

INFORMATION ABOUT INFORMATION: A TAXONOMY OF VIEWS

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Appendix A

Background

This background discussion outlines the definition, etymology, and chronological development associated with the term information, with attention to certain recurring aspects.

Dictionary definitions of information are typically more inclusive than precise. For example, from Merriam-Webster (2010):

- 1:** the communication or reception of knowledge or intelligence
2 a (1): knowledge obtained from investigation, study, or instruction (2): INTELLIGENCE, NEWS (3): FACTS, DATA **b:** the attribute inherent in and communicated by one of two or more alternative sequences or arrangements of something (as nucleotides in DNA or binary digits in a computer program) that produce specific effects **c** (1): a signal or character (as in a communication system or computer) representing data (2): something (as a message, experimental data, or a picture) which justifies change in a construct that represents physical or mental experience or another construct

The concept of information can be traced to the Greek *forma* and the Latin *informatio* and *informare*, meaning reinforcement or detection; to make or produce both technically and biologically, to describe or define, or to unfold or illuminate, to put into form (Applegate et al. 1999; Haken 1992). Virgil wrote of Vulcan and the Cyclops hammering out (*informatum*) lightning bolts for Zeus, and Tertullian refers to Moses as the *populi informatory*, the people's educator or molder (Capurro 2003). Augustine defined information as a molding process like the representation or impression of a ring on wax, and called the process of visual perception *informatio sensus*. Information-as-form was the representation of the one, true, external reality on the moldable mind.

In medieval times information continued to be used in an active, constructive sense as something that gives a certain form or character to matter or to the mind, a contribution to knowledge (Campbell 1982). The idea of information as a meaningful contribution to knowledge continues

to this day (Tuomi 1999). However, after the middle ages, information also began to refer to communication. Peters (1988) suggests that was due in part to Descartes' interposition of ideas between nature and intellect. Rather than direct (or objective) perception of external real things in the world impressing the mind and informing, ideas insulated the mind from the world, and as a result no direct perception of one true reality was possible. What was left was the perspective that ideas or models and the information they produced were communicated between minds.

Later, during the industrial age, the opportunity to create communication networks rewarded objectively measured information. An information concept was needed that would be more suitable for the engineering of communication networks, a view that could measure information. Shannon's definition of information as the measurable reduction in uncertainty gained prominence. This definition was completely independent of the meaning of the communication, independent of its meaning to the receiver.

This quantitative view of information led to advances in the natural sciences because this view was a perfect fit with philosophical assumptions of natural science. This quantitative viewpoint was rapidly applied to entropy in physics, to genetics in biology (Capurro 2003), and in a number of mathematical and logic disciplines. For example, information turned out to be the missing factor in Maxwell's demon, a fictional character seemingly capable of decreasing entropy without expending energy. Popper (1959) linked information to logical probability by asserting that hypotheses that are more improbable, if true, are more informative (Newman 2001). For the first time, information could exist outside the mind, enabling research in knowledge management systems and in organisms and organizations that could exchange information with their environments. This approach to information is an example of the syntax view.

At this time, some called this objective–engineering–communication perspective the American School. In contrast, the British School influenced by Donald MacKay, advocated a perspective on information that emphasized the older concept of information as constructive impression, as connotation, and as a medium for meaning. This British School view suggested that meaning is internal to an observer. MacKay and others within this semantic perspective proposed definitions of information as distinctions that make a difference (Bateson 1973; MacKay 1969). When information is received, it causes a change in the representation that is used to depict what is known and how individuals can respond, given appropriate circumstances. Communication leads to knowledge by allowing individuals to replicate the representations of others (MacKay 1969). In this modern semantic perspective, information-as-meaning changes the state of a representation.

The other leading modern view of information emerged with the advent of the computing machine. Information processing theory developed in the 1970s in the domains of cognitive psychology and artificial intelligence. In information processing theory, information is an objective token that is manipulated in ways common to both men and machines. As a result of the pioneering work of Newell and Simon (Newman 2001), it became common to think of information as a part of a mechanistic process used in computing machines. This approach to information is labeled the token view in the taxonomy presented in this paper.

More recently, an age-old ontology has entered the information debate as well. Various labels—subjectivism, nominalism, or anti-positivism—this ontology denies the existence of an objective reality, and hence assumes that information is created by the informed. This train of thought has led to information-related theories of autopoiesis (Maturana and Varela 1980), second-order cybernetics (von Foerster 1984), and cybersemiotics (Brier 2005), a set of theories included within the adaptation view.

While differences abound, several important aspects of information are common to many of the definitions. For example, most theories propose that information is related to knowledge, reduces uncertainty, is related to unexpectedness, is based on differences in data, is understood by a system that changes its internal organization, and is escorted by well formed symbols (Hofkirchner 1999). In addition, most definitions are consistent with several intuitive ideas about information (Floridi 2005). First, information is additive—two pieces of information are generally more informative than either by itself. Information is nonnegative; if information is informative, the receiver or interpreter always knows more, never less. Information is also irreversible; once sent or perceived, information cannot be undone. Further, information is also context dependent; some news is more informative in some contexts than others (Gernert 1996). Finally, information implies a sign. For example, a sign of glowing red informs that the stove top is hot.

Most theories view information as something more than data. Some theories make a distinction between data and information by stating that data are raw facts and information is processed data that reveals meaning or is in meaningful form. Data, from the Greek *diaphora* for difference, are facts regarding some differences or, more simply, a lack of uniformity (Floridi 2005). Most theories of information agree that information depends on data being well formed. Well formed data are at the same time the resources and constraints that make information possible. In this sense, information comes from data as shelter from bricks (Floridi 2005). Shelter, while it consists of bricks, is not the bricks. Shelter is constrained by the bricks, it may be thought of as a particular presentation of bricks, like information is a particular (re)presentation of data.

This historical review suggests that as philosophical outlooks have changed, information has changed (Volz 1996). Currently, philosophy has no universal theory of the structure of the world; therefore, a universal theory of information should not be expected (Horz 1996). Absent a

unifying view of philosophy, present day scientific domains make a variety of assumptions about ontology and epistemology that lead to multiple perspectives on information. For example, in various domains information is order (De Vree 1996), a sign (Stamper 1985), a truth condition (Israel and Perry 1990), a property of the universe, on objective commodity intrinsic to objects (Dretske 1981; Stonier 1996), or simply the combination of a sign, a thing, and a person (Borgmann 1999). This surfeit of definitions, and the lack of a unifying philosophical outlook, has produced a preparadigmatic state of flux.

Appendix B

Information Articles Reviewed²

Information	Cite	Title	Authors
Information Systems Research			
Token	Jun-07; 18(2); pp. 150-172	Product Development and Pricing Strategy for Information Goods under Heterogeneous Outside Opportunities	Chen and Seshardi
Token	Mar-07; 18(1); pp. 23-41	Releasing Individually Identifiable Microdata with Privacy Protection Against Stochastic Threat	Garfinkle, Gopal, and Thompson
Token	Dec-06; 17(4); pp. 332-351	Perceived Information Quality in Data Exchanges: Effects on Risk, Trust, and Intention to Use	Nicolaou and McKnight
Token	Jun-06; 17(2); pp. 162-179	Understanding the Adoption of Multipurpose Information Appliances: The Case of Mobile Data Services	Hong and Tam
Token	Dec-04; 15(4); pp. 336-355	Internet Users' Information Privacy Concerns	Agarwal, Kim, and Malhotra
Token	Mar-04; 15(1); pp. 22-36	Economics of an Information Intermediary	Bhargava and Choudhary
Both	Mar-03; 14(1); pp. 47-65	Informational Influence in Organizations	Sussman and Siegal
Token	Jun-03; 14(2); pp. 170-188	The Impact of Experience and Time on the Use of Data Quality Information in Decision Making	Fisher, Chengalur, and Ballou
Representation	Mar-03; 14(1); pp. 87-106	The Social Construction of Meaning	Miranda and Saunders
Token	Mar-03; 14(1); pp. 107-123	Information Goods Pricing and Copyright Enforcement: Welfare Analysis	Chen and Png
Token	Dec-02; 13(4); pp. 428-434	Intrafirm Resource Allocation with Asymmetric Information and Negative Externalities	Nadiminti, Mukhopadhyay, and Kriebel
Token	Sept-01; 12(3); pp. 286-301	On Heterogeneous Database Retrieval	Krishnan, Li, Steier, and Zhao
Token	Sept-02; 13(3); pp. 296-315	The Measurement of Web-Customer Satisfaction	McKinney, Yoon, and Zahedi
Token	Mar-00; 11(1); pp. 17-36	A Formal Approach to Workflow Analysis	Basu and Blanning
Journal of MIS			
Token	Sum-07; 24(1); pp. 201-231	Broken Ties: The Impact of Organizational Restructuring on the Stability of Information-Processing Networks	Jeon, Kwon, and Oh
Token	Sum-07; 24(1); pp. 329-353	Intrusion Prevention in Information Systems: Reactive and Proactive Responses	Cakanyildirim and Yue

²“Both” designates that the paper used token and representation definitions about equally.

Information	Cite	Title	Authors
Token	Spr-07; 23(4); pp. 7-9	Integrating User Preferences and Real-Time Workload in Information Services	Konana, Gupta, and Whinston
Token	Spr-07; 23(4); pp. 29-51	Interoperability of E-Government Information Systems: Issues of Identification and Data Sharing	Feltz, Hitzelberger, and Otjacques
Token	Fall-06; 23(2); pp. 203-231	Consumer Perceptions and Willingness to Pay for Intrinsically Motivated on Line Content	Lopes and Galletta
Token	Sum-06; 23(1); pp. 293-319	Information Processing Design Choices, Strategy, and Risk Management Performance	Fairbank, Labianca, Steensma, and Metters
Syntax	Spr-06; 22(4); pp. 305-336	Exploring Attribute Correspondences Across Heterogeneous Databases by Mutual Information	Zhao and Soofi
Token	Fall-04; 21(2); pp. 87-107	Poaching and the Misappropriation of Information: Transaction Risks of Information Exchange	Clemons and Hitt
Token	Fall-04; 21(2); pp. 109-135	Information Exploitation and Interorganizational Systems Ownership	Han, Kauffman, and Nault
Token	Sum-04; 21(1); pp. 203-226	Stopping Behavior of Systems Analysts During Information Requirements Elicitation	Browne and Pitts
Both	Fall-03; 20 (2); pp. 113-136	Contingency Pricing for Information Goods and Services under Industry Wide Performance Standard	Bhargava and Sundaresan
Both	Wint-02; 19(3); pp. 17-41	Newly Vulnerable Markets in an Age of Pure Information Products: An Analysis of Online Music and Online News	Clemons, Gu, and Lang
Token	Wint-02; 19(3); pp. 69-86	Market Segmentation and Information Development Costs in a Two-Tiered Fee-Based and Sponsorship-Based Web Site	Riggins
Token	Fall-01; 18(2); pp. 65-88	Achieving the Optimal Balance Between Investment in Quality and Investment	Aron and Clemons
Token	Fall-01; 18(2); pp. 89-106	Information Goods and Vertical Differentiation	Bhargava and Choudhary
Token	Fall-01; 18(2); pp. 107-131	Forward Versus Spot Buying of Information Goods	Gundepudi, Rudi, and Seidmann
Token	Sum-01; 18(1); pp. 151-183	Exploring Perceptions of Organizational Ownership of Information and Expertise	Jarvenpaa and Staples
Token	Wint-99; 16(3); pp. 157-185	Information Overload: Addressing the Productivity Paradox in Face-to-Face Electronic Meetings	Gallupe and Grise
MIS Quarterly			
Token	Sept-07; 31(3); pp. 525-546	Enhancing Information Retrieval Through Statistical Natural Language Processing: A Study of Collocation Indexing	Arazy and Woo
Representation	Sept-07; 31(3); pp. 579-615	The Dynamic Structure of Management Support Systems: Theory Development, Research Focus, and Direction	Clark, Jones, and Armstrong
Representation	Mar-07; 31(1); pp. 19-33	The Value of Privacy Assurance: An Exploratory Field Experiment	Hui, Hai Teo, and Tom Lee
Token	Mar-07; 31(1); pp. 89-104	Cognitive Stopping Rules for Terminating Information Search in Online Tasks	Browne, Pitts, and Wetherbe
Token	Mar-07; 31(1); pp. 105-136	Understanding and Mitigating Uncertainty in Online Exchange Relationships: A Principal-Agent Perspective	Pavlou, Liang, and Xue
Token	Dec-06; 30(4); pp. 865-890	Understanding the Impact of Web Personalization on User Information Processing and Decision Outcomes	Tam and Ho
Both	Jun-06; 30(2); pp. 247-267	An Empirical Analysis of the Value of Complete Information for ECRM Models	Kimbrough, Padman, and Zheng
Representation	Mar-06; 30(1); pp. 13-28	The Personalization Privacy Paradox	Awad and Krishnan

Information	Cite	Title	Authors
Token	Dec-05; 28(4); pp. 585-620	An Empirical Investigation of Net-Enabled Business Value	Barua, Konana, Whinston, and Yin
Representation	Sep-04; 28(3); pp. 363-394	Informating the Clan: Controlling Physicians' Costs and Outcomes	Kohli and Kettinger
Token	Jun-04; 28(2); pp. 255-281	The Effect of Relationship Encoding, Task Type, and Complexity on Information Representation	Kumar and Benbasat
Token	Mar-04; 28(1); pp. 107-142	The Resource-Based View and Information Systems Research	Hulland and Wade
Token	Jun-02; 26(2); pp. 119-144	Inducing Sensitivity to Deception in Order to Improve Decision Making Performance: A Field Study	Biros, George, and Zmud
Token	Dec-00; 24(4); pp. 569-600	Technology Adaptation: The Case of a Computer-Supported Inter-Organizational Virtual Team	Ba, Majchrzak, Malhotra, and Rice
Both	Sep-00; 24(3); pp. 449-471	The Effect of Multimedia on Perceived Equivocality and Perceived Usefulness of Information Systems	Benbasat and Lim
Both	Mar-00; 24(1); pp. 43-79	Understanding Computer-Mediated Discussions: Positivist and Interpretive Analyses of GSS Use	Trauth and Jessup
Adaptation	Mar-00; 24(1); pp. 3-40	A Confessional Account of an Ethnography about Knowledge Work	Schultze
Token	Sep-99; 23(3); pp. 397-420	Chartjunk or Goldgraph? Effects of Presentation Objectives and Content Desirability on Information Presentation	Meyer and Tractinsky
European Journal of Information Systems			
Token	2007; 16; pp. 178-191	Towards an E-Government Efficiency Agenda	Hackney, Jones, and Losch
Token	2006; 15; pp. 511-524	Business Customer Communities and Knowledge Sharing	Erat, Desouza, Schafer, and Kurzawa
Token	2006; 15; pp. 635-647	A Conceptual Framework for the Implementation of Enterprise Information Portals in Large Organizations	Scheepers
Token	2005; 14; pp. 273-287	Designing Consumer Interfaces for Experiential Tasks	Wells, Fuerst, and Palmer
Token	2005; 14; pp. 361-370	User Involvement and User Satisfaction with Information-Seeking Activity	Santosa, Wei, and Chan
Token	2004; 13; pp. 65-79	Electronic Trading and the Process of Globalization in Traditional Futures Exchanges	Barrett and Scott
Representation	2004; 13; pp. 210-220	Hermeneutics, Information and Representation	Chalmers
Representation	2002; 11; pp. 142-158	The Organisational Learning Effects of Management Accounting Information under Advanced Manufacturing Technology	Choe
Token	2002; 11; pp. 181-195	Personality Traits and Effectiveness of Presentation of Product Information in E-Business Systems	Jahng, Jain, and Ramamurthy
Syntax	2001; 10; pp. 41-54	Design and Delivery of Information	Korn