather than those molecules themselves. Logan seems to be asking us to conceive of information simultaneously as material (i.e., as biomolecular matter) and immaterial (i.e., as some sort of property of that matter). Yet it remains unclear precisely what kind of middle ground is ontologically available to us between (as Lowe (2006) would have it) information-as-object and information-as-mode, or precisely how Logan's conception relates to Stonier's (1986) or Bates' (2005, 2006) versions of information-as-organization.

7.6.2 Díaz Nafría (2010)

We turn now to another author whose institutional connections place him at the center of the *Information–TripleC*–UTI–FIS group identified earlier. José María

Díaz Nafría is a computer scientist and philosopher of science affiliated with the University of Léon, Spain, and the Hochschule München, Germany, as well as the UTI Research Group,[29] the Science of Information Institute (SoII),[30] the International Society for Information Studies (ISIS),[31] and BITrum.[32]

Díaz Nafría's (2010) WII is another review article, but he takes a somewhat more systematic approach than Logan, classifying conceptions of information on three separate dimensions: (1) degree of objectivity of information; (2) type of property emphasized; and (3) disciplinary source.

Objective–Relational–Subjective

The first of these dimensions is defined by a distinction between objectivity and subjectivity: "If it is objective it will be independent from mental states or user's intentions; if it is subjective it will depend on the interpretation of a cognitive or intentional agent" (Díaz Nafría 2010: 82). Díaz Nafría does not make it wholly clear what "it" refers to in this formulation, nor which (if any) of the following manifestations of the objective/subjective distinction he means to prioritize:

- information as a physical, material, concrete substance vs. information as an abstract property;
- information as a naturally occurring phenomenon whose existence as information is not (or not necessarily) the result of human creative activity vs. information as human artifact;
- information as a natural kind whose identity as information does not depend on its being identified as such in the course of human activity vs. information as a social construct; and

[29]See Sect. 7.6 above. Díaz Nafría is also a member of the editorial board of *TripleC*, and served on the advisory board for FIS 2010.

[30]The Science of Information Institute, founded in 2006, is "devoted to the development and recognition of information as a unique science that crosses traditional scholarly disciplines"; see http://www.soii.info/. Hofkirchner, Logan, and Díaz Nafría are among the members of its board of directors; Burgin, Collier, Dodig-Crnkovic, Marijuán, Salto, and Zimmermann, as well as Brier, Floridi, Elizabeth Buchanan (Center for Applied Ethics, Wisconsin-Stout), and Leah Lievrouw (Information Studies, UCLA), are among the members of its science advisory committee.

[31]The International Society for Information Studies was founded in 2011 with headquarters in Vienna, Austria, and has the aim of advancing "global and collaborative studies in the sciences of information, information technology and information society as a field in its own right by boosting the elaboration of common conceptual frameworks, the implementation of which in practice contributes to mastering the challenges of the information age"; see http://mod1.syros.aegean.gr/soii/index.php/en/news/3-newsflash/41-the-fifth-congress-on-the-foundations-of-information-science-will-be-held-next-summer-in-russia-under-isis-support

[32]BITrum is an "interdisciplinary research group … constituted to develop a conceptual and theoretical clarification of information, intending to gather all the relevant points of view and pursuing to preserve all the interests at stake (scientific, technical and social)"; see http://en.bitrum.unileon.es/. BITrum was founded by Díaz Nafría and Salto in 2008, and counts Brier, Buchanan, Burgin, Capurro, Dodig-Crnkovic, Fleissner, Floridi, Hofkirchner, Petitjean, and Zimmermann among the members of its scientific committee.

- information as a class of objects whose meanings are intrinsic and do not depend on human decision-making vs. information whose meanings are determined by interpreters.

The upshot is a taxonomy of information theories arrayed from the "most extreme" objectivist category (which includes, for example, Stonier's theory of information as a fundamental physical entity on a par with matter and energy; p. 82) to the most subjectivist (i.e., theories in which properties such as relevance and truthfulness are treated as identity conditions for information; Díaz Nafría places theories of semantic information such as Dretske's (1981) towards this pole).

Syntactical–Semantic–Pragmatic

Díaz Nafría (2010) argues that it is useful separately to categorize information theories on a second dimension according to the kind of "major questions" about the properties of information that they address, and identifies three such kinds:

- questions about the *syntactical* content of information—e.g., "How is it expressed?" (p. 84)—where "messages that . . . [comply] with all syntactic requirements" are treated as informative to some extent, even if "false, incorrect, useless, [or] redundant" (p. 81);
- questions about the *semantic* content of information—e.g., "What does it represent?" and "With what truth value?" (p. 84)—"whereby the signals or symbols considered by the MTC [Shannon's mathematical theory of communication] are necessarily referred to something" (p. 81); and
- questions about the *pragmatic* content of information—e.g., "What value and utility has it?" (p. 84)—"whereby information is the foundation for action, whether by intentional actors, living beings or automatic systems" (p. 81).

Shannon's theory, for example, is located at the syntactical end of the spectrum, to be distinguished from the various probabilistic conceptions of information that have been provided by philosophers (e.g., Dretske 1981) concerned with measuring the semantic value of propositions. With regard to theories concerned with pragmatics, Díaz Nafría (2010) draws upon sources from anthropology and philosophy. It is notable that, despite the importance of the role played in pragmatics of conceptions of relevance, "truth, value, innovation, [and] surprise" (p. 81), and of the relationship of information to knowledge, he makes no reference to the LIS literature on these topics.

Technical Disciplines–Sciences–Philosophy

Díaz Nafría's third dimension is disciplinary source. Here librarianship is listed (along with automation, telecommunications, and computing) as one of the technical disciplines acting as sources of information theories, but is the only one of the disciplines in Díaz Nafría's taxonomy not to be associated with a named theory.

Díaz Nafría (2010) notes a broad correlation between all three of his dimensions: "the fact of having natural sciences on the left [of the diagrammatic display of the disciplinary taxonomy] and social or human sciences on the right has the consequence that on the left the most syntactical and objectivist theories prevail, while on the right, the semantic, pragmatic and most subjectivist theories are predominant" (p. 88).

As many before have done, Díaz Nafría (2010) asks, "Is there a single notion [of information] useful for all disciplines? In other words, might every scientific notion be reduced into a single and fundamental one?" (p. 88). Rather than providing a direct answer, his preference is to point to the fact that "there are some shortcomings in every concept of information with regard to others" (p. 88), and to indicate the most prominent issues on which agreement would have to be reached before any unified theory could hope to attract widespread support. With that latter goal in mind, the second half of his paper comprises a glossary of some of the concepts that are central to this discourse.[33]

The entry on "Library Science and Special Librarianship" in this glossary identifies "two opposing meanings" of the concept of information used in LIS: "(1) the information as an object in documents, and (2) its radical subjectivization, i.e., information as everything 'that can be informative to someone.'" (p. 101). The distinction being made seems to be that between two separate features of instances of information—viz, their ontological status as concrete objects (in Lowe's (2006) terms), and their representational function—both of which are consistent with various versions of a simple view of information as meaningful data (cf., e.g., Logan's (2012) version of the DIKW pyramid) that is not fully integrated into Díaz Nafría's framework. On this view, the two meanings are complementary rather than "opposing."

7.7 Conclusion

Luciano Floridi is currently the most prolific and most widely celebrated scholar working on problems of philosophy and information (cf. Furner 2010: 170–173). In recent years, he has developed a hierarchy of categories of phenomena that includes (i) data; (ii) (semantic) information, a.k.a. (semantic) content—i.e., *meaningful*, well-formed data; and (iii) factual information, a.k.a. "epistemically-oriented" semantic information—i.e., *truthful*, meaningful, well-formed data (see, e.g., Floridi 2003: 42–46). Floridi's "general" definition of information (GDI) specifies three conditions (data-ness, well-formedness, and meaningfulness) that must be satisfied for an *x* to qualify as an instance of information, while his "specific" definition of information (SDI) adds a fourth (truthfulness). He notes that the general sense

[33] A continuously updated and collaboratively authored version—the *Glossarium BITri*—is available online at http://glossarium.bitrum.unileon.es/glossary

in which information is understood simply as semantic content is "trivial" (Floridi 2003: 46), and that, in the context of communication, "the most important type of semantic information is *factual information*" (Floridi 2003: 45, emphasis in original). Floridi (2003: 42) asserts that the general definition has nonetheless become the "operational standard" in fields such as LIS.

Why should this be so? For what reasons have scholars working in LIS come to adopt the general definition rather than Floridi's (or any other) specific definition? Floridi points in the direction of a possible answer with his identification, among a set of "very important" concepts of information that he elects not to consider further, of "*pragmatic information* . . . [which] includes *useful information*, a key concept in . . . information management theory, . . . where characteristics such as relevance, timeliness, updatedness, cost, significance, and so forth are crucial" (Floridi 2003: 57, emphasis in original). This list of values—alternatives, in a way, to truth—serves to remind us that LIS scholars' conceptions of informativeness and knowledge itself are typically quite different from those traditionally acceptable either to epistemologists or to natural scientists. LIS theorists in the socio-cognitive tradition, for instance, tend to be interested in changes in personal cognitive structures or "images" of the world, in how such changes are produced, and in how personal needs and desires are thus met, rather than in matters of "truth"; and those in the semiotic tradition tend to subscribe to one or other of the subjectivist versions in which the meanings of signs are underdetermined by properties of the signs themselves (cf. Furner 2010: 173–178).

An upshot of what we might take to be the determination of LIS scholars not to get locked into any "special" definition of information is the ontological pluralism of the field. We should not necessarily expect members of the LIS community to supply any fundamentally original possibilities for conceptions of information. As I indicated at the start, that is the job, strictly speaking, of proper ontology, and LIS is not ontology. But perhaps we do have grounds for taking a moment to reflect approvingly on the lack of *a priori* constraints on the ontological commitments expected of the field's contributors. As the range of options listed in Tables 7.1 and 7.3 is intended to indicate, it seems that we have barely considered many of the ontological possibilities that are open to us. Instead of ruminating on what we might imagine to be the limited extent to which ideas originating in LIS have influenced the wider debate on the nature of information, we may wish to challenge ourselves to specify with precision whatever it might be that is distinctive, and distinctively useful, about LIS-sourced conceptions of information—in other words, to specify what is missing from a literature in which LIS contributions are too often ignored. The use of proper ontology is suggested as a potentially productive means of identifying hitherto-unexplored possibilities.

In "Information studies without information" (Furner 2004), I argued that we don't really need a separate concept of information to do information studies, because we already have perfectly good concepts of sign, data, meaning, relevance, and so on, that allow us to get the job done. In this paper, I have wanted to draw attention to the fact that, conversely, there are several scholarly communities other than information studies that do require a separate concept of information, but that those communities have good reason to look to information studies for help. Any approach to conceptualizing information that downplays the contributions of LIS—i.e., information without information studies—is needlessly impoverished, not least on account of the range of ontological possibilities that it misses.

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Chapter 8
Epistemological Challenges for Information Science: Constructing Information

Ian Cornelius

8.1 Introduction: Information and Action

How can we determine how we should act? This is normally posed as a question of ethics, of determining what constitutes good behaviour, but it also requires that we answer associated questions which are information questions. The question 'should I steal to give to the poor?' is an ethical question. The question 'how should I steal?' may be an ethical question but it is also an information question, and the answer would include lots of what we commonly call 'information' about means, which might be fairly general, and also about very particular things that relate to the opportunities I might have to steal. So, the proposal to steal would be dependent on acquiring some knowledge but it would also include some theoretical knowledge on how the act could be done: there would be a theory of knowledge behind the action, which would also include reasoning about why stealing might be the right thing to do. By and large, libraries and librarians, and their extensions in various online search engines and databases, stop at the point where our hypothetical reader asks 'should I steal?' In this chapter I want to show that our reluctance to consider actions and our preoccupation with means (the knowledge we have in store) has distorted our view of information and our way of constructing the methods of Library and Information Studies (LIS).

This concerns three sets of arguments:

1. The arguments I present here about information and information theory.
2. The logical support for this argument.
3. The relationship of (1) to other LIS literature, especially work on theories and definitions of information.

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In this chapter I shall be dealing with only the first of these: the others would require as much space again and are treated only cursorily and in passing here.

The first decade of the twenty-first century has been a mixed blessing for LIS. As has always been the case, whichever decade you choose, there are immense challenges and opportunities, but recently there have also been some awkward contradictions that confront some of the (usually unspoken) set of beliefs of the information professions and the associated academic disciplines.

One could caricature some of this set of beliefs around a commitment to the idea that access to information is a ‘good thing’, that getting more of the right information aids decision-making and also general personal and social development. Additionally, the information professions can make it easier for you to get the right information, when you need it and in the form that suits you best, by helping you to use the technical devices they have developed. These include, from the more traditional professions, the development of document surrogates (catalogue entries, abstracts) that consistently and mnemonically represent information in an objective way and which can be interrogated by indexing systems, gathered together in meaningful groups by classification systems, embellished by annotations (metadata), and accessed in either physical form through large stores or in electronic form through search engines. In either case there is an assumption that the necessary social institutions and technical capacity will continue to exist.

The justification for this edifice is plausible enough: that there is a very large amount of recorded information available and someone, anyone, at any time, might need, or just be curious about, any of it. We tolerate such statements of need because we believe that democratic societies themselves rest on such universal access, or, if you are not very democratic, just that people might need to have access to a cultural record that supports a particular social and political structure or technical information that allows a certain group to retain political power.

The information professions have some unresolved problems in relation to individual readers, the books, and the societies we live in. By and large we tend to support societies that believe in giving access to information, but we just assist in the preservation of the record and the supply to readers: we don’t interfere with what the readers do with the information and we obey the law if our society decides to restrict access to materials. For example, we can give information about the law in the form of the text of statutes, constitutions, secondary legislation, legal decisions, and ancillary supporting materials like legal dictionaries and encyclopaedias, but we don’t, and would feel very uncomfortable, telling anyone what the law on a particular topic might be. We also have a very ambivalent attitude towards the materials, because even though we strongly maintain they should be freely available we don’t voice opinions about the intellectual status of the documents we curate. We do not, for example voice opinion about what is currently accepted knowledge in various scientific or technological fields, even though we might think some older documents may not necessarily reflect the current view on any topic. Furthermore, we do not question readers to test their suitability to read some documents. Our commitment is professional, but it is also indifferent in an attempt to remain impartial and objective.

8.2 Action and Knowledge

Is this a confused position? Not necessarily, if you accept that we are just a service activity working within the established social order and not presuming expertise we don't have. But, this theory of action, like every theory of action, presupposes a theory of knowledge. What is the knowledge we have that determines our actions? Obviously, it is not just that we serve the users, because we don't blindly, without any coherence or continuity, meet *seriatim* every succeeding individual's user needs; indeed, how could we organize our access to the materials if we did not have some predetermined view of what users in general might want? It is also clear that our actions in relation to records do not reflect just what the historical sequence of users has sought. If that were the case we would have no expertise beyond what search engines and citation indexes can do. It is thus difficult to construct a theory of knowledge that accounts faithfully for what the professional information community does purely on the basis of serving the users: there has to be something that goes deeper into the intellectual justification for our actions. Perhaps more importantly, we need not just a policy-level *dictum* about the reasons behind our actions but also an understanding of the process of reasoning that provides us with a justification for our actions that is deeper than just a desire to provide a service. The emotional commitment to serve is unimpeachable but more significant is the process that identifies for us the principles that give the reasons for our willingness or determination to act in a certain way – the way that we call professional for the information professions. The field of LIS gives us those principles, along with other intellectual equipment, and should be concerned with developing the theory of knowledge that underlies our professional activities.

LIS has successfully developed, or inherited, a body of knowledge that serves our activities by building the theoretical structures that support our technical operations – the theory of information retrieval, or of indexing, or of classification, etc. These are not our immediate concern here. We have three other areas of intellectual concern to explore. First, there could be some theory about the readers or users, that is, some theory about information behaviour. Second, there could be some theory about the society we serve, such as theories about knowledge societies or information ages or the way information and knowledge circulate and affect our societies. There has been no shortage of work on these topics and they seem to be regularly revisited by numerous disciplines. Their attraction for LIS and its related professions is that the ideas about information societies would seem to make the information professions central in modern society, but if that is true we seem to have lost that place to those occupations more closely identified with the electronic manipulation of the information. Third, we could have some theory about information or knowledge itself. In fact we have a long record of producing theories of information and, rather startlingly, and unlike theories about knowledge societies or information behaviour, they don't seem to get used, to lead on to anything else, or to determine the character of our field or of the information professions. I do not know what it is that we currently cannot do because we do not have a universally accepted (within LIS) definition of information. This, the persistent development of unused theories of information, is one of the paradoxes we must confront.

Examining the way we have tried to develop some theory about information is particularly poignant now because the vastly increased availability of information in the world has not led to better decision making – in fact the increased speed at which information moves to ever more people, in ever more formats, seems to increase economic volatility in the world. At the same time, we have better than ever search engines, larger libraries than ever before, larger annual totals of books and journals published and data sets stored and accessible, and better than ever means of social information exchange through new social media. The information professions have had unparalleled technical success but at the same time access to information is taken more for granted and the quality of decision-making seems not to have been universally improved (even if it is no worse). There must be some question about the overall point and success of information delivery in the world. For example, nobody has suggested that Shakespeare could or would have written better plays and poetry, or Kant better philosophy, if they had had the kind of access to information that we have today. Yet the more traditional information professions are said to be more under threat than ever before in my professional lifetime. There have always been, since the introduction of computers into non-scientific life, predictions that we will live in paperless societies and that computers will replace libraries and librarians. A current version of that focuses on the 'disintermediation' that online searches allow, cutting out the need for a librarian. The move whereby publishers build social media systems to allow direct access to their publications is another aspect of this.

What is the place of information and theory about information in this picture? As said earlier, all theories of action presuppose a theory of knowledge, and it would seem obvious, useful, and necessary to have a useable theory of information as a foundation for the construction of an information science. In fact, it seems anomalous to make claims to an information science unless we know the place of information within it. However, just making a statement about information does not seem sufficient. We need to know what we can do with a definition of information or a theory of information. We also need to know how we stand in relation to other disciplines even if we do have a satisfactory theory or definition of information. We have to show that the theory of knowledge underlying our actions is enough to sustain a claim to being a discipline worthy of recognition as such by other fields. To that end we need to show that we have the characteristics of an academic field of study.

8.3 Reconceptualizing Information Science

What would characterize Information Science if we were to start it afresh? It is a disadvantage that the field has such a variegated set of origins, and that primacy goes to whatever background any individual participant may have. Broadly, and probably incompletely, we could trace an historical sequence that started with librarians, and possibly archivists. These people could be identified with our concern with sources and materials. The field then attracted those working in scientific information who typically came into the field from the experience of working as scientists. These people brought with them a concern for slightly different systems, wanting more indexing and slightly different and more precise classifications. They also developed the concern for user behaviour and started the study of information. Latterly the field attracted managers and computer scientists. Computer science itself also developed a very successful approach to information retrieval. The field began to develop different manifestations or conceptions, mutating as it did so. According to your perspective and your sense of what is mainstream, all the other elements might be seen as space invaders, bringing their own intellectual baggage with them and adding to the intellectual tool kit of the field while also changing its sense of central purpose.

The way conceptions develop, and the way the field mutates from one conception to another, I outlined in *Meaning and Method in Information Studies* (Cornelius 1996b). However, no set of explanations of how LIS came historically to develop as it did can be a substitute for an intellectual analysis of what it is, and does, now, even though such an analysis would inevitably reflect that history. If we were to set out the ideal characteristics of any subject, we would probably recognize a set of topics or problems or phenomena, a set of methods or approaches, and a set of explanatory or predictive theories. We would also see that other disciplines could recognize those characteristics and could accept that they constituted a real subject, that the subject had a claim on intellectual space within the academy, and that the resolution of the problems, or the development of further theories or knowledge about the phenomena of study, were necessary for the advancement of knowledge and human progress. Does LIS meet this standard? At present I think it has not unequivocally established that it does, and in consequence we are faced with the task of, at least, epistemological repair. I think the task is no worse than that, and that the work we have done so far in LIS can be part of a successful presentation of what we do. We can find a theory of knowledge to underlie our actions in LIS, and the actions of those in the information professions. Some disciplines have established themselves beyond question: mathematics and philosophy are examples. Others, and that includes LIS and its manifestation as Information Science, have to work harder for acceptance, status, and, critically, resources. For some fields, such as History, just doing it, within the accepted rigorous methods of the field, seems sufficient, because the need for history and its role in our lives and our society seems to be accepted without need for further justification. The purpose of history is generally understood. LIS needs to get itself to that situation and can do so by a more exacting examination of its central concepts and mechanisms.

The mention, above, of progress introduces another consideration and some further constraints on the field of LIS. What is it that drives our belief that information is, colloquially, 'good for you'? We are driven by a foundational belief that making information available to people is essential for certain purposes and also desirable. At this point I should say, parenthetically, that I am using the word 'information' in three distinct senses. Here it is the common usage that is employed, the sense that information relates to data found in real or virtual documents. (The other uses will be introduced later.) I want to claim that, although we have had libraries and records for thousands of years, this foundational belief in information and its provision is a development of, or at least co-extensive with, the Enlightenment. The belief that the application of reason to problems and to the understanding of the world makes it a better place, puts us more in command of our environment, and, most crucially, develops knowledge to the point that humankind can progress and improve. The impetus that this has given to the generation, accumulation, and dissemination of knowledge both requires and assists the development of libraries and the spread of information or knowledge. Furthermore, we are told that the broad dissemination of information and its easy access through stores or online sources is essential for any democracy, in company with the spread of literacy and education. It is from within this tradition that our commitment to our current conception of our professional purposes may stem.

Of course, a concern with knowledge, and with the structure of knowledge, had been the concern of philosophers for millennia. In fact, librarians came rather late to ideas about classification. The failure of philosophy to arrive at a universally agreed structure of knowledge and the relationship of one subject to another was hindered by the onset, with the Enlightenment, of a restructuring of the academy and the subjects it contains. New subjects appeared in the, roughly, 1750–1850 (CE) period that previously lay hidden or undeveloped under other names. Physics, chemistry, biology, and their later derivatives like genetics, previously sheltered under the label ‘natural philosophy’, and the whole field of social sciences as we now know them developed with the Enlightenment. Although this did not change the process of reasoning about the classification of knowledge it certainly changed the practice of naming branches of knowledge and the process of drawing linkages. Philosophical speculation about the order of the sciences stuttered in the early nineteenth century and proved decreasingly helpful for the new fashion of arranging books in libraries by subject and of opening up the shelves to direct access. The library community’s response resolved, up to a point, the practical problem but separated librarians from deeper analysis of knowledge. The down-side of Dewey’s decimal classification was that it concentrated librarians’ attention on the practical arrangement of books and on the notational aspects, rather than on the ideational problems, of classification. I identify this as one of three critical developments that have separated LIS from the character of mainstream academic subjects and which, ultimately, have served us ill.

8.4 Three Problems of LIS

On the surface, the development of workable classification systems is a mark of the success of the information professions. This is a matter not just of arranging books on the shelf but also of bringing together works on similar topics in a way that has been replicated in indexing systems and the search engines of online services.

However, success in practical matters speaks to the potency of the profession but does not supply the necessary theory of knowledge that underlies such actions. Has technical success determined the purpose of the field and associated professions, or has it led us into a blind alley with no further room for development? Are we resolving general problems about information, or knowledge, or are we just dealing with technical issues? The success of practical solutions has turned us away, for the most part, from association with work on the organization of knowledge being done in other disciplines, and separated us from continued connection with more abstract work on knowledge and the place of information in our lives. One of the claims made for good theory – good in the sense that it explains more and can predict more, thus guiding action – is that a good theory of any subject will allow the generation, as an automatic consequence of the theory, of further testable hypotheses which will extend the range of the theory and the amount of knowledge on the subject. It is not clear to me that LIS has been able to develop in this way and in particular that the efforts to generate theory about information have proved as fruitful as we could wish. I suggest it is time to change our approach.

The shift of focus from books and, latterly, journals to information takes us to the second great snare in which we have become entrapped (the first being the preoccupation with solving practical tasks). I refer to the move to make the study of information a science, mimicking at first the methods of the physical sciences and settling into the more Positivist model of the social sciences. The social success of science over the last few hundred years has made its methods and approaches particularly attractive. Disciplines that seemed to be scientific had a built-in advantage in securing credibility. LIS was in the position of supporting the practical business of the information professions and the technical systems they used: scientific method seemed the best way to find evidence to support product and process development. Understandable though this was, and is, I believe it has taken LIS down a route that is ultimately misleading, because I do not believe that the basic entities we are concerned with, human information users and information resources, are similar to the basic elements of the natural world that constitute the focus of science. Attempts to show that information is like matter or energy, or a process, or some product of natural phenomena, have not progressed beyond assertion and remain, mostly, appeals to the significance and the invisibility of information by analogy. Had we been able to find some underlying tool, like mathematics, that would equip us to resolve the problems we face, then the scientific approach may have been adequate and profitable, but no such resource has emerged or has been found. The fascination with science has led us to concentrate on the phenomena we investigate as if they were objective facts about the world, to emphasize experimental methods, and to seek measurable properties. Even when work has been done outside a strictly scientific work-frame, there has in the past been a concern to satisfy criteria that mirror, equate to, or replicate, those of the conventional sciences. Working to seek a correspondence between our methods and theories and an objective external world might have given LIS much of the methodological security of science but has come up short on producing a discipline of information.

For LIS, the problem with the scientific approach arises because the phenomena we investigate are social products and social 'facts' (that is, social inventions), which cannot always be treated in the same way as the phenomena of interest to science. Information is not only a social product in its physical form but even in its logical form (as content) it is without meaning outside the social practice that produced it (Cornelius 1996a). So far we seem to have lacked the level of self-confidence that has enabled other social science disciplines and the humanities to develop and sustain rigorous methods that give them the security of rendering a satisfactory account to themselves, and to others, of their work. Our involvement with science has been reinforced by the need, given our attempt to work as a science, and to build systems, to treat information entities as if they had an objective independent existence and could be treated as items within a class. It is only by accepting that claim, and operating as if documents and their logical surrogates[1] had objective and real existence, that we can manipulate representations of information in our systems. We have therefore a commitment to believe in the objective properties of the data that we call information, and to believe that the data elements and sometimes the documents can be recognized and accepted as coherent discrete meaningful entities.

While strictures about scientific method, and about disciplines attempting to legitimize themselves by mimicking science, are common but lack impact when there are successes to acclaim, it is also true that the humanities have seemingly not supplied a substitute. The seeming failure of the humanities to provide us with an alternative set of methods that would enable us in LIS to establish the theory of knowledge we need has led us away from potentially productive forms of investigation. I refer, *inter alia*, to questions about the aesthetic qualities of information and its associated products and services, and to the rich tradition of the humanities in developing understanding of practices. This brings me to the third critical development: the concentration of attention in LIS on information as a phenomenon.

The acclaimed success in 1948 of Shannon's work on information, despite being a mathematical solution to an engineering problem, encouraged the growing tendency in LIS to see the question of information, particularly scientific information, as the central issue in the field. The flow, accelerating at that time, of people with scientific experience and backgrounds into the information professions, also helped build a concern with information as a central issue for the field. In *Meaning and Method in Information Studies* (Cornelius 1996b), I showed how different conceptions of the field can appear, grow, become dominant, and fade. Apart from 'information' itself, LIS has also invested in systems, users, institutions, materials, and professional techniques as central issues. The 1948 London conference on scientific information accelerated this trend. We have had a

[1] I use 'logical surrogates' to mean all things like abstracts or catalogue records that can represent the content of a document.

long series of investigations and claims about information since that time, many of them reviewed in Bates' (2010) recent article in the third edition of the *Encyclopedia of Library and Information Sciences*.

Historically, most of the other claims about information have hovered around the idea that information exists in the world, that it is a basic element in the universe, that it exists independently of human beings, and that it is a fact, a phenomenon to be investigated. Work on information, broadly speaking, emphasizes either the need for a definition of information or for a theory of information, often associated with a concern to measure or quantify information. My concern is not whether or not information is an objective fact; my concern is with the methodological point about the way we should handle our approach to the question of information. I want to shift attention away from information as one of the problems or facts we must deal with and to concentrate instead on information as part of the apparatus that we use to construct the field of LIS. So, instead of seeking a definitive and final definition of the fundamental phenomena we investigate – information, or seeking associated explanatory theories of information – both of these being presumed tools that would enable us to conduct information science, I wish to step back and consider from a different perspective the problem of a definition of information and the connected problem of the proper role of theories of information.

8.5 Rethinking Information

I am encouraged in this approach by the reflection that library users do not approach a librarian and ask 'I think I want some information, but as I don't know what information is then maybe I really need something else'. Nor do readers say 'I need some information, but maybe it is facts, or data, or knowledge that I really need, and not information'. The common work experience we have does not invest the term 'information' with some specialised technical meaning; it seems to be just a word which stands in place as a dummy argument, a spur to dialogue. To say 'I want some information' is not like saying 'I want some food', or something more specific like 'lunch', or 'a salad' or 'an apple'. We use the term 'information', if we use it at all, as a placeholder. It is not as if information, or items of data, were just lying around waiting to be found and picked up, like fruit that had fallen from a tree. In that example, we invest what we find under the tree with the label 'fruit' because that helps us understand what it is and what action we can take about it. The individual data elements or the complete documents containing the data might have some independent coherence and meaning for us but we can't say axiomatically that all such items do have that characteristic and that, as such, we can guide our own reaction to them by labelling them information.

To make this point another way, when we conduct searches we know already what kind of answer we expect. The answers to the questions 'When is the next train to Paris?', and 'What is the theory of relativity?', are unlikely to be confused and we would know if we had been given the answer to a question other than the one we had asked. Of course, some theatrical farce turns on confusion about responses to questions, but we in the audience laugh at the apparent confusion of the actors; we are not confused as members of the audience. Some other dramatic genres make use of ambiguity to conceal from the reader or audience the proper significance of a statement. The point here is that in seeking information we seek to avoid ambiguity, so much so that when using online search engines we use all the available devices to be more specific about our request so as to exclude the irrelevant; however, in doing that, we also show that we have some idea what the answer will be. The 'information' that we seek is not just something 'out there' which we have to uncover, it is something that happens to match the conditions of our request – it is as if we knew how to formulate a question that would have the possibility of an answer being found. Of course, a more expert enquirer might want a more sophisticated answer than a casual user would be satisfied with, but in each case they seem to know when they have what they want because they stop searching. In each case, the understanding of what constitutes information, or 'the information' is conditioned by the social practice of which they happen to be a participant and by their own status (which might be dynamic) within that social practice. It is the context of the practice that makes something 'information'.

For us to build a discipline that has some real-world correspondence, we have to start with the way the term 'information' is used in the real world. It is, as indicated above, a generalised term that stands as proxy for something else. It is, possibly, not something in itself. (Even if it were, following my characterization of the way the term is used colloquially, we would have to have good reasons to pursue that idea of information as opposed to the way it is used by people. What is the point in having a definition of something just to have a definition?) The word 'information' is used extensively in all fields and disciplines, mostly without any extended meaning but occasionally as a specialised term, along with an associated information theory, in particular practices or disciplines. What distinguishes LIS from the others is that no other field is at risk if its understanding of information, or information theory, should fail, mutate, or fall into abeyance. LIS, in contrast, if it really claims to be a science of information, would seem to be more at risk.

I contend that there is no real-world 'information' out there to be defined external to the social practices in which it occurs. In consequence, I think we are at risk if we pitch ourselves into the casual and contingent everyday and everywhere use of the term 'information'. We need to build our own technical sense, or senses, of the word, which plays a role in our own construction of our discipline. As part of our methodology, it must help explain our understanding of the problems we identify as proper to our field and it must supply a means to explain how we resolve them and how we perceive the universe of information that is specially the province of LIS.

Our use of the term 'information', and our construction of theories of information would be more productive if we focused on social practices. Crucially associated with this is the claim, a central point for my argument, that we as information professionals are a social practice and we construct our ideas about information and our theories of information in our constantly developing attempt to understand how information is used. Each attempt to formulate a definition or a theory of information is not, as we tend to have seen them, yet another almost useful but ultimately discarded exercise in discovering the Newtonian moment for our discipline, but rather the continuing process of proposing a standard against which we could assess the success of our own efforts to understand, and our professions' efforts to provide, information. Two things follow from viewing the process this way. First, the work so far on defining information or articulating theories of information should not be seen as wrong, just wrongly understood but still useful. Second, by using our work on information as a standard or benchmark, we will be able to use it reflexively to assess not just our success in providing information but also to assess our own disciplinary mechanisms, methods, and meanings. Several questions follow from this claim and I wish to respond to the following points. First, my claim that information is tied to the social practice in which it occurs would seem to support claims that limit the meaning of information to particular social practices. It may be that in certain practices, 'information' does have a tightly circumscribed meaning, but such incidence does not limit my claims or arguments.

To clarify the character of my claims about the way we construct information, I will explain some aspects of the process of construction and I will examine how some other points about information are consistent with constructivist claims. I will also show how we can use our constructed theories about information normatively to help build an information science. In effect, in this interpretation, 'information' becomes a proposal, a putative solution to a problem, and it can be used as a tool of enquiry as well as a benchmark or standard. (This is the second sense in which the word 'information' is used in this chapter.) This approach to information also frees LIS from commitment to any one definition. But, as we shall see, the corollary is commitment to a standard of enquiry that is stringent and exacting but one that will give LIS a more useful device for building the discipline. It will also free LIS from the fruitless quest for a single 'right' definition of information, the one enlightening description that discovers as well as defines information and reveals to us our raw material and our purpose. In contrast, we don't have to discover information, we just have the properties that we, for any particular scholarly enquiry, would like it to have.

Does all this mean that we should abandon attempts to find realist definitions of information as something that exists independently in the world? I don't think so, because although some people might think that information really does exist 'out there', from my perspective 'out there' is also a social construction: it's just that such a search will be unproductive. By adopting in preference the approach I am proposing, we will have more potent tools of enquiry that will assist the building of LIS, for the construction of information allows us to specify the consequences of a particular construction, giving us also an explanation rather than just a description. This becomes possible because we can seek reasons for understanding something as information, and those reasons will be dependent on the principles that give rise to them.

8.6 Information as Enquiry

Economists speak of notional markets where there is perfect information – all participants in the market have all the information, so there is no unevenness or inequality or lack of knowledge. In such a situation, if it ever existed, information would not be a problem and it could be ignored. Attention would concentrate on other issues. So, the need for information arises only when there is some disequilibrium or problem. Actually, to say that information is needed is to jump several steps in the process. We do this because our primary interest is in the practical action that needs to be taken. We don't seek information just to find it, we invest in the search because we need to do something which can only be done with the information we seek. To uncover the steps that have been jumped we can conduct a thought experiment. You may take public transport to work every day, and you probably know when you need to be at the bus stop or the train station. But just to know that is dependent on an extensive structure of practical knowledge. You need to know which form of transport, train or bus, is right for your journey; you need also knowledge of the transport network, the web of bus routes, and how to choose the bus that gets you closest to your work. You also need to know the frequency of the buses, the nearest bus stop to your home, the nearest bus stop to your workplace, and the journey time. Without some of this information you might not get your bus. But you would know that you needed that information; it would be the putative solution to your problem.

But even this is to miss some steps in the process: you need to know that you need that information. Without knowledge of that structure, you won't know what information you need. The situation of someone arriving in a strange town and unfamiliar with public transport networks is more complex. For that person to construct the structure of information and to identify the particular components of that structure they need to be able to put together the knowledge that allows them to act – action in this case being movement to the right bus stop at the right time. So, information is not just something that is 'out there', it has another dimension. The information, we hope, is 'out there' in some form that we must learn to identify, and we must learn how to formulate the question that enables us to identify the form, and the documentary form, of that information. We may at times be formulating ideas about the knowledge structure that identifies information we need that in fact does not exist and is not 'out there' in the world, but the information analysis remains valid. A natural example would be about tomorrow's weather. Of course, rarely are we in totally uninformed states: mostly we have some idea of what we seek and how to seek it, but that is because we have been schooled, either formally or by experience, and we have learned, in a similar way, to generalise from experience to the point that we are constantly aware that we may confront information problems and need to develop general templates to guide our actions. The information problem may be reduced by the way we learn to live in the world or by formal instruction but, in essence, the problem remains the same: catching the bus requires some theory of knowledge to guide our actions and although individuals may be equipped in different degrees to cope, the basic information problem is the same.

However, the picture is still not complete. We need to identify the limits of information enquiries. Questions like ‘Should I go to work?’ really are moral rather than information questions; they are seeking to identify what is right or what is good, and they are not directly information questions. However a related question, ‘Could I go to work?’ is a question as to whether something is possible, and remains within the information realm. So, information science, in formulating a potential solution to a problem, might be using the same structure as ethics or philosophy but it is confined, as philosophy is also confined, to part of the spectrum of questions that could be raised, and it is, like philosophy, putting forward a putative solution to the question about appropriate actions. So, like philosophy or, more strictly in this case, ethics, in information science we seek an answer to the question ‘How shall we act?’ by producing a set of possible ways to proceed. Ethical enquiry would ask two associated questions, already hinted at, questions of right and good. It is in providing answers to these questions that we discover the particular nature of information. Is the stuff about bus times ‘good’ – or as we might say, ‘useful’? Does it constitute information? It may be that it is good for you, because you did not know this potential solution to your question ‘What should I do?’, but it may be no good for me if I don’t work at the same place as you. Is it right? If it provides you with the information you need to get to work, then it is right. In that sense it has a truth value (‘this proposition about how you might get to work, if you follow it, will get you to your work’). The information is the construction that turns out to have an empirical verification, but it is also a product of the practice you are in for reasons that take us further back into the decision-making process.

The question ‘how can I get to work?’ is a very superficial question with a simple answer, one that is easily tested with a small piece of information that was specifically constructed to answer questions like this – the bus timetable. When we have in our hands a document like the bus timetable and we are acting as a cataloguer who is in the process of ascribing and attaching metadata to the document surrogate, in this example attaching index terms, we typically reverse the process described above by asking ‘given a document of this character, and with this content, what kind of terms would be used by someone trying to solve a problem that could be solved by the contents of this document?’ We then attach the chosen index terms, rather like bait to a hook, and hope that if someone at some time formulates a potential solution to a problem about action, that they will use the index term we selected that will retrieve this document. The processes of indexing have always assumed the same line of argument that I have advanced here for formulating our idea of information. Poorly chosen index terms will mean that a document is never retrieved or that it is retrieved as an inappropriate answer to another query – and what it contains never informs anyone. Of course, not only is the bus timetable not information, it is not even factual. It is at best some form of predictive data, and most probably a claim whose veracity lies in the historical record. The claim that the bus will arrive at a certain time is one we accept because we believe that, in the past, the bus did arrive at this time and, because it is in the timetable, we believe that all the actors engaged in the practice will ensure that the bus arrives at the time when people expect it. My claim is that it is not this data element that has a truth value (in the sense of correspondence with the real world) but the more general construction that, as a guide to our actions, leads us to this data.

8.7 The Drive of Information

The theory of action that leads us to certain data elements has some validity for us if we can say that this action will resolve our problem. But behind the theory of action are other understandings, in particular a view about information in general. It is this 'information in general' (the third sense in which I use 'information') that needs further unpacking, because it is the concept that drives us to seek data.

We all know that ours is the information age, and thousands of publications over the last 50 years have enumerated, explained, predicted, and analyzed it for us. But trade, technology, and the use of information all sit within a social environment that understands the possibility of information. This point, and its implications, can best be illustrated by posing the question 'What kind of question has as its best answer something that involves seeking information?'. Remember that, at the start, we cited a question that involved making some ethical decisions but also had an information content that could be separated from the ethical question. We have created a world where the possibility of information exists, and it is the creation of such an environment that constitutes the world of information in general. (You could call this 'grand information', or an 'information consciousness'.) Imagine a situation where someone has a problem like how to get to work, and unless they already know how to get to work, by walking a familiar route, they have no means of finding out. They are innocent and naïve. It just does not occur to them that there might be information aids and resources that would tell them about buses and trains and their times of arrival. Not knowing how to resolve their ignorance, they do nothing. We, for the most part, live in a different world where we constantly have an awareness of the information resources available to us and we quite automatically think of information as being the solution to problems. In fact, the information professions have, in part, embedded themselves within a world of information resources where we strive to make information available. In doing so, we cut some corners because we don't think through the intellectual process of resolving a problem. We resolve the problem by generating a concept of an answer that leads us to seek information. We are only able to generate that sense of information as part of the logical solution to a problem if we have an understanding of a world in which information is available and there are devices that can guide us to it.

The example we worked through, of finding how to get to work, is very simple and can be simply resolved, but many questions require more complex answers. However, the logical process of generating the model of what the information answer would be is just the same. The answer to a question like ‘Should I invest in oil or manufacturing?’ will take you through the same logic but the data that your logic will lead you to seek will be much more extensive and complex than a bus timetable. Nevertheless, in both cases the information is a guide to action. The critical point about the information (and this is sense two of information: not the data but the logical process) is that, if your information analysis is good, it will lead you to the right information, or to the statement that no information is available. The test of the logic is the conclusion, which might be ‘What I need is the bus timetable’, or it might be ‘There is no information that can answer my question’. If your information analysis was sloppy, inexact, or incomplete, you would not be able to reach either of those conclusions with the necessary confidence. We need to think of what creates the general level of confidence that by using information a solution can be found: that confidence comes by sustaining a belief in the possibility of information, the right information, being available (in the sense that it exists) and accessible (in the sense that some logical process will lead to it). The question of availability is acute because there are questions we ask everyday that have only very imprecise information solutions. A question like ‘Will it rain tomorrow?’ might, with the right analysis, lead you to lots of meteorological data but it should also say that there is no certain information answer to the question. The same would be true of a bet on the outcome of a horse race. In that case, there will be a very large array of data, and opinion and analysis, about which horse might win the race, but it is in the nature of horse racing that we cannot know in advance which horse will win (except in the evasive tautological response that ‘the horse that finishes first, within the rules of the race, will win the race’). The question of accessibility is the justification for the work of the information professions – the collection of physical or virtual documents, the generation of useable surrogates and metadata, the ascription of index terms and classifications, the building of databases and refinement of search engines, the provision of reference and advisory services. All these build confidence in the existence of the information worldview that creates the possibility of logical enquiry leading to an information solution.

But what determines how all that information paraphernalia, all the tools that librarians and others create, comes into existence and takes the form it does? We can’t really say that databases are just waiting to be created or that indexes write themselves. An orientation towards what have been called information objects will lead to the production of something, but it is not clear that there is one and only one obvious type of information product or process and that type of product is what we will inevitably produce. The answer is easier to discern when we work from within subjects where we have the comfort, support, and structure provided by all those who have gone before and those who are currently working in the subject. If you construct a classified bibliography of a subject, you are hoping to provide something useful but you are also competing for attention and trying to occupy the central ground in the definition of what that subject is. If your classification and organization of the entries do not correspond to current convention, or do not provide an organization that is evidently superior, you will probably not retain the attention of your target readership. They want something that helps explain the subject to them but which also resonates with all other readers in the subject and with a sense of where and what the subject is now. There is a perspective, a common view on the subject. Similarly, we could say that there is at any one time, and perhaps varying according to place and other issues, a perspective on what the information world is, what it offers, how it works, and what it is trying to do. Perspectives might change but we could say that if you are in the information professions, and maybe if you are in an information business with a product or process to sell, that you have to have such a perspective, in fact that it is imperative that you do. This is not to say there is a prescription on which perspective you might have but that you must have one. This perspective will animate your sense of what is to be done, and how. It will frame and condition the way you formulate the logical response to information problems. We can say both that you would have a concept of what the information world is and what it should be doing, and that various conceptions would enable the realization of that concept. In another work (Cornelius 1996b) I have discussed in some depth how conceptions of a subject are formed, and how they change, and there is no need here to go over that ground again, except to note that the conceptions are embedded in a particular social practice. There I showed how conceptions of LIS form and change: the process of forming conceptions of information will be similar but I am not making a direct claim that a conception of information must map on to a conception of LIS. We may expect such a correspondence but it may not be axiomatic. The conceptions will embody principles that lead to the reasons that support the conceptions and the process of analyzing information problems within them.

The point to make is that we have a concept that offers support to the theory of information actions. That concept is information (in the third sense in which I use the term, information-in-general), the idea that by using information (in all the senses in which I have discussed the term here) you can get necessary guidance for your actions. The particular conception will vary according to a number of other considerations that relate to your understanding of how an information analysis can guide actions, both in general as a universal statement about making use of information and, as an essential validation of the approach, in any discrete situation (otherwise the conception would have to be changed because it did not work in practice). The analysis that the conception provides as a guide to action in any one situation will lead to what we commonly group together as information resources. We need to say a little more about how these resources relate to the overall concept of information.

8.8 Professional Information Techniques and Resources

Most information resources exist anyway, at least all the primary ones do: whether they can help answer any queries is another question. Our professional concern is to work on these to produce a range of secondary or tertiary resources that describe, summarise, locate, bring together, or make accessible those primary documents and their logical contents. Historically catalogues, indexes, bibliographies, databases, search engines, classifications, calendars, and so on, all the tools of the information professions, have been seen as a by-product of the primary publications – you cannot have a database of things that do not exist. It may be that they come into existence this way, but I want to put the question 'How can you be sure that you can answer an information question, even if your logic of enquiry is correct?' The answer I propose is that the concept of information is realisable because these information resources, in particular the tools of the information professions, exist. They might be thought of as stemming from the primary publications they record, but they contribute to a system: classification schemes are for all knowledge, not just the small part of it represented by the materials immediately to hand. Moreover, classification schemes accommodate publications, and changing conceptions of knowledge, through time.

This is not to say that there can be no concept of information without them, but that the concept, just like the conceptions, is facilitated by these tools. So, in the construction I am putting forward, the existence, and continued development, of these information resources, the professional tools, should be seen not just as a contingent aspect of the information world but as an important component of the construction of a normative theory of LIS, supporting the concept of information as a guide to action. Because we know that there are information tools available that enable us to find facts and data, we can propose that there is an information-based answer to the question 'How should I act?'. Let me give an analogy. Most of the world's oil resources have existed undisturbed for millions of years; only in the last 150 years have we had the knowledge of their existence and location, the technology to extract and use them as heat sources or propellants, and the need so to use them. If there was a cheaper and more accessible source of heat and power we would ignore oil, and, similarly, if we lacked the financial or other resources to use oil we would use other means of transportation and ignore the oil. As things are, we think about the world in terms of oil: we are conscious of it as a resource. Similarly, with the (soft) technologies we have developed to locate and extract information, we think of the world in terms of the availability and utility of information. A visitor from another planet, or a poor person in a resource-poor country, might see things differently. Our consciousness of the general possibilities of information informs our consciousness and our sense of how we can act. This knowledge of the range of possibilities of finding useful data performs the role of the theory of knowledge that underlies the theory of information action. It gives us the principles that lie behind the reasons that justify our information inquiries.[2] It is this sense of the efficacy and possibilities of thinking in information terms when seeking answers to problems that all of us in LIS and the information professions have to protect and develop: it gives us the justification for our subject.

[2]There is much more to be said, more than can be dealt with here, about the way reasons and principles bolster these arguments about information.

We can illustrate this with aspects of the Enron story. Enron was a large American energy provider, the seventh largest corporation in the USA, that collapsed spectacularly in 2001, leading thousands of employees to lose their jobs and their pensions, landing some of its senior managers in jail for a very long time, and leading to the closure of one of the world's four main accountancy firms. Malcolm Gladwell (2009) recounts the story of Enron's collapse in a piece about the perils of too much information. Enron provided a lot of information to the financial markets, and even gave help to journalists who were trying to interpret the figures. Companies need good write-ups in the financial press and good ratings from the ratings firms to maintain their share price: they have to look like a good investment; otherwise their investors get worried. Enron filed all the necessary reports but it also engaged in activities that, as it was a very large company, generated huge quantities of information. Gladwell distinguishes between puzzles, where there is information missing, and mysteries, where there is too much information, so much that it is difficult to see the real picture. Enron was a mystery, and the diligent searches of experienced financial journalists did not reveal the real picture of the company's finances. The availability of extensive information, the data the company was required to supply, and all the additional information it produced, either hid the true picture or obscured from the readers the core information that was crucially important to understanding it. Even experts who read through much of the data (in one case a 200 page summary of a 1,000 page summary of about 120,000 pages of submission) were unable to comprehend the exact situation of the company and doubted if anyone else, including the company auditors, did so. What led to the journalists' breakthrough? Of course we don't expect everyone to understand complex financial (or medical, or scientific) statements, but we expect experts to act as intermediaries, translating technical information into statements that we can all understand. That intermediary function is an important part of the information process. In Enron's case, the clue to its financial position lay in its tax situation, but understanding the tax code requires special training; it is necessary to know which questions to ask. When Enron's tax returns (paying very little tax) were matched against the other information it had filed (making large paper profits), it was possible to see, if you knew how to interpret both types of data, that Enron was in trouble. This brings us directly to the difference between the first and second senses in which I have used 'information' in this chapter. In the first, 'information as data', we can, at best, identify documents with some element in common and then gather them together but we cannot (in ordinary search operations) interrogate beyond that level. In the second sense I have used 'information', as the question that identifies the standard that must be met to satisfy the query, that is, the normative information against which the available data will be tested. The information about Enron was in the documents but not immediately discoverable by conventional searches. What was needed was a query that stated what kind of data was needed to answer the question about Enron as an investment, and an associated query about the documents that might contain it. That combined query, restated as a proposition that effectively constructed a normative standard for Enron to meet, was the real information. It was that which enabled the financial journalists and analysts to identify the real state of

Enron finances. LIS has to focus on its role in relation to that normative notion of information that others should conform to when using data, facts, or other contents of documents.

What I have proposed in this chapter is a challenge to traditional ways of thinking about information but it is consistent with most work practice in the field and with much academic commentary and analysis. The main departure I recommend is that we cease searching for a definition of information and refocus our theoretical constructions about information on the way it can be used and away from attempts to explain the raw data and documents we commonly call information. The point of this is to enable us to construct an information science that focuses on showing how information can help us decide how to act. We are able to do this because we have a concept of information as a resource in the world, but that resource is not the raw data itself, which can rarely of itself solve our queries. The resource is the range of secondary and tertiary services that guide us to the raw documents that might answer our queries if we have asked the right questions. The right questions are those that lead logically to a potential information answer. This constructivist account places LIS and the information professions within a virtuous circle of service and analysis. By approaching the typical and central problems of information science, such as the problems of information retrieval and the character of information use and behaviour from this perspective of constructed information, we can build a better science and we can make statements that can contribute to the work of other disciplines; however we cannot do this unless we subject our understanding of information to the kind of scrutiny that I have given it here.

8.9 Degrees of Compatibility

To illustrate how this chapter is consistent with other work on ideas about information, I refer again to Bates' encyclopaedia article on 'Information'. Bates reviews the work of 20 authors on information, which she gathers into seven categories. She refers to information as a term and also as a concept, although in neither case is the term used as a discriminating word. She gives considerable space to the ideas of Claude Shannon and Norbert Wiener, and some space to those of Karl Popper. Although it is conventional to date the modern era of information to the work of Shannon published in 1948, Shannon and Wiener were more concerned with the transmission of signals than with the logical content of any signal. Bates gives them space because of the continued attempts to apply their ideas in the social sciences and, she claims, their pervading influence in LIS that we cannot entirely escape. Popper did not fully develop in any publication his ideas about World 3, but they captured the imagination of several writers in LIS, including Brookes whose much-cited formula for information has never, to my knowledge, ever been put to any practical use (Cornelius 2002). Brookes (1980) claimed that information inputs changed the knowledge structure of a recipient's mind. It is not entirely clear if it is Brookes' claim that only material that effects that change can be counted as information or if any material (information) will have that effect. Brookes' claim seems to focus on an item of information, but that view is not inconsistent with my claims. If we rephrase Brookes' formula to state that it is information that effects a change in the knowledge state of a mind, and that what any query identifies as the material that can answer that query will be considered information then we see that Brookes' formula, restated, can have some useful application in LIS. Bates also cites several definitions such as that of Bateson (1972), ('information is the difference that makes a difference'), Bates herself (2006), ('information is the pattern of organization of matter and energy'), and others that are really too vague or general to be any use for our particular purpose.

More usefully, Bates mentions Dretske (1981, 44), whose tautological definition ties information to a signal – in other words to a particular item: 'information is that commodity capable of yielding knowledge, and what information a signal carries is what we can learn from it'. Again, the first part of Dretske's claim is quite consistent with a normative view of information if we invert the statement. When we, normatively, define information in the form of a proposition that identifies the information resources or data that can guide action by answering a query, we are asking for something that can yield knowledge (as long as we avoid the confusion that might arise if we attempt to discriminate between information and knowledge).

Bates also cites Fox's (1983) claim that information is a proposition that the recipient can know is true. This requirement for a truth condition places many restraints on information (for example, children are mostly not in a position to know whether information put to them as a proposition is true or not: they have to take it on trust, and sometimes things are conventions – how is it we know that 4 times 5 is 20?). However, the truth requirement is one that normative constructions of information can meet by being right. The normative formulation of an information statement ('the answer to your query is that the city bus timetable will show that the number 10 bus at ten past the hour will take you directly to your work place in 15 minutes') can have a truth value in itself. But, there remains a question as to whether you as the recipient of that information can know that it is true. However, what has to be true is not the fact in the life of the world but the statement itself, the statement that the bus will come at that time – whether it actually comes or not. The truth you have to be able to know is that the document in your hand does give you the bus times that you want – you have to recognise that it is a bus timetable and not some other set of times or numbers. Remember, the justification for our grand overall concept of information is that the information resources will reveal to you sources that will guide your actions. If the logic is right, the truth requirement is met.

Bates also quotes from Buckland's (1991) tripartite division of information as thing, process, and knowledge. Information as 'thing' echoes, according to Bates, Farradane's (1979) notion of information as a physical surrogate for knowledge. As such, it is quite incompatible with my claim and the way Buckland deploys his other concepts of information shows a concentration not on the logical question about something we want to know the answer to but on the notional impact on us when we receive it. Buckland also contends that almost anything, potentially, can be information, emphasizing his focus on objects and documents, or any signal source, rather than on the structure of enquiry.

Bates, most strangely, does not discuss the work of Belkin, except to mention him in passing as someone who has reviewed the use of the term ‘information’. Belkin is the author who has called most explicitly for a concept rather than a definition of information. Anyone reading this chapter and the structure I have used of concepts and conceptions will wonder why his work has not been mentioned previously. The reason is that my ideas needed to be put forward on their own account and not discussed within the framework of the work of others. Belkin (1978) called for a concept rather than a definition because he felt a definition had to be true whereas a concept merely had to be useful. He stipulated the properties that a concept of information should have, and they are more demanding than the formulation I have used. Belkin requires that any concept of information account for the effects of information on a user, the question of desired information, and for its use in the human communication process. Belkin thus wants his concept to account for the phenomena of a scientific enquiry, whereas I am using the concept of information as a means of explaining the way a science of information can be constructed. Belkin’s concept is neither normative nor constructivist.

Bates also mentions Floridi’s work as another attempt to build a particular view of information. Floridi (2011) identifies semantic information as ‘well-formed, meaningful, and truthful data’ – obviously consistent with the first sense in which I use the term, namely the everyday colloquial use of the term, but he sticks with the data as the locus of the information, and although he builds a complex defence of his analysis, I do not think he has developed the term in a way that usefully builds an information science, whatever else he might achieve. He claims that ‘Data are at the same time the resources and constraints that make possible the construction of information .... The best information is that better tuned to the constraining affordances available’ (Floridi 2011: 78). He thus directly links information to data, a position I am rejecting, and which an LIS that seeks to take command of its concept of information must reject too. However, he immediately continues, ‘Thus informational coherence and adequacy do not necessarily entail or support naïve or direct realism, or a correspondence theory of truth as this is ordinarily presented’, a statement that is more enabling of the position advanced in this chapter.

Floridi is attempting to build a philosophy, one moreover that makes information central to his claims (so it is more than a ‘philosophy about information’). He imposes requirements on himself that LIS cannot meet, and whatever insights his work offers, they do not allow the construction of a concept of information that LIS practitioners could relate to. His earlier claim (Floridi 2002) that LIS is a ‘practical’ philosophy of information, and in which he identified LIS as a materials-based science, is not repeated in, and that earlier work is omitted from the bibliography of, his recent comprehensive book (Floridi 2011).

8.10 Conclusion

I have proposed a normative theory of information. This is a theory of knowledge about the world and the information in it that supports a theory of information actions. It should be said that this is not an 'action theory' of information or information science. Rather it gives us an alternative to scientific approaches to the epistemology of LIS, one that does not depend on identifying information as a real thing in the world. This theory makes information normative by setting information not as the final retrieved objects of any enquiry, but as the logic that determines what type of statement would constitute an answer to the enquiry. This process must take place within a context of belief in the utility and availability of information as an aid to action and decision-making.

This is possible because the concept of information we have is given effect by the availability of information finding aids that make it possible to identify if anything exists that matches the normative standard we develop in any inquiry. That matching function which is made possible by the work of the information professions is the justification for those professions. The ethic of those professions is to sustain a normative concept of information, in one or another of its conceptions, that allows information to be a resource in the world and a guide for action. The three senses of information I have used should all be seen as part of the overall construction I propose.

It will be apparent that I have used the examples of Enron and of getting to work as cases of particular enquiries. However, the sense of my remarks is that the same process applies in determining what a concept of information could be: there is coherence of approach between the grand theory and ground-level information work.

A normative theory of information that also provides a theory of LIS itself will connect LIS more closely to other disciplines that seek to explain human actions. These disciplines are, mostly, in the humanities and social sciences, and the theory of LIS I have proposed connects, more closely than has recently been common, to the methods of the humanities. What is proposed will link LIS more firmly to problems that arise about the use of information and will divert the field from an unfruitful pursuit of a definition of information as some mind-independent objective fact.

Little that I have claimed in this chapter is in conflict with already existent claims in LIS and its approach to information. There is still the possibility of finding a definition of information 'out there' in the world, but because 'the world' is itself a constructed concept, that pursuit could only be procedurally rather than substantially effective. I ask that we switch our attention from the objects (that currently are held to contain or yield information) to the logical processes of thinking through information problems. Information science should be a way of solving problems by developing (rather than discovering) useful concepts. My claims need not interfere with attempts to make LIS an experimental science, but the constructivist account of information I have proposed will make a more coherent connection between information and LIS thought and actions.

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Chapter 9
Information Science and Its Core Concepts: Levels of Disagreement

Birger Hjørland

9.1 Introduction

This chapter is going to address some issues about information science (IS) or library and information science (LIS) as an academic field. The main purpose is to set up a number of interrelated dimensions or levels, which are perhaps often taken for granted, but are here considered to be in need for systematic consideration. Each level is discussed in a separate section:

2. Is LIS an academic discipline?
3. What are the various names given to the field? How do they reflect underlying conceptions of the field?
4. What is the aim of LIS? What are we trying to achieve?
5. What are the core concepts of information science?
6. What are the most important metatheories and research traditions in the LIS?[1]

In Sect. 9.2 the question is raised whether LIS is an academic field – and whether it is a good idea to endeavor to institutionalize it as such or not.

Section 9.3 constitutes the longest part of the chapter. In it, the many names that have been used in relation to the field (or significant sectors thereof) are presented and discussed. An examination of these names is necessary, for, if one is to discuss the nature of the field, one needs to be in the clear whether the various names used

[1]Two other dimensions also deserve consideration but will not be treated here for lack of space; they are embodied in the questions "What are the subdisciplines of LIS?" and "What are the most important disciplines related to LIS?".

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in relation to it have the same reference or whether, in fact, they designate different things. Furthermore, a discussion of the ways in which the field has been designated demonstrates that names are not just neutral labels, but are connected with different underlying views and perspectives regarding the field.

Section 9.4 discusses disagreements about the aims of the field and Sect. 9.5 briefly considers different suggestions as to what its basic concepts are. Finally, Sect. 9.6 examines different metatheories and research traditions. These last sections are the most important ones from a theoretical point of view because the conceptual and (meta)theoretical perspectives constitute the level that determines the answer to many of the other questions: for example, if you have chosen a cognitive perspective, then, by implication, the cognitive sciences are the most important related disciplines. Such metatheoretical perspectives also are instrumental in determining what is considered the aim of the field: If one considers the primary aim of IS to be to help people find relevant literature for a specific task, the discipline looks very different than it would to somebody who took its primary aim as contributing to the production of more user-friendly electronic devices.

This chapter shows the interrelatedness of all these dimensions or levels of disagreement. Most attention is here given to the problem of naming the field because such a systematic review has not been hitherto available in English. The question of metatheories (or "paradigms") has been considered in a number of publications, including many by the present author (cf. Sect. 9.6, below), but is still in need of further clarification.

9.2 Is Library and Information Science (LIS) an Academic Discipline?

In some ways it is rather evident that LIS is an academic discipline. We have schools or departments of LIS with professors, textbooks, study programs, and research activities all over the world. We have many academic journals dedicated to our field; the papers of these journals are indexed in bibliographic databases such as Library and Information Science Abstracts (LISA)[2] and there is a category "Information Science & Library Science" in the Social Sciences Citation Index (SSCI). Maps of the most influential researchers and research trends within LIS are often produced from citation indexes (e.g., White and McCain 1998; Åstrøm 2006). We also have many regular research conferences such as the Annual Meeting of the American Society of Information Science & Technology,[3] the biennial conferences of the International Society for Knowledge Organization (ISKO), and the biennial conferences on

[2]Meho and Spurgin (2005), however, confirmed earlier research findings indicating that LIS literature is highly scattered and not limited to the standard LIS databases alone.

[3]*The American Society of Information Science & Technology* decided in 2012 alter its name to *Association for Information Science & Technology* (ASIS&T). By the time of the writing of this chapter, the change was not yet implemented.

Conceptions of Library and Information Science (CoLIS), as well as encyclopedias summarizing the knowledge in our field such as the recent third edition of the *Encyclopedia of Library and Information Sciences* (Bates and Maack 2010). In short, we fulfill all the formal, external criteria for being an academic discipline.

There are, however, two major challenges to the claim that LIS is an academic discipline. The first is that it is not a monodiscipline, but rather an interdisciplinary field.[4] The second – and more serious challenge – is that LIS is not a scholarly or scientific, but rather a "professional" field based on the teaching of some practical skills such as searching electronic databases and cataloging books according to certain norms, such as the Anglo-American Cataloguing Rules (see Sect. 9.3.1 below on library economy and, for example, Hjørland 2000c). On this view, LIS (despite the term "science" in its name) is not a science or an academic discipline.

Is LIS synonymous with information science? With library science? Are they one, two, or more disciplines? To make things even more complicated, the plural "information sciences" is also sometimes used. Machlup and Mansfield (1983), for example, suggested that one should speak about "the information sciences", just as one speaks of the social sciences (the plural form was also chosen by Bates and Maack (2010), the editors of the most recent edition of the *Encyclopedia of Library and Information Sciences*). How many information sciences do we have (if any)? What should be included in LIS and what should be excluded? Internet Research, for example, is sometimes reported in information science journals, sometimes in computer science or communication studies journals, and sometimes in journals devoted to Internet studies, among other fields. Is it a part of information science, of computer science, of communication studies, of all, or is it becoming a new field of its own? When do we use different names for the same field, and when do we use the same name for different fields? How can we find out?

Besides conforming to the formal, external criteria of disciplinehood, there is another dimension to being an academic discipline: the existence of theories and a body of relatively accepted knowledge that is considered the common reference point in the discipline. Can we identify LIS by such a body of knowledge? Consider what Michael Buckland has written about introductions to IS:

> One might have thought that, for so important a field, a general introduction would be easily written and redundant. This is not the case. Each different type of information system (online databases, libraries, etc.) has a massive and largely separate literature. Attention is almost always limited to one type of information system, is restricted by technology, usually to computer-based information systems, or is focused on one function, such as retrieval, disregarding the broader context. What is published is overwhelmingly specialized, technical, "how-to" writing with localized terminology and definitions. Writings on theory are usually

[4] The disciplinarity of a research field is usually determined by its leading research journals. This is, however, becoming much more complex because, as demonstrated by Chua and Yang (2008), authors publishing in the leading *Journal of American Society for Information Science and Technology* (JASIST) have grown in diversity from those being affiliated predominantly with library/information-related departments to include those from information systems management, information technology, businesss, and the humanities.

> very narrowly focused on logic, probability, and physical signals. This diversity has been compounded by confusion arising from inadequate recognition that the word *information* is used by different people to denote different things (Buckland 1991: p. xiii).

Cultural issues are often taught and researched at schools of LIS (in particular, in Europe, as is, for example, the case at the Royal School of Library and Information Science in Denmark, RSLIS). The researchers at such schools may be considered to be part of LIS, but many of them publish in other journals, attend non-LIS conferences, and so on. For many of these researchers, the formal, exterior apparatus of being an academic discipline that LIS possesses may not be relevant. What are today known as i-Schools, or LIS Schools, were once called library schools. This name signalled that their curricula were not based on any one scholarly discipline but rather consisted of a congeries of subjects supposed to be relevant for professional education. We may still have a mixture of fields rather than one coherent discipline. Some may even feel that the attempt to construe the field as a single discipline is not a good idea: We could say that there are not only centripetal[5] currents within LIS, which are directed towards constituting the field as a single, more-or-less unified discipline, but also a centrifugal[6] tendency, which relates the problems studied in the field to the context of other disciplines and so promotes intra-disciplinary dispersion rather than unity.[7]

Does that mean that LIS is an interdisciplinary field? The dynamics of specialties and disciplines are addressed by Tengström (1993: 12), who emphasizes that cross-disciplinary research is a process, not a state or structure. He differentiates three levels of ambition regarding cross-disciplinary research:

- The level of "pluridisciplinarity" or "multidisciplinarity"
- The genuine cross-disciplinary level of "interdisciplinarity"
- The discipline-forming level of "transdisciplinarity"

Tengström expresses the view that social fields are dynamic and changing. LIS, for example, can be viewed as a field that started as a multidisciplinary field based on literature, children's culture studies, psychology, sociology, management, computer science, etc., which is developing towards a monodiscipline in its own right. Whether or not this happens depends on the relative strength of the centripetal and the centrifugal tendencies at play within the field. The same is the case in regard to the question of being scholarly at all: The development of LIS into a well-integrated scholarly field depends on a sufficient number of engaged people willing to do the job at a truly scholarly level. It is important not to believe that somebody else will do that for you.

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[5] A centripetal force is a force by which bodies are drawn or impelled, or in any way tend towards a central point.

[6] A centrifugal force is a force that tends to draw something away from the center. The concepts of centripetal and centrifugal forces were developed in physics but have also been applied to social phenomena by the literary scholar and linguist Mikhail M. Bakhtin; see Bakhtin (1981: 271–272). Cronin (2002: 5) also applied these concepts to information science.

[7] Becher and Trowler's (2001) discussion of "convergence" and "divergence" in research fields is related to the concepts of centripetal and centrifugal tendencies.

In some institutions, such as the RSLIS, both information science and cultural communication are researched and taught (within the same educational program). Although, as Buckland (2012: 6) has recently noted, information science is 'incorrigibly cultural', it makes a big differenc whether cultural communication and LIS are considered to be two different disciplines or whether cultural studies are viewed as (part of) the foundation of LIS. To the degree that LIS and cultural communication are considered two distinct fields (but united in the same study program), the education and the research tends to become fragmented like a patchwork. The danger in this is that students are not developing a professional identity and professional competencies in either field.

The conclusion is therefore that it is important that we build a discipline and consider the best metatheoretical alternatives for doing so. In this regard, it is important to select metatheories that promote a centripetal self-understanding of the field. After all, as Blaise Cronin (2012) has recently noted, "epistemic promiscuity comes at a price".

9.3 What Is the Name of the Discipline?

In this section, I am going to survey ten different candidates (and some additional variations) for the name of the field known as LIS in order to demonstrate that the name itself is one level of disagreement. The purpose of this exercise is to provide a background for the understanding of underlying theoretical tensions in the field, for a given name is not just a neutral designation, but something that involves a certain conceptualization of the field. By presenting and discussion the different labels, I aim to examine and discuss some of the important underlying views regarding the nature of LIS. Let me be clear: I am not claiming that these 10+ names are all synonyms. It is itself a controversial issue which terms are synonyms and which are not, so we cannot exclude any of them in advance. The presentation is also historically oriented because only knowledge about the development of the field provides a sufficient understanding that makes future conceptual decisions well-informed.

9.3.1 Library Economy

When Melvil Dewey established the first library school in 1887 at Columbia University in the USA, the field was termed "library economy". The Dewey Decimal Classification (DDC) used the term "Library Economy" for class 19 in its first edition, which was published in 1876. In the second edition (and all subsequent editions) it was moved to class 020. The term "Library Economy" was used until (and including) the fourteenth edition (1942). In the fifteenth edition (1951), class 020 was renamed Library Science; from the eighteenth edition (1971) of the DDC to the present, it has been called the "Library & Information

Sciences". "Library economy" is still used today in French and Italian under the forms "bibliothéconomie" and "biblioteconomia", respectively.[8] The term "library economy" seems to suggest an approach to the problems and activities of LIS that emphasizes practicalities, efficient management, and standards rather than a scholarly, theoretical approach. Brown (1903; 7th edition 1961) is an example of a manual that uses the term "library economy" and the contents of which reflect a thoroughly practicalist approach to the substance of LIS.

9.3.2 Library Science

The term "library science" was first used in Germany, where the first textbook in the field was published between 1807 and 1829 by Martin Schrettinger, who held that library science encompasses "all precepts necessary to the practical organization of a library, provided that they are based on sound principles and reducible to one supreme principle.... [namely, that] a library must be arranged in such a way as to render speedily accessible whatever books are required to fill every literary need" (translated definition cited from Schrader 1983: 36). Schrettinger's book is a systematic treatise on the principles of librarianship. However, as Vakkari (1994) writes, the scientific nature of Schrettinger's book is, to say the least, debatable (if "science" is understood as a systematic body of knowledge formed by the scientific method, consisting mainly of theories). It was "professional literature, not science". Vakkari found, however, that the development of library science as a science in the strictest sense was under way by the time that Graesel (1902) published his handbook on librarianship. The designation "Library Science" was also used by, for example, Pierce Butler, a prominent educator at the University of Chicago's Graduate School of Library Science, the first doctorate-granting library school in the United States, who authored a programmatic essay entitled "An Introduction to Library Science" (1933). Cronin (2004) considers the historic and contemporary import of Butler's book, characterizes the content of each chapter, and critically analyses the central theses. He relates Butler's positivistic premises, assumptions, and conclusions to the congeries of competing epistemological and ideological standpoints that define current thinking in LIS research and concludes, contrary to Butler's conceptualization of the field, that "There is, and can be no such thing as 'library science'" (Cronin 2004: 187), thus denying the possibility of a discipline of that name.

"Library science" is thus an old-fashioned designation for the field that we know today as LIS. A problem associated with this label is that core issues related to the development of library services are not specific to libraries, but may be understood as embodying principles common to other kinds of information systems,

[8]Examples of institutional names using the phrase are "L'Ecole de Bibliothéconomie et des Sciences de l'Information" of the "Université de Montréal" and the department of "Archivistica e Biblioteconomia" at the Università di Roma, La Sapienza.

information services, or documentation practices. For example, the indexing and representation of documents in bibligraphic records is not unique to libraries: indeed, most of the relevant principles used today have not been developed within the library community, but by other communities. This goes both for technical and management issues, which have been developed by, among many others, computer scientists, and for content-oriented issues, such as knowledge organization systems, which have often been developed by subject specialists. A core qualification of librarians is that they possess bibliographic knowledge of literatures. On the other hand, there still are research questions connected with the term "library" (such as library history, library management, and the social roles of libraries), which may not be covered by "information", "documentation", or other labels. This may be the reason why the label "LIS" is still preferred by some. The main objection to this term can be expressed this way: to name the field "library science" corresponds to calling medicine "hospital science": just as medicine is the study of health, illnesses, and their treatment (and not the study of hospitals), LIS is the study of information and document provision (not of libraries).

9.3.3 Bibliography

The term "bibliography" designates both a kind of document and a field of study. As a kind of document, a bibliography is characterized by the fact that it consists solely of references to other documents. The field of bibliography includes the study of bibliographies and the techniques for constructing them, bibliographical databases, bibliometrics (formerly termed "statistical bibliography"), as well as issues related to scholarly and scientific communication and to the study of texts and the history of the book.

The use of the name "bibliography" to designate the field known as LIS can be traced back to the turn of the last century: for example, Paul Otlet founded the *Institut International de Bibliographie* in 1895 and, by 1903, was trying to define "the science of bibliography". Alan Pollard and S. C. Bradford, who were strongly influenced by Otlet's vision of "bibliography", created *The British Society for International Bibliography* in 1927, while a *Department of Bibliography* was founded in 1944 at Tartu University in Estonia (in which a general course in bibliography was mandatory for all students in history and philology). The latter institution changed its name to the *Department of Librarianship* and in 1993 to the *Department of Information Studies* at the University of Tallinn. A similar development took place in South Africa where the *Department of Librarianship and Bibliography* changed its name to the *Department of Library Science* (cf. Dick 2002). Further discussions of bibliography include Balsamo (1990), Bates (1992), Besterman (1935), Blum (1980, 1991), Macevičiūtė and Janonis (2004), and Woledge (1983).

We observe that "bibliography" has been used as a name for what was later termed LIS, and this terminological shift has been accompanied by some voices claiming that "the bibliographical paradigm" is obsolete (e.g., Henri and Hay 1994). Hjørland (2007a) mounts a defense for 'the bibliographical paradigm': there seem to be no sound arguments for denying bibliography the status of being a core concept in the field. What is even more regrettable is that, with the marginalization of the concept of bibliography, there has also come a neglect of the description of documents and information sources for users. For example, in 1986, the American Library Association published a guide to the literature of the social sciences (Webb et al. 1986) which has not been updated since: this betokens a lack of interest in bibliography that, unfortunately, seems to be a general trend.

9.3.4 Documentation

The field of documentation (or documentation science or documentation studies) is associated with the movement founded by Paul Otlet (1868–1944) and Henri Lafontaine (1854–1943); as Otlet's foremost biographer has noted,

> The term "documentation" is a neologism invented by [Paul] Otlet to designate what today we tend to call Information Storage and Retrieval. In fact it is not too much to claim the *Traité* [*de Documentation* 1934] as one of the first information science textbooks (Rayward 1994: 238).

The relations between librarianship and documentation have been described in the following way:

> The main differences [between library science and documentation] were identified as lying in the areas of bibliography and what came to be called "documentation". Exactly what the differences between these new "documentalists" and traditional librarians were was not altogether well defined. However, there was general agreement that documentalists were concerned not only with the physical handling of documents, but, to a much greater extent than traditional librarians, with the exploitation of the information contained in the documents. This practical thread generated some of its own theory, a noticeable example being Bradford's law of scattering (Meadows 1990: 59).

When electronic databases became common in the 1960s and 1970s, searching was done by intermediaries who were referred to as (research) librarians, information specialists, or documentalists. Online intermediation was the last common job-function involving "documentation" in relation to information work: Danish research libraries, for example, had documentation departments until about 1990. With the arrival of end-user searching, this function was downgraded in most places (cf. Hjørland 2000b), and the use of the term "documentation" disappeared almost totally.

The label "documentation" has generally been abandoned in favor of the term "information science".[9] One especially salient case of this was the change in name that the American Documentation Institute (founded in 1937) underwent when it

[9]"The use of "documentation" has survived, however, for example, in the title of the prominent British *Journal of Documentation* founded in 1945.

became the American Society for Information Science (ASIS) in 1968 (Farkas-Conn 1990). Although the general trend has been to replace "documentation" with "information science" in the English-speaking world, a small but growing group of researchers has argued that the term 'documentation' should be preferred as a designator for the field (more about this in Sect. 9.5 below). In 1997, Tromsø University in Norway decided to use the term "documentation science" for its educational program, thus attempting revive the term.

Some benefits of the term "documentation" are that it is related (both historically and logically) to the term "bibliography" discussed above, and that it emphasizes aspects of scientific and scholarly communication that are relatively distinct from the more technical aspects of computer science and information technology; it thus both is expressive of a unique focus for LIS and provides a perspective more connected to the history and aim of the discipline.

9.3.5 Information Technology (IT)/Information and Communication Technology (ICT)

Information science is sometimes confused with IT and with computer science and is seen by some people as being primarily about IT and computers. One indication of this is that, in the year 2000, the American Society for Information Science decided to add "and Technology" to its name. Another is the tendency to merge departments of LIS with departments of computer science.[10] A third indication is that a core subfield, information retrieval, is dominated by the computer science community.

A historical examination of the meaning of IT is useful:

> In fact, the great majority of references to information technology have always been concerned with computers, although the exact meaning has shifted over time (Kline 2006). The phrase received its first prominent usage in a *Harvard Business Review* article (Haigh 2001; Leavitt and Whisler 1958) intended to promote a technocratic vision for the future of business management. Its initial definition was at the conjunction of computers, operations research methods, and simulation techniques. Having failed initially to gain much traction (unlike related terms of a similar vintage such as information systems, information processing, and information science), it was revived in policy and economic circles in the 1970s with a new meaning. Information technology now described the expected convergence of the computing, media, and telecommunications industries (and their technologies), understood within the broader context of a wave of enthusiasm for the computer revolution, post-industrial society, information society (Webster 1995), and other fashionable expressions of the belief that new electronic technologies were bringing a profound rupture with the past. As it spread broadly during the 1980s, IT increasingly lost its association with communications (and, alas, any vestigial connection to the idea

[10]Cronin (2012) wrote: "In the 1980s I was head of the Department of Information Science (Department of Librarianship in an earlier incarnation) at Strathclyde University; it has since been merged with the Department of Computer Science. During the 1990s and beyond I was dean of the School of Library and Information Science at Indiana University; in June 2013 that school will be merged with the School of Informatics and Computing."

> of anybody actually being informed of anything) to become a new and more pretentious way of saying “computer”. The final step in this process is the recent surge in references to “information and communication technologies” or ICTs, a coinage that makes sense only if one assumes that a technology can inform without communicating (Haigh 2011: 432–433).

Today IT is often used *retronymously* about media for recorded knowledge and libraries. Johann Gutenberg’s invention of the movable type printing process in 1450, for example, is today often mentioned in histories of information technology (e.g., Butler 1997). But it is important to consider that IT implies a specific way of conceptualizing media and libraries.[11] It is a conceptualization that may be useful for automating libraries but problematic for understanding the qualitative, content-oriented functions for supporting learning, research, and cultural development.

There is today a tendency to consider IT as a new discipline independent from computer science. The establishing of special journals and educational programs is an expression of this trend. The *Journal of Information Technology* and the foundation of the IT University of Copenhagen[12] in 2003 serve as examples.

There are different attitudes about the relation between LIS and IT. Some researchers who espouse a “systems driven paradigm”[13] may understand LIS as part of IT while others, for example, Buschmann (1993) are very critical of this view. It is my own attitude that the strong confusion of LIS (or IS) with IT has deprived the field of some of its core perspectives and thus caused a crisis of identity for the field. As Warner (2010) notes, current work on information retrieval (IR) often overlooks perspectives derived from LIS tradition. Warner (2000) and Finnemann (1999) emphasized that IT should not be seen only as a driver of development, but that it is given form and function by social, cultural, and political needs. The technological determinism often inherent in the notion is strange since the computer is a cultural artifact, a product of human ideas and physical work. This view may provide a platform for establishing one or more disciplines concerned with the humanistic aspects of IT. In Denmark (at least) “humanistic IT” (or humanistic informatics)[14] is an emerging field which so far has lived in isolation from LIS, though there are now signs of a rapprochement between the two fields.

[11]Wiener’s (1948: 16) seminal book on cybernetics stated: “Society can only be understood through a study of the messages and communications facilities which belong to it.” Today this view is often associated with the much-criticized concept of “the conduit metaphor”.

[12]http://www.itu.dk/en/

[13]Korfhage (1997), a book that reflects an understanding of IS and LIS from a computer science-inflected perspective, was the winner of the ASIS 1998 Best Information Science Book of the Year Award. That book could also be considered a representative for the “systems-driven paradigm” in IS. Saracevic (1999: 1057) describes the “systems centered approach” (and its alternative, the user centered approach): “We now have two distinct communities and approaches to research in the retrieval cluster. They became commonly known as systems-centered and user- (or human-) centered. Both address retrieval, but from very different ends and perspectives”. A criticism of this dichotomy was given by Hjørland (2010).

[14]Humanistic IT is a humanist approach to IT and should not be confused with IT for the humanities (humanities informatics).

9.3.6 Information Science(s) (IS), Information Studies/Information Science and Technology

The American Society for Information Science & Technology (ASIST)[15] is one of the most influential organizations in information science today. As noted in Sect. 9.3.4, it changed its name from the American Documentation Institute to the American Society for Information Science in 1968. The overall trajectory in the development of the self-designation of this leading professional organization reflects the fact that information science developed from documentation (see also Kline 2004).

In the year of the name shift to *American Society for Information Science*, the society's journal published an article by a leading information scientist entitled "Information science: What is it?", in which the field was defined in the following terms:

> Information science is that discipline that investigates the properties and behavior of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability.
>
> It is concerned with that body of knowledge relating to the origination, collection, organization, storage, retrieval, interpretation, transmission, transformation, and utilization of information. This includes the investigation of information representations in both natural and artificial systems, the use of codes for efficient message transmission, and the study of information processing devices and techniques such as computers and their programming systems. It is an interdisciplinary science derived from and related to such fields as mathematics, logic, linguistics, psychology, computer technology, operations research, the graphic arts, communications, library science, management, and other similar fields. It has both a pure science component, which inquires into the subject without regard to its application, and an applied science component, which develops services and products (Borko 1968: 3).

This definition has recently been criticized by Capurro & Hjørland:

> In our view, this definition does not contain a good identification of the special focus of information science. No science should be defined by its tools (e.g. modern technologies). All fields are supposed to utilize the most appropriate tools available. A science should be defined by its object of study. As such, the study of information is a better one. We need, however, to identify the specific role of information science in relation to "the generation, collection, organization, interpretation, storage, retrieval, dissemination, transformation and use of information" as distinct from the activities in which other professionals are more qualified. In our view, information professionals usually have a broad overview of information sources, sociological patterns in knowledge production, document types, and so on. They should also have a broader knowledge of the philosophy of science (e.g., paradigms and epistemology), and of the principles of language use for special purposes. We believe that the focus of information professionals (as distinct from the professional groups they are serving) implies a sociological and epistemological approach to "the generation, collection, organization, interpretation, storage, retrieval, dissemination, transformation and use of information". Information scientists – by the nature of the field – must work in a top-down mode from the general field of knowledge and information sources to the specific, while domain experts must work in a bottom-up mode, from the specific to the general (Capurro and Hjørland 2003: 389).

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[15] See note 3 concerning the recent name shift of this association.

This lack of a satisfactory definition of information science may well be correlated with the field's lack of institutionalization as a full-fledged discipline as noted both by Wersig (2000) and by a recent edition of the *Encyclopedia Britannica*:

> The institutionalization of information science as a discrete discipline thus has not occurred, and the number of its scientist-practitioners is low. Computer science and engineering tend to absorb the theory- and technology-oriented subjects of the field, and management science tends to absorb the information systems subjects. Hundreds of professional associations do exist that are concerned with information-related disciplines, providing a forum where people can exchange ideas about information processing (Encyclopædia Britannica 2013).

Sometimes the plural "information sciences" is used instead of the singular form, a *façon de parler* that makes the meaning of the term "IS" even more complex. Occasionally, a single author even uses the singular and the plural form without clarifying the difference.[16] Machlup and Mansfield (1983) suggested that one should speak about "the information sciences", similar to the way one speaks of the social sciences. How many information sciences do we have (if any)? Yet another variation is the label "information studies", which is also widely applied.

As stated above, in the year 2000, the American Society for Information Science decided to add "and Technology" to its name. The same name shift appeared in its journals.[17] The decision to alter the name in this way was made by the then president of the society, Eugene Garfield, although there was no discussion of the rationale for it in the research literature. The decision seems strange: the theoretical basis for much of the research in the field – for example, Garfield's own specialty of bibliometrics – derives not from technological imperatives, but rather from the insights of bibliography, sociology, science studies, and epistemology. The decision to adopt the new name was probably made in an attempt to recruit new members to the society rather than out of any deeper scholarly motivation. Yet, information science (as defined by the association and its publications) is not primarily about developments in IT such as storage technologies, programming languages, and so on.

The term "information science" is today well established and should be maintained in spite of well-founded theoretical objections. These objections can be met by combining it with other terms such as "documentation".

[16]This is, for example, the case with the journal "Information Sciences: Informatics and Computer Science Intelligent Systems Applications," which writes "Readers are assumed to have a common interest in information science, but with diverse backgrounds in fields such as engineering, mathematics, statistics, physics, computer science, cell biology, molecular biology, management science, cognitive science, neurobiology, behavioural sciences and biochemistry." The use of the plural form may be motivated by a desire to emphasize the interdisciplinary nature of the field, much as Machlup and Mansfield (1983) did. However, authors electing to use the plural form have a logical obligation to describe the different single information sciences and their mutual relations.

[17]Note, however, that the recently discontinued *Annual Review of Information Science and Technology* had this name from the publication of its first volume in 1966.

9.3.7 Informatics

"Informatics" is a term that can be traced to German *Informatik* (1957), French *informatique* (1962), and Russian *informatika* (1966).

> It is likely that the Russian, German, and French nouns were coined independently of each other. The three foreign-language nouns were originally semantically distinct: German *Informatik* originally denoted the automated processing of information, French *informatique* the branch of study dealing with information processing in general (although especially by automated means), and Russian *informatika* the theory of scientific information. However, in later use they also came to be used to denote the academic subject which is called computer science in English and this is now their chief sense. The same semantic development is also seen in their parallels in most other European languages, except in English (Wordwizard 2012).

The term "informatics" is sometimes used synonymously with "information science". This is, for example, the case in the definitions found in WordNet:

> Information science, informatics, information processing, IP (the sciences concerned with gathering, manipulating, storing, retrieving, and classifying recorded information) (WordNet 3.1, April 2012).

The Russian concept has played a role in LIS. The International Federation for Information and Documentation (FID) proposed the following definition:

> Informatics is the discipline of science which investigates the structure and properties (not specific content) of scientific information, as well as the regularities of scientific information activity, its theory, history, methodology, and organization (Mikhailov et al. 1967).

The *International Encyclopedia of Information and Library Science* contains both an article about informatics (Fourman 2003) and an article about information science (Bottle 2003), but it remains unclear whether the authors regard these words as synonyms or not. Sometimes "informatics" is used as a broader term encompassing both computer science and LIS.[18]

Although Wellisch (1972) suggested that the term "informatics" should be preferred for "information science", the term "informatics" is generally used in senses that are closer to information technology and computer science than to library and information science (LIS) and there is not much need for this extra term except in compound terms such as social informatics and medical informatics.

9.3.8 Library and Information Science (LIS)

The term "LIS" (also "library and information sciences" and "library and information studies") is a combination of library science and information science.

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[18]This is, for example, the case at the *School of Informatics*, University of Tsukuba, Japan, which is made up of the following three colleges: *College of Information Science* (here understood purely as computer science), *College of Media Arts, Science and Technology* and *College of Knowledge and Library Sciences*. (Information retrieved 2012-08-13 from: http://inf.tsukuba.ac.jp/eng/)

It is associated with schools of LIS, which generally developed from professional schools to research-based university institutions during the second half of the twentieth century. In the latter half of the 1960s, schools of librarianship began to add the term "information science" to their names. The first school to do this was the one at the University of Pittsburgh in 1964. More schools followed during the 1970s and 1980s and, by the end of the 1990s, almost all the library schools in the USA had added the element "information science" to their name. A similar development has taken place in many other parts of the world. For example, in 1997 the *Royal School of Librarianship* in Copenhagen changed the English version of its name to RSLIS. The name shift has generally been motivated by a growing emphasis on the application of new electronic and computer technologies.

The current Prorector at the RSLIS, Jack Andersen, articulates the following understanding of LIS:

> Library and information science (LIS) is the study of knowledge production as it is materialized in documents, and of through which channels this knowledge is communicated and how one can make access to this knowledge in terms of organization and representation of documents. In this way, the study of knowledge organization plays a crucial role in LIS.
>
> The study of knowledge organization has a long tradition in LIS. However, this tradition has been characterized by searching for techniques for knowledge organization rather than having arrived at a profound understanding of the nature and function of knowledge organization in society. Therefore, it is important to connect the study of knowledge organization and its problems with analyses of society's production of knowledge.
>
> In order to arrive at an understanding [of] the production of knowledge in society, philosophical, historical, sociology of science and knowledge, cultural, literary, and social aspects of knowledge production need to be recognized. Knowledge should not be conceived of as scientific knowledge only, but also as artistic, technical, and 'everyday life' knowledge; that is a basic pragmatic view on knowledge. A practical consequence of this conception must be to contribute to an understanding of why it is important to "keep the valuable from oblivion" (Patrick Wilson 1968, p. 1; Andersen 2011).

Today the terms "information science" and "library and information science" are sometimes considered synonyms, sometimes not (as, for example, in the aforementioned University of Tsukuba, Japan, in which Information Science is understood to be equivalent to computer science). In both cases, the term "information" should imply something broader than libraries, i.e., it should include the study of archives, museums, bibliographical databases, and the Internet.

9.3.9 Information Management (IM), Knowledge Management (KM), Information Systems and Informing Science

Information Management (IM)

The term "information management" has come into increasing use over the last 20 years. An indication of the trend towards IM is that the important *School of Library and Information Studies* at University of California, Berkeley, changed its name in 1995 to *The School of Information Management and Systems* (http://www.sims.berkeley.edu/about/history/).[19]

At the end of a study examining the field of IM, Maceviciute and Wilson came to the following conclusion:

> In the 1980s information management was emergent and perceived by some to be simply a re-write of traditional librarianship. However, it has continued to thrive and much of what is now included is far removed even from modern information science, although information management draws upon ideas from both librarianship and information science. In one form or another it is likely to persist in the future, since information problems are likely to persist in organizations. The means for resolving the problems may change, but the need to understand those problems and develop solutions will remain (Maceviciute and Wilson 2002: 26).

Wilson added, in the course of another study on the theme, that

> Whether information management is a passing fancy or a new way of considering the role of information in organizational performance must await the test of time; however, there can be little doubt that the concept has had a significant impact on the thinking of professionals working in a variety of fields. Managers of computer services have become information managers (and even directors of information management services); records managers, archivists, information scientists and special librarians have changed their titles and shifted their professional orientations; .... (Wilson 2003: 275).

IM is an ambiguous term. A part of the problem is that it has different meanings that are often not separated in practice. It can carry the following significations:

1. A process such as indexing (the direct management of information). The journal *Information Storage & Retrieval*, which changed its title in 1975 to *Information Processing & Management*, is a core journal in Information Science using IM in this first meaning, according to which the term is purely a synonym for information organization and retrieval.
2. The process of managing information services (e.g., library management, managing a team of indexers), that is to say, the indirect management of information in what have traditionally been considered LIS-related contexts such as libraries and bibliographic databases.
3. Management of information in organizations, Business Information Science (much of which is non-public domain and not book-like) expands the traditional field of LIS into new applications and is perhaps more related to business and management studies.

Sheila Webber, a faculty member in the *Department of Information Studies* at the University of Sheffield, has expressed concern with the tendency to change the titles in courses offered by British universities on the Masters level from ‘information science’ to ‘information management’:

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[19]Note, however, that in 2006, it underwent a further name change, becoming the “School of Information”.

> In course names, Information Management is the phrase in the ascendant. This is most obvious when looking at UK undergraduate course titles. 'Engineering: Electrical and Information Sciences', which is the only course [out of 74] to mention IS. None of the other courses use this phrase. 'Information management' is the title of 38 courses. There are 18 course titles using the word 'studies', e.g. 'Information Studies', 'Information and Library Studies'. Of the 56 courses mentioning information management or studies, 45 are dual degrees with a subject obviously outside the discipline, e.g. 'Information Management and Business Studies' (the most popular combination) (Webber 2003: 325–326).

Webber argues that this tendency is connected to fads and social trends, for the term "management" is popular whereas the term "science" is less so when it comes to attracting students. She further asks (p. 328) "'Library and Information Management': is it merely an umbrella term and administrative convenience? Is it a new name for IS? Is it a different discipline?"

Alastair Black, an eminent information historian of English origin, finds that library education in England has been under pressure from, among other fields, IM, which he claims is a field without a history[20]:

> Yet education for librarianship, certainly in Britain, has been under pressure from the appearance of new disciplines—such as information management, information systems, and knowledge management—which claim, by comparison, to be technologically adroit . . . Whereas disciplines as varied as management and medicine and, in the information sphere, documentation, bibliography, information science, and librarianship each have a body of historical knowledge attached to them, the discipline of information management does not (Black 2004: 29).

Knowledge Management

According to Wilson, the term knowledge management

> did not occur until 1986 and from 1986 to 1996, there were only a few occurrences in each year. From 1997 to date, however, the growth has been exponential, but the data for 2002 suggest that the rate of growth has slowed considerably [. . .]
>
> The inescapable conclusion of this analysis of the 'knowledge management' idea is that it is, in large part, a management fad, promulgated mainly by certain consultancy companies, and the probability is that it will fade away like previous fads. It rests on two foundations: the management of information – where a large part of the fad exists (and where the 'search and replace marketing' phenomenon is found), and the effective management of work practices. However, these latter practices are predicated upon a Utopian idea of organizational culture in which the benefits of information exchange are shared by all, where individuals are given autonomy in the development of their expertise, and where 'communities' within the organization can determine how that expertise will be used (Wilson 2002).

[20]Note that Black et al. (2007) have begun to redress this with their jointly produced history of information management practices in early twentieth century Britain.

Maceviciute and Wilson found the use of the label "knowledge management" to be based on unserious motives:

> There are strong pressures at the moment ... to subsume information management within 'knowledge management'. We believe, however, that information management has a stronger theoretical base than knowledge management and that the latter is simply a label, designed, like other labels, for presentational purposes, to impress the consumers of consultancy companies by giving the impression of something new and serious. Perhaps we shall re-visit this topic in a few years' time to discover whether we are right (Maceviciute and Wilson 2002: 26).

Information Systems

"Information systems" is defined in Wikipedia as "the study of complementary networks of hardware and software that people and organizations use to collect, filter, process, create, and distribute data".[21] Ellis et al. (1999) and Monarch (2000) have studied the relations between "information science" and "information systems" (or information systems research) as a case of conjunct subjects but disjunct disciplines. Again "information systems" is often treated as a separate field. However, bibliographical databases and libraries, for example, are kinds of information systems. We also note that Buckland (1991) titled his well-known monograph on information science as *Information and information systems*. Therefore it seems to be unfortunate that "information systems" is used as a label for a different field.

The general conclusion of this section is that "IM", "KM", and "information systems" are sometimes used as trendy new synonyms for "information science"; however, they are also sometimes used to designate emergent new fields outside of information science as such. There are almost never clearly articulated conceptual and theoretical points of view that could justify the use of these labels as either synonymous with LIS or as names for new separate fields.

Informing Science

A new interdisciplinary field, informing science, came into being around 1998 to promote the study of informing processes across a diverse set of academic disciplines, including management information systems, education, business, instructional technology, computer science, communications, psychology, philosophy, library science, information science, and many others. Informing science is represented by the Informing Science Institute, the journal *Informing Science: The International Journal of an Emerging Transdiscipline*, and several other publications.[22] Given that LIS is also an interdisciplinary field with extremely open borders,

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[21] http://en.wikipedia.org/wiki/Information_systems; accessed September 30, 2012.

[22] For the Informing Science Institute and its publications, see http://www.informingscience.us/icarus/

it seems unmotivated to develop yet another one. It seems as if new disciplines are often suggested just in order to claim novelty without relating to already established fields.

9.3.10 Archives, Library and Museum Studies (ALM)

Archives, libraries, and museums (among other institutions) have been termed *memory institutions* (cf. Hjørland 2000a; Robinson 2012[23]). While library science, archival science, and museology exist as separate disciplines in some countries (e.g. in Sweden), there are also tendencies to integrate them. For example, a Department of ALM was established at Uppsala University in Sweden around the year 2000.[24]

The motivation to integrate these disciplines may be related to a general tendency towards media convergence, for all kinds of memory institutions are utilizing the Internet and other digital media. However, because neither "information" nor "documentation" is included in the name, important perspectives and areas such as bibliographical databases seem to fall outside its ambit. Subfields or specialties such as bibliometrics, scholarly communication, bibliography, Internet research, information literacy and and many other streams of research (fields that are actually taught at the department of ALM in Uppsala) are not covered by the term "ALM".

It could be argued that the inclusion of the terms "documentation" and "information" in the name of a discipline implicitly covers not just libraries, but also other kinds of memory institutions; thus, there is no need to list these institutions explicitly in the name. But scholars interested in memory institutions may have perfectly good strategic reasons to prefer the label "ALM".

9.3.11 What Should the Name of the Field Be?

We have now seen a complex pattern of names applied to the field in which we are interested.[25] I hope the reader has come to the conclusion that the issues surrounding the designation of our field are many and complex, and that we should attempt to

[23]Robinson (2012) interrogates the idea of "memory institutions" and proposes that such a generic concept is not especially productive in facilitating the thorough, critical analysis necessary to highlight both the synergies and discords in the history and memory-making techniques of museums, libraries, and archives.

[24]The URL is: http://www.abm.uu.se/about_us/

[25]Whether all of these labels are designating a single field or a family of related fields is the question, just as it is a question how "the field" of LIS should be delimited. In order to study this issue we have, however, had to consider this whole complex of different concepts and their historical development.

reach a higher level of clarity regarding its name, what is included under the name, and what should be considered other (but related) fields. How do we determine which seemingly different fields should be considered parts of LIS?

Bibliometric studies may reveal whether a given label for a discipline is used consistently, but it is also necessary to examine whether different labels cover the same theoretical assumptions (cf. Hjørland 2012b). Scholarly and scientific concepts, including labels for disciplines *should be theoretically motivated*. They should not be motivated by "smart" attempts to attract students or funding agencies, reflect different organizational attachments, or just satisfy a wish to be the creator of something new, if it is not based on new theoretical points of view. Disciplines and their knowledge should be based on serious arguments. When one uses ambiguous terms such as "information" (meaning both "bits" and meaningful messages, for example) or "information management" (meaning both indexing and library management, for example), something is gained and something is lost. What is gained is the freedom to do as you like (i.e., not being "disciplined," as expected in an academic discipline) as well as to give students the impression of broadness and freedom. What is lost is the serious collective effort to build a field from which we and our students may earn respect in the broader scientific community – and, in the end, earn a living. The extreme use of ambiguous terms causes confusion both inside the field and in relation to external partners, which is the opposite of what we as scholars are supposed to produce.

In general, different organizational structures tend to separate related fields. It has been argued, for example, that dictionaries are a kind of knowledge organization system (KOS) and thus share important properties with other kinds of KOS (Hodge 2000). If that is correct, it is most fruitful that the study of dictionaries (lexicography) is understood as part of information science (and knowledge organization). However, because dictionaries are mostly studied by lexicographers and linguists, while information retrieval thesauri are mostly studied in relation to the design of bibliographical databases, these different forms of KOS tend to be differently institutionalized and discussed within different disciplinary discourses with the result that the study thereof is not theoretically well-integrated.

In 2002, two different international conferences about the foundations of information science took place. One was the Fourth Conference on Conceptions of Library and Information Science (CoLIS 4) in Seattle, USA, the other was the International Conference on the Foundations of Information Science (FIS).[26] Were these conferences discussing two different fields, each of which claimed to be an "information science", or were they two different scholarly meetings in the same field? Perhaps they are both forums for multidisciplinary approaches using different

[26]The first FIS conference was held in Madrid in 1994; the second in 1996 in Vienna, and an electronic conference was held in 2002; the third FIS conference was held in 2005 in Paris and the Fourth International Conference on the Foundations of Information Science was in Beijing in August 2010. The list of authors presenting at FIS 2010 may be found at the following URL: http://www.sciforum.net/conf/fis2010/authors; Interestingly, there appears to have been no overlap between this roster of authors and those who participated in CoLIS 7 in London in 2010.

disciplinary outlets? Whether they represent one, two, or more kinds of information sciences can only be uncovered by theoretical analysis of the core assumptions expressed in the respective conferences and their proceedings. Inasmuch as FIS is founded on cybernetics and CoLIS is founded on something more related to social and epistemological studies of knowledge production and dissemination, different information sciences may well be at play.

I have, in the present paper as well as in several other papers, argued that concepts such as knowledge production, documents, bibliographies, and domains/epistemic communities are core concepts in information science and that a social and philosophical approach to the study of knowledge production, dissemination, and use lies at the heart of all problems in our field (e.g., Hjørland 2002b, 2007b; Hjørland and Albrechtsen 1995). My approach may or may not turn out to be fruitful. Other researchers may develop a more fruitful theoretical framework. One or more theories may succeed, or, in the worst-case scenario, no frame will survive and the field may die or be absorbed into other fields such as computer science. In the process of developing a theoretical framework for a discipline it is important to have an open debate.

Given the situation today, the best compromise I see between the need for a theoretically satisfying name and the terminology actually used is *library, information and documentation science* (LID); the motivation to include "documentation" is laid out at the end of Sect. 9.3.4, as well as in Sect. 9.5, in which the argument for the importance of the concept of "document" is given. However, given the present use of terminology, the terms *information science* or LIS may for practical reasons be used as synonyms (depending on the context and the intended audience).

9.4 What Is the Aim of LIS? What Are We Trying to Achieve?

People within LIS may have different visions of what the field is going to accomplish. For example, researchers interested in human-computer interaction may aim at contributing to the design and evaluation of electronic devices (such as geographical positioning systems, GPSs), while those oriented toward knowledge organization may seek to create tools, such as thesauri and classifications, that help make information more readily retrievable. There is not much overall analysis of the connections between different conceptions of the field on the one hand, and and, on the other, the problems that LIS researchers are trying to solve. Often it is difficult to understand how a specific research paper or a course contributes to any overall goal, although implicit aims may sometimes be inferred. The problem is whether or not there is an agreement between our more or less implicit aims and the kinds of activities that our research and teaching qualify us, as information specialists, to perform.

Hjørland (2012a) described the aim of LIS as basically being about helping people find the books, articles, pictures, music, and information resources they need or would like to read or experience. Information specialists help students, researchers, the general public, and everybody else to find the documents they need in order to solve tasks, including writing theses and research papers. The most advanced use is in scientific documentation where subject databases are developed and used to satisfy the needs of advanced user communities. The needed documents used to be kept in physical libraries, archives, and museums but are increasingly available in digital form, sometimes free, sometimes with toll access. We may term all this "the information ecology" and information scientists are the people studying this universe in order to help people utilize its resources optimally for their specific purposes.

Although much information is available in digital form, the study of information is not identical with the study of computers, information, or communication technology. LIS is rather about knowledge production in society and how this knowledge is materialized in documents (including digital documents) and how it is organized, labelled, and managed in order to serve different groups and individuals.[27] LIS is about what Google and Wikipedia can do for you, but it is also about what Google and Wikipedia cannot do for you, what else needs to be consulted. It is about how to improve access to information by progress both in computer-based retrieval and in the forms of information services provided by information professionals. Such information services include the teaching of 'information literacy' to students and helping professionals, for example medical doctors, who practice evidence-based research. Another way to describe the difference between computer science and LIS is to say that for the first of these fields, the interaction between humans and computers is a core topic. In the case of LIS, it is rather the interaction between people and the whole information ecology. This is a crucial difference between the two disciplines, although computer science is an important adjacent discipline to LIS.

The unique focus of LIS in relation to other disciplines is therefore: the study of the information ecology in order to facilitate its utilization for many specific purposes. It follows that LIS is a pragmatic enterprise: it studies knowledge and information for a purpose, in order to support progress in human life and the improvement of things in the world (though, of course, "progress" and "improvement" may mean different things to different people).

Not all approaches to LIS serve this proposed aim equally well. The present author has argued that the domain-analytic approach to LIS is the best alternative for this purpose (cf. Hjørland 2002a).

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[27] This definition is adapted from Jack Andersen, cf. the quote from Andersen (2011) in Sect. 9.3.8, above.

9.5 What Are the Core Concepts of Information Science?

In the fourth chapter of a new introductory textbook to information science, Bawden and Robinson (2012) discuss the "basic concepts of information science", among which they include:

- Information
- Knowledge
- Documents
- Collections
- Relevance
- Aboutness
- Information use and users

The following concepts, however, were *not* included:

- Domain
- Sign, language, special language
- Memory institutions (libraries, archives, museums, database hosts, etc.)
- Communication, media, genre, literature
- Concepts, conceptual systems, classifications, theories, paradigms

The list is not exhaustive and the omission of such concepts is strange considering, for example, that Bawden and Robinson (2012) devote a chapter to domain analysis, but do not include "domain" among the basic terms. The point of view I wish to put forward is that the basic concepts of LIS are dependent on the paradigm from which you consider the field. The basic concepts are not *given*. It is not even given that "information" is among the core concepts: Buckland (1991), Hjørland (2000a), Lund (2004), Ørom (2007), and others have argued that the concept of document is the most fruitful one to consider as the core concept in LIS. The concept of document is understood as "any concrete or symbolic indication, preserved or recorded, for reconstructing or for proving a phenomenon, whether physical or mental" (Briet 1951/2006: 7, here quoted from Buckland 1991, 47). Recent additions to this view are Frohmann (2004), Furner (2004), and White (2010). Furner (2004) argues that all the problems we need to consider in information studies can be dealt with without having recourse to a concept of information. He suggests that to understand information as relevance is currently the most productive approach for theoretical information studies. All of the aforementioned authors assume that the concept of document is a more precise description of the objects that information science is about, but they see documents as a larger universe of informative objects. White (2010: 4499) writes: "When IS [information science] is defined as the study of literature-based answering, much else falls into place."

It is not just the case that each paradigm in LIS produces (or implies) its own set of basic concepts (with possible overlaps). It is also the case that each basic concept is understood differently by researchers in different traditions. In the tradition deriving from Shannon, "information" may be understood as bits; in the cognitive tradition, information is understood according to Brookes' "fundamental equation of information science", as "extra-physical entities which exist only in cognitive [mental or information] spaces" (Brookes 1980). Finally, in the domain-analytic tradition, information is understood as "a difference that makes a difference"[28] (implying that different theoretical perspectives do not emphasize the same differences and thus consider different things informative and information). A similar analysis can be made regarding other basic concepts, for example "aboutness" or "subject" (e.g., Hjørland 1997), relevance (e.g., Hjørland 2010), etc.

9.6 What Are the Most Important Metatheories and Research Traditions in the LIS?

In LIS different theories, metatheories, "approaches," "paradigms", and research traditions exist. The situation is rather chaotic and it is difficult to get a clear overview of the theoretical landscape of the field as a whole. Even the definition and understanding of such common terms as "theory," "metatheory" and "paradigm" is a difficult task (not just in relation to LIS, but in relation to all disciplines). Bates (2005) provided an initial useful survey of such concepts but more is needed.

Fisher et al.'s (2005) compendious *Theories of information behavior* provides short presentations of 72 "theories" in our field. But are they all really about "theories"? Many of them seem rather to be about concepts, topics, or perspectives from other disciplines. And how are all these "theories" related to more fundamental "metatheories"? The book clearly reveals the extremely fragmented state of LIS. One comes away with the impression that one has heard a lot of different voices without any overall attempt to cooperate towards the generation of broader frameworks.

In the early 1990s, two metatheories (or "paradigms") seemed to dominate disciplinary discourses within information science: "the physical approach" (or "the systems centered approach") on the one side and "the cognitive approach" (or "the user-centered approach") on the other (cf. Ellis 1992; Saracevic 1999). The physical approach is associated with tests of different kinds of indexing languages/search mechanisms and measures the effectiveness of document retrieval systems by the well-known measures of 'recall' (percent of all relevant documents retrieved) and 'precision' (percent of relevant documents retrieved in relation to all retrieved documents), which were developed in the 1960s within the framework of the so-called Cranfield experiments. According to Ellis, it is called "physical" because

> [t]he assumption that index languages consisted of amalgams of index language devices meant that index language performance (in terms of the measures recall and precision) could be directly explained by reference to the combination of use of the different index

[28] This definition origins from Bateson (1972: 453) but is used in domain analysis in not quite the individualistic sense that he used it.

> language devices, just as the performance of a mechanical system can be explained with reference to the contribution of the different elements of the system (Ellis 1992: 51).

The cognitive approach, on the other hand, is based on the assumption that "the retrieval must, in some way or another, operate with a model of the cognitive state of the user" (Ellis 1992: 53). Ellis also found, however, that the cognitive view never succeeded in establishing any prototype like the physical paradigm.

It is important to realize, that such different paradigms have different disciplinary affiliations:

> The split is not only conceptual, looking very differently at the same process, but also organizational. The systems centered side is now mostly concentrated in the Special Interest Group on Information Retrieval (SIGIR) of the Association for Computing Machinery (ACM), while the user-centered cluster congregates around the American Society for Information Science (ASIS). Each has its own communication outlets—journals, proceedings, and conferences. There is less and less overlap of authors and works between the two outlets. We have two camps, two islands, with, unfortunately, relatively little traffic in-between (Saracevic 1999: 1057).

During the 1990s, more frameworks emerged, and by the middle of the first decade of the twenty-first century, Bates (2005) could identify no fewer than 13 different metatheories[29] in LIS:

- A historical approach.
- A constructivist approach.
- A constructionist or discourse-analytic approach.
- A philosophical-analytical approach.
- A critical theory approach.
- An ethnographic approach.
- A socio-cognitive approach.
- A cognitive approach.
- A bibliometric approach.
- A physical approach.
- An engineering approach.
- A user-centered design approach.
- An evolutionary approach.

Bates' overview of metatheories in information science is probably the best available today, but there is a need for much more research on this issue. Steve Fuller, for example, at the session on "metatheoretical snowmen" at the CoLIS 7 in London 2010, asked whether bibliometrics is an approach, or whether there are different approaches to bibliometrics. Hjørland (2010) found the dichotomy

[29]The terms "theory", "metatheory", "epistemology", "epistemological families/approaches" and related concepts shall not be discussed in depth in this chapter (there is really a need for one or more papers on that issue in itself). In many of my works, I have argued that researchers in LIS (as in other fields) may work from *implicit* philosophical assumptions that can be uncovered by relating them to philosophical traditions (see, e.g., Hjørland 2011a, b).

between "the system's view" and "the user's view" problematic and thus also called into question the whole idea of a dichotomy between "the physical approach" and "the cognitive approach". It seems, therefore, that many current interpretations of different approaches in LIS strongly need further investigation.

The general development in the field can perhaps be characterized by a movement from information theory (Shannon and Weaver 1949) towards semiotic theories (e.g., Wersig 2003; Brier 2008) – that is, towards theories of signs, languages, and meaning in a social perspective.

In a series of papers (e.g., Hjørland 2009, 2010, 2011a, b), it has been argued that rationalism, empiricism, historicism, and pragmatism/critical theory may be viewed as the basic approaches to LIS and that versions of pragmatism/critical theory are the most fruitful of these alternatives. This point of view may also be considered a version of *social epistemology* (Wong 2011): LIS is about providing knowledge resources for users, and the questions of what knowledge is, and what the best knowledge resources are, and how to identify them, are, in the end, questions of epistemology. There may be different views of which research findings and thus documents or "information" are relevant for a given question (cf. Hjørland 2010). Such questions of relevance are clearly scholarly and epistemological (not technical and not psychological, as has been assumed in the dominant paradigms).

9.7 Conclusion

We have in this chapter considered disagreements about the question of whether LIS is a scholarly discipline or not; disagreements about how to name the field; disagreements regarding the aim of the field; disagreements as to what should be considered to be the core concepts of LIS; and disagreements between different metatheories, paradigms, and research traditions within LIS. These issues are not randomly interconnected, but some layers of disagreement are basic while others are consequences of deeper layers of disagreement.

The deepest layers are the metatheoretical one and the political one about determining the goals for the discipline. The choice of metatheory, the basic assumptions with which we approach the domain of LIS, determines the concepts and research methods we are using, the naming of the field, the related fields we draw attention to, which subdisciplines we consider parts of our field, and so on. Such internal connections may, however, be opposed by external forces such as the tendency to use fashionable terms and topics imported from other fields and by institutional pressures to do things other than what is needed from the perspective of building the discipline. Sheila Webber's (2003) observations, discussed in Sect. 9.3.9.1 above, about changing terminology in order to attract students is a clear indication of how such external pressures may cause dispersion in the field.

The task for scholarship is to produce knowledge for society at large. Such knowledge should be based on appropriate research methods, concepts, and conceptual frameworks. Whereas the metatheoretial framework that a field adopts governs its practitioners' decisions as to what concepts, theories, and methods are appropriate for research, it is no less important to develop an adequate disciplinary language in which to express these. "Poor terminological hygiene" (Konrad 2007) should not be accepted in the academic community and thus the development of proper terminology should be an important part of any scholarly field.

Richard Whitley (2000) classified scientific fields according to their intellectual and social organization and described management studies as a 'fragmented ad-hocracy',[30] a field with a low level of coordination around a diffuse set of goals and a non-specialized terminology but with strong connections to the practice in the business sector. Åström (2006) applied this conception to the description of LIS. Just because such a label is not unique for LIS, it should not be viewed as an acceptable or desirable position in which to be. A greater amount of theoretical coherence seems necessary if our field is going to survive.

Fundamentally, the basic problem for LIS seems at the moment to be a lack of sufficiently strong centripetal forces keeping the field together. People in the field (and our students) should not just specialize in some fashionable topic but should be more generally concerned about the field as a whole and should see themselves in the perspective of the historical development of the field. If the field is considered weak, if students and teachers in the field cannot find useful knowledge within LIS, they tend to use knowledge from other fields instead, thus contributing to the centrifugal tendencies and the erosion of the field. It should be mandatory for students and researchers to be well read in the literature of LIS and any research problem should take its point of departure in the literature of the field. This is a difficult goal to set under the present conditions, but there is no alternative if we want to improve the status of the field.

Bawden and Robinson (2012) is probably the best textbook of LIS today because it presents the field in a holistic way and also discusses the different paradigms in the field. At the same time, it is also an expression of the unsatisfactory condition in which the field is. We have already seen that the chapter 'Basic concepts of information science' does not relate the concepts to the paradigms presented earlier in the book. Also, in each specific part of LIS it should be specified what difference it makes whether one or the other paradigm and philosophical position is taken as the point of departure. That is important work to do, and it has yet to be done. Buckland (2012: 5) has stated that Brier's (2008) cybersemiotics provides a coherent unifying theory for an existing field, namely LIS. However, this has to be shown by concrete studies, which have hitherto not been carried out by Buckland, Brier, or anybody else. Bawden and Robinson, in a similar way, have great expectations for

[30] "The combination of high task uncertainty and low degrees of mutual dependence characterizes what I have termed 'fragmented adhocracies' because research is rather personal, idiosyncratic, and only weakly coordinated across research sites [. . .] [Researchers in such fields] tend to make relatively diffuse contributions to broad and fluid goals which are highly contingent upon local exigencies and environmental pressures" (Whitley 2000: 159).

the philosophy of information developed by Luciano Floridi, but this philosophy has not hitherto been applied in the specific areas of LIS described in the rest of their book. We need to go from the concrete to the abstract and back again. This is the most urgent task for research in LIS.

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Chapter 10
Visual Information Construing: Bistability as a Revealer of Mediating Patterns

Sylvie Leleu-Merviel

10.1 Introduction

According to Yair Neuman (2006), information science deals with two complementary axes. The syntactic axis concerns the formal representation of information, whereas the semiotic axis concerns the meaning of information.

As Yair Neuman (2006: 1436) recently stated, "While the first axis has been intensively studied and formalized in information sciences, the second axis has been almost exclusively studied by other field such as semiotics and pragmatics. [. . .] One reason is probably the theoretical obscurity of concepts associated with this axis, such as *meaning* and *context*, and the lack of any formalization of these concepts for the working scientist".

From a more human-centered point of view, Buckland (1991) identified three different kinds of "information", as Ibekwe-SanJuan (2012: 16) has reminded us:

- Information-as-thing or object (data, documents . . .)
- Information-as-process (information as an action)
- Information-as-knowledge (the result of this process).

Thus, meaning is a concept that improves the understanding of living systems from immune recognition (Neuman 2004) to the neurology of perception (Freeman 2003). Our aim in this paper is to propose a model of the emergence of meaning. To do so effectively, we first need to lay the groundwork by considering some of the key concepts forming the background against which the model is set: information, data, and the interpreting process.

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*For color reproductions of the Figures accompanying this chapter, see http://extras.springer.com

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10.2 Information, the Raw Material of the Sense-Making Process

The statistical definition of information introduced in Shannon's "communication theory" (MTC: Mathematical Theory of Communication) first proposed in the late 1940s, continues to find an audience within information science, although it completely avoids meaning. Shannon (1948: 379), who developed the theory for the analysis of signal transmission over telecommunications systems, specified that: "[f]requently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem".

In light of this, we shall revisit the concept of information in this chapter, as well as several other concepts that have been recently associated with it, as discussed by Leleu-Merviel and Useille (2008, 2010) and Useille (2007).

10.2.1 Bateson's Cybernetic Perspective

Bateson (1972: 315) defines a *bit* of information as "*a difference that makes a difference*". According to Bateson, information is "*that which is conveyed by a message and provokes a response*", whereas a message is "*a portion of the world that comes to the attention of a cogitative system*", whether human or non-human. In this approach, information exists in between the responding system and the differential environment. Bateson assumes that a differential unit – i.e., the shortest interpretable set of bits – receives meaning only in context (Bateson 1972: 408) – i.e., on a higher level of organization[1] — and only as a result of interaction between the organism supporting the cogitative system and the environment. This implies that converting a signal – the container – into meaning involves an intermediate operation of capturing/construing information from the message.

This point of view sees sense-making as an active process for extracting operational elements conveyed by a message, since information is the value one may assign to an indeterminate signal (Neuman 2006: 1437).

10.2.2 Floridi's Diaphoric Definition of Data (DDD)

More recently, Floridi (2011)[2] gave *a data-based definition of information*. The founding hypothesis on which his approach is constructed is the following:

[1] The meaning and definition of "higher level of organization" will be specified later in this chapter.

[2] This article, first written in 2005, was "substantially" revised in 2011 – however, the revision didn't touch Floridi's treatment of the DDD.

information has a permanent role in shaping the construction of experience from undifferentiated personal experience. His GDI ("*General Definition of Information*") assumes that σ is an example of information if, and only if:

- GDI 1: σ consists of one or more datum;
- GDI 2: the data in σ are well-formed;
- GDI 3: the well-formed data in σ are meaningful.

According to this, data are the "stuff" of which information is constituted. "Well-formed" means that the data are clustered together correctly, in accordance with the syntactic rules that govern a given code or language. "Meaningful data" means that the data are executed according to the semantic rules of a given system (code or language) and so are endowed with significance.

According to Floridi, a datum is a diaphora (*diaphora* is the Greek word for difference). He posits that there are three different levels of diaphora:

- DDI 1: *diaphora de re* refers to any given lack of uniformity in the real world out there; they are "pure, 'proto-epistemic' data" – designated as *dedomena* by Floridi (2011) – that show "fractures in the fabric of being". They are comparable with Kant's *noumena*,[3] in that they cannot be directly known but simply inferred from experience (Mugur-Schächter 2009);
- DDI 2: *diaphora de signo* refers to the lack of uniformity between two physical states of a signal (for example, a variation in an electric signal during a telephone conversation);
- DDI 3: *diaphora de dicto* refers to the lack of uniformity between two symbols, for example two letters of the Latin alphabet or two bits.

Every level of diaphora justifies the next one, as Floridi (2011) observes: "*Dedomena in (1) may be either identical with, or what makes possible signals in (2), and signals in (2) are what make possible the coding of symbols in (3)*".

10.2.3 Bates's Definition by Pattern

Bates (2005, 2006) sets forth a comprehensive theory of information. Her intention is to summarize the different understandings of the concept of information in such a way that they can be used in physics, biology, and the human and social sciences. Her aim is to supply a solid conceptual basis for answering the question "under what conditions are we in the presence of information?". In this way, Bates tries to unite a "subjective" perspective (belonging to the human sciences) to an "objective" perspective that derives from the positive sciences.

[3] According to Kant, a *noumenon* is a thing-in-itself existing utterly independently of the human mind and, in principle, entirely inaccessible to it, whereas a *phenomenon* refers to a thing as it presents itself to the human mind through the senses.

Bates (2005) distinguishes between what she calls information 1, information 2 and knowledge:

- Information 1 is defined as the pattern of organization of matter and energy;
- Information 2 is defined as some pattern of organization of matter and energy that has been given meaning by a living being;
- Knowledge is defined as information given meaning and integrated with other contents of understanding.

She also identifies several kinds of data. For her, "data 1 may be seen as that portion of the entire information environment available to a sensing organism that is taken in, or processed, by that organism. What is too distant or otherwise outside the sensing purview of the animal cannot be data, it is simply information 1" (Bates 2005: 8–9). So data 1 become information 2 when they are given meaning.

10.2.4 Discussion of Data, Information, and Meaning

In Bates's view, information, like energy, is conceived as a basic property of the universe, which objectively constitutes patterns of organization of matter and energy, whether a "cogitative system" – as Bateson referred to it – feels an interest in it or not.

This view was sharply criticized by Hjørland (2007): as a matter of fact, Capurro and Hjørland (2003), among many other information scientists, prefer a subjective and situated conception of information, where a reasoning interpreter is always necessary as assumed by Bateson.

Nevertheless, the notion of data as defined by Floridi and Bates is interesting and productive. So, we postulate that a differential environment – a *diaphora de re* – is converted into data – a *diaphora de signo*, or variation in a signal – by a cogitative system which pays attention to this variation and observes it (possibly by means of specific equipment). This particular interest generates an interaction between the organism and the environment. During this interaction, some new relations, depending on the context, the situation, and the objectives of the organism, arise in its mind. These higher-level patterns stand at the heart of information. They are *not* properties of the universe, but the result of constructions by a reasoning entity that lead to a singular view of facts or events. These constructions are subjective, partial, situated, and temporally dated, since the properties are objective and converted into data through an observation process.

Such a view is congruent with Hjørland's (2007: 1451, 1449) postulate that: "To consider something information is thus always to consider it as informative in relation to some possible question [. . .] What is information for one person in one situation needs not be information for another person or in another situation". Information is then the raw material of a meaning-making process that provokes a response to stimuli from the external world as mentioned by Bateson – we will not comment here on the notion of "response".

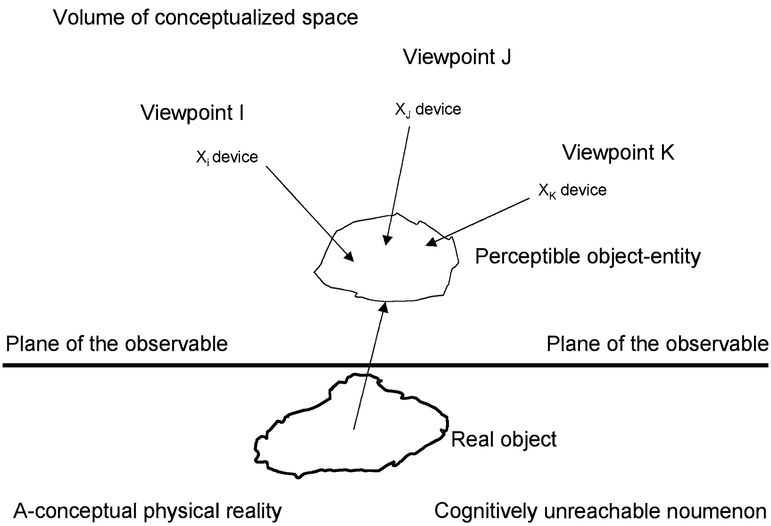

Fig. 10.1 Viewing and conceptualizing (From Mugur-Schächter 2006)

10.2.5 Theoretical Formalization by the MCR Method

Mugur-Schächter has formalized the constructive process of sense-construing that semantizes and transforms the perceived entities into meaningful ones. From a magma of indistinct percepts, through *aspects* that build *aspect-views*, an arbitrarily great but finite number of aspect-views, bound together, lead to an *outlook* or a *viewpoint*. In this way, the constructive process of sense-making transforms the perceived into meaningful entities.

To formalize rigorously this process without going deeply into the MCR Method detailed in Mugur-Schächter (2006), one can summarize it in three different steps:

1. A "cogitative system" generates an "object-entity", i.e., it captures purely factual, still a-conceptual, fragments of substance. It is important to underline that this capture is made without any conceptualization. These fragments are drawn from a much more complex reality and are treated afterwards as raw material for a progressive semantic construction. As shown in Fig. 10.3, they constitute the first level of semantization over *diaphora de re* in Floridi's framework.
2. Some "aspects", or "dimensions of qualification" then emerge. These are *diaphora de signo* according to Floridi, or data in many information theories. These aspects form the basis for "aspect-views" of the object-entity.
3. Finally, a grid of qualification includes an arbitrarily great, but finite number of aspect-views. This grid formalizes a collection of data. It is called an "outlook" or a "viewpoint". It defines one representation of the object-entity among an infinity of possibilities. Figure 10.1 shows that a single unique plane of observable

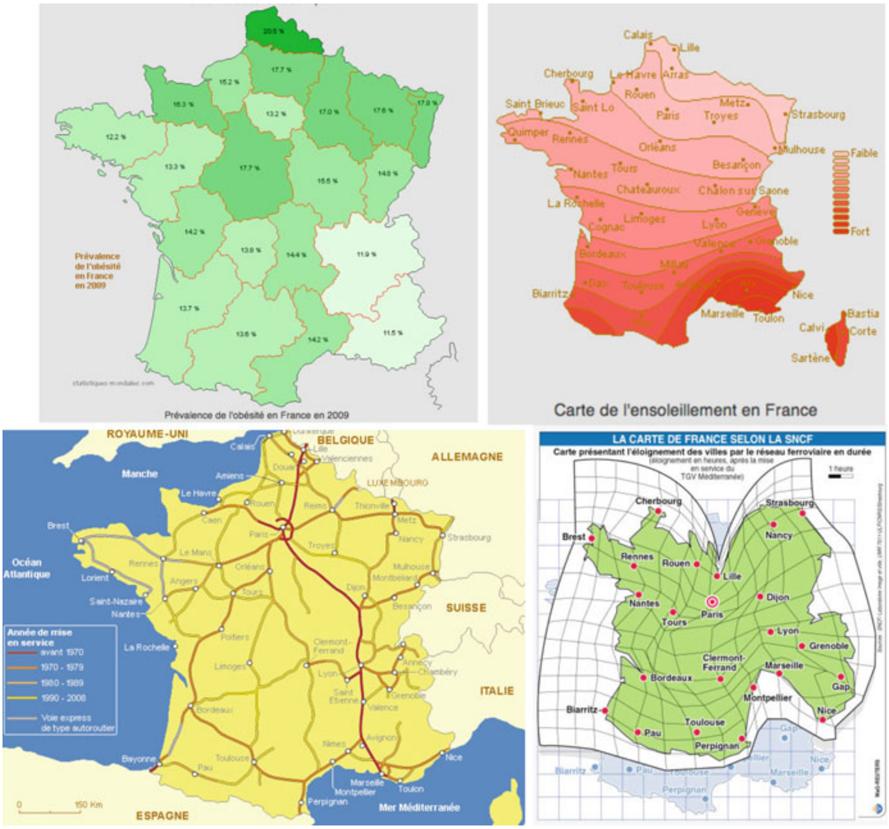

Fig. 10.2 Four different choices of aspects retained in maps of France, among an infinity of possibilities

reality supports divergent viewpoints, through the choice of various aspects to qualify the entity-object. However, such different viewpoints are all acceptable as pertinent representations of a single reality – see Fig. 10.1.

It can be noted that the grid for qualifying properties can result from an objective and quantified measure generated by one or more recording devices and/or apparatus, or from a qualitative appreciation belonging to the subjective, emotional and/or psychic sphere.

To offer a concrete illustration of the abstract concepts of "aspects" or "grid of qualification", we can use the classical question of "map and territory", first approached by Alfred Korzybski (1950). As Korzybski (1950: 25) observed, "the premises are very simple [. . .]: a map *is not* the territory; a map covers *not all* the territory". According to our statement, the territory is a *noumenon*, a thing-in-itself, existing as something prior to the human experience. And a map drastically simplifies its complexity by retaining only a little few aspects of it. In the maps of France given in Fig. 10.2, we have, for instance, (x,y) planar representations of the territory of France and representations of (1) the positions of highways on French territory (yellow map), (2) the level of sunshine on French territory (red map), and (3) the prevalence of obesity on French territory (green map). In the map in the lower right-hand corner, the geometrical distance from Paris to other towns in France is replaced by the duration of the journey by the TGV (i.e., a very high speed train).

10.2.6 Synthesis and Attempts to Reconcile Different Points of View

Human intelligence is characterized by its ability to produce knowledge and make sense. It identifies and isolates attributes considered as qualifying aspects for an a-conceptual object-entity generated by an active consciousness. This form of intelligence also creates information on the basis of connecting these data (Leleu-Merviel 2003).

The hypothesis here advanced posits that the human mind constructs schemata for signifying, structuring, and organizing understanding. These are based on a *viewpoint* or *outlook* resting on discrete *qualifying aspects* connected by links or relationships, which we call *lictions*.[4] This concept was introduced for the first time in Leleu-Merviel (2005) and was developed in Leleu-Merviel and Useille (2008) and Leleu-Merviel (2010). Lictions result of the creation of tension between different aspects; they lead to a combination of representations created at a higher level and so may help bring about innovative understanding.

This vision of the signifying process explained in terms of lictions (relations, links, or connections within a higher level of coherence) echoes the structural and/or organizing dimension that Bates calls a pattern.

The schema of Fig. 10.3 is an attempt to reconcile the different theories summarily presented in this chapter. It presents the different strata of the signifying process that allows a human being to convert perceptions of *diaphorai in re* into patterns, organizing structures that characterize information.

This synthesis shows that the data are not "data" in the usual sense, ready to be seized, but rather are captured by an active consciousness and invested with qualifying attributes; on these is based the construction of patterns as intermediary mediations indispensable to data sense-making.

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[4]We derive the term *liction* from the Latin verb *intellegere*, *intel/legere, intel/lego, intel/lexi, intel/lectum* which gives *lectus-lectum*. In Gaffiot (1934: 837), *intel/ligo* is mentioned as a variant that would logically lead to *lictus-lictum*.

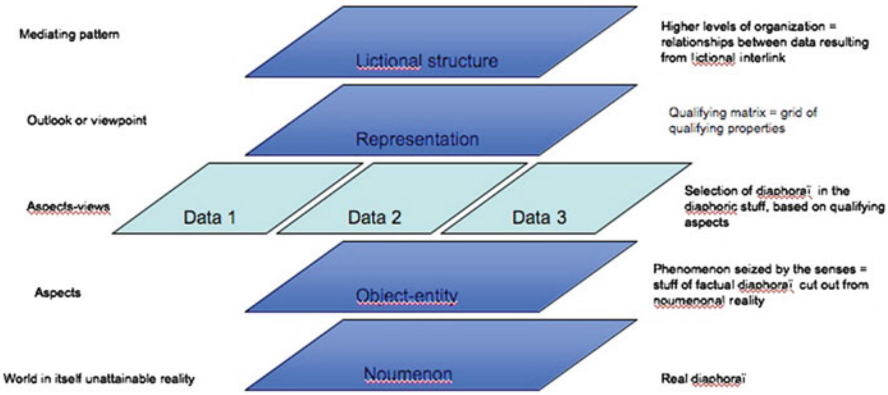

Fig. 10.3 From *noumenon* to informational structure through conceptualization: a synthesis

10.3 Revealing Patterns Through an Experience of Images

Over the course of the preceding review, we have come to a significant description of the informational process. This description avoids an ontological view of information as a thing, but following Bates, is founded on the emergence of patterns of organization, defined as a structure of bonds between aspects or “dimensions of qualification” (i.e. chosen attributes) to build a “viewpoint” of the object.

In so doing, we transferred the question of defining information (which does not seem necessary) to that of identifying patterns and their mediation towards meaning and/or sense-making. Thus, the real question is: what are patterns?

10.3.1 Considering Images as a Way of Increasing the Understanding of an Informational Process

All the theories that we have reviewed, from *difference* (Bateson) and *diaphora* (Floridi) through *pattern* (Bates) to *aspects*, *viewpoints*, and *outlooks* (Mugur-Schächter), are interested in the sense-construing of physical objects in functional settings.

To provide a somewhat different perspective on the informational process, we will in this section take a look at images and consider them as signs. We will not consider them from an aesthetic point of view focused on their beauty or the pleasure they produce. Rather we examine how they induce sense-making and/or meaning. This can be assimilated to a semiotic point of view, where a sign is a sign if it expresses ideas and causes an interpreting process. We pursue then the inaugural question of Roland Barthes: “How does meaning come to the image?” (Barthes 1964: 573).[5]

Following Bates and extending her point of view, we earlier defined patterns of organization as lictional structures of bonds between aspects that build a significant view of the object. We will now try to reveal patterns through an experience of sense-construing from images.

10.3.2 Visual Data

At the start of the process, our senses, or more precisely our visual organs that interest us here, seize “visual data” (that is to say the *diaphorai* of object-entities that are visually perceptible by definition, but not yet qualified).

There are several types of elements:

- letters and graphic symbols,
- lines,
- colors,
- shapes, etc.

During the elaboration of a viewpoint, elementary data are assembled to constitute entities created at a higher level:

- words and texts,
- drawings,
- figures and images,
- spaces, etc.

This composition is the result of a reading process by an interpreting entity (i.e., a cogitative system *à la* Bateson). The data, then, constitute patterns depending on a context, situation, or specific objectives, etc.

10.3.3 The Flexibility of Informational Content

However, meaning is not “given” by the organizational structures that informational elements constitute (from data to patterns through all intermediate structures), for meaning is not recorded, encoded, and written down in data or their structure. As noted in Section 10.2.4 above, even information is a construction on the part of the interpreter. As we embark on our examination of meaning-making, we should keep in mind that even basic “information content” is flexible.

[5]“*Comment le sens vient-il à l’image ?*” (in French in the original text, translation by the author of the chapter).

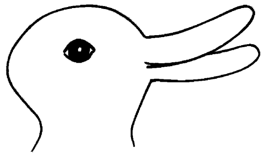

Fig. 10.4 Duck or rabbit?

Figure 10.4 presents a famous example of an ambiguous drawing of which more than one acceptable interpretation can coexist. In this drawing, originally created by the psychologist Joseph Jastrow (1863–1944), and popularized by the philosopher Ludwig Wittgenstein (1889–1951), it is possible to discern either the head of a duck or the head of a rabbit.

This example, among many others, shows that in the visual domain, as in writing, informational content is not an inert fact, encoded once and for all in data and automatically deduced from them.

Some data create, by assembling elements, undecidable or even bistable,[6] patterns. Above all, the reading of images is a constructive process, in which the human interpreter connects data together and contextualizes the links that unite, and even invent, data by a continuity that does not exist but that one can nevertheless see – as has been pointed out notably in the literature concerning optical illusions (e.g., Ninio 1998).

Before looking at sense-making, we will see that the reading operation is already a dynamic operation in which an interpreter engages in acts of construction.

10.3.4 Emerging Patterns

The key point now is to understand how meaning can be attributed to signs like images.

Previously, we saw that meaning is not given, ready to be captured. It is a construction on the part of the interpreter. This observation finds its concrete form in the concept of pattern. This leads to a first postulate.

Postulate 1: Patterns are not facts but human constructions.

The following example shows how the interpreter proceeds. Returning to the figure inspired by Jastrow, we can superpose the emerging pattern over the drawing (Fig. 10.5).

[6]Jastrow's duck/rabbit is certainly the most famous example of bistable image. However, the aim of this section is to reveal patterns through an intuitive experience of images, rather than to state bistability as a support for a theoretical approach (this will be the aim of Sect. 10.4). A fuller exposition of bistability is given in Sect. 10.4.1 below, to which we refer readers unfamiliar with this concept.

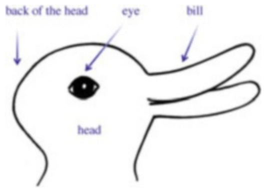

Fig. 10.5 Duck's mediating pattern

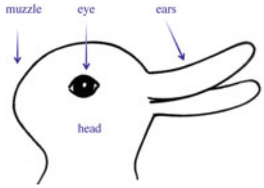

Fig. 10.6 Rabbit's mediating pattern

Aspects (black lines and shapes on a white background) bound together by lictional binding form an acceptable scheme that respects a kind of template – the reader's previous knowledge about the shape of a head –, and leads to a possible interpretation: this is a duck.

However, a different scheme replaces the first one, causing it to disappear for a few moments and appearing in its stead. Figure 10.6 shows this second template.[7]

This second view, based on the same data, allows another interpretation: the drawing also represents a rabbit. Both interpretations are "correct" in terms of the drawing. How is this possible?

10.3.5 Coalescence Through the Assimilation of Patterns

By definition, coalescence is a process in which two or more dispersed bodies of the same kind of substance unite to become one. In physics, there is the example of drops of mercury that, when they touch each other, suddenly come together to form one drop. The term is also used for organs of the same nature that are linked without being fused together: for example, the petals of a flower coalesce.

Claude Lévi-Strauss (1993: 31) was the first to use term "coalescence" to refer to the visual perception of an image in *Regarder, écouter, lire*[8]: "*In what does the strength and the bewitchment of the trompe-l'œil consist? In the coalescence obtained, as if by a miracle, from fugitive and indefinable aspects of the world*

[7] A template is a model of a pattern that has been previously identified, coded, and memorized and is then recognizable and ready to use for interpretation.

[8] "Look, Listen, Read".

perceptible by the senses, with technical procedures, the fruit of knowledge slowly acquired and of intellectual work, which allow the reconstitution and stabilization of these aspects".[9]

This passage underlines how a coalescence, based on the convergence of different "aspects",[10] joins two object-entities having no actual similarity, like noumenonal reality and a painting.

On the basis of what was presented in Sect. 10.2 of this chapter, one can describe the process in the following way. The human mind links up some aspects of what it sees inside compatible viewpoints through which similar patterns are recognized. However, these successive converging operations fuse in the reading of two object-entities corresponding to two different kinds of noumenal objects without any links between them (for instance the real 3D world and the flat figure of a painter's canvas are different by essence, but are assimilated by coalescence – the process critiqued by René Magritte (1898–1967) in his famous painting, "This is not a pipe"). In the first paragraph of this section, we stated that coalescence – in the physical meaning of the term – takes place between dispersed bodies (e.g., drops, petals, and so on) of an "identical substance". In this case, two different realities coalesce by the way of their patterns (which share the same nature: an abstract scheme supporting an acceptable interpretation). Elsewhere we show that this process is at the heart of what we call "semic contamination" (Leleu-Merviel 2014).

As Fig. 10.7 shows, the process of coalescence fuses what is assimilable (based on what is compatible) and bypasses what is not assimilable, as if aggregative compatibilities had systematic preference over differences. In other words, coalescence occurs as if the interpretative process, i.e. at the pattern level, were not based on distinctive elements – as is the case with data – but on aggregative compatibilities. Coalescence, then, involves compatibilities and not identity and/or analogies. It is not necessary for the attributes to be identical or analogical, resemblances are sufficient and assimilable in reality.

This begs the following question: how does one define the compatibility between patterns? If compatibility does not involve identity, similarity – in the mathematical sense of the term –, or analogy, then in what, precisely, does it consist? When are two assimilable aspects assimilated and when are they not? These questions need further study in future investigations.

We can now answer the question that ended the previous paragraph: two different interpretations can be appropriate to a drawing when two different patterns are simultaneously coalescent with the drawing.

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[9]"*A quoi tiennent donc la puissance et les enchantements du trompe-l'œil? A la coalescence obtenue comme par miracle d'aspects fugitifs et indéfinissables du monde sensible, avec des procédures techniques, fruit d'un savoir lentement acquis et d'un travail intellectuel, qui permettent de reconstituer et de fixer ces aspects*" (in French in the original text, translation by the author of the chapter).

[10]We note that "aspects" is the term used by Lévi-Strauss, and that he doesn't define it precisely.

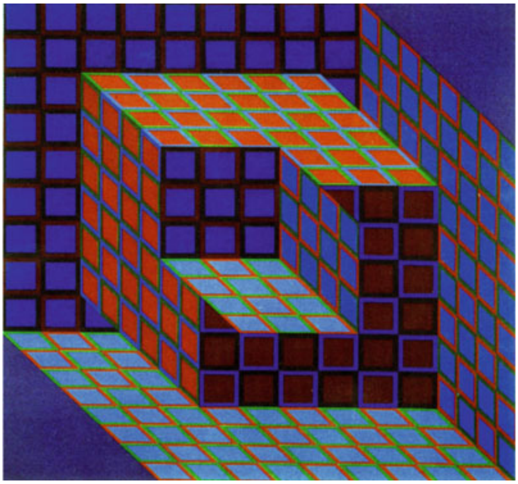

Fig. 10.7 A typical dynamic painting by Victor Vasarely

With this example, we can follow the path from *diaphorai* (black lines on a white background) to meaningful entities (duck or rabbit) through patterns. In this case, this process is especially noticeable because the patterns are twofold and compete with each other.

10.3.6 How Does Meaning Come to the Image?

We can now summarize the process of attributing meaning to images. Based on an image, the human being assumes that it is a sign, and searches then for the meaning of this sign. The interpreter captures data, qualified by aspects from the image in order to recognize a previously well-known pattern. The person stops this process as soon as a pattern assures a coalescence that is credible and relevant in the context of interpretation.

As noted above, this process is so naturalized that it is very difficult to be conscious of it. For this reason, it requires a specific approach to make it explicit. This is the aim of the following section.

10.4 Using Bistability to Reveal Visual Information Construing

The duck/rabbit inspired by Jastrow is a famous example of a bistable image (Long and Toppino 2004). We will now use another example of bistability to go further in exploring the process of visual information construing.

10.4.1 A Brief Characterization of Bistability

Bistable perception occurs when distinct interpretations of an unchanged stimulus alternate spontaneously in the mind of the observer (Leopold and Logothetis 1999). As Pressnitzer and Hupé (2006: 3) noted, "The study of bistable perception has generated a sustained interest in visual neuroscience, as it decouples the conscious perception of the observer from the characteristics of the physical stimulation: the same stimulus evokes different percepts". But they studied the phenomenon from a neural point of view, whereas we are examining it in order to understand the sense-making process.

Bistability is theoretically defined by three properties:

- Exclusivity, which certifies that perceptual interpretations are mutually exclusive;
- Randomness, which characterizes the statistical distribution of the time spent on each percept;
- Inevitability, which indicates that observers have only limited volitional control of the perceptual alternation that they experience.

The ambiguous, equivocal, and even paradoxical property of these images makes them "undecidable" in the mathematical sense of the word. Furthermore, bistability is a major characteristic of a post-modern tendency in various kinds of art; see, for instance, Blanckeman (2000) for the narrative aspects of this tendency. Their "undecidability" challenges the sense-making process. In ambiguous works, it can happen that the human brain allows different interpretations of the same data.

10.4.2 Contextualized Interpretation of the Same Set of Visual Data

Within a given context, aspects, bound together by lictional binding to form an appropriate scheme with respect to a given template, lead to an aggregative interpretation. We express this by means of postulate 2.

Postulate 2: Only contextual meaning can be given to a differential unit[11] within a coherent pattern.

We saw this above for the example of duck/rabbit image inspired by Jastrow. The same process is at play in the many dynamic paintings produced by Victor Vasarely,[12] one of which we have selected for consideration here (Fig. 10.7). In this

[11] A differential unit is the smallest set of connected *diaphorai* that can receive an interpretation.

[12] Hungarian-born Victor Vasarely (1908–1997) is known as a founder of optical art. He emigrated, in 1930, to Paris where he developed his particular vision of the "color-surface-perception" relationship. As early as 1936, in *The Chessboard 2*, a black and white checked design, Vasarely explored the visually vibrating effect of insistent pattern as well as the appearance of depth despite

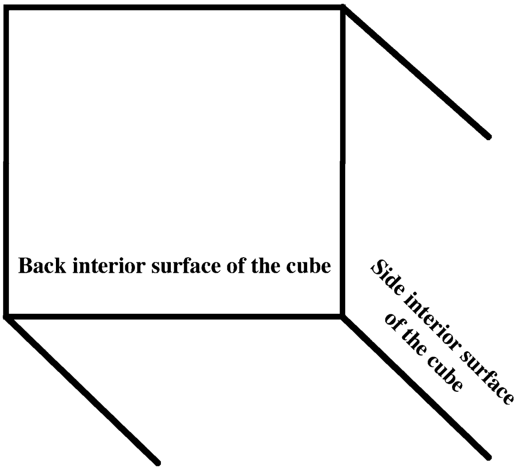

Fig. 10.8 The background pattern of the painting

painting, one can see a single image of a cube that appears alternatively and under partial volitional control (as required for a bistable image) to project away from and towards the observer.

The pattern spontaneously associated with[13] each differential unit of the painting is a geometrical shape: the cube.

In the first perspective of perceptual alternation, the pattern corresponds to a concave shape, as shown in Fig. 10.8, representing the interior surfaces of the background cube, and we see in Fig. 10.9 a blue room, with a red cube inside it; finally, Fig. 10.10 shows that this red cube has a blue hole inside it.

In the second perspective of perceptual alternation, however, the pattern is a convex shape, taking the form of an outwardly projecting cube as shown in Fig. 10.11, and we see the shape of a blue building (something like a type of skyscraper). Figure 10.12 shows that the building has a red hole inside it, but with a smaller blue building ensconced within the red hole, as shown in Fig. 10.13.

This dynamic painting by Victor Vasarely is effectively bistable, since it respects the three conditions listed in Sect. 10.4.1. As postulated above, we can see here how the elements of understanding, captured in the painting, are contextually bound together (by means of a lictional binding) according to a coalescent pattern that guides sense-making. Here, two mediating patterns are alternatively coalescent with the painting (this property being inherent to bistable images). But our objective in

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the use of flat shapes and the absence of modeling. Vasarely increasingly found his subject matter in the sciences – such as physics, biochemistry, and magnetic fields – and described his abstract art as "... poetic creations with palpable qualities capable of triggering emotional and imaginative processes in others" (Rogallery 2013).

[13]Or, to put it more precisely, "lictioned with".

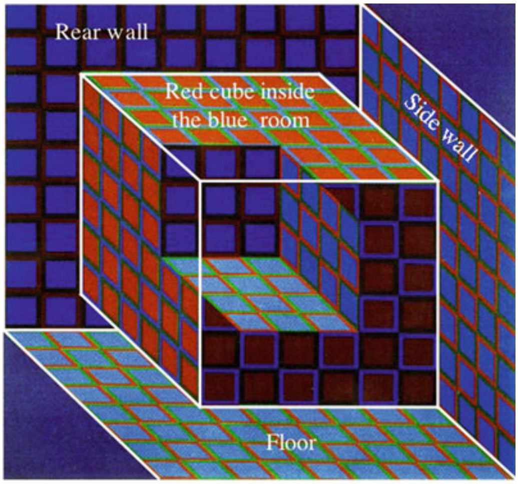

Fig. 10.9 Intermediate view underlining the *red cube* inside the *blue room*

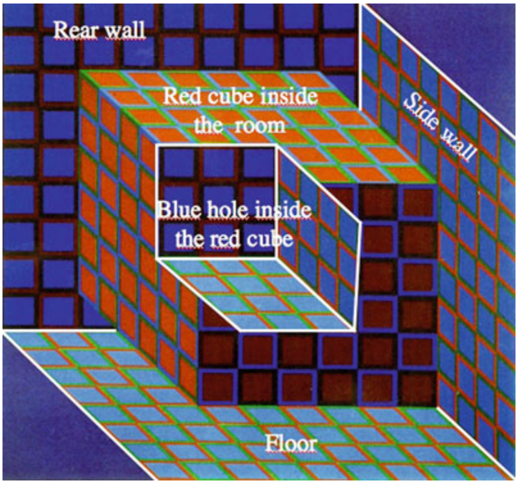

Fig. 10.10 Final view of an entering cube leading to the first alternative interpretation

this section was to prove that the same visual data (the same lines and/or the same faces) are contextually interpreted in conjunction with the contiguous elements, and can have opposite interpretations (for instance inwardly *versus* outwardly oriented cubes, in such a manner than the viewer sees, in a single set of lictioned surfaces, a concave sort of "room" or a convex sort of "skyscraper-like building"). Both constructions are appropriate to the painting; neither of the two interpretations is more appropriate than the other.

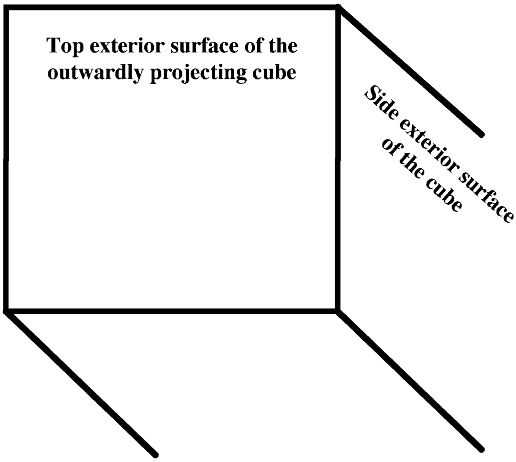

Fig. 10.11 The background pattern of the painting with perspective reversed

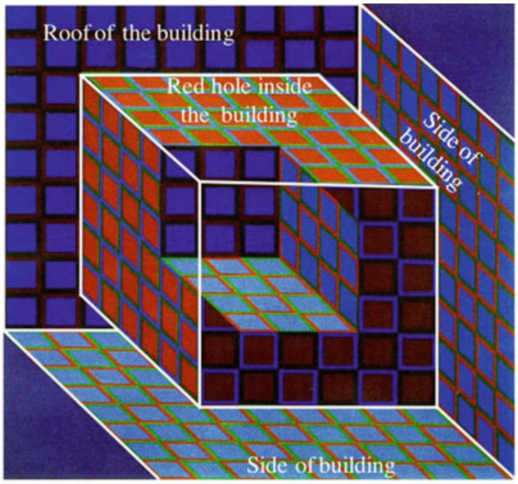

Fig. 10.12 Intermediate view underlining the *red hole* inside the *blue building*

10.4.3 Neglecting Dissimilarities or Aberrations

Thus far, two postulates have been advanced:

Postulate 1: Patterns are not facts but human constructions,
Postulate 2: Only contextual meaning can be given to a differential unit within a coherent pattern.

According to these postulates, we used a bistable image to illustrate the sense-making process, since a bistable picture is the best choice to reveal a coalescent pattern, because there are two such patterns that alternate with one another.

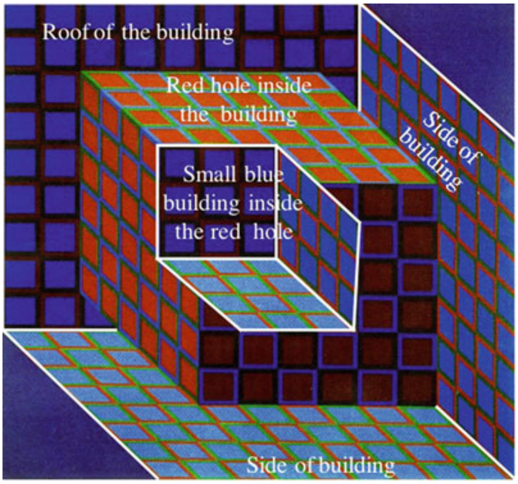

Fig. 10.13 Final view of the outwardly projecting cube of the second alternative interpretation

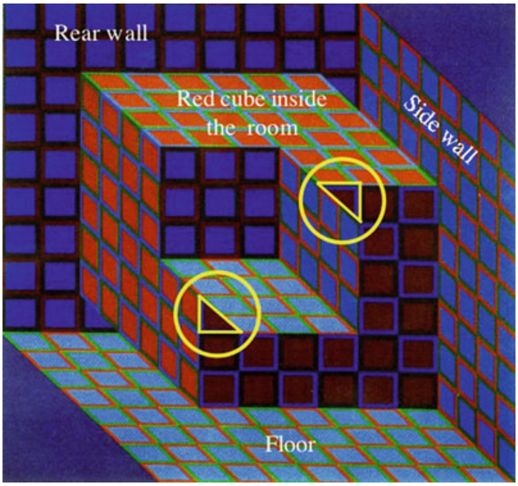

Fig. 10.14 Mathematical aberrations for the view of the inwardly projecting cube (first interpretation)

But this example also highlights how coalescence merges with what is comparable, bypassing what is dissimilar or aberrant. For in each of the two versions, the painting presents mathematical aberrations. There are elements that are anomalous, deprived of any kind of sense. Two triangular shapes (but different for each case) are not interpretable according to the laws of perspective applied to pictures. In fact, if they appear "unjustified" in a given perspective, it is because they are serving to maintain the linear unity of the figure in the *other* perspective: thus, in the first interpretation, the irregular red triangles are necessary to retain the contours of the blue building of the second interpretation (Fig. 10.14), whereas in the second interpretation, the seemingly aberrant blue triangles are necessary to retain the contours of the red room inside the blue cube of the first interpretation (Fig. 10.15).

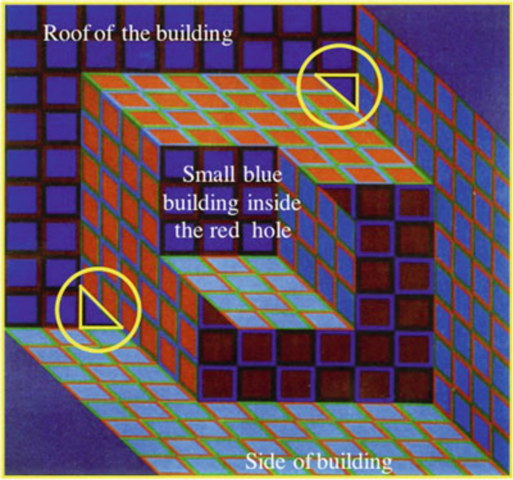

Fig. 10.15 Mathematical aberrations for the view of the outwardly oriented cube (second interpretation)

The human mind passes over these aberrations so that the remaining elements are contextually coherent, are set in conjunction with one another, and are bound together so as to form a possible scheme of interpretation.

10.4.4 The Horizon of Relevance: A Frame for Information Construing

We noted in the previous section that some rules of drawings (according to laws of perspective) are transgressed by the two anomalous triangular shapes, but these defaults are neglected in order to construe an interpretation. There is also an interpretatively less appropriate perspective on the painting, in which three buildings are piled up: a little red building on top a big blue building, and a smaller blue one on top a red one as shown in Fig. 10.16.

But this pattern is rejected by the mind because it is incompatible with the "horizon of relevance" determined by the laws of perspective, insofar as the vertical orientations are reversed for each building.[14]

We see that the notion of the "horizon of relevance" corresponds to a frame for information construing, based on practices, laws, and rules that eliminate some possibilities because of the "inappropriateness" of the frame. A viewer ignoring the laws of perspective, however, can retain this specific interpretation, because for that person, there is no cognitive dissonance (Festinger 1957) between this interpretation and his or her knowledge.

[14]This reversion of vertical orientations involves anomalies in the angles as well.

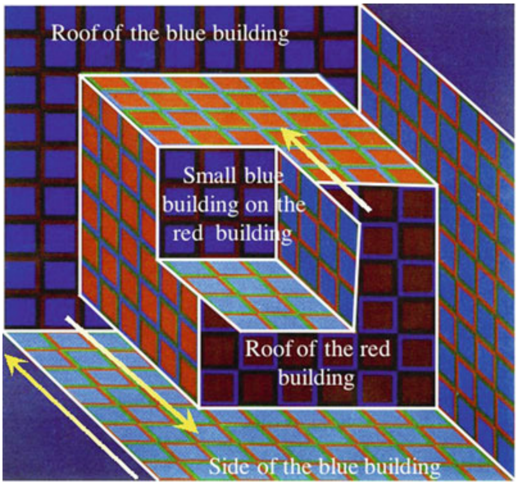

Fig. 10.16 An inappropriate interpretation transgressing laws of perspective

We can now be more precise in our answer to the initial question "How does meaning come to the image?". The interpretation process involves assimilation through the coalescence of:

1. comparable aspects,
2. compatibility between views,
3. identical patterns within a same "horizon of relevance",
4. neglecting differences or aberrations.

Figure 10.17 gives a visual representation of this process.

10.4.5 Summary

The notion of the "horizon of relevance" introduced in the previous section is based on the combination of two theoretical constructs: namely, Jauss's (1978) idea of the "horizon of expectation" and Sperber and Wilson's (1989) "relevance theory".

Here, it is important to underline that sense-making is constrained by a horizon of relevance depending on:

1. knowledge,
2. previous experiences,
3. cultural background,
4. a personal perspective that highlights and makes relevant a given series of *diaphorai*/aspects/data/patterns and not another one.

This leads to a third postulate.

Postulate 3: Based on the informational process outlined above, sense-making refers only to individual, uncommunicable experience.

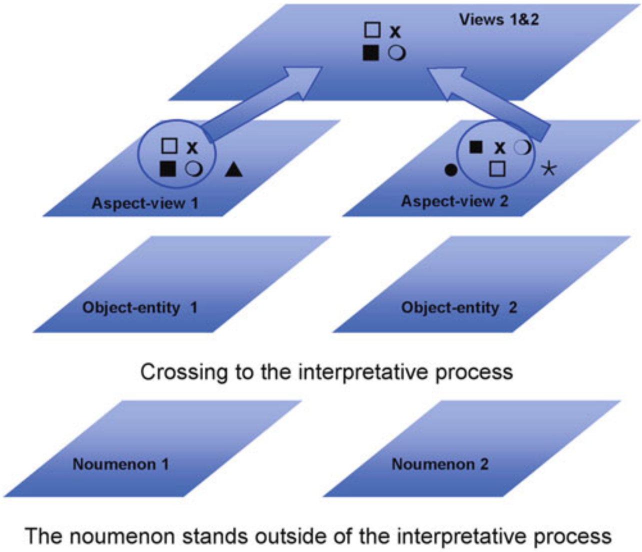

Fig. 10.17 Interpretation by coalescence: a synthesis

This remark explains why identical facts can lead to divergent interpretations. A change in the horizon of relevance is sufficient to explain this.

At this point, we come to the following conclusion: choices and cognitive construing are not the same from one person to another; everything is a personal construction in the informational process. This supports Capurro and Hjørland's (2003) view of information as subjective, situated, and pragmatic.

But this point of view raises a challenge to the commonly held intuition that information is a tool for sharing an understanding of the world. That intuition seems to contradict the results that we have reached thus far. In Sect. 10.5, we will try to make the theory consistent with our intuition.

10.5 Information: An Individual Construction or a Social Object?

In this section, we will once again consider images as signs and will return to coalescence to explain the way in which they induce meaning. This point of view can be assimilated to a semiotic perspective that studies how a sign passes through the interpreting process.

Although one could embark on a review of successive semiotic theories, here we shall restrict ourselves to using the principal results of a tradition extending from Ferdinand de Saussure (1916) to Umberto Eco (1973) via Charles Sanders Peirce (1931–1958, 1958) and Algirdas-Julien Greimas (1970) among others.

10.5.1 Three Types of Images

We will not discuss here the hypothesis that an image is a sign inasmuch as it is a present object of some sort that stands for, or represents, another, absent thing – whatever its nature and technical appearance. Indeed, it is the major characteristic of a sign to be present to indicate or signify another, absent thing, be this abstract or concrete. There are three types of images that are to be discussed here: imitative images, traces, and evocative or suggestive images.

First to appear in human history in the form of drawings on the walls of caves was the type of image that imitates – and simplifies – the forms of people or real-world objects. Such images describe or visually represent a real thing by means of a schematic pattern. They are fabricated.

The second type of image corresponds to recorded traces (by a photographic process, cinematographic process, physical imprint...) of a previous existing event or thing, according to the concept of "*ça-a-été*" ("that-which-has-been") as formulated by Roland Barthes (1980) in *La chambre claire* with regards to photography. These images are visualizations of physical phenomena (such as light impressions on a film support, satellite supervision, or medical imagery, such as radiographies or echographies). They operate as an indicator of something else (traces of human presence and testimony, tumors, fetal growth, movements around a military base, etc.). This second type of image also appeared on the walls of prehistoric caves – but apparently later than the first type of image according to current hypotheses – in the form of positive or negative hands of parietal art (Encyclopaedia Universalis 1999).[15]

The third type of image is evocation or suggestion. Dream, imagination, poetry, art, innovation, and creativity are sites of unrealistic, unrealizable, and even unreasoned or irrational images. They have existed for a long time, although they have been mostly investigated since surrealism, and express the most creative part of the human being (Harpham 2006).

10.5.2 Three Kinds of Signs

One can draw analogies between these three types of images and three kinds of signs posited by Peirce (1931–1958).

Icons have an analogical similarity with the original person or thing. Whatever they are (drawing, painting, photograph, 3D synthetic image), they "look like" the referent in such a manner that coalescence is "naturalized".

[15]Hands are frequently encountered in Upper Paleolithic cave art. Prints were obtained either "in positive", by pressing the hands, smeared with red, white, or black, over the wall surface; "in negative", by outlining the hands in color; or in "pseudo-positive", by outlining the hands in one color and pressing them against the wall, which was painted with a different color. They are almost always left hands (the right hand was used for painting).

	Icons	Indexical signs	Symbols
Imitation	**1**		
Trace		**2**	
Evocation/suggestion			**3**

Fig. 10.18 Categorization of images: recapitulative table

Indexical signs have a causal relationship of physical contiguity with what they represent—for example, paleness for tiredness, smoke for fire, cloud for rain, and footprints for human presence—in such a manner that the contiguity is rationalized.

Symbols are associated with a referent by pure convention: the dove for peace, flags for countries, and also words for things or ideas. In this case, the relationship is purely conventional and culturally assigned.

10.5.3 Referential Table

By crossing the three types of images with the three kinds of signs, we obtain the matrix table given in Fig. 10.18.

This categorization is useful for understanding images and their working modalities, but it has to be employed with flexibility. Of course, no sign belongs exclusively to one of these categories, but only primarily to one or the other: a footprint "looks like" the sole of the foot, and so this indexical sign has an element of iconicity as well. On the other hand, a realistic painting employs elements of convention, like rules of perspective. Even symbols can partake in iconicity (such as the five Olympic rings to represent the five continents). One can multiply the examples of such mixtures of the three basic types indefinitely.

Nevertheless, an image that "imitates" reality has a predisposition to be an icon and to be naturally interpreted by coalescence; the natural destination of a trace is to function as an index, i.e. a proof; evocation and suggestion are obviously related to symbolic ability. These considerations encourage us to insert the three dominant classes of images into the three diagonal places in Fig. 10.18.

10.5.4 The Distinction Between Meaning and Sense

Let us have a look at contemporary painting. Ever since its emergence, Abstractionism has often been characterized as art that has no signification or meaning. People are often disoriented by non-figurative art. This leads them to

Fig. 10.19 "Without title" by Philippe Merviel (1993)

conceptualize what they see along the lines of "impressivism": not as an analogy with the object, but as a transcription of the visual sensation it produces. This kind of work started of course with the impressionists, and the famous painting of Claude Monet "*Impression, rising sun*"[16] that gave its name to the corresponding artistic school. This perspective brings us back to the symbolic dimension of evocation/suggestion. We have just observed that a cardinal feature of contemporary art is that, since the advent of Abstractionism, it has tended not to have any precise signification. Let us dwell a bit on this apparent lack of meaning. Reverting back to the third column of Fig. 10.18, we examine the relation between visual information construing and suggestive symbols.

Consider the abstract painting reproduced in Fig. 10.19. This contemporary artwork is not figurative, and the artist, like a number of others, does not want to guide the persons viewing it, or spectators, towards a given "signifying intention" by means of a title. We conducted an investigation to understand how the visual sensation of spectators related to evocation/suggestion by asking persons seeing this painting for the first time a question: "What do you see?".[17] The answers were extremely varied: a fire (even a barbecue), a family (father and mother taller than several children at the rear), a town under sunset lighting, modern apartment blocks... Interestingly, many spectators said: *September the 11th, 2001 in New York, the Twin Towers*, although the painting had been created in 1993!

We can see with this example that the meaning is once more "undecidable" – because all these verbalizations of what the different spectators saw as effects of their respective visual sensation are acceptable. But we observed that the observers

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[16]The original French title was « *Impression soleil-levant* ».

[17]This painting was given to me and hangs in my office at the university. During the first years the picture was hung there, I asked every new person who saw it for the first time to answer the question. I noted the various answers of nearly 150 adults – the age range of the spectators was from 18 years old (students just arriving) to 65 (colleagues ending their professional service)—over approximately a 3 year period extending from 2002 to 2004.

tended to associate the object with something that suggests “heat” – for the person having expressed this, the family is associated with the “heat of love”. This painting is symbolic, because a convergence appears, inside our culturally homogeneous public, around a suggestion/evocation of heat, despite the fact that many personal values were expressed within the different responses to our question.[18] This phenomenon highlights the part of social agreement necessary (but not sufficient) to institute an image as a symbol – not sufficient because it requires also a convention that has perhaps nothing to do with the intuitive suggestion (as dove for peace: in our case, a title chosen by the painter himself would have been sufficient to institute the painting as a representation of what is announced by this title). So the apparent gap in meaning is filled in by a new dimension: the process of social sharing (founded on a convergence of evocations or an agreement with a purely conventional association) that occupies the last line and last column of the table in Fig. 10.18 and defines the “value” of a suggestion in terms of its social penetration and diffusion – passing from personal views to a collective shared value.

This experience leads us to enlarge our perspective from a strictly cognitive point of view (in the restricted area of referential or denotative functions of sense-making) to a new “communicational” semiotics embracing all the functions – particularly metalinguistic, phatic, and poetic functions –, and can highlight other types of existing procedures like social sharing and diffusion.

In light of the foregoing, we adopt Rastier’s (2003) proposal that one invert the two notions of sense-making and meaning. As we said previously, sense-making refers only to individual, uncommunicable experience. But meaning is normalized sense-making, detached from its context, generalized, and relatively stable: it becomes communicable, able to circulate, and to be shared, and so teachable; thus, it is established as a social object requiring an interpretative agreement within a given human community. This point of view reverses a common assumption, in which sense-making is meaning “corrupted” by the context (Rastier 2003). We argue here for the opposite: meaning is elaborated by normalizing the collective results of different, strictly personal modes of sense-making.

10.5.5 Introduction of Social Consensus in Symbolic Attribution

We arrive, then, at our final postulate.

Postulate 4: Meanings are the result of a normalizing process that implies public procedures to legitimate it. These procedures need social agreement, however partial.

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[18]One should note that there is no universal color convention: in fact, the vivid orange-red and yellow colors that dominate the painting are not readily assimilable to fire or heat; but the liction between those colors, the shapes of the drawing, the frame, etc. led our culturally homogeneous public to this common sensation.

According to Postulate 4, information arises from a response to negotiated, agreed, and shared tools (i.e., signs and particularly images) to represent the world.

To close the loop, we can now re-examine how the process of signification works. According to Joly (1993: 62), the perception of objects and shapes is culturally constrained. When an image seems analogical with a reality, it means that we decipher it in much the same way as we decipher a reality within the world itself. The units we locate on a shape are "cultural units" determined by our habit of locating them in other coalescent contexts. In fact, objects and events of the world are complex, i.e. describable *ad infinitum*. This point of view is coherent with the idea of complexity articulated by Edgar Morin and Jean-Louis Le Moigne (Morin and Le Moigne 1999; Le Moigne and Morin 2007). The way we capture data from an image, by cutting it into discrete units that "make sense", informs us about the way we perceive and "cut" all our percepts into culturally agreed units.

To formalize rigorously this process, let us come back to the MCR Method. One can add a fourth step to the three previous ones:

1. A "cogitative system" generates an "object-entity", i.e., it captures purely factual, still a-conceptual, fragments of substance. It is important to underline that this capture is made without any conceptualization. These fragments are drawn from a much more complex reality and are treated afterwards as raw material for a progressive semantic construction. They constitute the first level of semantization over *diaphora de re* in Floridi's (2011) framework.
2. Some "aspects", or "dimensions of qualification" then emerge. These are *diaphora de signo* according to Floridi, or data in many information theories. These aspects form the basis for "aspect-views" of the object-entity.
3. A grid of qualification includes an arbitrarily great, but finite, number of aspect-views. This grid formalizes a collection of data. It is called an "outlook" or a "viewpoint". It defines one representation of the object-entity among an infinity of possibilities.
4. Such a viewpoint is then possibly converted into a symbol, i.e., *diaphora de dicto*. The level of symbol often is not reached. For it requires a collective consensus regarding a socially shared value that is formed inside a given community, however reduced in size, and so is based on a connection established by convention.

This last level allows us to integrate into our model Floridi's concept of *diaphora de dicto*, which, until now, had not had a place therein.

10.6 Conclusion: Informational Process and Visual "Sense-Construing"

Daniel Pressnitzer has shown that the cases of Figs. 10.4 and 10.7, the duck-rabbit of Joseph Jastrow and the dynamic paintings of Victor Vasarely, correspond to classic cases of visual bistability. Moreover, Pressnitzer and Hupé (2006) have proven that visual bistability reveals fundamental principles of perceptual organization. Using bistable images, the analysis conducted in this chapter has highlighted and concretely illustrated the role of patterns, founded on the emergence of lictions, in the interpreting process. It was founded on four postulates coherently linked together.

Postulate 1: Patterns are not facts but human constructions.

Postulate 2: Only contextual meaning can be given to a differential unit within a coherent pattern.

Postulate 3: Based on the informational process outlined above, sense-making refers only to individual, uncommunicable experience.

Postulate 4: Meanings are the result of a normalizing process that implies public procedures to legitimate it. These procedures need social agreement, however partial.

On this basis, this chapter has shown how two acceptable interpretations can be derived from the same data by means of variable lictions and patterns of derivation. It accredits the idea that patterns built up through the process of lictional binding are the heart of information, and appear in a context by connecting features at a level higher than that of data. It also proves that the study of visual information construing can guide the cognitive process in general. This study shows that the interpretation of visual images has many dimensions beyond that of strict rationality. Ambiguous artworks show themselves to be particularly helpful for understanding these complex processes.

The concept of coalescence was introduced to describe the interpretation of images through the convergence of similar patterns and the passing over of dissimilarities or aberrations. Without being identical, this echoes the idea of conceptual blending articulated by Fauconnier and Turner (2002). The brilliant idea of conceptual blending is to point out that some interpreting connections emerge through viewpoints. The connections are based on the aspects of these viewpoints, but are not naturally inscribed in reality.

This consideration leads us to propose a new approach. During the cognitive process, qualified aspects of viewpoints, i.e., data, interact with each other, are knitted together, as Edgar Morin has suggested. This means that they interlink: the attractive or repulsive tensions (bonds, echoes, strengths . . .) resulting from this operation are called *lictions*. In fact, lictions take place between data, inside the gaps of meaning that our mind fills in by relational links. Liction is not possible within reality perceived as a continuum. The phenomenon of lictional binding needs discrete units and gaps between them to appear.

We conclude by proposing a new field of research. As a matter of fact, everything has to be discovered about lictions. Nevertheless, we assume here that information is founded on lictional patterns that conjoin elements of data with one another. Studying this will further our understanding of information itself. First of all, the types of "proximities", attractive or repulsive conjunctions, between aspects that create lictions need to be examined. We think they are not determined by a geometrical distance, but by a topological or "semiotic" neighborhood. As for conceptual blending, these types of "compatibilities" generate, across gaps of meaning, higher-level patterns founded on data, thus supporting coalescence: such patterns form the basis of information construing.

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Chapter 11
Understanding Users' Informational Constructs *via* a Triadic Method Approach: A Case Study

Michel Labour

11.1 Introduction

This chapter looks at the conditions in which it is possible to understand how users' informational constructs of screen-based experiences influence a situational knowledge building process. According to De Jong and Ferguson-Hessler (1996: 106) situational knowledge helps users identify "isolated features" in a given problem situation. Such situational knowledge provides, if necessary, supplementary information to create a representation of the problem from which additional knowledge can emerge.

The chapter is divided into five basic sections. The first section presents the context that launched our multidisciplinary research study. The second section lays out the methodological framework where key concepts regarding the phenomenon of informational constructs are presented. This groundwork having been set, the third section presents the research method, which is based on an adaptation of the repertory grid of George Kelly (1955/1963). The fourth section details the findings about how viewers made interpretative sense of a film snippet. The final section of the chapter explores how further study of the resonance effects of informational constructs can contribute to a theory of knowledge creation.

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11.2 Research Study Context

The entry point of our study was a joint social science and informatics science research project investigating the decisional process of viewers who had watched a snippet from a film they had not seen before. After having viewed the snippet, viewers were asked whether they wished to see the whole film or not. The ultimate aim of the project was to help filmmakers and screenwriters better understand different viewers'—that is to say, users'—viewpoints and the role they play in shaping their decisions regarding the films they wish to see.

In order to scientifically contextualize this project, Tsoukiàs' (2008) model of the Decision Aiding Process was used as a conceptual starting point. The model consists of four interlinked categories: (1) identifying a *Problem situation*; (2) setting up a solvable "problem" relevant to the identified situation – essentially focused on users' viewpoints (*Problem setting*); (3) creating an *Evaluation model* to assess alternative choices to solve the set problem; and (4) drawing up *Recommendations* with/for a client wanting to make a considered decision. Figure 11.1 below summarizes the main elements of Tsoukiàs' Decision Aiding Process model. The figure highlights in bold, the focus of our study; the qualitative-based *Problem setting* phase of the decision aiding process.

In this context, the research problem can be summarized as follows: How can one understand – theoretically, and from an operational field research perspective – informational constructs concerning a film snippet from viewers engaged in a decisional sense-making process?

In the following section, the methodological framework of our study is laid out to make explicit the reasoning of our research method from a qualitative axiomatico-inductive approach (see Sect. 11.4.1, below).

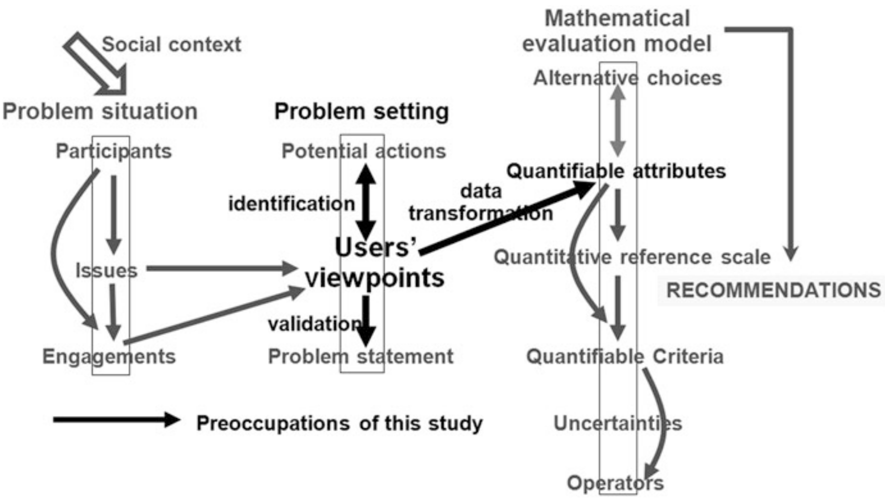

Fig. 11.1 Decision aiding process (Adapted from Crévits and Tsoukiàs 2012)

11.3 Methodological Framework

The aim of our framework is to explicate on what epistemological basis the research method, and its attending techniques and protocols, rested. The entry point of our framework is essentially qualitative. This has two major epistemological implications for the social science researcher.

First, by "qualitative" is meant that the focus is placed on an element, or a reduced amount of elements, that (appear to) interrelate a series of "data" about the lived experience of an individual. It may be that the unifying qualitative element in question may not be quantitatively (statistically) significant. Nonetheless, this element could represent a key factor to understanding how a series of different data make up a coherent and (more or less) functional whole—if not for the individual concerned, then, at least, for the researcher. This is not to say that the quantitative aspects of the data are irrelevant, but rather that they are not considered as the ultimate explanatory factor.

Second, a qualitative piece of research has a more specific sense for the ethnomethodologically driven researcher seeking to interpret how users make sense of their world. At the heart of our methodological framework is the guiding assumption that the mission of the researcher is to make sense of how other social actors make interpretative sense of their thoughts and actions. In this light, the researcher has the task of establishing a template for a second order sense-making process based, in part, on the first order sense-making process of social actors. In the course of the chapter it will be shown how the "interpretive" sense-making process (see Gadamer 1960/2004: 295 in Sect. 11.3.1 below) can be documented *via* informational constructs conveyed through users' interpretation of "constraining affordances" (Floridi 2011b: 87).

The aim of this research study is effectively limited to examining the epistemological nature of the first order sense-making process of users. This aspect of our framework is outlined in Sect. 11.4.1 below. It explains our micro-social premise that a user (for example a film spectator) is considered as a "condensed product" of a broader social process (Lahire 2006: 17). This constitutes an axiomatic pillar of our research methodology.

In discussing how to make sense of cinematographic[1] works, Vanoye and Goliot-Lété (1992: 43) summarize three basic approaches. First, there is the focus on the author's intentions by reconstituting what the author wanted to express. Second, the internal coherence of a film becomes the preoccupation of the sense-maker. Here, the film is understood independently of all (biographical, social, psychological, economic, etc.) elements outside of what is put on-screen. Third, the central sense-making element rests on the meaning that a viewer ascribes to a film in terms of his or her knowledge, preferences, and values in a given socio-historical situation.

[1]This schematic overview could also apply to other artificial and synthetic systems such as computers and organizational systems.

Our research methodology adopted a user-centered sense-making approach based on a novel concept, which we have called triadic informational constructs. In order to clarify the concept of informational constructs, it is necessary to consider the underlying idea of information as a "relational" phenomenon. This is effectively done in the next section by examining briefly two influential accounts of information: Luciano Floridi's "General Definition of Information", followed by Marcia Bates' pattern-centered approach to information.

Since there is a certain lack of operational clarity in Floridi's and Bates' approaches for field research, we shall revisit the writings of Gregory Bateson concerning his concept of information as an "in-between" temporal experience. We will then show how Bateson's concept is implicitly applied in the epistemologies of Brenda Dervin's "Sense-making" methodology in communication science, and Hans-Georg Gadamer's philosophical hermeneutics.

11.3.1 Information as a Social Science Phenomenon

For Floridi (2010: 2), current understandings of the concept of information are still at "a lamentable stage when disagreement affects even the way in which the problems themselves are provisionally phrased and framed". To clarify the situation, he has put forward a concept of "semantic information" (Floridi 2011b: 261–262, 267–268, 288), according to which information is a phenomenon that can be analyzed in terms of *well-formed* (in terms of syntactical norms), *meaningful* (interpretable), *truthful* (non-contradictory nature of contents from a modeled system), *relevant* (for a rational agent capable of semantic interaction) "data" embedded in a *network of relations* (of queries and answers). This concept is placed within a "General Definition of Information" (GDI) framework wherein data are grounded on the "fractures in the *continuum* or lacks of uniformity in the fabric" of an external reality that can be inferred empirically from experience (Floridi 2011b: 50–69, 84). In this light, a *datum* is a relational entity that appears as "an anomaly, often because the latter is perceptually more conspicuous or less redundant than the background conditions" (Floridi 2003: 129, 2011a). A *datum* thus involves, at the very least, a second entity in relation to which the *datum* is seen as meaningfully different by an "information agent".

> Understood as relational entities, data are *constraining affordances*: they allow or invite certain constructs (they are *affordances* for the information agent that can take advantage of them) and resist or impede some others (they are *constraints* for the same agent) depending on the interaction with, and the nature of, the information agent that possesses them (Floridi 2011b: 87).

As constraining affordances, data allow a process of queries and answers at a given level of abstraction: thus, according to Floridi (2011b: 87), semantic information can be understood as "data + queries". Floridi's view that information has a truth value leads him to state that knowledge encapsulates truth because it has its basis in semantic information, which, in turn, encapsulates truth in the "web of mutual relations that allow one part of it to account for another that helps make sense of the reality they seek to address" (Floridi 2010: 51, 2011b: 288). Semantic information must thus be both "truthful and relevant" in order to qualify as knowledge (Floridi 2011b: 244). In this context, Floridi (2010: 51) considers "knowledge" as comprising explanations or accounts that make sense of semantic information in terms of the reality it seeks to address. From this perspective, semantic information provides an "ideal and robust" way to analyse knowledge (Floridi 2011b: 209).

In our brief overview of Floridi's semantic information, three points stand out. First, as the decision aiding engineers Bouyssou et al. (2006: 29) point out, the human decision process invariably depends on the qualitative and situated nature of different logics, rationalities, knowledge, skills, beliefs, and personal values. Little credence appears to be given to these different logics and rationalities in Floridi's framework. This can be explained by Floridi's avowedly quantitative theory of semantic information. Floridi (2011b: 243) clearly states that his aim is to develop a "non-doxastic" foundation of knowledge that can be applied to artificial or synthetic agents such as computers and organizations. In short, Floridi appears to bracket that part of reality that does not conform to his framework. Other researchers, like Brenda Dervin, however, take a less selective approach. Dervin (1999b) seeks to make-sense of human reality with its cognitive, emotional, physical, spiritual "gappiness" (discontinuities). We expand on Dervin's qualitative approach below. The question, here, is whether a qualitative approach is compatible with the essence of Floridi's quantitative theory? We argue that this is possible. In Sect. 11.3.2, below, we present the seminal work of George Kelly (1955/1963) as a bridge between a qualitative and a quantitative research approach in knowledge creation.

Second, when Floridi (2011b: 85) refers to a *datum* as a "distinction"[2] between two uninterpreted variables that is left open to further interpretation, little is said about what is understood by the term "interpretation". The notion of interpretation has been the subject of much study in the social sciences, for example, in the field of hermeneutics. Accordingly, we will examine the philosophical hermeneutics of Hans-Georg Gadamer to shed some light on Floridi's "uninterpreted variables" as fractures, lacks of uniformity, and anomalies.

Third, Floridi (2010: 51) does not appear to take into account the theoretical ramifications of the sense-making nature of a "web of mutual relations". Given this, we develop below Marcia Bates' (2005) pattern-based approach to defining informational phenomena in order to clarify Floridi's idea of a sense-making web of mutual relations. This is followed by an examination of Gregory Bateson's idea of "information" linked to Brenda Dervin's sense-making approach.

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[2]According to Floridi (2010: 23), Donald Mackay (1969) argued that "information is a distinction that makes a difference" well before Gregory Bateson's more well known (1972/2000: 315) idea that a "bit" of information as "a difference which makes a difference".

At first sight, Marcia Bates (2005) takes a very different tack from that of Floridi in her analysis of the phenomenon of information. Nevertheless, there are points of convergence. She defines information as a pattern of organization of matter and energy that is everywhere "except where there is total entropy". It would seem that Floridi's use of the term "web" – when referring to relationships involved in a sense-making process – seems to globally correspond to Bates' concept of a configurative informational pattern. Bates develops this viewpoint by formally separating first-order information (*Information 1*) from second-order information (*Information 2*).

On one hand, Bates (2005) understands *Information 1* to be patterns of organization of matter and energy not inherently meaningful in themselves (e.g., the tree rings of a tree trunk). This corresponds to what Floridi calls a diaphora[3] *de re*—i.e., proto-epistemic data before they are interpreted. These "raw" data act as "an external anchor of our information" (Floridi 2011b: 85). *Information 2*, on the other hand, is "some pattern of organization of matter and energy given meaning by a living being". This corresponds to Floridi's (2011b: 86) diaphora *de dicto*, which indicates a "lack of uniformity between two symbols", whose presence is "empirically inferred from, and required by experience" by an information agent. Bates presents *Information 2* as a necessary but not a sufficient cause for "knowledge" construction. In her view, knowledge occurs when "information is given meaning and integrated with other contents of understanding" (Bates 2005) in a cognitive bridge-making process.

Bates (2005) and Floridi (2010) attempt to connect the idea of "information" with "knowledge", but it is not clear how their theories account for the relationship between information and knowledge creation that takes into account a decisional process. Moreover, little is said about how such theories can be linked to field research. It is thus necessary to bridge the gap. One approach to doing this can be found in what we have dubbed the Triadic Method (Labour 2010). Before presenting this method, however, it is necessary to first look at its epistemological underpinnings by revisiting the works of Gregory Bateson, Hans-Georg Gadamer, and George Kelly. To do this, it is necessary to go beyond Bateson's initial well-known definition of information as a "difference which makes a difference":

> A "bit" of information is definable as a difference which makes a difference. Such a difference, as it travels and undergoes successive transformation in a circuit, is an elementary idea" (Bateson 1972/2000: 315).

Bateson (1972/2000: 315) points out that the movement, and successive transformation, of differences is constitutive of a holistic circuit in which "no part (. . .) can have unilateral control over the remainder of any other part". What is entailed in the notion of "successive transformation in a circuit" (see Sect. 11.6, below)? How does a "difference" travel (under what conditions?) to become transformed (by whom or what?)? What is the ontological nature between the gaps of the whole

[3] *Diaphora* is the Greek word for "difference" (Floridi 2011b: 85): following Floridi's lead, we shall use it and the adjectival form "diaphoric" in our discussion here.

and the parts of a "holistic circuit"? What sorts of co-occurrences can be inferred from the epistemological "tensions" associated with differences linked to "gaps" in a sense making process? We explore these issues in some depth in Sect. 11.6 below.

A response to these questions can be found in the creative and trial-and-error nature of what Bateson called *Mind*,[4] found "in circuits which are complete within the system – man *plus* environment" (Bateson 1972/2000: 317). In this context, Leleu-Merviel (1996) sees in Bateson's approach a blurring between the age-old distinction of process and result, content and container:

> A difference that changes itself in a series of modifications in a circuit brings forward a key idea. With this idea, information is not separated from a process that carries and transforms its differences. The container thus blends with its contents (Leleu-Merviel 1996: 29).

Can one be certain that Bateson meant to say there is a blending between the container with its contents as Leleu-Merviel (1996: 29) argues? If so, how does this blending happen? What enables/constrains it? In *A Sacred Unity: Further Steps to an Ecology of Mind*, Bateson presents the postulate of "difference" from an epistemo-ontological perspective. To illustrate his point, Bateson (1991/1996: 278) takes two sheets of paper, one of which is yellow, the other white. He argues that the difference "between" (inverted commas in Bateson's text) them is to be found neither in the chemical composition between the colors nor in the measurable space that separates the pieces of paper. Rather, the epistemological difference lies in the "time it takes us to pass from one sheet to another". This "difference" has no measurable dimension besides an experiential (socio-psychological) sense "of entropy and negentropy". This is a key element of Bateson's epistemology, and, by extension, of this chapter.

Bateson's postulate – that an epistemological difference is related to experiential time – is based on the Weber-Fechner law, according to which the intensity of a perceived difference between two noticeable external stimuli is related to the ratios of their perceived intensity (cf. Carr 1927). Based on this, Bateson (1991/1996: 277) infers that "the first and most fundamental step of mental life – the receipt of news of a difference from the outside –" depends upon differences that are, in fact, ratios. A Batesonian difference is thus neither subtractive nor additive, but one that involves (ratio-based) *relationships* of perceived intensity between at least two noticeable stimuli.

Drawing on Norbert Wiener's work on clonus muscles to buttress Weber-Fechner's law, Bateson (1991/1996: 278) refers to the oscillating, and barely perceptible, micronystagmic process of the eye. This process constantly compares and contrasts different meaningful percepts when one is engaged in making sense of noticeable external stimuli. This leads Bateson to hypothesize that a unit of information involves the barely perceptible experiential time it takes for a person to make sense of one meaningful entity in terms of another *via* a series of "back and

[4]Hence the title of his often cited work, *Steps to Ecology of Mind* (1972), and a less well-known work, *A Sacred Unity: Further Steps to an Ecology of Mind* (1991).

forth" (in-between) perceptual processes. This oscillatory movement is linked to the perceived intensity attributed to the relationship between at least two noticeable stimuli.

Bateson's approach is fruitful, for it allows us to anchor Luciano Floridi's and Marcia Bates' speculative approaches to empirical-based research. This is crucially important if one is to get a purchase on the often elusive concept of information in the social and human sciences in a way that makes it useful for the field researcher in the information and communication sciences. Bateson's approach, however, has its limitations, for he did not expand on how experiential time can contribute to an operational use of a "difference which makes a difference". For our purposes, it can be usefully supplemented by Brenda Dervin's notion of "gap bridging", and Hans-Georg Gadamer's view of an "interpretative" process as an essentially historically based experience.

Brenda Dervin (2006) points out that the terms "information" and "knowledge" have been "fodder" for continuing debate in library and information science right from its origins. She cites the writings of Marcia Bates as being particularly useful in clarifying the debate. In this context, Dervin (1999b) states that her qualitative "sense-making" methodology focuses on the roles of patterns and "gaps or, if you will, chaos, in the conduct of human affairs" that are considered as problematic to a person.

Dervin's problem-solving methodology is founded on the idea that knowledge must be able to point to "empirically confirmed answers" (Dervin 2003). Within this framework, her methodology can be resolved into three interrelated parts.

First, it is important to establish the initial problematic situation by clarifying what a person (for example, an information seeker) needs in order to achieve a given objective. Second, it is necessary to encourage the person to make clear his or her questions and perceived "ambiguities" (gaps) about the problematic situation. In focusing on the gaps, Dervin assumes that this is "the most efficient and effective way to get to the heart of the difference at hand that makes a difference in gap-bridging" (Dervin 2006). Third, the person is asked to verbalize the nature of the help and of the expected results he or she is seeking.

Of particular note here is Dervin's assumption that all epistemological and ontological differences are manifestations of a sense-making process situated in a particular time-space. Without these differences, communication between human beings is unnecessary.

> Reality is assumed to manifest both patterns and closures; gaps and holes; and, human "knowing" sometimes achieves useful statements about the "real", and sometimes is manifested by gaps. These gaps come from differences in time, place, observing strategies, cultural assumptions and narratives, personal assumptions and narratives, linguistic constraints, and so on (Dervin 1999b).

In short, interpreting social human reality means addressing how individuals make sense of what they consider as "connections" and "contests" in a given situation. Dervin (1999b) suggests individuals can do this by comparing different viewpoints in "how they are like each other and how they contest each other", and what material-interpretive conditions might help understand perceived differences. This can be done by intra- and inter-individual and collective dialogues that enable individuals to "learn something from the bridges constructed by others".

The dialogue that seeks to make sense about how individuals bridge perceived epistemological and ontological gaps needs to anchor thoughts, feelings, observations, and conclusions in a framework that "inherently addresses history, struggle, growth and change as well as structure, constraint, habit, and repetitiveness" (Dervin 1999b). This approach was used in our interview protocol as a preamble to documenting viewers' sense-making informational constructs *via* a similarity-dissimilarity triadic grid (Sect. 11.4.2, below).

From this perspective, the decision aiding process approach of Crévits and Tsoukiàs (2012, see Sect. 11.2 above) shares Dervin's qualitative preoccupations. What Crévits and Tsoukiàs (2012) add to the process, however, is a mathematical evaluation of possible solutions in order to reinforce, if need be, recommendations to the person seeking help. Furthermore, Dervin does not develop a direct link between gap-bridging and a systematic investigation of lessons learnt from past experiences (i.e., case-based reasoning)[5] indispensable in situational knowledge creation (cf. De Jong and Ferguson-Hessler 1996: 111).

An author who has made a significant contribution to developing the idea of sense-making as "gap-bridging" linked to what can be considered as a qualitative form of case-based reasoning is the philosopher Hans-Georg Gadamer. Central to his methodology is the importance given to how an individual takes into account socio-historical norms and values when making sense of stimuli associated with gap-filling interpretative processes. For the purpose of our study, Gadamer's epistemological precepts can be outlined in three broad strokes.

First, Gadamer's interpretative focus is linguistic rather than perceptual. In his view, "nothing exists except through language" (Gadamer 1960/2004: 295)—a point reaffirmed in the social sciences by theorists of social constructivism like Vygostky.[6] This insight has led Gadamer to pose the fundamental question of the "bridge or barrier" role of language in the interpreting process (Scheibler 2000: 63):

> It is this experience of language – in our growing up in the midst of this interior conversation with ourselves, which is always simultaneously the anticipation of conversation with others and the introduction of others into the conversation (Gadamer 1960/2004: 547).

The epistemologies of Gadamer and Dervin converge on this important point about the formative role of verbalizing external experiences. Dervin's (1999b)

[5]By case-based reasoning is meant a problem-solving process that uses solutions of "similar" past experiences to resolve new problems.

[6]"The relation of thought to word is not a thing but a process, a continual movement backward and forth from thought to word and from word to thought. In that process, the relation of thought to word undergoes changes that themselves may be regarded as developmental in the functional sense. Thought is not merely expressed in words; it comes into existence through them. Every thought tends to connect something with something else, to establish a relation between things. Every thought moves, grows and develops, fulfills a function, solves a problem", Vygotsky (1934/1986: 218).

sense-making methodology assumes that talk (including talk carried out with oneself) is a universal human practice in which "one struggles to move the inarticulate to the articulate, the embodied to the cognitive, the suppressed to the conscious, the oppressed to the open".

The "unified meaning" of a text is determined, however, not just by its linguistic codes and norms but also by the cultural traditions of a sense-maker's context (Gadamer 1960/2004: 294, 299). In this sense, interpreting the meaning of a text does not depend on the contingencies of its historical author, but on sense-makers' historical sense of the cultural traditions in which they participate (Gadamer 1960/2004: 296). Interpreting, as a form of "understanding", is thus not a re-productive process but rather constitutes productive knowledge creation. The bedrock of this production is a confrontation of standpoints that takes into account the continuity of norms and values of questions and solutions handed down through "traditions" to individuals as socio-historical actors.

> *Understanding is to be thought of less as a subjective act than as participating in an event of tradition*, a process of transmission (*Überlieferung*) in which past and present are constantly mediated (Gadamer 1960/2004: 291; emphases in the original text).

Second, Gadamer (1960/2004: 295, 431) argues that grasping how an individual understands "all that can be understood" starts by questioning the socio-historical "bond" between the person and the subject at hand. The bond is described as a tension "in-between" (*Zwischen*, in Gadamer's original German formulation) an individual's preconceptions (including prejudices), and the perceived "familiarity and strangeness" (Gadamer 1960/2004: 295) of what is perceived as an external stimulus with regard to the language and the story it addresses to a person's sense of "traditions" (Gadamer 1960/2004: 295). This in-between tension constitutes a concrete form of Bateson's concept of information as an "in-between" temporal experience (Bateson 1991/1996: 278). In this sense, Gadamer's interpretive approach is congruent with an ethnomethodological approach that rests on how users, as social actors, make sense of a given situation (cf. Lahire 2006: 17), as well as with the retrospective, case-based reasoning of "situational knowledge" (De Jong and Ferguson-Hessler 1996).

Third, for Gadamer (1960/2004: 291) the "construal process" is governed by reflective conversations ("dialogues").[7] The anticipation of meaning that emerges from these dialogues travels "from the whole to the part and back to the whole" (Gadamer 1960/2004: 291). This process occurs when dialogues go beyond the standpoint of a present situation governed by a set "horizon" – i.e., the extent an individual is able to look beyond what is close at hand and "to see it better, within a larger whole and in truer proportion" (Gadamer 1960/2004: 304).

The broadening of a horizon occurs when hitherto "alien" elements are appropriated in the meeting of another horizon. Gadamer (1960/2004: 302, 537) calls this

[7]The process of dialogue is seen as an "art of thinking" that raises questions and possibilities with reference to a subject matter – and resists being "suppressed by the dominant opinion" – to enable sense-makers to "metamorphose" their viewpoints (Gadamer 1960/2004: 361, 381). This point echoes Floridi's "network of relation" of queries and answers.

epistemological meeting of "unfamiliar" horizons, a *fusion of horizons*. This fusion gives rise to new knowledge in a given situation. In this way the phenomenon of interpretive understanding involves interrelating what a user sees as known and unknown, consonant and dissonant, reassuring and worrisome by the means of cultural artifacts. The process is ongoing and unpredictable and, as such, not totally accessible to the sense-maker.

Viewed in this light, the epistemological approach of Gadamer goes beyond stressing the importance of an individual's experience of language and culture. He does this by underlining a user's sense of the norms, values, and traditions associated with cultural artifacts. On this account, interpreting is not a purely subjective act but participates in a social handing down of norms, values, and traditions between the past and the present. The approach brings to the fore, in a tangible way, what Bateson (1972/2000: 315) calls information (e.g., elements of "traditions" involved in a "construal process") that "travels and undergoes successive transformation in a circuit". Gadamer also provides support for Leleu-Merviel's (1996: 29) argument that information (e.g., in the form of cultural norms and values) is not separated from a process (e.g., an individual interpreting external stimuli) that carries and transforms epistemological differences.

The idea that an interrelating sense-making process is not an incidental ("subjective") act implies that one must take into account an individual's feeling and emotions (including those associated with preconceptions and prejudices) regarding the "familiarity and strangeness" (Gadamer 1960/2004: 295) of meaningful external stimuli. The linking up of these feelings and emotions with the individual's rational reasoning is comparable to what Bates (2005) calls "meaning" in her definition of *Information 2*, i.e., "some pattern of organization of matter and energy given meaning by a living being".

As we shall presently see, Gadamer's leading concepts such as interpreting, dialogue, and the role of language has inspired our research methodology. The question now is how the identification of salient data and the interpretative process can contribute to the construing of informational constructs.

11.3.2 Information as an Epistemological Construct

Bateson (1972/2000: 314) regrets that there is no one word in English to express both the epistemological and ontological premises that human beings hold, often unconsciously, about their lived world and the way that they act in it.

> The living man is thus bound within a net of epistemological and ontological premises which – regardless of ultimate truth or falsity – become partially self-validating for him. (...) In George Kelly's vocabulary, these [premises] are the rules by which an individual "construes" (Bateson 1972/2000: 314).

What, then, does Kelly mean by construing? According to Kelly (1955/1963: 50, 120), to construe implies abstractive sense-making. Construing designates a level of abstraction where a person notes how two apparently salient reference points are apparently similar (analogical reasoning) in contrast to a third significant reference point (Kelly 1955/1963: 50, 59, 111). This reasoning involves simultaneously establishing how an apparent similarity between two epistemic reference points is dissimilar to a third reference point of a like nature. Kelly summarizes this dual contrastive process in the following way:

> Before we can count (1, 2, 3) we must construe their concrete difference from each other, their abstract likeness to each other, and their abstract difference to other things which are not to be counted. We must be able to construe where one thing leaves off and another begins, which one is similar enough to the others to be counted, and what is extraneous. What counts depends on what we abstract to be counted (Kelly 1955/1963: 54).

Kelly (1955/1963: 63) argues that unlike "classical logic", he does not confuse what is "contrasting" (meaningful differences) with what is "irrelevant" (meaningless differences). This means establishing similarities has the correlative of recognizing meaningful dissimilarities between objects. Identifying similarities and dissimilarities are two sides of a single reality; they make sense one in terms of the other. Likewise, Dervin (1999b) advocates the importance of knowing in what manner perceived objects "connect" and "contest" each other in their apparent similarities and dissimilarities. Unlike Dervin, however, Kelly, explains how a construing logic can be deployed to systematically document an individual's informational constructs in a way that encapsulates both qualitative and quantitative aspects of what is being documented. Kelly thus goes beyond "knowing that" (declarative knowledge) abstract contrastive dynamics exist at the heart of the sense-making process; he also seeks to "know how" (procedural knowledge) individuals go about creating knowledge of their situation through lived experiences (knowledge by personal acquaintance). The idea of knowledge by acquaintance is understood in the sense of the British social theorist, Isaiah Berlin, who wrote:

> There is an element of improvisation, of playing by ear, of being able to size up the situation, of knowing when to leap and when to remain still, for which no formulae, no nostrums, no general recipes, no skill in identifying situations as instances of general laws can be a substitute (Berlin 1997: 33).

Berlin (1997: 34, 35) underlines the gap between theory that deals with idealized entities and a particular concrete situation – "the simplicity of the former, the excessive complexity of the latter" – when seeking to make sense of the relationships of actual things and persons. In line with this perspective, our study adapted Kelly's construing process in seeking to understand how viewers made sense of scenic "affordances". By affordance is meant semiotic elements that grab a user's attention where global "meaning is observed before the substance and surface, the color and form are seen as such" (Gibson 1979: 134). Such affordances are seen as offering opportunities for use in a given situation (Gibson 1979: 139). What characterizes an affordance is that it represents a knowledge-building reference point in order to fulfill a given objective. Seen from the semantic information perspective of Floridi (2011a), an affordance can be related to a *datum* that strikes a user insofar as it is "more conspicuous or less redundant than the background conditions". As he puts it,

Table 11.1 A standard triadic grid

	Pursuer	Pursued	Passers-by	
Police				Open minded

Understood as relational entities, data are constraining affordances, exploitable by a system as input of adequate queries that correctly semanticise them to produce information as output (Floridi 2003: 129).

In the context of our research project, a pilot study revealed that viewers of a snippet of film featuring a car chase scene identified three epistemic reference points – seen as constraining affordances – when watching it. The viewers were intrigued by the relationships linking the *pursuer* in a nondescript car, the two *pursued men* in a police car, and *passers-by* in a busy city centre. These three reference points, acting as an "input of adequate queries", were later used in the main research study.

When the interviewer-interviewee dialogue turned to filling in the triadic grid (see Table 11.1 above), the first set of ascriptions[8] occurred when the person expressed in what ways the Pursuer (Reference point #1) of the car chase and the Pursued car (Reference point #2) was similar in contrast to Passers-by (Reference point #3). We call this process of contrasting between two different reference points relative to a third reference point diaphoric$_1$[9] reasoning, and in so doing we take into account this aspect of the diaphoric concept of Floridi (2011b: 86). In this case (see Table 11.1, above), the viewer felt there was a link with the law, in that reference points #1 and #2 are both linked to crimes. It was then decided that the term "Police"[10] best encapsulates the link between the Pursuer and the Pursued relative to the Passers-by. The interviewee then wrote down "Police" on the left-hand side of a triadic grid, see Table 11.1.

The construing similarity-seeking process continued until the individual could think of no other ascriptions. After this, the cluster (Pursuer/Pursued relative

[8] Ascriptions occur when an interviewee assigns attributes to a phenomenon based essentially on lived experiences, cf. Haferkamp and Smelser (1992: 109–111).

[9] A diaphoric$_1$ process establishes how two of the data (within a triadic cluster) are apparently similar to each other but different to the third datum in a given communicational space, in this case, when viewing a cinematographic car chase in a semi-directive interview condition.

[10] An inappropriate similarity ascription would have been, for example, if the person had said that a similarity between the Pursuer and the Pursued is that they are "human beings". This would not have been useful as the term "human being" could also apply to the Passers-by. The researcher asked the user whether the term "human being" applied or not to "Passers-by" in order to check if the ascribed meaning of "human being" applies or not to "Passers-by". If so, the term was considered inappropriate.

to the Passers-by) was modified, for example, by changing the Pursuer/Pursued combination to a Pursuer/Passers-by combination relative to the Pursued men. This allowed a systematic cross-matching of the data constituting the cluster.

From an epistemological standpoint, the similarity-seeking process effectively drew on analogical reasoning (see Sect. 11.6, below) to bridge a gap between different meaningful reference points (e.g., Pursuer/Passers-by in contrast to Pursued). The psychologists Gentner and Colhoun (2010) contend that analogical reasoning is fundamental to human cognitive prowess. In their view, this analogical capacity provides a person with a "vast set of insights resulting from parallels past and future" when she or he faces a new encounter in the here and now.

A second set of ascriptions focused on establishing relative dissimilarities. After the interviewee had documented the similarities between the reference points, he or she was asked to construe dissimilar ascriptions (e.g. "Open minded", see Table 11.1) in contradistinction to a previously ascribed similarity (e.g. "Police"). The interviewee was free to make explicit reference to any or to none of the reference points. When an appropriate term was found and discussed with the interviewer, it was duly noted down on the right hand side of the triadic grid (see Table 11.1 above). This process can be described as a form of diaphoric$_2$[11] reasoning. In fact, the diaphoric$_2$ relation is constructed in terms of two principal factors. First, there is the diaphoric$_1$ relation ascription (to the left of the grid, see Table 11.1). Second, the personal value system of the interviewee (with its inevitable preconceptions and prejudices, as noted in our discussion of Gadamer in Sect. 11.3.1 above) is inevitably involved, especially as the viewer has the choice of referring to the three reference points or not.

Table 11.1 effectively presents the pair "Police/Open minded" with reference to a given triadic cluster. This configuration of (1) a cluster, (2) a similarity ascription (e.g. "Police"), and (3) a dissimilarity ascription (e.g. "Open minded") constitutes what Kelly (1955/1963: 50–51) calls a triadic "*construct*". In order to make explicit the form and the "level of explanation"[12] involved in construing such constructs, we advance a reformulation thereof in a non-ambiguous symbolic language:

$$\{\{[(x \sim y) \approx z] \rightarrow a_1\} \not\approx a_0\} \mapsto C$$

where:

C is an informational construct resulting from an ascription of *similarity* $\mathbf{a_1}$ (e.g. "Police"; see Table 11.1) that stands in a diaphoric$_2$ relation ($\not\approx$) to an ascription of *dissimilarity* $\mathbf{a_0}$ (e.g. "Open minded", see Table 11.1);

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[11]A diaphoric$_2$ process establishes how a chosen attribute is meaningfully contrary to a given diaphoric$_1$ attribute.

[12]For Floridi and Sanders (2004: 17) a "Level of Explanation" is an important kind of "Level of Abstraction" (specification of elements that can be meaningfully broached and the kind of data that can be expected from a given operation). A Level of Explanation describes, for example, "the expert's or the layperson's point of view" without claiming to reflect an ultimate description of the system (p. 27).

if:

x (e.g. Pursuer/Reference point #1), **y** (e.g. Pursued/Reference point #2), and **z** (e.g. Passers-by/Reference point #3) are in a diaphoric$_1$ relation ($\approx$) within a meaningful cluster for the interviewee. In this way, the diaphoric$_1$ relation effectively brings out how two items of a cluster are similar in a way that the third item is not.

given that:

$\sim$ means "is more or less similar to" (analogical relation)
$\approx$ means "is more or less in contrast to" (diaphoric$_1$ relation)
$\not\approx$ means "is more or less dissimilar to" (diaphoric$_2$ relation)
$\rightarrow$ means "generates" (temporal relation)
$|\!\rightarrow$ means "can be encapsulated as" (principle of parsimony).

Our formal representation of Kelly's level of abstraction represents one way of theorizing information by taking into account how a consciously aware (sentient) informational agent goes about processing data into information. This was done by operationalizing key aspects of General Definition of Information set forth by Floridi, for whom, in order to establish the nature of a *datum*, it is necessary to ascertain the level of abstraction of what he calls an "informational agent" (Floridi 2011b: 87). Our formal expression of construing informational constructs thus clarifies the level of abstraction involved in documenting an informational agent's viewpoint. Our study posits that an adaptation of Kelly's construing process, *via* a field-research triadic grid, gives the researcher access to, and allows the agent to identify, data-bearing informational constructs about a given problem situation.

The filling in of the grid – more commonly called a "repertory grid" – is detailed in Sect. 11.4.2 below. The term "triadic grid" was retained to highlight our modifications of the grid, notably the preference indicating "Phase 5" (see Sect. 11.4.2, below) of the interview protocol.

It is important to underline at this juncture that the triadic grid and its formalization serve both as a way to help individuals document their informational constructs, and as a way to help, at the very least, the researcher make sense of what was documented. Viewed in this way, a triadic grid can be understood as a sense-making document that renders coherent a set of ascriptions from a given "viewpoint". In this context, informational constructs act as building blocks in a coherence-seeking "sense-making" process (cf. Labour 2011: 92–102). The usefulness of formalizing Kelly's level of abstraction lies not only in its formal robustness and coherence, but also in its applicability in the situation to which the formalization refers. In light of this, the documentation of viewers' self-reports of their informational constructs can be considered as a form of "rewriting" initial experiences of perceived data. In our case, it involved interrelating the cinematographic experiences of a user within a given communicational space. Epistemologically speaking, this rewriting process constitutes a key element of how a user interrelates apparent similarities and dissimilarities in confronting a decisional problem, namely whether he or she wishes to see the whole film, or not, after having seeing a snippet thereof.

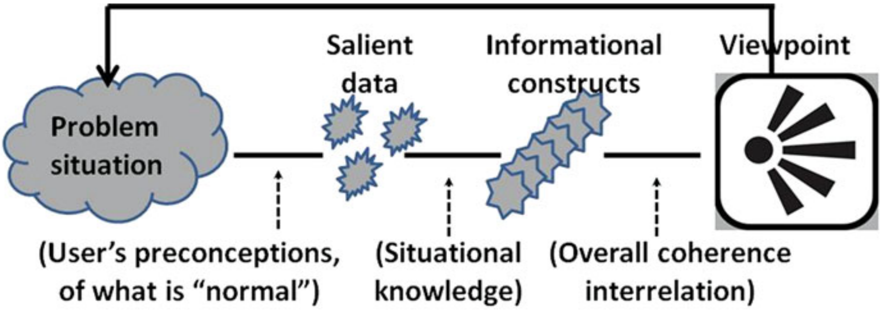

Fig. 11.2 Schematic representation of a viewpoint and its place within an intrapersonal knowledge building process

These self-reports, generated by a rewriting of lived experiences, enable ascriptions to migrate from an *intra*personal to an *inter*personal situation regarding how a viewer made sense of a cinematographic experience. In our study, the intrapersonal situation was the user viewing an action film snippet of a car chase. The interpersonal situation was an open-ended dialogue (adapted from Brenda Dervin's sense-making approach), followed by a more constraining phase where the interviewees could "rewrite" their experiences by filling in the triadic grid (see Sect. 11.4.2 below). For Jeanneret (2008: 88) such rewriting is not just an act of sharing or recording objects but also one of sense-making mediation. It is through such rewriting that sense-making events stand out from a succession of perceived data. In this way, the Triadic Method enables data-bearing information to "travel and undergo successive transformation in a circuit" (Bateson 1972/2000: 315). The migration from one lived situation to another can thus transform a user's viewpoint – in our case, the decision whether or not to watch a film after having seen a snippet of it. In our study, such transformation came about by allowing viewers to verbalize their on-screen experiences.

11.3.3 Representation of a Viewpoint Building Process

Figure 11.2 above highlights the essential epistemological features of our methodological framework by formally simplifying the (unpredictable; cf. Gadamer 1960/2004: 302, 537) process of intrapersonal knowledge creation. The nature of each horizontal line is described in parentheses to indicate the dominant character of each process.

Figure 11.2 assumes that a problem situation includes proto-epistemic saliencies in the apparent uniformity of the perceived "external" world. Floridi (2011b: 33, 85) considers these proto-epistemic saliencies as "uninterpreted differences" of symbols or signals that act as an external anchor of information that can be empirically inferred from experience. This inference occurs when a sentient information agent identifies salient features (De Jong and Ferguson-Hessler 1996: 106) as relevant affordance-based data (Floridi 2003: 129).

In this context, we hold that the identification of knowledge-building epistemic saliencies is the result of knowledge-creating "tensions" between a user's "preconceptions and expectation" of a problem situation and the socio-historical "familiarity and strangeness" of what is perceived as an external object for a user (Gadamer 1960/2004: 295).

With the help of a situational knowledge framework, these data become transformed into informational constructs (Kelly 1955/1963: 54). It is assumed that the interrelated "tensions" of different informational constructs act as epistemological building blocks in an overall coherence-seeking, interrelating process that leads to the emergence of a user's viewpoint as a form of "fusion of horizons" (Gadamer 1960/2004: 302). This fusion comes about by a transformative process. In Sect. 11.6, below, we develop the hypothesis of "informational resonance" to clarify the idea of knowledge-building tensions that make up a transformative informational process.

Once a viewpoint has been formed, it becomes part of a broader decisional process. A viewpoint is understood as an interrelation of a series of epistemologically informational constructs into a functional whole by a user engaged in a decisional sense-making process vis-à-vis a problem situation. According to Crévits and Tsoukiàs (2012), a viewpoint constitutes the "problem setting" phase of a decision aiding process (see Fig. 11.1 above). The value of a viewpoint is that it crystallizes the "issues" and the "engagements" that the problem situation implies for a user. This crystallization is then confronted with what the person envisages as "potential actions" to resolve a designated problem. The result of the confrontation is formulated as a "problem statement".

In conclusion, the methodological framework of our study was based on the guiding assumption that a decisional sense-making process consists of a user's ability to interrelate a series of informational constructs construed from what the person considers as salient data. To this end, the methodological framework married declarative knowledge to a contextualized knowledge-by-personal-acquaintance approach into a single field research framework. Having established this as the methodological framework for our study, we present below the different techniques that constituted our field research method.

11.4 Research Method

The research method was centered on a 5-minute car chase taken from the action film, *Vantage Point* (2008). A team of film specialists selected the snippet as one of the highlights of the film. The snippet was 5 minutes long because this length seemed sufficient to generate a potential sense-making unit with a beginning, development, and climax. One reason for choosing the snippet was that it represented a reversal of the cops-and-robbers car chase scenario typically found in action films. In it, one sees a man in a black suit, frantically driving a nondescript small blue car behind a police car with sirens blaring, with two occupants dressed in police uniforms shooting in the direction of the blue car while careening through a jam-packed city centre. It was assumed that the scenario of having a police car pursued by another car – instead of pursuing it – would intrigue viewers.

11.4.1 Objective

Our research objectives rested on an axiomatico-inductive approach. It accepted as an axiomatic truth that a user as a social actor can be considered as a "condensed product" of a broader social process (Lahire 2006: 17). This social *pars pro toto* (a part taken for the whole) axiom refers to extensive studies in the micro-social domain. For example, Elias (1991) argues that every society has its own history and shared culture that mold humans as singularly socialized individuals. This social individualization process ensures that personal differences contribute to the co-construction of social norms and values. In this regard, Elias sees the bottom-up (of individual ideas and actions) and the top-down socialization processes (of a social structure) as co-dependent. Giddens (1976: 121) takes up this point to argue for a circular causality between individuals, as self-reflexive agents, and society that structures individual ideas and actions. In this sense, individuals produce social structures and forms that at the same time enable and constrain individual ideas and actions. This leads Giddens to state that society provides "forms", which include resources, such as frames of meaning, that affect people insofar "as structure is produced and reproduced in what people do" (Giddens and Pierson 1998: 77).

The inductive aspect of our approach implied that there were no preconceived formal filters of hypotheses, principles, or theories as to what the user might or might not say and what this could mean for the researcher. This approach helped the interviewer to be receptive to what interviewees said and meant. The aim of such an approach was to take into account different observations in order to establish broader (data driven, bottom-up) generalisations. The interpretation of the research findings thus did not directly depend on the methodological framework of the study. If this were to be the case, the findings would be the products of a circular, self-confirmatory approach. This would be antithetical to an axiomatico-inductive approach.

In this light, the research objective sought to grasp what viewers' informational constructs tell us about how they appear to make sense of scenic affordances. The objective relied on viewers making sense of cinematographic codes (rules that decipher a set of signs; e.g., hairstyles, dress code) and stereotypes (categorizations that differentiate entities by highlighting their similarities and underplaying their differences, or *vice versa*; e.g., between the "good guys" and the "bad guys" in a film) *vis-à-vis* social norms about driving on public roads, the role of the police, and whether action-films encourage anti-social behavior. These norms, codes, and stereotypes can be considered as giving historical continuity passed on by what Gadamer (1960/2004: 291) calls "traditions", in this case, in the cinematographic domain.

In conclusion, the research objective focused on highlighting how viewers made sense of norms, values, and expectations regarding what they experienced on-screen *via* a bottom-up interpretation of informational constructs.

11.4.2 Interviews

The semi-guided research interview of this study is considered as a Gadameresque dialogue that produces understanding by a "fusion of horizons". In this case, the fusion occurred, principally, through a dialogue about the relationship between the expectations of university-educated adult viewers and an emerging horizon linked to watching a filmed car chase scene screened on a 17-in. computer screen placed on an office desk in front of a comfortable chair. The scene was watched individually by each viewer in the interviewer's office. The same interviewer conducted the exchanges individually with each viewer about what he or she experienced. The dialogues lasted about 60 minutes and were tape-recorded. In terms of conversational analysis norms, the role of the interviewer was that of a non-confrontational active listener (for a more detailed description, see Labour 2011).

After a pilot study to validate the research protocol, 20 adults who were finishing a 3-year degree in adult education were interviewed about what sense they made of the car chase. The interview started with the interviewer explaining the broad objectives of the study; then the interviewee filled in an informed consent form, followed by a close-ended questionnaire about personal leisure and driving preferences (Questionnaire #1). After this, the following instruction was given: "Please watch the film and tell me what you think about it as if you were talking to an acquaintance who wanted to know if it was worth seeing". The viewer then watched the filmed car chase. The film was screened once in order not to take up too much of the viewer's time. Following this, the person immediately filled in Questionnaire #2,[13] which asked whether he or she wanted to see the whole film and what the car chase meant to the person.

The answers given in Questionnaire #2 acted as a launching pad for a semi-guided interview based on Dervin's (1999a) qualitative global sense-making technique. This acted as a prelude to Kelly's (1955/1963) analytical, and partly quantitative, triadic grid method. The grid was used to crystallize and document viewers' declared preferences. Questionnaire #3[14] came near the end of the interview to see if, after dialoguing about the film, viewers had modified their initial decisions about watching the film.

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[13]Based on a *Visual Analogue Scale* psychometric sliding response scale, Questionnaire #2 consisted of four questions to establish if the viewers wanted to see the film, found the film animated, were drawn to the screen, and felt emotions. The questions were developed from the results of a preceding pilot study.

[14]Using a *Visual Analogue Scale*, Questionnaire #3 asked if the viewer wanted to see the film in its entirety.

Table 11.2 An enhanced triadic grid

1 Similitude attributes	Pursuer	Pursued	Passers-by	**5** Dissimilitude attributes
(C1) S1/Police	**1**	**1**	**5**	D1/Open minded

In this study, the interviewee filled out the triadic grid in five basic phases, in dialogue with the interviewer.

Phase 1. Three protagonists ("Pursuer", "Pursued", and "Passers-by") were placed next to each other in columns. These three elements (considered as "constraining affordance" related data, cf. Floridi 2011b: 8; see Sect. 11.3.1 above) correspond to the *x*, *y*, and *z* components of our symbolic formalization of Kelly's construing process (see Sect. 11.3.2 above). The viewer was asked to construe how two of the designated protagonists were similar in a way that the third was not.

Phase 2. After the viewer construed a similarity, designated as "S" (see Table 11.2), or a_1 in our symbolic formalization, between the protagonists, the person found a keyword, in the form of an attribute (considered to be diaphoric$_1$; see Sect. 11.3.2 above), to summarise his or her thoughts. The word was discussed with the interviewer and then noted down to the *left* of the columns ("S1/Police"; see Table 11.2). As the dialogue moved on, other words were found and listed vertically one under the other. When the viewer had exhausted what could be said about a cluster (e.g., C1 of the Pursuer/Pursued relative to Passers-by), a new cluster (C2) was created with a new configuration (e.g., Pursuer/Passers-by relative to Pursued). The process stopped when the interviewee had nothing left to say (saturation principle).

Phase 3. To the *right* of the vertical solution columns, viewers then identified an attribute that they considered to be meaningfully dissimilar to the corresponding similarity-attribute (e.g., "S1/Police"). The dissimilar attribute (or diaphoric$_2$, see Sect. 11.3.2 above) was designated as "D" (e.g., "D1/Open minded", see Table 11.2) in the triadic grid. This was indicated as a_0 in our formalization of the Kelly's construing process.

Phase 4. When all the ascriptions had been established, viewers expressed their preferences by a numeric value on a five-point scale. The preference was established by comparing each of the protagonists (vertical dimension), one at a time, with each pair of ascriptions (horizontal dimension) line by line. The value of "1" of the five-point scale represented a strong preference for the similarity-ascription on the left of the triadic grid, while "5" indicated a strong preference for the contrast-ascription on the right. Between these two extremes, the "2" designated a relative preference for the similarity-ascription (on the left) and "4" indicated a relative preference for the contrast-ascription (on the right). The value of "3" expressed an undifferentiated preference. These choices were made in dialogue with the interviewer to create an ordinal data adjacency matrix.

Phase 5. This final phase was an innovation added to the triadic grid in order to clarify the viewer's value system. To do this, the viewers indicated which of the three main protagonists they preferred by putting an "X" on the column of their choice. The preference was based on the interviewee's value system. The viewer verbalised on which (moral, personal comfort, aesthetic, etc.) basis the preferences were founded. The choice was left up to the viewer. It was often at this phase that the viewer's preconceptions and prejudices (cf. our discussion of Gadamer in Sect. 11.3.1 above) came to the fore and were discussed. This process was repeated for each ascription of the similarity-dissimilarity pair—i.e., viewers chose if they preferred either the similarity or the dissimilarity ascription by putting an "X" on their choice to the left or to the right of the grid. Viewers were systematically asked to speak about the meaning of their choice. In this way, the verbalization of viewers' choices allowed the researcher to gain insight into the basis on which the users interrelated different informational constructs.

The major contribution of this study to the operational elaboration of Kelly's "repertory grid" (cf. Atherton 2011) lays in its solicitation of the user's value system as well as its embedding of the grid within the structure of an interview protocol. To this end, the grid-filling protocol coupled viewers' ascriptions to numeric preferences with a running commentary from the person. This process represented an operationalization of Floridi's (2011b) "General Definition of Information" concerning well-formed, meaningful, truthful, and relevant data embedded in a network of relations. In this sense, the grid can be said to document viewers' verbalized informational constructs about a particular situation.

11.5 Findings

In this chapter, we advance two hypotheses that arose from our study of the viewers' interpretation of the film snippet that they saw. Hypothesis #1 is based on a global interpretation of 20 viewers' cinematographic experiences. Hypothesis #2 analyzes one of the viewers' recorded experiences to get a more detailed sense of how the person interrelated his or her informational constructs.

The aim of the global interpretation was to establish the extent to which a migration from an *intra*personal communication situation (viewing the film snippet alone) to an *inter*personal communication situation (dialoguing about the snippet) influenced a user's viewpoint regarding the snippet (see Sect. 11.3.2 above). The findings show that the interpersonal dialogues focused on the background passers-by of the car chase as a form of epistemological touchstone. In this context, the dialogue situation had, broadly speaking, three different kind of effects.

A first effect was a reaffirmation of the initial decision, whether it be positive or negative, about the film. This we call the *stabilizing effect* in its reinforcement of the viewers' viewpoints about the film. A second effect led some viewers to change their initial decision whether to watch the entire film or not: this can be described as a *propellant effect*. In this case, it appears that the dialogic exchanges enriched the situational knowledge of viewers. A third effect involved a disagreeable feeling of dissonance[15] about the film, which the film theorist Frank Manchel (1990: 543) has called the *boomerang effect*. This effect is best explained as arising from the fact that the film brought out inconsistencies in the viewers' knowledge system. Its net result was that the viewers did not want to see the film.

In the light of these findings, we advance *Hypothesis #1*, arguing that when viewers of a film "dialogue", in Gadamer's sense, about the sense they make of their experiences, an epistemological "touchstone" emerges. It is not clear, however, what precisely constituted the informational constructs that led to this touchstone. What is needed is a microscopic analysis of these constructs to understand how a viewer can transform the "constraining affordances" of data (Floridi 2011b: 87) into informational constructs. It is at this juncture, that the documentation process of the Triadic Grid becomes an indispensable analytical tool to identify tangible scenic elements of a situation that make a meaningful sense-making difference tied to viewers' declared preferences regarding the film that they viewed.

Due to constraints of space, we have opted here for a detailed analysis of one of the interviews conducted in our study. For the sake of anonymity, we shall call the interviewee by an assumed name, Lewis. As a social actor, Lewis is a "condensed product" of a broader social process (Lahire 2006: 17). His viewpoint is thus not considered as merely a set of passing whimsical feelings, but rather as a *reflection of broader socio-historical processes*. This point constituted the axiomatic bedrock of our research approach (see Sect. 11.4.1, above). Lewis was chosen because he had described himself as an unconditional fan of car chases (Questionnaire #1) and his responses fell squarely into the majority group who had experienced the *stabilizing effect* of the interview.

At first view, little seems to have predisposed Lewis to take into account the role of nondescript passers-by in the film. In effect, immediately after watching the snippet, Lewis described how he was "riveted to the screen" with the pleasure and excitement of the car chase. What attracted his gaze was the "flashy blue" color of the Pursuer's car. He literally felt his adrenalin rising when he put himself in the role of the Pursuer. This would suggest that he identified himself spontaneously with the Pursuer.

Yet, in Table 11.3 below, Lewis indicated that he preferred the Pursued men, compared to the Pursuer and the Passers-by. How can one explain this declared preference at the end of the interview?

Can the preference for the Pursued men be explained by the fact that Lewis, as an unconditional fan of cars, saw the pursued men as the only *good drivers* (Informational constructs, S1-D1, see Table 11.3 below) of the car chase? Effectively, by the time it came to attributing a numeric preference to his informational constructs, Lewis had modified his initial point of view and rated the Pursuer as having few driv-

[15]Cognitive dissonance arises when a person is confronted with stressful and unresolved conflicting events arising either from past experiences and/or internal inconsistencies in his or her decisional process, or when there is a preoccupying conflict between what the person does in public and what he or she privately believes (Festinger 1957: 14).

Table 11.3 A triadic grid documenting Lewis's informational constructs

	1. Similitude attributes	Pursuer	X Pursued	Passers-by	**5.** Dissimilitude attributes
X	(C1) S1/Good drivers	**4**	**1**	**3**	D1/Can't anticipate other cars
X	(C1) S2/Main actors	**1**	**1**	**1**	D2/Little presence
X	(C1) S3/Have fixed objectives	**1**	**1**	**2**	D3/Lack determination
X	(C1) S4/Tight close-up shot	**1**	**1**	**5**	D4/Wide shot
X	(C1) S5/Shared history	**2**	**2**	**5**	D5/No link between characters
X	(C1) S6/Unpredictable	**5**	**5**	**1**	D6/Stereotypic good/bad guys
X	(C2) S7/Interaction-obstacle	**1**	**5**	**3**	D7/Interaction-escape

(C1) (Pursuer.Pursued)Passers-by; (C2) (Pursued.Passers-by)Pursuer

ing skills. Indeed, at the end of the snippet, the Pursuer ended up crashing against a wall. This admiration for driving skills can explain Lewis's preference for the Pursued men, which he indicated by placing an "X" next to their name at the end of the interviewer. Lewis also indicated the importance he accorded to driving skills by putting an "X" next to the attribute "S1". Yet, when Lewis explained his preference for the Pursued men, he felt the need to explain that he had chosen the Pursued "just to be different, because it is not the obvious choice", rather than linking his choice to his admiration for driving skills. For Lewis, the obvious choice was to have opted for the Pursuer as the stereotypic Hollywood "good guy". Lewis thus sought to show that he knew that his situational knowledge transgressed certain norms.

What sense can be made of Lewis considering the Passers-by as the *main actors* (S2-D2) at the same level as the Pursued men and the Pursuer? Surely, one could have expected a clearer distinction between the Passers-by, as the cinematographically secondary actors, and, at the very least, the Pursued men, whom Lewis visibly preferred. In short, how can scenic background data (the Passers-by) be considered as equally significant as foreground data (the Pursued men standing in relation to the Pursuer)?

When Lewis was asked to describe what the Pursuer and the Pursued men had in common that the Passers-by did not have (Cluster #1/C1), he spontaneously identified, with frank admiration, the accomplished driving skills of the Pursuer and the two Pursued men (Informational construct, *Good drivers*, S1). He went on to describe how he was fascinated by the driving stunts and intrigued by the make of cars used in the scene. He initially thought the snippet was an advertisement for a German car.

For Lewis, each of the three types of main actors had some attributes that they shared with each other and others wherein they differed from one another. In this instance, a feature that the Passers-by shared with the other two types of protagonists was that they had "fixed objectives" (Informational construct S3-D3)—that is to say, they were leading their own respective lives. According to Lewis, this was the only point of commonality that the Passers-by had with the other two protagonists.

With the informational construct *Tight close up shot/Wide shot* (Informational construct S4-D4), what distinguished the Passers-by was that their on-screen presence was limited to “wide (angle) shots”, unlike the Pursuer and the Pursued men. These wide angle shots portrayed the Passers-by “as an anonymous mass”, with no direct link (i.e., no “shared history”) with the Pursuer and the Pursued men (Informational construct S5-D5). For Lewis, this lack of “shared history” implied that the Passers-by were less predictable in their behavior than the actions of the stereotypic Pursuer and the Pursued men (Informational construct S6-D6).

In responding to the first cluster (C1), Lewis essentially documented what he had already said in the more open-ended first part of the interview. However, when asked to describe what the Pursuer and the Passers-by had in common that the two Pursued men did not have (Cluster #2/C2), Lewis initially said he had nothing to say. After taking time to reflect on the new cluster, and looking at his partially filled-in grid, he theorized about on-screen car chases (Informational construct S7-D7).

Lewis described fictional car chases as being either a rally or a Formula 1 racing type scenario. In a Formula 1 race, the main objective is to keep control of a car at top speed on a road having few extraneous obstacles, such as in the film *Bullitt* (1968). In rally races, on the other hand, drivers weave around obstacles. After taking this dichotomy into consideration, Lewis concluded that the snippet was of the rally type. In this case, the obstacles were the Passers-by and the tables and chairs on the pavement. The Pursuer’s challenge was to avoid obstacles in the city center (Informational construct S7, *Interaction-obstacle*), while the obstacles acted as screens to cover the escape of the Pursued men. The role of the Passers-by was neither to escape nor to avoid obstacles but to be present in order to give dramatic meaning to the chase.

Lewis’ insight into the car chase represents a “fusion of horizons” (Gadamer 1960/2004: 302, 537) because he managed to interrelate a number of elements to discover new relationships between salient elements of a problem situation. After making this point, Lewis had reached saturation point; he had nothing else to say about the second or the third construct (i.e., What did the Pursued men and the Passers-by have in common that the Pursuer did not have?).

On the face of things, Lewis may come across as being oblivious to the negative consequences of car chases on bystanders. In effect, the declared features of Lewis’ value system showed the importance he ascribed to the main actors (S2) being able to drive skillfully (S1) in order to attain a set objective (S3), linked to a common history (S5), despite unpredictable (S6) obstacles (S7).

In a last-minute reflection, however, Lewis freely admitted that his enjoyment of the car chase was a type of *Schadenfreude* (a secret guilty pleasure at another’s misfortune). He said he would never openly admit to enjoying watching a car chase to someone who had directly or indirectly been involved in a road accident. In stating this, Lewis tacitly acknowledged the importance of social norms concerning the fragility of human life even when enjoying an action film. What this indicates is that informational constructs can rest on underlying ambiguities, such as a user’s feeling of *Schadenfreude*. There is ambiguity insofar as the feeling can encompass different elements, such as guilt, empathy, or even the desire to avoid creating a conflict situation. These emotions can create a basis for knowledge-building tensions in the way users develop their situational knowledge. In this case, Lewis' pleasure at watching the snippet was not completely divorced from off-screen reality. His situational knowledge linked up on-screen fiction to off-screen reality without hampering his decision to watch the film.

The case study interpretation of Lewis's triadic grid offered here throws into relief the presence of knowledge-creating interrelations in an individual's sense-making process. These interrelations entail the emergence of epistemological "tensions", involving a variety of emotions, feelings, beliefs, and situational knowledge, in the construing of a user's informational constructs. This leads us to advance *Hypothesis #2* concerning the epistemological role of such tensions associated with the interrelations of informational constructs. We argue, in the following section, that these tensions can be understood as informational "resonances", based on epistemological "touchstones" (see *Hypothesis #1*).

11.6 Informational "Resonances"

In order to help clarify the idea of an epistemological difference that "travels and undergoes successive transformation in a circuit" (Bateson 1972/2000: 315), we put forward the idea of "informational resonance", which is based on Hypotheses #1 and #2 (above).

From a neurological point of view, Decety and Chaminade (2003: 128) point out that developmental research suggests that the phenomenon of human knowledge-building resonance is probably neurologically hard-wired as a "distributed neural mechanism". This neural-based resonance is consistent with the notion of "shared representations", which postulates that perception and action share common cognitive and neural codes. On a more conceptual level, St. Clair and Busch (2000) note that the idea of resonance is especially appropriate as a metaphorical encapsulation of expressions of emotions, shared feelings, and other experiences of numinosity, as well as the impact of visual forms, a sense of the profundity of music, and other lived experiences. In a similar vein, Edwards (2005: 4) writes that the metaphor of resonance expresses the ability of "verbal formulations to capture the essence of various aspects of unformulated experience". However, these experiences are "not digital units of compartmentalized life but analogs" (St. Clair and Busch 2000: 72). It is this metaphorical understanding of resonance that we seek to develop as a step towards theorizing key aspects of an informational process that "travels and undergoes successive transformation in a circuit" (Bateson 1972/2000: 315). What elements are involved in such a process? If this point could be clarified, it would provide guidelines about what to look out for when interpreting users' interrelation of informational constructs in a problem situation.

It is with these questions in mind that we advance the idea of an epistemological "sounding board". To do this, our axiomatico-inductive approach considers the role of informational constructs from an analogical point of view. Analogical reasoning focuses on relational properties of similarities by creating a link between a base analog (in this case, an acoustic guitar) and a target analog (in this case, our findings) in order to draw inferences. For Gentner and Colhoun (2010: 38) this type of reasoning is one way of dispelling "the mystery of how abstract ideas can arise from experience". Such an approach corresponds to what Bateson (1979/1984: 149–151) called knowledge-building "abduction" – that is a comparison of similarities that can be ascribed to apparently unrelated phenomena. This process "laterally extends abstract components of a description" (Bateson 1979/1984: 149) when analogies explicate what logically connects apparently different phenomena. The aim is to infer to what extent the phenomena under study belong to the same logical category for the purpose of a given discussion.

In this light, if one accepts that the Passers-by represent a significant *datum* (Hypothesis #1), the analogy of a "sounding board"[16] seems a useful metaphor to encapsulate their relationship to the Pursuer and the Pursued men of the car chase. We argue that as an epistemological sounding board, the Passers-by act as a resonating *Gestalt* that creates oscillatory dynamics (Bateson 1991/1996: 278; see Sect. 11.3.1 above). These dynamics imply interconnecting "vibrations" emanating from, in this case, the Pursuer and the Pursued men, that have elements in common. This gives generative force to a resonance that brings together, and invests with meaning, different elements of the film that the viewers, as sense-makers, identify as salient attributes. It is these attributes that represent the common elements between the base entities (i.e., salient data) of a resonant system. In our case, such resonances connect and highlight lived experiences when an individual encounters an event. The highlighting of particular aspects of a person's lived experience, we hypothesize, renders him or her conscious of the sense-making dimensions of the event that are as yet not clearly, if at all, formulated in a given situation. In the case of Lewis, it was the resonating process of the dialogue about his experiences that led to his realization of how Formula 1 and rally type car chases can be presented on-screen. In other words, resonating oscillatory dynamics do not exist as such, but only in situational interactions between a user and the data that the person includes in his or her sense-making process. This resonance thus entails a "fusion of horizons" between a perceived "external" object and a sense-maker's "internal" interpretive process. Our triadic research approach thus highlights the importance of a dual similarity-dissimilarity construing process related to a person's situational knowledge and expectations about an identified problem situation.

If it is accepted that the background Passers-by represent a sort of resonating sounding board, then the foreground Pursuer and the two Pursued men can be seen as the "strings" of an "acoustic guitar" (i.e., the film) played according to the skill and style of a user (i.e., the film viewer). To continue with the analogy of an acoustic guitar, this means that an intermediary "bridge" (i.e., informational

[16]In its technical acoustic sense, a sounding board is a structure that amplifies the sound of a speaker or a player of a string instrument. The quality of a sounding board depends on its resonating properties.

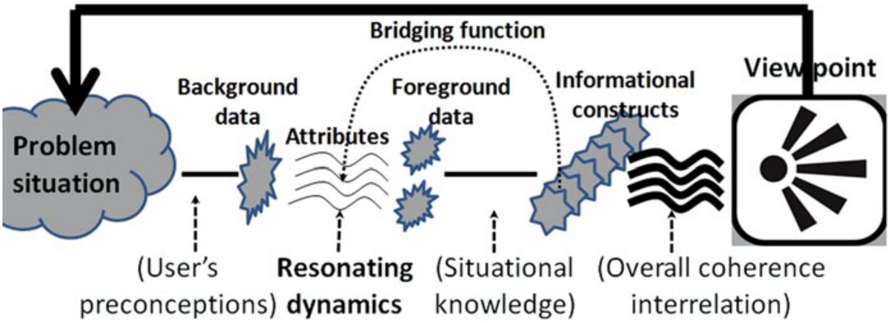

Fig. 11.3 Resonating dynamics in a sense-making process

constructs) is needed to hold in place the "strings" (i.e., the Pursuer and the Pursued as foreground characters) at the appropriate distance from the "sounding board" (i.e., the background Passers-by). This distance is necessary for the vibration of the "air" (i.e., the informational process) between the background sounding board and its foreground strings to amplify the sound (i.e., user ascribed meaning) of the instrument.

It is in this way that the bridging function of informational constructs can bring together attributes that resonate from the sounding board to create the building blocks of a user's sense-making process. The adjustment of the strings on the "bridge" (the informational constructs) of the metaphorical "guitar" ultimately depends on the situational knowledge that the user marshals in a problem situation. In fact, the user's interpretation of the demands of a problem situation represents the golden thread that links up the different levels of the interrelating resonating processes, as shown in Fig. 11.3 above.

We hypothesize that the resonating dynamics have an accumulated, knock-on effect on the overall interrelation process. If we take the case of Lewis, the attributes that he identified are presented in the triadic grid (Table 11.3, above). These attributes are by no means exhaustive but indicate some key aspects of the problem situation according to Lewis' preconceptions, reactions, and expectations. In effect, the interrelating resonances of Lewis' attributes travelled from the user's mind to the triadic grid and in the process were transformed into informational constructs.

The first resonating process involved the "bridging" function of construing informational constructs between the external data and the user's own ascribed attributes. In this case, Lewis's triadic grid shows seven pairs of attributes. Their interrelations are numerically transformed by a five-point preference scale, which the interviewees explicated point by point when making their choice, into informational constructs.

If these resonances are not linked to the user's set objective and situational knowledge, they will sooner or later become disordered and dissipated. Such dissipation can be avoided with the creation of a viewpoint about a problem situation.

In the logic of our hypothesized informational resonating process, Lewis' viewpoint emerged as a consequence of following a second set of resonances between the informational constructs and the problem situation with the aim of crystallizing a viewpoint. What characterized this coherence-building resonance was its focus on interrelating and evaluating the viability of different relevant solutions (called "potential actions"; see Fig. 11.1, above) to a problem situation. In Lewis' case, the problem was to decide, after seeing a small excerpt from a movie, whether or not to watch a film in its entirety, and under what conditions, i.e., as an "escapist entertainment after a hard day's work". The decision also involved not discussing the film with someone who has been affected by a major road accident or not watching the car chase with such a person if the film is screened at home (on television or by a DVD).

In the light of our idea of informational resonances, a major challenge for researchers in the information and communication sciences is the identification of the less immediately visible informational constructs. As was pointed out above, the verbal ascriptions of attributes perceived by users are by no means exhaustive. Non-verbal ascriptions could also be used to compensate for the inevitable socio-historical bridge and barrier roles of language in the interpreting process (cf. Leleu-Merviel and Labour 2012).

A case in point of the limit of verbal ascriptions can be found in Lewis' triadic grid where there is no presence of attributes concerning his ambiguous feeling of *Schadenfreude* (see Sect. 11.5, above) about car chases. It appears that in spite of his surface eagerness about the snippet, Lewis had, in fact, certain reservations about the film. This constituted a "weak signal" (Ansoff and McDonnell 1990: 20–21) about Lewis' viewpoint. Given the effective presence of "weak signals", which function as "ambiguous" (polysemic or incomplete) warning alerts concerning a problem situation during the process of documenting perceived sense-making data, what is needed is a more finely tuned method of interpreting informational constructs so that such signals can be usefully identified and capitalized. This domain, however, needs further study, notably in research focused on anticipatory decisional activities from an information science perspective.

11.7 Conclusion

The thrust of our study was to understand how users' informational constructs can influence a situational knowledge building process. The axiomatico-inductive research approach established the guiding assumption that the informational process is based on a social actor's ability to make sense of informational constructs construed from what a user considers as salient data in a given communicational situation. The saliency of these data conditions what an individual experiences as preeminent "constraining affordances" (Floridi 2011b: 87) impinging upon the achievement of a set objective in a problem situation. To this end, the triadic approach provided a useful method for capturing the scenic and the interpretative sides of an on-screen document as a sense-making experience. The findings of the study identified the informational constructs that viewers considered as their epistemological "touchstone" (Hypothesis #1) and the role of the background features of a film as an epistemological "sounding board" (Hypothesis #2).

Further research on the role of informational constructs is needed to develop the theoretical and operational framework presented here; especially fruitful, in this regard, would be a closer examination into the relationships between epistemological resonances and informational constructs.

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Chapter 12
Documentary Languages and the Demarcation of Information Units in Textual Information: The Case of Julius O. Kaiser's *Systematic Indexing*

Thomas M. Dousa

12.1 Introduction: Textual Information, Documentary Languages, and Information Analysis

At present, there is little consensus within information science (IS) about the definition of the phenomenon that it takes as the object of its study—information: a number of different conceptualizations of information coexist, often quite uneasily, in an atmosphere of theoretical pluralism and vigorous debate (for overviews, see Bates 2010; Case 2008: 39–67). There is, nevertheless, general agreement among researchers about what, on a pragmatic level, counts as information within the context of the information systems with which IS is primarily concerned. This consensus is rooted in the history of the discipline. IS developed from the field of documentation in the 1950s and 1960s, which, in turn, had emerged from the domain of bibliography at the beginning of the twentieth century (Lilley and Trice 1989: 1–2, 15; Rayward 1983: 351–353, 1985). Building upon and extending its bibliographic heritage, documentation took as its central concern the selection, acquisition, organization, storage, and retrieval of *documents*—that is to say, objects such as books, journals, papers, films, sound recordings, and so on, marked by their materiality, semiotic properties, and informativeness.[1] The transition from

[1]Within IS and its antecedents, the definition of the term "document" has historically been an elastic one, ranging from restriction of the term to "graphic records" (such as books, articles, manuscripts, and photographs) to the expansion thereof to encompass audiovisual materials (such as sound recordings and films) and even museum objects (including artefacts and even natural objects such as zoological specimens); for overviews of the main lines of discussion and a *plaidoyer* for the more expansive view, see Buckland (1991a, 1991b, 1997). In practice, attention has tended to focus on the treatment of graphic records bearing texts or other representations of data that are, in principle, reducible to linguistic expression (cf. Pagès 1948: 56; Hjørland 1997: 14–17).

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documentation to information science did not lead to an abandonment of documents as an object of interest, but it did promote the theoretical redescription of them, in some quarters, as “documentary information” (Borko 1968: 5) or, more generally, “recorded information” (e.g., Fry, in Wagner 1960: 108, s.v., “document”; cf. Foskett 1996: 3; Kent et al. 1958: 3). The results of this semantic shift are still palpable today, for the statement that “recorded information” produced by humans is the core focus of IS has become a staple feature of programmatic accounts of the nature and aims of the field (e.g., Bates 1999: 1048; Bawden 2007: 307). The fact that documents can be viewed as comprising recorded information and, conversely, the universe of recorded information can be taken as composed of documentary packages is a significant one, for the weight that one gives to either the document-oriented or the information-oriented interpretation can shape one’s conceptualization of what the tasks of the field are and how it should set about to accomplish them.

One of the central tasks of IS as an applied science has traditionally been to develop and maintain mechanisms to help persons consulting collections of documents to find those items of recorded information that are most likely to prove relevant to addressing whatever purposes motivated them to undertake their search. This area of endeavor is known as information retrieval (IR) and the sets of protocols and mechanisms designed for executing searches and communicating to the searcher which items of recorded information within a given collection are most likely to correspond to his or her stated information need are IR systems. Although any number of attributes of the documents represented within the framework of an IR system (e.g., by author, title, publisher, date of publication, and so on) can serve as the basis for a search, many inquirers consult IR systems to find items of information that might enlighten them about a given subject and so subject searches are an important element of IR.[2] If a searcher is to identify and select those items of recorded information dealing with a certain subject of interest, the IR system that he or she is using must provide some indication of the subject(s) associated with the document(s).

Today, IR systems typically use algorithmically-based, computational methods to identify subjects on the basis of automated mathematical or statistical analysis of word token frequencies within, and across, documents in a collection or aggregation (e.g., Larson 2011); as a result, IR is often associated primarily with methods of subject indication based on word extraction from computationally manipulable free text (e.g., Robertson 2012: 7–9). Yet, viewed from a broader historical perspective,

[2]The definition of “subject” is a controversial matter within IS; for some seminal discussions, see Hjørland (1992); Miksa (1983: 1–85); Serrai (1979a: 56–80); Wilson (1968: 69–92). Perhaps the best lapidary characterization of the concept is that of Nichols (1892: 407), according to whom, in a bibliographic context, a subject is “any event, place, person, fact, relation, topic, or anything which may be an object of thought and may become an object of search”. This can perhaps be provisionally generalized, at least for textual documents, as follows: a subject is some feature of the world about which the discursive contents of a given document provide information.

IR has had a far wider remit than the current focus on automated techniques of derived indexing would suggest. Historically, IR systems have made use of the results of manual indexing by human indexers to indicate the subjects of recorded information (e.g., Metcalfe 1976; Sharp 1965) and certain kinds of IR systems, such as library catalogs and bibliographical databases, continue to make use of such modes of indexing to this day. The typical mechanisms for the manual indication of subjects have tended to be what are known as *documentary languages*. The term "documentary language" has traditionally been applied to subject classifications and indexing schemes, and reflects a conceptualization of such systems as written artificial languages consisting of a finite, (typically, though not necessarily) controlled vocabulary of terms and restricted sets of syntactic rules for combining these terms, if need be, into more complex expressions (Buckland 2007: 250–252; Coyaud 1966; Hutchins 1975; Maniez 1993; Menon 2007). Within any IR system, the terms that are enumerated in, or can be generated from, the vocabulary being used function as names of subjects and are assigned to descriptive records, or metadata, about individual items of recorded information on the basis of an interpretation of the informative potential of the latter (Hjørland 1992: 85, 1997: 40–41): in other words, they serve as linguistic tools for subject indexing. In providing terse linguistic representations of the informative potential of the items of recorded information available for consultation within a collection, documentary languages can be said to serve as "channels of communication" between documents and their potential users (Hutchins 1975: 9; cf. Coyaud 1966: 16–17).

Broadly construed, then, IR systems are mechanisms for facilitating the retrieval of items of recorded information and documentary languages are the linguistic tools by which the informative potentials of those items are indicated to the users of many such systems. What, however, are the items of recorded information to be retrieved? As has frequently been noted (e.g., Bar-Hillel 1957: 104–106; Capurro and Hjørland 2003: 382–383), the term "information retrieval" is somewhat of a misnomer, for IR systems have typically served the purpose of document retrieval—that is to say, the unit of retrieval in IR systems has typically been a documentary item, most often a graphic record such as a book, a journal article, or a technical report. Alongside this dominant tradition of document retrieval, there exists another approach to IR that has sought to develop techniques for information retrieval in a more literal sense of the term. The central tenets animating this approach are that the content of documents, in particular those of a textual nature, can be conceptually decomposed into smaller units of information—variously characterized as "facts", "ideas", "data", or "elements"—and that these units, rather than documentary units, should be the objects of subject description and retrieval in IR: accordingly, following Metcalfe (1957: 223), I shall call this approach *information analysis*. Although the information-analytic approach to IR has fairly deep historical roots extending to the turn of the twentieth century (Dousa 2010), it has lost none of its actuality for IS research. It forms the basis for such contemporary projects as automated information extraction (Gaizauskas and Wilks 1998) and focused retrieval (Trotman et al. 2010): indeed, its core assumptions underlie the vision of the Semantic Web (e.g., Fast and Campbell 2001: 12–16).

If one grants the central premise of information analysis—namely, that those items of recorded information known as documents can be analyzed into smaller units of information, a number of fundamental questions arise. What is meant by "information" in the context of information analysis? What might it mean to speak of a unit of information? What are the criteria for demarcating such units? What role, if any, might documentary languages have in the constitution of such units? Needless to say, there are different ways of approaching these questions. One is to attempt the rational reconstruction of a general doctrine of information analysis. Such a strategy holds out the appeal of providing a unified characterization of the position. However, it runs the risk of eliding together or occluding significant differences between the different versions of information analysis that have been proposed in the past and so, in seeking to distill them all in one fell swoop, it may end up mischaracterizing at least some and adequately representing none. Another, more concrete way of getting a purchase on our questions is to examine, in some depth, exemplary cases of how past theorists have sought to isolate units of information within text-bearing documents for the purposes of IR. Although such a case-study approach may strike some as overly idiographic in tenor, it has the distinct advantage of giving us a fixed point of reference from which to take our bearings and furnishes us with a firm empirical basis for future comparisons: accordingly, that is the course that I have adopted here.

This paper takes as its focus the version of information analysis articulated by one of its earliest proponents, Julius Otto Kaiser (1868–1927). Kaiser was an indexer and who worked at a number of commercial, corporate, and technical libraries in the United States and Great Britain between 1896 and 1927 (American Society of Mechanical Engineers 1928; Metcalfe 1957: 75–76, 234–236). While serving as a librarian for the Philadelphia Commercial Museum in the late 1890s and, later, in his capacity as librarian for Joseph Chamberlain's Tariff Commission in London from 1903 to 1911, he developed and codified a mode of information analysis that he called *systematic indexing* (Kaiser 1908: t. p., 1911: § 20, 1926: 20; Metcalfe 1976: 176–177; Svenonius 1978: 134). Best known today to students of IS as the first indexing theorist to use general categories as a principle for structuring an indexing language (Svenonius 2000: 6, 173–174; Vlasák 1967: 152–153), he was also one of the first advocates of indexing as a tool for information analysis (Dousa 2010).

Kaiser's views on information analysis are, in many ways, comparable to those of his better-known contemporary, Paul Otlet (1868–1944), who, as the *primus movens* of the documentation movement, is generally acknowledged to have been one of the most important early pioneers of IS (Day 2001: 7; Rayward 1991: 137). Among Otlet's (1892, 1903, 1918: 149–150, 1934: 409–410) numerous contributions to the theoretical armamentarium of IS was the leading idea that individual documents could be decomposed—intellectually and/or physically—into component "facts" or "ideas", which, in turn, could be reorganized in vertical files and/or card catalogs in accordance with the Universal Decimal Classification (the UDC), which he created in collaboration with Henri La Fontaine (1854–1943). Latter-day commentators consider this notion of information analysis, enshrined in the notion of the "monographic principle", to have been one of the cornerstones of his documentalist project (Day 2001: 16–17; Frohmann 2008; Rayward 1990: 6–7, 1994: 240, 1997: 295, 2008: 14–16) and an anticipation of the analysis and recombination of informational elements within digital documents in today's electronic environment (e.g., Bishop 1999: 258).

Whereas Otlet's ideas about the decomposition of documents into informational units have come to enjoy a fairly high profile in the annals of IS, Kaiser's version of information analysis, which he developed independently of Otlet, has hitherto received only limited attention (Dousa 2010; Metcalfe 1957: 235–236). Yet there is good reason to take Kaiser's method of systematic indexing as a paradigmatic example of information analysis here. In a series of densely written works, Kaiser (1908, 1911, 1926) set forth both a theoretical rationale for, and a set of methodological protocols for the analysis of textual documents. Unlike Otlet, whose published discussions of information analysis were formulated at a high degree of generality, he offered a very detailed account of a method for the "systematic analysis of literature" for the purposes of indexing (Kaiser 1911: § 17): accordingly, we are able to trace, in detail, how his ideas about information informed his practice of information analysis. As we shall have occasion to see below, Kaiser understood information to be constituted by both the objective features of texts and the subjective interpretations of authors, readers, and indexers: this view decisively shaped his method of information analysis and his account of how a documentary language could be used to individuate items of information within texts in a way that respected both the ontological and epistemological dimensions of information. Although Kaiser, like Otlet, worked out his system in a technological *régime* featuring the index card and card cabinet as its primary material tools his views about information analysis were based on principles that are no less relevant to our current digital dispensation. In light of these considerations, Kaiser's theory and method of systematic indexing serve as an appropriate entry-point into the foundational issues of information analysis.

12.2 Kaiser's View of Information: Ontological and Epistemological Dimensions

The ambition to decompose documents into smaller units of information presupposes that one has a notion of what information is in the first place. Accordingly, we must begin by considering what Kaiser understood information to be. Writing some 40 years before a full-blown theoretical discourse of information emerged in the late 1940s and early 1950s, he appears to have taken lay understandings of information as the starting point for his theory and method of information analysis and thus we shall take them as our point of departure as well. Over the last century-and-a-half, the word "information" has signified, in everyday discourse, various aspects of the idea of *knowledge communication*, whether referring to "the act of informing or communicating knowledge" (Ogilvie and Annandale

1883: v. 2, 606, 1 s.v. "information") or "knowledge communicated and received" (Century Dictionary 1911: v. 5, 3088, 2 s.v. "information").[3] In relation to textual documents, this meaning can be understood as having both an *epistemological* and an *ontological* dimension. Inasmuch as a document bears expressions of the products of cognitive activity, the information that it conveys has an epistemological dimension, for it serves as a representation of its author's (claims to) *knowledge* and, under the right circumstances, the messages that it conveys can shape, or inform, the cognitive activity of other persons. However, by the very fact that it bears an *externalized representation* of knowledge (claims), a document clearly has an ontological dimension, for, once the creator of a document sets down the results of his or her cognitive activity in a tangible, publicly available form, it becomes, in Buckland's (1991a) well-known term, "information as thing".

12.2.1 Kaiser and the Idea of Textual Information as Thing

How does Kaiser's view of information appear in light of the framework set forth above? A preliminary indication may be found in a passage in which he discussed the nature of "literature"—his term for textual documents—and its place within a rudimentary model of what might be called a cycle of document creation and processing:

> Literature is a record.... What we record is what we *observe*, what we *reason out*. Language is that by means of which we describe or record intelligently. Records represent knowledge, they give information, information belongs to our business materials; we use it, we apply it, hence we group it into classes to make it accessible, we index it. (Kaiser 1911: §§ 52–53 [emphases his])

From this series of brisk, staccato statements, several elementary points clearly emerge. First, in Kaiser's view, written documents constitute representations of the product of human cognition concerning the world—i.e., knowledge. Second, the representation of knowledge in documents takes place by the mediation of written language. Third, documentary records encoded in written language are sources of information that may be harnessed by users for their individual purposes. Finally, if the information borne by documents is to be rendered maximally accessible to its potential users, it must undergo processing whereby it is classed and indexed.

Taken together, the foregoing statements characterize information in both epistemological and ontological terms, relating it to knowledge and associating it with material written records. Other passages in Kaiser's works bear out, and add

[3]Nunberg (1996: 108–111) has dubbed this sense of the word "information" the "particularistic sense", since it involves the conveyance of knowledge in particular discursive transactions; see also Machlup (1983: 642). For a broader overview of the spectrum of different nuances of the term in everyday discourse, see Capurro (1978: 196–204).

complexity to, this initial impression. The epistemological dimension of information emerges at points where Kaiser discursively set knowledge and information in parallel to one another, as if they were to be equated (e.g., Kaiser 1911: §§ 23, 297). For example, in outlining the standpoint from which systematic indexing is to proceed, he wrote that "we take as our basis *knowledge*, the information ... conveyed by written language" (§ 297 [emphasis his]), adding shortly thereafter that it is "knowledge [that is] conveyed by literature" (§ 298). An attentive reader will note, however, that the qualification of knowledge and information as *conveyed by written language or literature* already accords them status as an entity of some sort.[4] This is not an isolated instance. As a rule, Kaiser's characterizations of information tended to present it as a kind of entity straddling the line between abstractness and materiality: for example, in his writings, information is "contained" in documents but can be "dissociated" or "abstracted" from them (1911: § 83, 1926: 32, § 37); it can be transferred from original documents to card index records by the act of transcription (1908: § 91); it can be written or disposed on the surface of an index card (1908: § 97, 1911: §§ 375, 399, 626, 647); it can be collected and arranged in a card index (1908: § 241, 1911: §§ 47, 364, 544); it constitutes a "valuable commodity" like other, more tangible wares (1911: § 6; cf. §§ 73, 621); and it can be "concrete" in nature (Kaiser 1911: §§ 73, 611). Indeed, he even proposed using the term "information" as a count noun—i.e., "an information"—to refer to individual "piece[s] of literature", ranging from periodical articles as a whole to individual paragraphs therefrom (Kaiser 1911: § 305; cf. §§ 89, 304, 306, 308, 656).[5] In short, whereas Kaiser agreed with the traditional definition of information as "knowledge communicated and received", he foregrounded its latent ontological aspects and so set it firmly in the realm of information as thing (Kaiser 1911: § 73).

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[4]Note that to be "conveyed by written language" is not the same as to be equated with written language itself. In this passage, at least, Kaiser did not fall into the trap of identifying information with the visible marks of written language as such: rather, his usage approximates the idea of information as abstract "semantic content" posited by later theorists (e.g., Svenonius 2000: 7).

[5]To understand the import of this move, it is important to recall the linguistic distinction between mass nouns and count nouns. Count nouns express countable kinds of things and take both singular and plural forms (e.g., "books", "apples", "minds"), whereas mass nouns express uncountable kinds of things and, in ordinary discourse, typically take only the singular form (e.g., "gold", "water", "traffic", "beauty"); see Fox (1983: 88); Matthews (1997: 80, s.v. "countable"). In English, "information" is typically treated as a mass noun and its use as a count noun is rare, though by no means unparalleled (Oxford English Dictionary 2010: II.5.b, s.v. "Information"; cf. Bates 2010: 2351): as Nunberg (1996: 111) notes, the latter treatment is frequently encountered in other European languages. Treating information as a count noun in a language is to suggest that it has a discrete character or, in other words, is composed of individuable units: it thus constitutes a step on the road to a "particulate" view of information. For a slightly different interpretation that views this usage as indicative of a "particularistic" rather than strictly "particulate" view of information, see Nunberg (1996: 110–111).

12.2.2 Kaiser's Epistemology and Its Bearing on His Understanding of Textual Information

Whatever its precise ontological status, information, in Kaiser's estimation, is situated in the expressions of knowledge inscribed in documents and so is a product of human cognitive activity. Accordingly, he developed an account of knowledge to characterize the conceptual contents of information. In his view, knowledge is derived from two cognitive activities, namely observation and reasoning: "what we record is what we *observe*, what we *reason out*" (Kaiser 1911: § 52 [emphases his]). Of these two activities, he gave observation pride of place (§§ 53, 560) in accord with the standard empiricist tenet that "all knowledge proceeds originally from experience" (Jevons 1958/1877: 399). Now the act of observation presupposes objects to be observed and these, according to Kaiser (1911), can be divided into two broad categories: "*things* in general, real or imaginary, and the *conditions* attaching to them", which he called *concretes* and *processes* respectively (§ 52 [emphases his]).[6] Kaiser viewed things, or concretes, as having ontological priority and assumed that they would be the primary focus of observation (§ 53): nevertheless, he averred, it is by attending to the actions performed on or by concretes—that is to say, the processes in which they are implicated—that we come to know them best (§ 55).

If observation is the means by which we come to acquire knowledge about objects in the world, then any limiting conditions placed upon it cannot but shape the very texture of knowledge. Kaiser identified three such conditioning factors. First, he held that observations, whether individual and collective, are inherently partial and incomplete, and do not yield definitive accounts of concretes: "[w]e are unable to give a complete description of any concrete, no matter how many attempt a description" (Kaiser 1911: § 54). Second, he argued, all assertions about concretes

[6]Kaiser's subdivision of concretes into *real* and *imaginary* things requires a brief comment. Other passages in his writings (e.g., Kaiser 1911: §§ 38, 108–109) indicate that, for him, the prototypical types of concretes were physical, tangible things, which he doubtless would have classed as "real" things. Much more difficult to assess is what he meant by "imaginary things", for he did not elaborate further on this subject, although it is doubtful that, given his focus on business literature, he had unicorns, goat-stags, hippogryphs, or other members of the menagerie of the imaginary in mind. For a discussion of the different possible boundaries between the real and the imaginary, see Century Dictionary (1897: Vol. 6, 4985b, 3 s. v. "real"). If one were to understand "real things" as referring to physical objects alone, then one might interpret "imaginary things" as intangible, abstract "things" (such as, e.g., a "nitrate bill" [§ 455], "loan" [§ 344], or "patent" [§ 522], understood as "social objects" rather than the paper documents representing them): there is, however, no warrant for such an interpretation in Kaiser's texts. Alternatively, if "real things" denoted objects actually existing at a time *t*, then "imaginary things" could refer to possible things—e.g., things that were planned for the future but not yet realized, such as, for example, an invention that had been planned and perhaps even outlined in a blueprint but that had not yet been built or tested. Here, too, however, Kaiser's writings do not offer any elucidation of the matter. Most likely, "real and imaginary" functioned as an expression of totality, meaning, in effect "all things (whether real or imaginary)": at any rate, the distinction did not play a role in the elaboration of his indexing system.

are to be considered provisional, for the observations on which they are based are embedded within a pre-existing conceptual framework that is, in principle, revisable in the light of further discoveries: "every new discovery ... forces us to modify sometimes some of our fundamental conceptions of concretes, which in turn leads to modifications in our methods of observing and describing them" (§ 54). Finally, he maintained that "observation is individual" (§ 57) and thus different individuals observing a given phenomenon may come to describe it in different ways: in other words, any description of concretes and their attendant processes is a description from a given perspective and not all perspectives are compatible. In light of these features imputed by Kaiser to the activity of observation, we can characterize his epistemological views as empiricist in general orientation, fallibilist in outlook, and perspectivist in tenor (cf. Dousa 2008: 244–245)—a view of knowledge that would re-emerge in the writings of later IR theorists (e.g., Perry 1956: 69, 74–75; Perry et al. 1956: 61).

Kaiser's epistemological position informed his understanding of the informational content carried by documents—in particular, business documents, whose primary purpose, in his view, was to provide descriptive accounts of commodities, the locations in which they were produced or marketed, and activities concerning them. Making use of a trope found elsewhere in contemporary literature on indexing and documentation (e.g., Clarke 1905: 49–50, 118; Otlet 1891–1892: 12, 16–17, 1903: 84), he spoke of books, articles, and other textual materials as containing "facts" and "opinions" (Kaiser 1911: §§ 79, 115).[7] By this, he appears to have meant that the textual content of documents contains statements, based on various individuals' observations and reasoning, that are evaluable in terms of truth and falsity,

[7] As a number of modern commentators have noted, Otlet held a very similar view, according to which documents were, essentially, containers of facts intermixed with other discursive elements, the task of the documentalist being to disengage these facts from their documentary matrix (e.g., Frohmann 2008: 78–81; Ibekwe-SanJuan 2012: 61; Rayward 1994: 247). Given that Otlet discussed in print the relation of facts to documents long before Kaiser wrote his account of his indexing system, one may well wonder if the former's ideas had any influence upon the latter's or whether Kaiser developed his views independently of the Belgian father of Documentation. The meager evidence at our disposal does not allow us to reach any definite conclusion on this score but suggests that the latter scenario was much more likely the case. Although Kaiser (1911: §§ 271–275) could read French, had some familiarity with the UDC (to which, by the way, he took a highly critical attitude), and knew of the indexing activities at Otlet's Institut International de Bibliographie, he seems to have thought that the latter were confined to the indexing of documentary units as wholes: there is no indication in his writings that he associated the idea of resolving documents into aggregates of facts with Otlet. This *argumentum e silentio* does not, of course, *prove* that Kaiser was unaware of Otlet's approach to documents as containers of facts. However, there is an additional consideration that makes it plausible to think that this was indeed the case. Otlet held that the documentalist should seek to sift out only facts—"all that has been established as true", in the words of one latter-day commentator (Rayward 1994: 247)—from documents, whereas Kaiser (1911: §§ 48, 660–661) believed that an indexer should treat "facts" and "opinions" alike, leaving the task of differentiating fact from opinion to the user of an index. When combined with the lack of positive evidence for influence, this difference in perspective makes it highly unlikely that Kaiser drew upon Otlet's ideas in articulating the information-analytical ideas behind systematic indexing.

and that some of these statements have stronger claim to be regarded as true than others (cf. Century Dictionary 1906: v. 5, 4127b, 1 s.v. “opinion”; Encyclopaedic Dictionary 1884: v. 3, part 2, 455, I.3, s.v. “fact”). This mixture of probably true and possibly false statements can be said to constitute what Wilson (1978: 10) dubbed “information in the weak sense” and stands in contrast to “information in the strong sense”, which is veridical in nature.[8] Needless to say, the concept of weak information is congruent with fallibilism and is easily accommodated to perspectivism. Nevertheless, Kaiser’s assumption that business literature conveys information in the weak sense raises problems of interpretation for the reader and of policy for the indexer, to which we shall have occasion to return.

The sifting of weak information in a document is an act of interpretation. For Kaiser, however, it forms only one part of a broader process of textual interpretation occasioned by what he saw as the inherent fragility of linguistic communication. He believed that there is a radical disjunction between cognitive activity and linguistic expression: as he put it, “the fact of observing and reasoning ... must be regarded as quite independent and separate from any record in words” (Kaiser 1911: § 59). In his opinion, rendering one’s concepts into words constitutes an act of translation no less intricate—in fact, more so—than translation from one language into another, for not only is it eminently difficult for writers to move from thought to word and choose words that will “cover [their] idea exactly” (§ 60), but the boundaries of the meanings ascribed to words may vary from person to person so that “it would be rash to say that there is a general agreement as to what is exactly covered by a particular name [sci., word—TMD]” (§ 112). The upshot of this semantic indeterminism, in Kaiser’s view, is that “language as a means of expression is not a systematic effort. There is ... no medium for giving exact expression to our thought” (§ 67). Consequently, he argued, there is no assurance that the creator of a written document will express his thought exactly in the text that he creates or that the reader of the document will interpret its text in such a way as to derive from it the precise message that the author intended to convey (§ 66). Indeed, as Kaiser put it, “in verbal description, it is all interpreting” (§ 69). Kaiser’s sensitivity to the semantic lability of natural language and the interpretative nature of linguistic activity—which, interestingly, would find echoes in the writings of much later IR theorists (e.g., Costello 1961: 474; Perry 1956: 71–72; Perry et al. 1956: 62)—had a palpable impact on his indexing methodology, for he held that the terms forming the vocabulary of a documentary language should be derived from the writings being indexed (Kaiser 1911: §§ 114, 318), apparently in order to reduce the risk of mischaracterizing an author’s message to the users of an index by “tampering” with his words. This respect for the words present in the text of a document would

[8] Wilson’s distinction between “weak information” and “strong information” is analogous to Floridi’s (2004: 42, 45, 46) distinction between a “general definition of information” and a “special definition of information”, the former of which stipulates that information consists of well-formed meaningful data and the latter, that information consists of data that is well-formed, meaningful, and true. Viewed in this light, Kaiser’s understanding of information as composed of facts and opinions clearly bears affinities, *mutatis mutandis*, with Floridi’s general definition.

prove to be of material importance for Kaiser's approach to information analysis, which combined the selection of objective textual elements with interpretation of their significance from the point of view of the community of users for whom an indexer was seeking to characterize the informational contents of documents.

12.3 Kaiser's Demarcation of Information Units: Objectivity and Interpretation

Kaiser's program of information analysis was premised on the idea that one can isolate individual items of information contained within pieces of business literature, dissociate these items (at least, in abstract terms) from the documents in which they are embedded, record them on index cards, indicate on each card the subject matter to which the item of information in question pertains, and organize the cards in a subject index file that would provide busy commercial workers immediate access to those items relevant to their work (Kaiser 1911: §§ 16, 83). The central presupposition underlying such a program is that it is possible to identify and demarcate units of information within a document for the purposes of IR. This inexorably leads to the question of what is to count as a unit of information in analyzing a document.

Within IS, the question of demarcating information units has been answered in a number of different ways, each of which has its strengths and weaknesses. Some commentators have held that an entire document can constitute a describable unit of information in its own right (e.g., Mooers 1951: 26; Taylor and Joudrey 2009: 4). This approach is continuous with longstanding traditions of library and bibliographic practice: however, insofar as it simply redescribes bibliographic units in informational terms, it does not constitute information analysis in the strict sense of the term. Other authors have suggested that formal textual divisions such as chapters, sections, and paragraphs can be considered as indexable and retrievable units of information (e.g., Milstead 1984: 3; Ranganathan 1967: 85, § CR 37; Salton et al. 1993; Stephan 2009: 78–79). Such divisions provide a more granular approach to the information carried by a document and, because they are defined in structural terms, permit a clear demarcation of individual units of information: however, not all texts are structured with the same degree of care, with the result that units of information demarcated by recourse to formal textual divisions may be "only weakly and inconsistently related to [the] intellectual content" of a document (Buckland and Plaunt 1997: 89). Moreover, such units can be decomposed into yet smaller elements.

A very common position is that declarative sentences (e.g., Ranganathan 1967: 85, § CR 38; Bhattacharyya 1979: 86) or, better, the propositions (or proposition-like structures) derivable from such sentences (Derr 1985; Fox 1983: 75–108; Frické 2012: 32) serve as basic units of information within textual documents. Sanctioned by a logical tradition that extends well back into the nineteenth century (e.g., Bain 1870: 44; Peck et al. 1892: vol. 12, 217; Peirce 1868: 429, (mis)quoted in

Wagner 1960: 429, 2. s. v. “information”; Salmon 2003: 39–40), this interpretation of textual information conforms to common linguistic intuitions (e.g., Jespersen 1961: 6, § 1.41) and admits a very high degree of granularity of analysis. Nevertheless, its use in information analysis for IR is not immune from critique: apart from the fact that most documents include non-declarative sentences that do not express propositional content evaluable in terms of truth or falsehood, the extraction of individual sentences from their documentary environment removes them from the larger context against which they must be interpreted if their import is to be understood and their credibility assessed (Wilson 1968: 18–19). Proposals to isolate thematically linked, textually contiguous sets of sentences or paragraphs as units (e.g., Hearst and Plaunt 1993; Llopis and Vicedo 2002) or to posit “conglomerate propositions” derivable from sets of sentences (e.g., Fox 1983: 91–93) within the body of a text address, at least in part, such questions of contextualization. No less important, they suggest that the boundaries of a unit of information need not be restricted by standard textual structures, such as sections, chapters, paragraphs, or sentences, but may occur at any point along a continuum extending from a document as a whole down to individual proposition-expressing sentences—or, according to some, beyond (Milstead 1984: 3; Ranganathan 1967: 85, § CR 38; Trotman et al. 2010: 411).

From the perspective of information analysis, then, the idea of what constitutes a unit of information for IR is an elastic and highly scalable one. This might naturally lead one to wonder where, along this scale of possibilities, Kaiser’s definition of a unit of information fell. Such a question, however, turns out to be a *question mal posée*. It is true that, at first blush, Kaiser’s (1911: § 48) claim that indexes designed according to his method “give an analytical statement of the information [sci. contained in documents—TMD], for it has been cut up into pieces, specific facts or opinions” could be interpreted as situating units of information at the level of proposition-bearing sentences: after all, as we saw earlier, facts and opinions, as they relate to the universe of business literature with which he was concerned, are nothing other than statements, whose truth, falsity, and credibility are all open to evaluation. However, this interpretation overlooks a point of central importance for understanding Kaiser’s views on how to demarcate units of information—namely, that such units are not to be determined by considering the internal features of texts’ rhetorical and linguistic structure alone, but by analyzing texts through the prism of a documentary language. To get a full picture of Kaiser’s approach to the demarcation of information units, we cannot limit ourselves solely to consideration of his understanding of textual structure alone, but must also take into account the type of documentary language that his method of systematic indexing was designed to create.

Although constraints of space do not permit a full exposition of Kaiser’s method of constructing a documentary language here, we can at least trace its general outlines. As noted earlier, Kaiser (1911: § 114) held that the terms comprising the vocabulary of an indexing system should be derived, either directly or indirectly, from the documents being indexed.[9] The types of terms to be collected from business literature reflect, in his view, the basic objects of observation and reasoning—concretes and their processes: "from the standpoint of knowledge ... literature is confined to the description of concretes and of the conditions attaching to them, and for our purposes literature may be analyzed into terms for concretes and terms for processes" (§ 298; cf. §§ 565–566). In light of the importance of geographical considerations for commercial interests, Kaiser extended this initially bipartite categorial scheme to include terms for countries, which, he argued, form a subclass of terms for concretes that should be treated as an independent category (§ 300).[10] Each term incorporated into Kaiser's scheme for a documentary language, then, is to be assigned to one, and only one, of three categories: *concrete*, *country*, or *process*. The terms falling under these categories compose the vocabulary of systematic indexing and form, so to speak, the linguistic matter from which an index is to be constructed. The categories themselves—which reflect a simplified view of the business world, wherein concretes are largely coterminous with commodities; countries are the locations with which concretes are associated; and processes represent the conditions to which concretes are subject or the activities that they undergo (Kaiser 1911: §§ 73, 299; Svenonius 1978: 139–140)[11]—provide a conceptual structure for partitioning this linguistic matter and so serve as a tool of primary importance for Kaiser's project of information analysis: in his words, "[c]oncrete, country and process may be said to be the elements of the information conveyed by Literature" (Kaiser 1911: § 302).

For Kaiser, then, terms for concretes, countries, and processes constitute the basic building blocks of textual information. However, within subject indexes constructed on the basis of his documentary language, individual terms are not to occur in isolation. Rather, they are always to be combined into more complex units structured

[9]As regards linguistic form, terms can range from a one word (e.g., "cattle", "machine", "wine") to multiple words (e.g., "high tension underground electric traction motor"); see Kaiser (1911: § 317), whence these examples are drawn.

[10]For discussions of this derivation, which, for definitional reasons that need not be discussed here, is quite problematic, see Dousa (2011: 165–166; Svenonius 1978: 137).

[11]Although Kaiser (1926: 39) believed that, with some adjustment, an indexing system based on these three categories could be applied to domains other than business, he acknowledged that his own method had been developed on "the basis of commercial and technical literature" (1911: § 21) and so was especially appropriate for the analysis of documents from that particular sphere of human activity (§§ 296–297). Later theorists of classification and indexing working within the tradition of facet analysis would create more differentiated sets of categories applicable across multiple domains: well-known examples include Ranganathan's (1944: 429–437) pentadic system of fundamental categories consisting of Personality, Matter, Energy, Space, and Time; Farradane's (1950: 87) triadic system of (concrete) "objects", "processes", and "abstract terms"; and Vickery's (1960: 23) system of categories for science and technology, which includes no fewer than 13 ("substance (product)"; "organ", "constituent", "structure", "shape", "property", "object of action (patient, raw material)", "action", "operation", "process", "agent", "space", and "time"). For broader surveys of category systems within indexing theory, see, e.g., Cheti (1990); Vlasák (1967).

according to a limited number of patterns in which terms belonging to the categories for concretes and/or countries always precede those belonging to the category of processes (Kaiser 1911: § 302):[12]

1. [Concrete]–[Process]
   e.g., Wool–Scouring
2. [Country]–[Process]
   e.g., Brazil–Education
3. [Concrete]–[Country]–[Process]
   e.g., Nitrate–Chile–Trade.[13]

Kaiser called such concatenations of terms *statements*. Now statements are, in essence, compound index terms, in which the first element is a main term and the succeeding terms function as subdivisions: within the framework of a card index, main terms are arranged by alphabetical order, as are the various subdivisions under each main term (Kaiser 1911: §§ 390, 393). Thus, from a practical point of view, statements serve as a mechanism for partitioning and structuring a card index file (§ 307; 1926: 22, § 7 & 25, § 16). However, Kaiser attributed to them another, information-analytic role as well. In his view, a statement consists of "connected terms all having reference to the same piece of information" and so "it indicates approximately the limits within which the information lies" (1911: § 302): in other words, statements serve as tools for demarcating pieces of information in a document.[14] More specifically, they determine what counts as a unit of information for the purposes of an index, for constellations of concepts, as expressed in structured strings of terms, are the criterion by means of which items of information are to be identified and isolated. *Mutatis mutandis*, these ideas would reemerge—apparently independently—in the writings of later IR theorists (e.g., Jonker 1964: 19–20; Perry et al. 1956: 7–8).

According to Kaiser (1911: §§ 300, 304, 349), a statement forms only "the skeleton of the information" that it demarcates and so must be completed by additional matter from a document if a full unit of information, or *index item*, is to

[12]Kaiser conceded that, in exceptional cases, the rule that a concrete and/or country must precede a process might be difficult to keep; for discussion of such situations, see Kaiser (1908: § 115; 1911: §§ 322, 346, 655).

[13]The tripartite pattern embodied in the form "[Concrete]–[Country]–[Process]" could also take a form in which the sequence of the first two members of the string of terms "[Country]–[Concrete]–[Process]" was reversed (Kaiser 1911: §§ 384–386). The interchangeability of terms for concrete and terms for countries in the first two positions of the string is in part a consequence of the theory that countries are a subclass of concretes and in part a reflection of Kaiser's belief that businessmen would be most likely to search their indexes for information about commodities and geography (cf. footnote 16, below).

[14]In his final presentation of his system, Kaiser (1926: 23, § 12) went so far as to characterize statements as constituting "something like ... unit piece[s] of knowledge". Taken *ad litteram*, this is too strong a formulation, for it suggests that the statement itself constitutes a "unit piece of knowledge", whereas what it does, in effect, is to stipulate a conceptual boundary for identifying units of information in the sphere of literature.

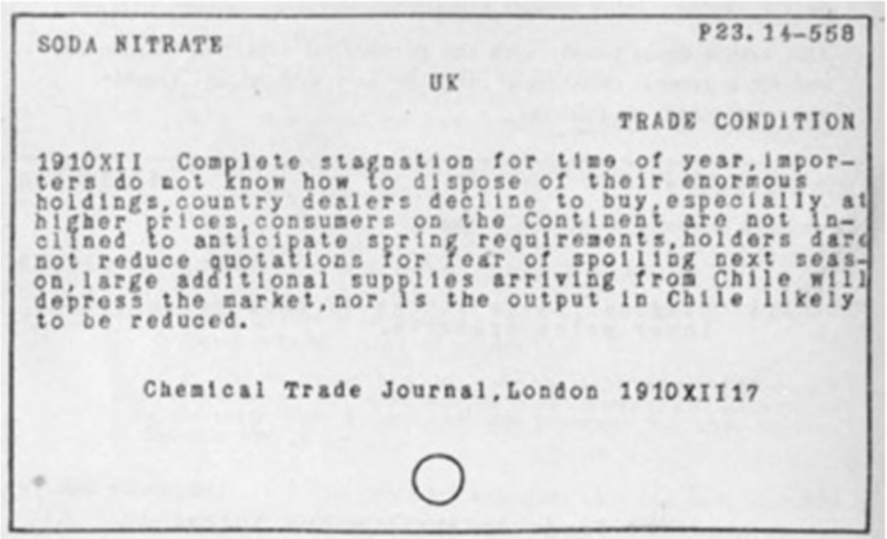
Information given	"During the last six months the prices paid for paper have been rising continuously owing to its scarcity. The Indian market seems almost depleted of stock, it is difficult to obtain any large quantities and in some instances the usual prices have advanced by 60 to 80 per cent."	307
Statement and extension*	PAPER INDIA DEMAND Prices have advanced 60-80% owing to scarcity.	

Fig. 12.1 An example of a statement and its extension relating to a short textual passage (Kaiser 1911: § 307). The spatial arrangement of the statement—"Paper–India–Demand"—at different horizontal levels reflects the disposition of these elements on index cards. The rationale for placing them on different lines was, for Kaiser, a practical one. In his view, terms for concretes tend to be longest in terms of phrase length, with those of countries taking second place, and the staggered placement of the component terms of the statement—terms for concretes at the *top left*, terms for countries at the *center middle*, and terms for concretes at the *bottom right*—was intended to procure sufficient space for concretes and countries (§ 376).

be established and recorded in a card index. This matter constitutes what he styled the *amplification* of a statement (§ 304). Typically, the amplification includes an *extension* of a statement, which takes the form of a short summary of the information in the text that has been marked out by the statement (§§ 353–357). Figure 12.1 offers a simple illustration of how an extension both summarizes the text demarcated by a statement and fills in, so to speak, the gaps in the statement to which it is conjoined.

Other salient features of the amplification include the date of the information (i.e., an indication of the time at which the state of affairs described in a text obtained), bibliographical data about the document from which the information had been extracted (i.e., the name of the publication; the name of the author, if given; place and date of publication or, for manuscript materials, inscription), and an indication of the call number by which the original document can be located within a business's document files (Kaiser 1911: §§ 350–352, 358–367). Taken together, a statement and its amplification form one index item—that is to say, one information unit—which can, in most cases, be set down on one index card (§§ 304–305). Figure 12.2 presents an example of how a unit of information appears when inscribed on a card.

Thus far, we have seen how Kaiser used the structure of indexing statements to mark out the boundaries of information units in conceptual terms for the purposes of systematic indexing. We have yet to examine his method for generating statements from the textual contents of documents. Here it is necessary to consider a little more closely the theoretical basis for the structure of the statements themselves. As noted earlier, in Kaiser's view, the category of countries is but a derivate of the category of concretes and so the categories encompassed in a statement are—in



SODA NITRATE P23.14-558

UK

TRADE CONDITION

1910XII Complete stagnation for time of year,impor-
ters do not know how to dispose of their enormous
holdings,country dealers decline to buy,especially at
higher prices,consumers on the Continent are not in-
clined to anticipate spring requirements,holders dare
not reduce quotations for fear of spoiling next seas-
on,large additional supplies arriving from Chile will
depress the market,nor is the output in Chile likely
to be reduced.

Chemical Trade Journal,London 1910XII17

Fig. 12.2 An index item consisting of a statement and amplification (Kaiser 1911: § 451). In this example, the statement—"Soda Nitrate–UK–Trade Condition", runs diagonally from *left* to *right* across the *top* section of the card; for the underlying rationale, see caption to Fig. 12.1. Below is a prose extension of the statement, forming a paragraph of nine lines, which is preceded by the date of information ("1910XII"). Underneath the extension are the bibliographical data for the source of the information summarized in the extension: in this case, the name of the journal and its place and date of publication. At the *top righthand corner* of the card is the call number ("P23.14–558") which indicates that this is the fourteenth issue (".14") of the periodical numbered 23 in a collection ("P23")—*in casu*, the *Chemical Trade Journal*—and that the article from which the information was extracted can be found on p. 558 of that issue ("–558") (cf. Kaiser 1908: § 238). The absence of an indication of the author's name most probably indicates that the article in question was unsigned (cf. Kaiser 1911: § 361).

principle, if not in practice—reducible to concretes and processes. Kaiser held that these two categories are ultimately derivable from literature itself: in his words, "literature names *things* and … these *things* are *spoken of* or described. The knowledge conveyed by literature all has reference either to *things* or to *spoken of*, i.e., concretes or processes" (Kaiser 1911: § 298 [emphases his]; cf. §§ 565–566). Such a characterization of the relationship between concretes and processes sets them into a "grammatical model" typical of proposition-bearing sentences, wherein the concrete is analogous to a subject and the process plays the role of a predicate (cf. Svenonius 1979: 66–67, 2000: 47). Now the "Concrete-Process" structure of index statements should not be viewed as a slavish reflection of the surface structure of sentences in a given text: Kaiser (1911: § 301) himself cautioned that "[c]are should be taken not to confound the two elements concrete and process with subject and predicate", arguing that terms for concretes can occur at any point within a given natural-language sentence.[15] Nevertheless, the analogy of concretes with subjects and processes with predicates cannot be gainsaid. For our purposes, its importance lies in the fact that it directs our attention toward a differential weighting of the two categories on the part of Kaiser. The grammatical model accords primacy to terms for concretes within the structure of an indexing statement, since they always take the first—i.e., the subject—position and so function as the main term in the statement (§ 313). The foregrounding of terms for concretes within statements derives from Kaiser's belief that concretes have ontological primacy over processes, which he neatly expressed in his aphorism that "there can be no process without [a] concrete" (Kaiser 1908: § 115, 1911: § 184): it also appears to be based on the largely unvoiced assumption that commodities—in Kaiser's view, the prototypical type of concretes—will be of primary interest to businessmen (cf. Kaiser 1911: § 38).[16] However this may be, concretes are the focal point of index statements in Kaiser's documentary language.

Kaiser's valorization of concretes has consequences for his method of information analysis as well. This is best seen if we consider his prescriptions for how, *in practice*, an indexer is to identify units of information—i.e., "index items"—within a document. We have already seen that index items are defined by statements and that, by virtue of their prototypical form (i.e., "Concrete[–Country]–Process"), statements are always statements about a given concrete. Thus, according to Kaiser (1911: §§ 452–453), the first step in picking out index items is to identify all the terms for concretes—including terms for countries—mentioned within a given text and to select from them just those terms that designate objects of interest to the business organization for which the indexer is working. Each concrete is a minimal indicator for the presence of an index item in the text: in Kaiser's words, "there will be at least as many items as there are concretes" (§ 308; cf. § 657). In the normal course of things, terms for concretes are to be directly extracted from texts, being subjected only to morphological normalization (§§ 318, 319, 348), whereas terms for countries—typically, proper names—may be normalized according to

[15]For example, in the sentences "Synthetic indigo is in great demand" and "There is great demand for synthetic indigo", the term "synthetic indigo" functions as the concrete, irrespective of the fact that in the first sentence it occupies the first position in the sentence as its subject and, in the second, the rear position as the object of a preposition (Kaiser 1911: § 301); despite the syntactic variation in the natural-language expression, both sentences would be adequately rendered by the statement "Synthetic Indigo–Demand".

[16]The roots of this view can perhaps be traced back to Kaiser's experience as an indexer and translator at the library of the Bureau of Information of the Philadelphia Commercial Museum where, by his own account, he first developed his method of systematic indexing (Kaiser 1911: § 20; 1926: 20, §§ 1–3). Alongside the Bureau of Information, the Commercial Museum presented exhibits of commercial wares from around the world, which were organized either by type of commodity (i.e., "monographic" exhibits) or by geographical provenance (i.e., "geographical" exhibits): the assumption of the museum's curatorial staff was that businessmen would be most interested in the "monographic" exhibits (Conn 1998: 124; Philadelphia Commercial Museum 1896: 16–17). It is likely that the division of the Museum's exhibits into "monographic" and "geographic" ones was a source of inspiration for Kaiser's categories of concretes and countries.

local preferences (§ 338–339).[17] Once the terms for concretes have been identified, selected, and extracted, the indexer must then determine which processes are to be associated with them. Here, Kaiser accords the indexer greater linguistic leeway: whereas terms for processes should reflect the contents of the text, they need not follow its exact wording and "may be chosen to suit our convenience" (§ 344; cf. § 452, 663, s.v. Concrete and Process).[18] A text may speak of several different processes in relation to a single concrete: in such cases, a term may be assigned to each separate process, according to the discretion of the indexer (§ 344) and associated with the corresponding term for a concrete to form a statement. Each combination of concrete and process constitutes a separate statement and "[a]n article or piece of literature ... consists of as many *items* for indexing as it contains separate *statements*" (§ 305 [emphases his]; cf. §§ 308, 657). In short, the presence of terms for concretes in the text of a given document constitutes, for Kaiser, a baseline for identifying and isolating units of information within the document.

Perhaps the most noteworthy feature of Kaiser's prescriptions for the practice of information analysis is the manner in which they posit both objective and subjective features in the constitution of units of information. On one hand, the tenet that terms for concretes and countries should be derived more or less directly from the text of a document sets a firm objective limit to the informative potential of the message encoded in that text. We have seen that Kaiser viewed business literature as providing descriptions of things—in particular, commodities. On this view, documents provide information about those things that are mentioned in a text: to take but one example, the short passage of text in Fig. 12.1 yields information about the price of paper in India and cannot be construed as giving information about the mining of nitrate in Chile, the cultivation of potatoes in the United States, or the

[17] Note, however, that Kaiser's (1911: § 318) strongly-worded stricture that "[i]n all cases the name of the concrete should be taken as it is found" was not absolute, for he also admitted "changes in terms may sometimes be necessary" for the sake of clarifying "the sense of the information" being indexed (§ 663, s. v. Analysis of Literature; cf. §§ 329–330). Furthermore, he also made allowance for supplying terms for concretes only implied in the text being indexed (§§ 322, 457).

[18] A good example of this freedom in choosing terms for processes can be found in our Fig. 12.1, where the statement "Paper–India–Demand" is derived from the two-sentence passage: "During the last six months the price paid for paper have been rising continuously owing to its scarcity. The Indian market seems almost depleted of stock, it is difficult to obtain any large quantities and in some instances the usual prices have advanced by 50 to 80 percent". Here the term for the concrete, "paper", has been directly extracted from the first sentence and the term for country, "India", has been normalized from "Indian market" in the second. By contrast, the process term "demand" does not occur at all in this passage. Rather, it has been derived from the informational content of both sentences, which can be reduced to the following propositions: (1) paper is in scarce supply in India and, as a consequence, (2) the usual prices for paper in India have increased by 50–80 %. According to an elementary tenet of economic theory, the supply of a commodity stands in inverse relationship to the demand for it and high demand for a commodity for which the supply is low will lead to high prices. Thus, the text can be construed as yielding information about the demand for paper in India and since, within the structural constraints of Kaiser's documentary language and from the point of view of a mercantile business, it is most convenient to speak of demand for paper in India, the indexer has chosen the term "demand" as his term of process.

raising of cattle in Australia. On the other hand, the relative freedom with which terms for processes can be assigned points towards the importance of interpretation in the determination of units of information. Again, the passage in Fig. 12.1 could be interpreted as referring to the *price* of paper in India, to the *supply* of paper in India, to the *sale* of paper in India, to the *scarcity* of paper in India or, Kaiser's own choice, the *demand* for paper in India (see footnote 18).[19] Each of these characterizations of what the passage is about seeks to reflect its content, but the different term for process used in each gives it a different nuance: for example, a statement formulated as "Paper–India–Price" would accentuate the monetary dimension of the information, which might be especially useful to the accountants of a firm, whereas the statement "Paper–India–Demand" foregrounds a parameter of particular interest to export merchants in the paper trade.

More generally, the notion of interpretation looms large in Kaiser's account of information analysis. He fully appreciated that, in the business world, persons belonging to different occupations might approach the same document from different perspectives and that an indexer's task is to formulate statements that reflect the particular interests of the person or organization for whom he is indexing it (Kaiser 1911: §§ 454–455).[20] This task requires not only the selection of contextually appropriate terms for processes, but, more generally, selection of what index items to demarcate within any given text in the first place. Kaiser took it as a given that "[e]very firm or individual who has occasion to index literature does so, not to make an absolute index to it (i.e., indexing the whole of the information) but to extract from it those parts which come within his purview" (§ 309). We have already seen that, in Kaiser's view, a given document contains, in theory, as many units of information as there are statements that can be generated on the basis of the terms of concretes present in its text: these constitute, so to speak, the informative potential of the text. However, only those items that are salient in a given context and useful for the purposes of the persons using the index, are to be put together by the indexer, registered on cards, and entered into a card index: through this process of selection, "indexable information is successively narrowed down by the standpoint from which we regard it, and by the use to which we may put it" (§ 459). Index items, then, are both derived from the textual substrate of a document and constructed by the indexer in light of the needs of his clientele: that is to say, both objective and subjective factors have a part to play in the constitution of units of information within the framework of Kaiser's method of systematic indexing.

[19]Note that, for Kaiser, "price" was a categorically ambiguous term that could be interpreted, in different indexes, as either a concrete or a process; see Kaiser (1911: § 325). Kaiser's own preference appears to have been to use it as a term for processes (§§ 476, 530).

[20]This perspectivist insight, which can also be found in contemporary library literature on classification (e.g., Brown 1906: 7–8, quoted in Kaiser 1911: § 278) reappears in the writings of some later IR theorists (e.g., Perry et al. 1956: 8–9) and forms one of the tenets of domain-analytic approaches to indexing and classification (e.g., Hjørland 1997: 111).

One final point should be noted regarding the role of interpretation in Kaiser's vision of information analysis. As discussed earlier, Kaiser understood the information conveyed by business literature to be information in a weak sense: itself the product of interpretation, it contains sentences expressing "facts" and "opinions" that may be either true or false. Since facts and opinions alike can be incorporated into the extension of an index item, the user of an index must be given a way to assess the credibility of the information presented upon the cards that she consults. Now a traditional critique leveled against the information-analytic approach to IR is that, in taking pieces of information as the primary objects of information retrieval, it unduly minimizes the place of documents in the informational landscape and pays insufficient heed to the importance of bibliographical data—for example, authors' names, their affiliations, and publishers—as an aid in assessing the quality of the sources whence the information is drawn (Capurro and Hjørland 2003: 384–387; Hjørland 2000: 33–34; Wilson 1968: 19). Such criticism cannot be applied to Kaiser, for, as we have seen, he made provision for the inclusion of bibliographical data, such as the title of the publication, date and place of publication, and the author, in the amplifications of index units. Indeed, his stipulation that the names of authors, if present, are to be included in the amplification was expressly for the purpose of establishing the credibility of information: as he put it, "[f]or indexing the whole question of authors resolves itself into this and this only: To what extent do their name, rank or sources guarantee the reliability of the information they give" (Kaiser 1911: § 358). He appears to have given considerable thought to the problem of establishing the cognitive authority of the sources of the units of information in an index: for example, in setting forth his prescriptions for entering authors' names, he discussed such matters as the differential weight that one should give to an author's name and title or affiliation (§ 359); the use of publication reputation as a substitute for authors in the case of unsigned articles (§ 361); and the need to verify information in ephemera whose authors were wholly unknown (§ 363). To be sure, Kaiser held that the onus of assessing the information yielded by an index ultimately falls upon its users: in his view, "... an index merely furnishes [informational—TMD] material; to turn it to account, to draw deductions, that is one of the functions of *business* properly so called" (§ 297 [emphasis his]; cf. §§ 660–661). Nevertheless, his rules for information analysis are designed to support the task of evaluating the quality of the information supplied by the index items of a card index.

12.4 Conclusion

Having considered, in some detail, the main lines of Kaiser's account of information analysis, let us draw up a balance sheet of some of our main findings, beginning with his notion of information. Kaiser adopted what is, in many ways, a narrow notion of information, limiting it almost exclusively to whatever is communicated by textual documents and training his attention primarily upon the domain of business literature. Within this framework, he conceptualized information as a representation of knowledge associated with written language and thus as a type of entity. The characterization of information as a type of entity that emerges from his writings is not consistent, oscillating between images of information as the abstract semantic content of a text and as written representations of language in material form. The information carried by written language represents, in Kaiser's view, the product of human observation and reasoning about objects in the world and the conditions to which they are subject. However, observation is conditioned by individual perspective and language is an imperfect instrument for the expression of thought; thus, the information conveyed in text includes statements of fact and opinion that may or may not be veridical. For Kaiser, information is information in a weak sense and so requires interpretation and verification.

Kaiser's understanding of information laid the foundations for his method of information analysis. We have seen that, for the purposes of IR, textual documents can be decomposed to different units of information at various levels of granularity, typically on the basis of formal or linguistic structures internal to the text. Kaiser, however, chose to demarcate units of information not in terms of such pre-existing structures, but rather by means of a type of documentary language whose structure, in his view, went beyond purely linguistic or logical considerations (Kaiser 1911: §§ 296–297). The template for this documentary language is designed in such a way that it is firmly rooted in the content of texts being indexed for IR and yet not entirely determined by their structure. On one hand, the basic matter for defining units of information—index terms—is to be drawn, with varying degrees of directness, from the texts themselves. On the other, this matter is incorporated into categorially structured index statements whose basic structure is consonant with a grammatical "Subject-Predicate" model but is not bound to the surface syntax of the texts themselves. Kaiser made provision for a certain amount of interpretative freedom in the constitution of such statements, both in the choice of terms for certain categories and in the selection of indexable matter within a text. Put together with other informational content drawn from the text and bibliographic data about its source, an index statement marks the limits of a single index item, or unit of information for the purposes of IR.

I conclude with a brief assessment of Kaiser's account of information, offered not as a final judgment on its adequacy but as an invitation to further reflection on its features. One can readily identify a number of points in Kaiser's understanding of information that are open to critique. For example, many IS researchers will find the almost total limitation of the concept of information to the domain of textual documentation to be overly restrictive; many more will take exception to the inconsistent depiction of information as something both abstract and material in nature; and those who hold that information is "an epistemic transaction" that occurs when a human mind engages with an informative object, be it textual or not (e.g., Serrai 1979b: 371; cf. Serrai 1974: 7; Yerkey 1991), will doubtless be scandalized by the strongly ontological coloring that Kaiser gave to the concept in the first place. Such critiques are, in large measure, justified. They should, however, be tempered by the realization that Kaiser's aim was not to offer a full-blown theoretical account of information as such, but rather to give one that would justify his method of processing commercial and technical literature for IR within an information-analytic framework. The pragmatic nature of his project and the kinds of documents with which he dealt in his day-to-day work as librarian and indexer could not but lead to an operational circumscription of information to textual documents and to the treatment of information as an entity of some sort.[21]

More importantly, the weaknesses in Kaiser's view of information should not lead us to overlook other, genuinely generative aspects of his thought. According to Capurro (1978: 289; cf. 239, 293), a concept of information adequate to the needs of IS should acknowledge that information has both an ontological and an epistemological dimension (as "documentarily fixed knowledge" and "the process and result of the appropriation of knowledge", respectively) and should seek to strike an appropriate balance between the two. Viewed from this perspective, Kaiser's conceptualization of information for information analysis—despite its early date—appears to be reasonably well integrated. Kaiser was well aware of the ontological aspects of information, as is manifest from his treatment of information as an object of processing and from his recognition that there are objective limits to the informative potential of a piece of business literature. On the other hand, he was also keenly sensitive to the epistemological dimensions of information as well. We have seen that, in his view, knowledge is always knowledge from a perspective; that the linguistic representation of knowledge is fraught with difficulties; that, accordingly, engagement with texts is inextricably bound up with interpretation on the part of indexer and reader alike; that the identification of units of information in a text is no less a process of construction on the part of an indexer than it is one of discovery; and that the units of information gathered into an index must be established in such a way as to answer to the purposes for which they might be used. It is evident that Kaiser's account of information analysis sought to do justice to both the "hard" objective and the "soft" subjective aspects of the concept of information. In the past, there has been a tendency among commentators to view information analysis as an approach founded on an "atavistic" or "obsolete" form of positivism (Rayward 1994: 248; Hjørland 2000: 33). The case of Kaiser suggests that this need not always be the case and, in an age when information-analytic work is being considered largely within the framework of automated systems, challenges us to consider afresh what the theoretical bases of information analysis can, and should, be.

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[21] As Buckland (1991a: 352) has noted, the tendency to treat information as an object appears to be endemic to any attempt to deal with informative objects within the framework of an information system: ""information-as-thing," by whatever name, is of especial interest in relation to information systems .... Information-as-thing is of special interest in the study of information systems. It is with information in this sense that information systems deal directly."

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