

Original Article

Information Behavior: A Socio-Cognitive Ability

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Abstract: How has human information behavior evolved? Our paper explores this question in the form of notions, models and theories about the relationship between information behavior and human evolution. Alexander's Ecological Dominance and Social Competition/Cooperation (EDSC) model currently provides the most comprehensive overview of human traits in the development of a theory of human evolution and sociality. His model provides a basis for explaining the evolution of human socio-cognitive abilities, including ecological dominance, and social competition/cooperation. Our paper examines the human trait of information behavior as a socio-cognitive ability related to ecological dominance, and social competition/cooperation. The paper first outlines what is meant by information behavior from various interdisciplinary perspectives. We propose that information behavior is a socio-cognitive ability that is related to and enables other socio-cognitive abilities such as human ecological dominance, and social competition/cooperation. The paper reviews the current state of evolutionary approaches to information behavior and future directions for this research.

Keywords: information behavior, socio-cognitive ability, ecological dominance, social competition, social cooperation.

Introduction

“Humans had in some unique fashion become so ecologically dominant that they in effect became their own principal hostile force of nature, explicitly in regard to evolutionary changes in human psyche and social behavior” (Alexander, 1990b, p. 4).

For more than twenty years, many leading social scientists have been exploring the questions: How has evolution shaped human cognition and behavior? (Barkow, Cosmides and Tooby, 1992; Buss, 1995, 2003; Cosmides and Tooby, 1997; Flinn, 2004; Mithen, 1996; Plotkin, 1998; Stevens and Price, 1996; Tooby and Cosmides, 1989). What general selective forces drove the evolution of hominids? (Alexander, 1990a,b, 2005, 2006) and What combination of selective forces caused the appearance of the various unique and

distinctive features of humans and their social life? (Alexander, 1990b; Baumeister, 2005). Many social science subjects are developing their fields of inquiry within such an evolutionary framework, including evolutionary biology, evolutionary ecology, evolutionary psychiatry, evolutionary psychology and cognitive archeology. In this paper we ask: How has human information behavior evolved? We also explore the relationship between information behavior, as a socio-cognitive ability, and human evolution.

Alexander's Ecological Dominance and Social Competition (EDSC) model currently provides the most comprehensive overview of human traits in the development of a theory of human evolution, sociality and socio-cognitive abilities (Alexander, 1971, 1979, 1987, 1990a, b; Alexander and Tinkle, 1981; Finn, Geary and Ward, 2005; Geary, 2005; Irons, 2005). Alexander's model provides a basis for explaining the evolution of human cognitive abilities as it centers on the ecological dominance of humans in nature and their competence in social competition. Humans have become ecologically dominant via increased inter and intra group competition and cooperation, and have developed various socio-cognitive abilities (Alexander, 1987). Irons (2005) and Flinn, Geary and Ward (2005) provide an extensive overview of the strengths and weaknesses of Alexander's Model for fields such as evolutionary psychology and anthropology, and highlight the validity of Alexander's Model with support from the human fossil record and findings from studies of the human brain and mind.

In this paper we briefly outline two views of human evolution, and then describe what is meant by a human socio-cognitive ability which is a uniquely human attribute (Alexander, 1990b). We then propose that information behavior is an important socio-cognitive ability and describe what is meant by the term information behavior from the perspective of information science, information theory/processing, evolutionary psychology and the emerging information behavior perspective. The paper then discusses how information behavior is emerging as an important human socio-cognitive ability from an interdisciplinary perspective. Such reviews are a useful way of understanding the interdisciplinary relations between fields incorporating evolutionary perspectives (Krill, Platek, Goetz and Shackelford, 2007).

Human Evolution: Two Views

Information behavior is a uniquely human attribute that differentiates humans from other mammals due to unique attributes of the human brain. Somewhere along the evolutionary line the human brain diverged from that of other mammals. There are various theories as to why this is so. One theory is that there is qualitative difference between the human brain as it is now and what it was in pre-human form. Spink and Cole (2006) refer to what is termed a great leap-type neurological transformation in the human brain (Ehrlich, 2000; Klein, 2000), which may have produced a dramatic transformation in human cognitive architecture (Mithen, 1988, 1996) and enhanced working memory (Wynn and Coolidge, 2004). This occurred from 40,000 to 75,000 years ago. According to Mithen (1996), this dramatic transformation allowed *Homo sapiens* to survive while Neanderthals did not. Human hunter-gatherers became dramatically more efficient in exploiting their environment, more able to cope with environmental extremes, and more flexible in social behavior (Mithen, 1988). Mithen's Great Leap forward theory is a radical form of the theory of punctuated equilibria which holds that evolutionary transformations took place in sudden, radical steps (Gould and Eldredge, 1977).

The opposite view of human brain evolution argues that the difference between the present day human brain and that of our mammal and primate ancestors can be explained by increased brain size alone. There has been a sevenfold increase in brain size relative to body mass from ape to present day human (Jerison, 1973). Often called “the strong form of the encephalization hypothesis” or the unitary hypothesis (Donald, 1991, p. 106). According to this hypothesis, there was one evolutionary adaptation only in human evolution, that of brain size, with the gradual increase in size

In the Ecological Dominance and Social Competition / Cooperation (EDSC) model, Alexander (1990b) states that: “During these several million years the hominid line diverged far from that of the apes, especially in regard to brain size and function, and accompanying complexities of behavior, particularly social behavior” (p. 3). The increased brain size could have been due to a specific human behavior, with the increasing but gradual need for human cooperation among groups to survive in an environment where competition was not so much from the environment itself but from competition from other groups. To compete and cooperate effectively, the human developed new types of behavior which in turn caused adaptations in the brain and other human physiology related to communication such as the larynx.

Alexander (1990b) asks what sort of challenges could have caused the human divergence to accelerate in its later stages. He concludes that the divergence may have been due to the development of human socio-cognitive abilities. Alexander (1990b) defines socio-cognitive ability as an attribute or trait that is unique and unusual to humans. These socio-cognitive abilities, according to Alexander (1990b) led to human evolutionary physical adaptations such as menopause, concealment of ovulation and altriciality.

These socio-cognitive abilities emerged and developed as humans evolved, allowing further selective human advantages due to these cognitive changes. Alexander (1990b) frames socio-cognitive abilities and human intelligence as a social tool and “the human brain has evolved in the context of social cooperation and competition” (p. 4). Physical changes to the hominid form were caused by the brain as a social tool to increase intra-group cooperation in competition with other groups. Hidden ovulation, hairlessness, and menopause--usually such radical adaptations occur elsewhere in animal world when animal entered new habitat (e.g., land to sea). But in humans it is Alexander’s and other’s view that these changes were due to social condition--brain as social tool--changing physical attributes. As another example, Lovejoy (1980) argues that even the advent in humans of bipedalism (standing erect), which involved huge risks (abandoning the safety of the trees, etc.) emerged in humans because of social stability or cooperation among humans (pair-bonding, shared infant care etc.).

It is precisely Alexander’s focus on the role he accords to society, competition and social cooperation in the development of human socio-cognitive abilities that we emphasize in this paper to balance the cognitive perspective of Mithen as we described in Spink and Cole (2006).

What we specifically set out to do here is to explore the notion that information behavior is a socio-cognitive ability which developed as a result of both cognitive and social factors during human evolution. We highlight information behavior and the evolution of human cognition in terms of information behavior and information.

This paper next discusses socio-cognitive ability, and then outlines what is information behavior from various interdisciplinary perspectives. We then discuss how information behavior is a socio-cognitive ability that is related to and enables other socio-

cognitive abilities, i.e., human ecological dominance, and social competition and cooperation.

Socio-Cognitive Ability

In human evolution from primate to *Homo sapiens*, no intermediate line of species survived, which is unique in evolution. The hostile forces of the environment could not alone represent a challenge great enough to have caused the human-ape brain divergence (Alexander, 1990a,b). One view is that our human ancestors were in competition with other forms of hominoid (e.g., the Neanderthals), and the human brain transformed as *Homo sapiens* developed socio-cognitive abilities and cooperated together to successfully compete against the Neanderthals. However, even when the Neanderthals died out the human brain continued to increase in size and functionality; in fact, the increase in size and functionality quickened. The more recent development of the human brain was caused by the human need to cooperate within groups to compete against other groups of *Homo sapiens*. The “cooperation-to-compete” hypothesis is that only humans among and between themselves could have developed a sufficiently large challenge to force the human adaptation process; that humans themselves became their own hostile force of nature.

The problems that have driven the evolution of human cognitive abilities are not problems due to the physical environment but primarily social problems. Humphrey (1976) describes his hypothesis of the evolution of the brain as a social tool; the human race selected for individuals who were good at social manipulation (Alexander, 1990b). Dunbar (1993) proposes that language developed out of the need for maintain social organizations. Even mathematics, which is a sort of linguistic ability, is created and used to advance the social concerns of the group in competition with other, hostile groups.

To understand the evolution of our understanding of information behavior as a socio-cognitive ability, we first discuss how the concept of information is evolving.

Information and information processing

Information

Information has been defined in various ways (Case, 2002; Cole, 1994). Buckland (1991) influentially divided the definitions into three types: information-as-thing, information-as-knowledge and information-as-process. Information-as-thing is probably the common conception of information--i.e., that information is additive and does not create a qualitative difference in the way the person receiving the information thinks. However, the information-as-process definition has gained favor in information science due in part to Brookes' (1980) influential fundamental equation which states that information modifies the knowledge structure of the person receiving the information. According to Brookes, knowledge structures provide a mechanism that subjectively interprets sense data in the environment, transforming this data into information. The information-as-process definition is useful because it provides a framework for how the transformation of sense data into information occurs.

The next section discusses how the cognitive sciences perceive information as process and explore information processing.

Information processing perspective in cognitive psychology

Information processing relates to the working of humans' cognitive architecture, information behavior models the behavioral manifestations of the information processing cognitive architecture (Atkinson and Shiffrin, 1968). The field of cognitive psychology investigates internal mental processes such as problem solving, memory, language and information processing within the context of understanding human thinking. The dominant theory in cognitive psychology dealing with information is information processing theory (Newell, 1990). The theory concerns how the human cognitive system deals with information, how and why did it evolve with its particular characteristics.

The information processing view within cognitive psychology provides a useful framework for how humans are able to cognitively transform sense data from their physical and social environment into information that enables adaptive processes to occur. The dominant theory in cognitive psychology dealing with information is information processing theory. Information processing theory describes information flow from environmental inputs entering the human information processing system to memory outputs. These memory outputs can take many forms. Here we narrow the discussion to the process of how information structures are retrieved from long-term memory (LTM) in reaction to an environmental stimulus. These information structures enable the decoding-type processing of the environmental stimulus, control how that stimulus is processed, and finally how the new stimulus is encoded in LTM.

There are complicated, structure-oriented models of cognitive architecture (Anderson and Lebiere, 1998; Anderson, Taatgen and Byrne, 2005; Baddeley, Chincotta and Adlam, 2001; Miyake and Shah, 1999). However, for the present purposes, a well-known model of cognitive architecture that describes the basic processes involved in human information processing is provided by Atkinson and Shiffrin (1968). Here, environmental input is first registered in a sensory store then shifted to a buffer or memory structure called the short-term memory store (STS). "This store may be regarded as the subject's working memory" (Atkinson and Shiffrin, 1968, p. 12). In Atkinson and Shiffrin, the STS can be in a separate physiological structure from LTS or simply "a temporary activation of information permanently stored in the long-term store" (Shiffrin and Atkinson, 1969, p. 180). In the STS, the input is either not attended to, leading to eventual decay or attended to and manipulated when appropriate stored information is retrieved from the long-term memory store (LTS).

Information structures are retrieved from the LTS via a self-addressing memory, which can be compared to a library shelving system. In a library shelving system, books are given a call number via a classification scheme which indicates both the book's storage position and the user's retrieval position on the shelf. In the Atkinson-Shiffrin model, to facilitate matching the storage and retrieval system likewise "mirror" each other (Shiffrin and Atkinson, 1969).

Pertinent to our article is a new environmental stimulus waiting processing in STS is matched to information structures in LTS via attributes or characteristics of the stimulus. A stimulus that is less familiar to the person takes longer to match than more familiar stimuli. Environmental stimuli causing humans to adapt to changing social and physical environmental conditions and their survival in that new environment are by definition unfamiliar to the human. Unfamiliar stimuli would have to be processed in some way, despite a lack of match, probably according to the "least effort" principle. This favors our thesis that the matching mechanism between an unfamiliar environmental input and the

LTS is set-up to select and retrieve social-themed information when processing new and unfamiliar environmental stimuli. A sort of default setting which through repeated selection would become reinforced over time--thus reinforcing the “social” vector of evolutionary selection and adaptation.

In other words, the default setting for dealing with unfamiliar stimuli input from the environment means that the selection, adaptation and expansion of those same information structures over the course of evolution will continue to be in the direction of ever more sophisticated “social-themed” information structures stored in the LTS.

Human information processing and the Atkinson-Shiffrin (1968) model of cognitive architecture that determine cognitive information flow also determine information behavior. Unresolved data and anomalies in the environment that enter the STS signal changes in the human social and physical environment that may lead to thinking, problem solving and learning activities that provoke information behavior. Information behavior plays the fundamental role of giving humans the ability to perceive changes in their physical and social environment through the perception of sense data, then cognitively transform this sense data into information, so that they can adapt to these changes. We have defined this ability here as a human socio-cognitive ability.

Scholars from the information theory/processing perspective also discuss the role of information in human cultural evolution, and the relationship between human information processing and evolutionary theory. Stonier (1997) provides a theory of how the brain works from an information systems perspective. Avery (2003) relates evolution and information theory via the second law of thermodynamics. Harms and Ruse (2004) create the conceptual foundations for a science and theory of knowledge through the application of evolutionary theory. Yockey (2005) discusses the use of information theory and coding theory in molecular biology.

Overall, the information processing approach focuses on how the mind functions; for example, how the left and right sides of the brain communicate or how fast neurons fire (Barkow, Cosmides and Tooby, 1992). This paper extends on the information processing approach to include consideration of information behavior. The next section of the paper describes what is meant by information behavior from the perspective of various scientific fields, including information science (non-evolutionary) evolutionary psychology and evolutionary information behavior.

Information behavior

Information science perspective

The field of information science includes the research area that studies human information related behaviors, including information seeking, information foraging, information retrieving, information organizing and information uses (Spink and Cole, 2005, 2006). The information behavior perspective assumes that information is a cognitive construction by humans during their behavior within social, cultural and organizational environments (Spink and Cole, 2005). More specifically focused than information behavior, Spink and Cole (2005) define *information seeking* as a sub-set of information behavior that includes the purposive seeking of information in relation to a goal; *information organizing behavior* is the process of analyzing and classifying materials into defined categories (which we extended to include human cognitive information organizing

behavior in Cole and Leide, 2006); and *information use behavior* involves incorporating information into an individual's existing knowledge base.

Research into information behavior in information science has largely built contemporary non-evolutionary models incorporating concepts related to contemporary information behaviors (Case, 2002; Spink and Cole, 2005, 2006). Other fields, such as social psychology, marketing and consumer buying, have also study contemporary information behavior (Case, 2002. Information science has largely adopted a focus based on solving the technological, psychological and social problems of the post-WWII information explosion and fulfilling Vannevar Bush's vision of the Memex machine (Bush, 1945; Saracevic, 1999), which foresaw the development of computers and techniques that would allow the more effective organization and retrieval of information (Saracevic, 1999).

Yet information behavior is a basic human behavior that has aided us in our survival from the beginning of human existence (Spink and Cole, 2005, 2006). Information science has recently begun to be influenced by Evolutionary Psychology and exploring the central role of information (Bates, 2005) and information behavior (Spink and Cole, 2006) as a mechanism of human adaptation and survival. Like the human behaviors surrounding food production, information behavior is a socio-cognitive ability facilitating adaptation and survival.

The next section of the paper outlines the current Evolutionary Psychology perspectives regarding information behavior.

Evolutionary psychology perspective

The evolutionary psychology approach to information behavior has focused on the behavioral aspects of humans and information behavior. Evolutionary psychologists and related researchers have written about information behaviors in an evolutionary sense. The history of information behaviors within evolutionary psychology is seen as related to the evolution of human behavior (Eibi-Eibesfeldt and Strachen, 1996).

The objective of evolutionary psychology is to explore functioning and development of the human mind from a human evolutionary theoretical perspective, including information behavior as a socio-cognitive ability (Barkow, Cosmides and Tooby, 1992; Mithen, 1988, 1996). Cognitive archeologist Mithen (1996) studied Upper Paleolithic cultures, focusing on prehistoric cave art and the meaning that can be derived from what he and other researchers interpret as a method and mechanism for information storage. Mithen (1996) advocates an interdisciplinary approach to scientific inquiry and has stated that "almost all disciplines can contribute towards an understanding of the human mind" (p. 10).

Kaplan (1992) as an evolutionary psychologist has written about some of the issues involved in a synthesis of humans, evolution and information. Kaplan (1992) states that within a framework of "affective biases toward patterns of information" he states that, "...not only information in its own right, but the concern for information is considered a basic part of the human makeup" (p. 582). Kaplan (1992) sees "concern" as encompassing a broad range of human affective relationships vis-à-vis information, such as "the motivation to seek information" (p. 582) and asserts that a variety of "human affective relationships to information...remain to be identified and conceptualized" (p. 582). Kaplan (1992) proposes several questions related to the nexus of humans, information, and evolution. He examines whether knowledge (i.e. information) has any relationship to human evolution.

Interdisciplinary evolutionary psychologists Barkow, Cosmides and Tooby (1992) and Mithen (1996) discuss conceptual integration that created anchor point links with other fields. Tooby and Cosmides (1989) view cognitive psychology and evolutionary biology as “sister disciplines” (p. 46). They assert that “the goal of evolutionary theory is to define the adaptive problems that organisms must be able to solve. The goal of psychological theory is to discover the information processing mechanisms that have evolved to solve them. Alone, each is incomplete for the understanding of human nature. Together they are powerful” (Tooby and Cosmides, 1989, p. 46-47).

In addition, other evolutionary psychologists are exploring cumulating information building as a major human ability (Coe, 2003) and the extraordinary range of information we use in comparison with other species. The famous Harvard linguist Steven Pinker (1999, 2003) highlights the need to understand more about the extraordinary human ability of information transfer abilities enabled by linguistic competency. In summary, various evolutionary psychology scholars are exploring information behavior. However, evolutionary psychology has not developed a coherent framework for information behavior as a socio-cognitive ability. The next section of the paper examines the evolutionary information behavior perspective emerging from information science that is building a framework for information behavior as a socio-cognitive ability.

Evolutionary information behavior perspective

The evolutionary approach to understanding information behavior is exploring the development of the information behaviors manifested and engaged in by humans and exploring how evolution shaped information behavior (Spink and Currier, 2006a, b). This approach is exploring how evolutionary changes in information behavior may mirror cognitive and societal development as humans endeavored to fulfill needs and resolve problems of everyday life and survival (Spink and Currier, 2006a, and b).

Consideration of evolutionary theory has recently emerged within the information behavior perspective (Madden, Bryson and Palimi, 2006; Spink and Cole, 2005, 2006; Spink and Currier, 2006a, b). The nature of information (Bates, 2005) and information behavior is being increasingly understood as a product of biological evolution (Spink and Cole, 2005, 2006) within a heuristic conceptualization and interdisciplinary framework for examining the nexus of human beings, information behavior’s and human evolution. The goal of this research is to understand how information behaviors may have changed and evolved across the arc of human existence and human evolution (Spink and Currier, 2006a, b).

Spink and Cole (2005, 2006) provide an overarching and evolutionary conceptual framework which encompasses an information behavior model, including information seeking, foraging, sense making, retrieving, organizing and use behaviors (Spink and Cole, 2005, 2006). They argue that viewing information behavior from only one perspective, e.g., that humans are foragers for information, provides a limited understanding of information behavior. Spink and Cole (2005, 2006) argue that humans engage in information seeking, foraging, sense making, retrieving, organizing and use behaviors at different times, and that these behaviors often occur in parallel. For example, for different tasks that are being processed by a person at different information processing levels within cognition (Spink, Cole and Waller, in press), a person may initiate an information seeking behavior and then switch to information foraging and then switch to making sense of the information retrieved.

Spink and Currier (2006a) examine the information behavior of various individuals from the past through their writings to begin the development of an evolutionary perspective for our understanding of information behavior, including Napoleon Bonaparte, Charles Darwin, Giacomo Casanova and others. They show that these persons of the past articulated aspects of their information behaviors, including information seeking, information organization and information use, providing tangible insights into their information-related thoughts and actions. Spink and Currier (2006b) also provide an initial chronological model of information behavior over human existence.

The underlying premise of Spink and Currier (2006b) is that: “Among other things consciousness implies the ability to think about times and places and events separated from our immediate personal circumstances. It implies the ability to use information from the social past to anticipate and alter the social future, to build scenarios, to plan, to think ahead, and to anticipate possible outcomes and retain [them] to act in several alternative ways, depending on circumstances that can only be imperfectly represented at the time the plans or scenarios are being made” (p.7).

In summary, an important link has emerged across evolutionary psychology and information science that links information behavior and evolution. The next section extends this interdisciplinary perspective further and discusses how information behavior is related to and is an enabling element in Alexander’s Ecological Dominance and Social Competition/cooperation (EDSC) model using Donald’s (1991) theoretical framework.

Information behavior as enabler of EDSC

Alexander’s EDSC model designates human social cooperation within the group to counter competition from other groups as the trigger that initiated physical transformations/adaptations leading to human ecological dominance. In this article, we discuss how EDSC is driven by information problems related to intra group cooperation and inter group competition, leading to the need to gather, process, sort, organize and use information about the ecology, sociality, morality, creation of culture, competition and cooperation elements of human existence. Information behavior may have evolved as a general adaptive protection from hostile forces and to enable human survival and competition/cooperation.

Information behavior is an adaptation based on a developing cognitive schema, human language systems/symbols that evolve within an individual based on innate dispositions, developmental learning, and human culture. Information behavior evolved as a survival imperative that drove the need to collect, synthesize and use information about kin, during warfare about competitors, collaborators, mating strategies and sexual reproductive partners. Information behavior via environmental scanning and human communication is reflected in cave art (Mithen, 1996) and other forms of information storage.

Humans developed a unique socio-cognitive ability to cognitively create information that they then store, organize, retrieve and used. There is a critical need to understand and incorporate information behavior into an evolutionary and life-span understanding of human behavior. We begin this process by discussing the human brain as a social tool and information behavior as a socio-cognitive ability inside the framework of Donald’s (1991) seminal description of the evolution of the human brain due to human social forces of cooperation/competition.

Using Donald's (1991) approach, in the next section we propose an evolutionary framework model for EDSC.

Evolutionary Framework for EDSC: Episodic, Mimetic and Theoretic.

Donald (1991) in his seminal book "The Origins of the Modern Mind" gives a unitary theory framework for EDSC and information behavior as a socio-cognitive ability. Obeying the unitary theory of the human brain's evolutionary development, the essence of his thesis is that the human brain expanded in size but always had the cognitive architecture capability for the sophisticated form of thinking we have today--"a single adaptation--brain-size--would suffice to trigger the novel cognitive capacities of humans" (Donald, 1991, p. 106).

Donald (1991) divides the brain's evolution into three transitions, but with only one adaptation (increase in brain size). These transitions represent the evolution of human cognitive development from one way of modeling or representing the world around them to a more complex way of thinking that allows more complex modeling. These transitions are: the episodic to mimetic culture, the mimetic culture to mythic culture, and the mythic to the theoretic culture, which is based on memory storage system (language and the rise of writing). Episodic is what we share with apes and other primates.

The key to the brain's evolution was the human need for social communication. Donald (1991) operationalized social communication in terms of our cognitive architecture as the ability to create a whole object out of discrete elements in an increasing complex narrative that was primarily developed for social reasons; for cooperation and control within groups to better compete and survive against outside groups. This social drive drove the evolution of the human brain because social communication required an ever increasing complexity in methodology of human integration of the disparate elements of human existence into a coherent narrative.

Great Leap forward theories of brain evolution such as the aforementioned Mithen mark the great adaptation, when humans acquired language, between *Homo erectus* and *Homo sapiens*. Donald differs from these theories because he sees the transition to language as a logical extension of *Homo erectus* when what he calls the Mimetic stage of human brain evolutionary development occurred. According to Donald (1991), the difference between this Mimetic stage of *Homo erectus* and the theoretic stage of *Homo sapiens* can be explained by a normal evolutionary transition of the human brain based on natural selection. The important feature to underline in Donald's theory is that vestiges of all three transitional stages of brain evolutionary development are still present in the human brain (Donald, 1991), influencing information behavior. As these vestiges are taken into account in our model of EDSC, we will briefly describe each of these three transitions in the next sections.

Episodic Culture: Donald (1991) creates a classification of representational strategies based on the evolutionary stages of the human brain according to the representations of human cognition; these are forms of mental models that allow humans to store information, that organize their cognitive processes, and that direct human behavior, including information behavior. Humans and most other mammals create episodic memory representations; these are unreflective, concrete, immediate, short-term, situation-bound representations of what occurs in front of the mammal's perceptual system. Apes, for example, can remember

signs for events and things if they are thoroughly taught these things, but their representation strategy is based on previous episodes of the same event or thing. The episodic mind can, however, juxtapose discrete or separate objects into a perceived situation, giving it extreme power and utility in human day to day life. For humans, “the type of memory that is important in social relationships is, above all, episodic memory” (Donald, 1991, p. 157).

Episodic to Mimetic Culture: The first transition in the evolution of the human brain was from episodic to a mimetic representation capability, a transition which distinguished humans from other mammals. The mental modeling becomes much more sophisticated where instead of specific events or situations human experience is modeled into some form of integrated form. An illustration of the “integrative capability of mimesis” is creating, duplicating and passing on rhythmic expressions of human experience (Donald, 1991). Mimetic modeling is involved in the “invention and practice of sport, games, dance, ritual, and craft” but without verbal thought as mimetic culture is nonlinguistic. Donald hypothesizes that Mimetic skill developed for social reasons, but in any case once it was established Mimetic skill led to advances in cultural development; it provided society with the skill to model itself (Donald, 1991). Mimetic culture is extremely useful today in civic and religious rituals where collective thought occurs; such exchanges are more common than most modern humans think (Donald, 1991). Mimetic expression was present in Homo erectus in games, tool making and ritual and standardized gestures done in a social setting. Mimetic representational capacity in Homo erectus, according to Donald (1991), set the stage for semantic memory storage, symbols, and the theoretic mind of Homo sapiens. In effect, mimetic representations serve as an interim stage between episodic and symbolic cultures in human brain development--i.e., the development of tools, for example, would have required some form of rudimentary symbolic representation to pass on the skill to the next generation.

Mimetic to Mythic Culture: The social role--i.e., to promote social cohesion and cooperation--of Mimetic skill was reinforced, according to Donald (1991), by the invention of myth. A society myth is a conceptual model of the human universe or existence inside the objective or physical environment. Myth builds up over generations and is the narrative for a specific human social group to be used to compete against other groups “In conquering a rival society, the first act of the conquerors is to impose their myth on the conquered” (Donald, 1991, p. 258). The power positions in that society are those who uphold and control the parameters of the group’s predominant myth, the priests and shamans. The Mimetic skill is “the prototypal, fundamental, integrative mind tool” (Donald, 1991, p. 215), both at the level of the individual in the society and, more importantly, for the social group itself, unifying its members to compete against other groups it comes into contact with. The increasing size and complexity of larger social groups, which could defeat smaller social groups they were in competition, required more efficient social relationships; they needed to be conceptualized and controlled. Language developed to facilitate myth development and transmission, not as it is commonly conceived the other way around: “The most important source of selection pressure for an improved vocal apparatus would have been a mind that needed the features of vocal language for its modeling agenda” (Donald, 1991, p. 220).

Theoretic Culture: Language was an adaptation “that met specific cognitive and culture needs,” which can be specifically labeled as “the formalization and unification of thought and knowledge” into theoretic systems (Donald, 1991, p. 216). Theoretic thinking was a much more powerful form of thinking than what had come before in the Mimetic culture. Theoretic culture includes analytic thought, grammatical invention, memory-management skills, attentional algorithms and the development of theories linking concepts together in abstract thought (Donald, 1991, p. 378). Theoretic concepts create symbols such as the equal sign that are what Gregory (1981) calls “mind-tools”, which capture a nascent mental model for a concept, allowing it to be used for storage, cognitive manipulation leading to generative information/knowledge processes.

Mythic to Theoretic Culture: The adaptive pressure driven by natural selection favored social groups with the greatest ability to symbolically model the world around them in a distinctively human reconstruction of reality. This is speeded up by human drive to increase the size of external memory in written text and computer systems.

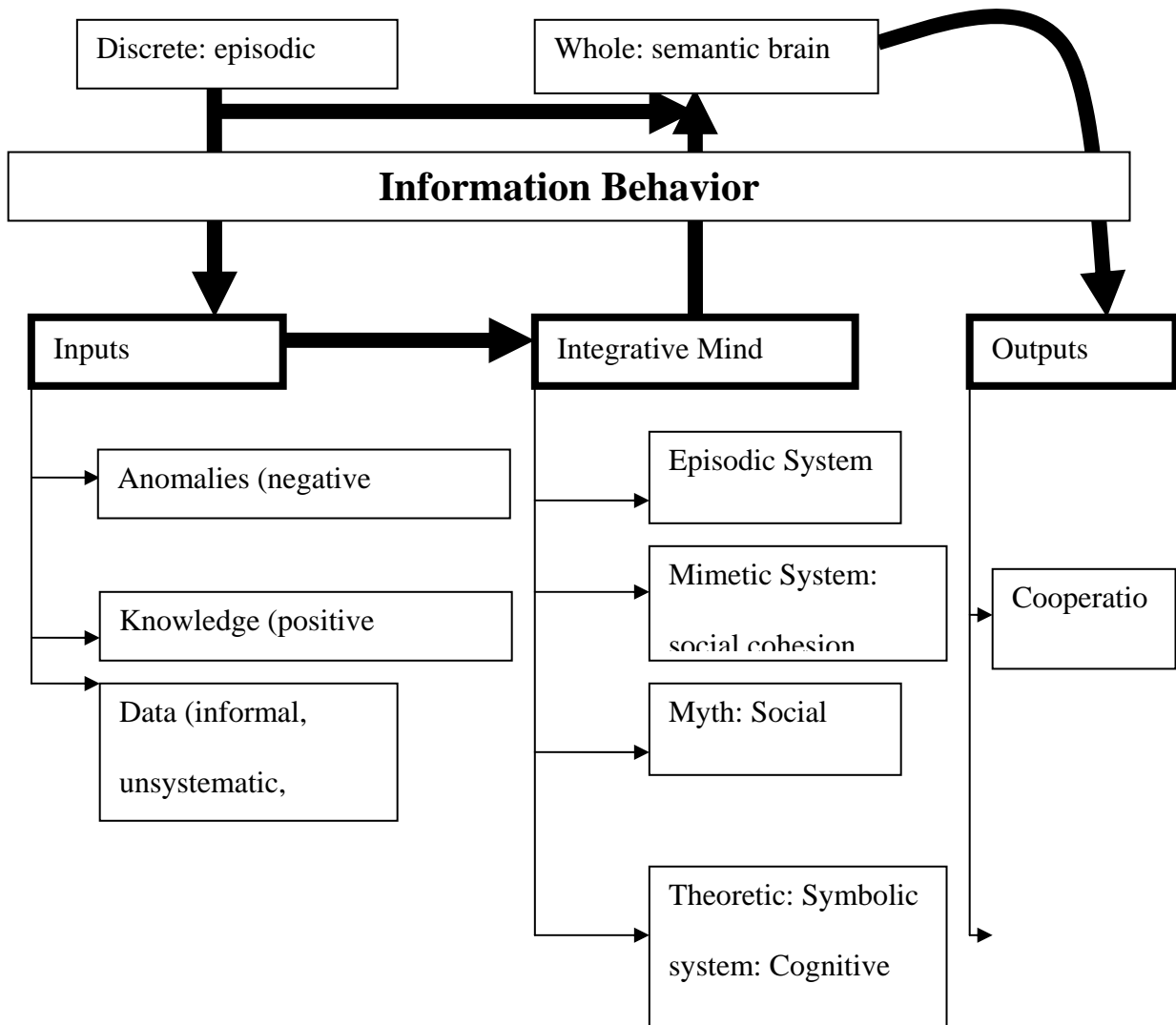
Model of Information in EDSC and Information Behavior

Figure 1 starts from Alexander’s (1990b) EDSC model and the centrality of man as a social being in our evolutionary story, we model Donald’s (1991) unitary theory of human brain evolution. Donald’s (1991) theory provides an overview of the evolution of human cognition based on knowledge structures stored in the human LTS. These knowledge structures provide information processing mechanisms in the STS for decoding and encoding operations in human memory which take place when environmental stimuli input enters the cognitive system.

According to this thesis, human brain evolution is driven forward by inter-group competition leading to intra-group social cooperation, which over the course of human evolutionary history has created an ever more complex human ability to create mental models of the human physical and social environmental and the place of humans in that environment. The driving force of this evolution is to form the integration of human experience into a coherent narrative of human existence. This narrative enables social cohesion within the group to more effectively compete against the other groups competing for limited resources.

In Figure 1 we model the human socio-cognitive ability as a system of inputs and outputs. The inputs are sense data from the physical and social environment, anomalies and knowledge from the social group and the individual. The outputs are greater social cooperation leading to increased efficiency when competing with outside groups for limited environmental resources. The integrative mind tools are located in the middle of Figure 1 and act as propulsions for transforming input data, anomalies and knowledge into social cooperation/competition outputs. We have listed the integrative mind tools systems of thinking capabilities vested in the human brain at various points over the course of human evolution, from episodic culture early on in evolution to theoretic culture in the present day.

Figure 1: Information behavior framework: a socio-cognitive ability



According to Donald (1991), these systems alternate control with each other depending on the circumstances, driving information behavior. Cognitive aspects of human socio-cognitive ability are briefly referred to at the top of Figure 1. Donald (1991) hypothesizes that while primates, as well as humans, have episodic memory (i.e., memory for discrete events); the semantic drive to integrate the events of human existence into some sort of coherent narrative is a feature of cognition.

In the Figure 1 model, we rely on two major components:

1. that the evolution of the human brain is driven by human modeling of the environment by integrating discrete events and things together into an increasingly complex narrative; and
2. that all phases of brain development are still present influencing information behavior, the focus of the model, and should thus be accounted for in our model (Donald, 1991; Smith, 2006).

This evolutionary perspective on information behavior and what constitutes information is a significant new view for information science. All phases of human evolution are present and operating in the human mind we have now, indicating that the episodic, mimetic, myth and theoretic minds all contribute tools to the human arsenal to achieve the evolutionary outputs of cooperation and competition.

In the hybrid scheme proposed here, the functional locus of “consciousness” can shift, depending upon the representational system currently in command” (Donald, 1991, p. 369).

An important conclusion is that all four types of minds motivate information behaviors.

Conclusion and further research

In this paper we have incorporated models and theories that highlight information behavior as primarily a social construct, driven by a survival mechanism that found its competition for survival in other human social groups rather than the environment itself as was the case with all other species. The evolution of social cultures created different human methods of representing and modeling human thought, and the transition from one socially derived method of mental modeling, from episodic to mimetic to myth to theoretic, drove brain development. Social cultures exist in the present human brain and thus influence information behavior.

In this paper we sketched the way intra-group cooperation to survive against inter group competition drives evolution. There is a communication aspect to creating cooperation. It drives the human to put a coherent narrative of human existence into symbolic form so that it can be communicated to others in the group. Information behavior in terms of both inputs and outputs as described in Figure 1 takes on various forms to further this communication drive. Information behavior is a socio-cognitive ability which humans have various aptitudes for; but on the level of *Homo sapiens* it is a species socio-cognitive ability that has ensured human cooperation, competition and survival, and lead to the increased pace of our evolution in an environment where there are no rival species.

Further theoretical and empirical research is needed to more fully explore these issues and examine the nature of information behavior as a socio-cognitive ability to fully grasp the relationship between information behavior and evolution. The evolutionary approach to understanding information behavior represents a significant intellectual shift that promotes connections between the human past and present, and at all way stations along the human evolutionary path. This approach reshapes the frame and refines the lens through which humans are able to look holistically at their past, present, and future information behavior’s in a temporally-expanded information-relevant context.

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