Studies in History and Philosophy of Science 34

Fidelia Ibekwe-SanJuan
Thomas M. Dousa *Editors*

Theories of Information, Communication and Knowledge

A Multidisciplinary Approach

Springer

Theories of Information, Communication and Knowledge

STUDIES IN HISTORY
AND PHILOSOPHY OF SCIENCE

VOLUME 34

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Editors

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A Multidisciplinary Approach

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Color Illustrations of Chapter 10 are available on http://extras.springer.com

ISSN 0929-6425
ISBN 978-94-007-6972-4 ISBN 978-94-007-6973-1 (eBook)
DOI 10.1007/978-94-007-6973-1
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2013943120

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

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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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F. Ibekwe-SanJuan and T.M. Dousa (eds.), *Theories of Information, Communication and Knowledge*, Studies in History and Philosophy of Science 34,
DOI 10.1007/978-94-007-6973-1_1,

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*.

Acknowledgements The scientific editors are very grateful to the Institute des Sciences de la Communication (ISCC[1]) of the CNRS (The French National Center for Scientific Research) and its board of directors for funding the EPICIC project which created the initial framework under which the work undertaken in this book could be gathered and then published. This book is a direct result of the EPICIC colloquium[2] held in Lyon (France) on 8 April 2011 and attended by many of the contributing authors. The colloquium featured very high-level and thought-provoking talks that formed the backbone of some of the chapters of this book. The editors would also like to express their gratitude to Lucy Fleet and Diana Nijenhuijzen of Springer and to Gounasegarane Shanthy of SPi Global for their expert, efficient, and cheerful work in shepherding this book through the press.

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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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F. Ibekwe-SanJuan and T.M. Dousa (eds.), *Theories of Information, Communication and Knowledge*, Studies in History and Philosophy of Science 34,
DOI 10.1007/978-94-007-6973-1_2,

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.