Behavior Toward E-Communication Tools: A New Theoretical Model Based on Evolution Theory

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Abstract

This paper presents a new theoretical model to explain behavior toward electronic communication tools based on evolution theory. The model proposes that inherited biological traits acquired by the human species through Darwinian evolution bias an individual's choice of preferred communication toward face-to-face communication. The model also suggests that e-communication media that selectively incorporate elements of actual unencumbered face-to-face interaction (e.g., physical presence, ability to see and hear others, synchronicity) will be perceived as more adequate for communication than other media devoid of those elements, and therefore as demanding less individual cognitive effort to be used, particularly in tasks requiring intense communication.

Keywords: Communication Media, Computer-mediated Communication, Evolution Theory, Biological Influences, Electronic Mail.

Introduction

The use of computer-based electronic communication (e-communication) tools has its roots in the 1960s with the advent of e-mail systems running on mainframe computers that allowed text messages to be exchanged among users registered in the operating system. These early e-communication systems gave way to more sophisticated ones with the interconnection of first mainframes, and then desktop computers through networks and the Internet, which have extended the reach of e-mail beyond single organizations. There have also been significant technological innovations in e-communication tools, such as the "group" sense of computer conferencing, the synchronicity and facilitation features of group decision support systems, and the "shared environment" sense provided by video-enhanced media spaces, all made feasible by cheaper technology and increasing bandwidth and connectivity.

Psychologists and sociologists have studied the use of e-mail and other e-communication tools in many environments and task situations, and attempted to explain interesting phenomena, such as flaming, withdrawal, and increases or decreases in task effectiveness in the context of previous technological and social theories. We believe there is more happening here than can be explained by simple adaptations of previous theories, and believe that a new theoretical look at the phenomena of e-communication tool adoption and use is appropriate.

Theories of e-communication behavior

Past investigations of e-communication behavior have shown that it is both complex and, notwithstanding much research done in the area, fairly unpredictable (DeSanctis et al., 1993; Postmes et al., 1998). In spite of this, an inspection of the e-communication literature strongly suggests the belief that e-communication behavior depends on a finite number of discrete factors. The search for this "holy grail" has led to the identification of key factors, found in e-communication theories and models developed over the years. Four main factors can be identified from the research literature in the field:

- The *communication medium* used by two or more individuals engaged in e-communication (Daft and Lengel, 1986; Daft et al., 1987). Examples of e-communication

media are e-mail, group decision support systems, and videoconferencing systems.

- The *task* carried out by two or more individuals with support of e-communication (Daft and Lengel, 1986; Daft et al., 1987). Examples of tasks are to prepare a contract, write a business report, and develop a new aircraft hull design.

- The *social environment* surrounding two or more individuals engaged in e-communication (DeSanctis and Poole, 1994; DeSanctis et al., 1993; Fulk, 1993; Fulk et al., 1990; Markus, 1994). Social environments are complex abstract structures made up of sets of stimuli, which are, by definition, are initially external to each individual and then become internalized as social information processing schemas (note: schemas = mental structures) through communication and learning processes. Examples of such sets of stimuli are memos stating formal and informal organizational norms, peer behavior that reveals cultural background traits, and oral statements by other individuals addressing self-perceptions.

- The *information processing schemas* held by two or more individuals engaged in e-communication (Lee, 1994; Ngwenyama and Lee, 1997). Information processing schemas (also loosely referred to as "knowledge") are internal to each individual and can be both innate and social. Innate schemas are inborn, e.g., the schemas that guide involuntary behavioral responses in the presence of food, potential mates, and danger. Learned schemas (referred to in this paper as "social" schemas) are constructed over the life of the individual, usually through social interactions, e.g., the schemas that guide context-specific eating behavior in restaurants, flirting behavior in pubs, and danger avoidance behavior in large cities. Information processing schemas influence how stimuli are sensed, interpreted and internalized by individuals. They also provide the basis for decision-making and action taking in reaction to stimuli.

Social environment and social information processing schemas evolve over time and build on each other. That is, past social environments in which an individual has lived or worked may influence the formation of current social information processing schemas. Similarly, information processing schemas developed over time may influence how cues from the social environment are interpreted.

Figure 1 illustrates the relationship among the factors above. In Figure 1, two individuals, John and Mary, undertake a collaborative task using a communication medium. A social environment surrounds each individual. The components of each social environment can be specific to that environment or overlap with those of the social environment surrounding the other individual. Each individual holds information processing schemas, which can be specific to that individual or overlap with information processing schemas held by the other individual.

Empirical research on e-communication has been conducted since the late 1970s, initially addressing asynchronous technologies (i.e., technologies that allow users to interact at different times). The 1980s have seen the emergence of several theories developed largely to explain accumulated empirical findings from the 1970s and 1980s. At the same time, more empirical research began to be produced based on experiments involving synchronous group decision support systems, which also led to the development of other theories. This theoretical body can be grouped into two main types, technological and social theories.

Technological theories of e-communication place particular emphasis on the fit between task and medium as a determinant of communication process and outcomes. That is, the foci of these theories are the communication medium and the task being accomplished through it. Examples of technological theories are media richness theory (Daft and Lengel, 1986; Daft et al., 1987; Lengel and Daft, 1988), the gains and losses model (Alavi, 1994; Nunamaker et al., 1991), and the task/technology fit theory proposed by Zigurs and Buckland (1998).

Among technological theories, perhaps the best known is media richness theory (Daft and Lengel, 1986; Daft et al., 1987; Lengel and Daft, 1988), which has been quite influential among e-communication tools developers and researchers (Jackson and Purcell, 1997; Kock, 1998; Lee, 1994; Markus, 1994), even though it was developed before the advent of most of the e-communication tools in use today. Media richness theory argues that rational individuals predictably favor the use of specific communication media to accomplish certain tasks. Media richness theory classifies different communication media according to a richness scale that features face-to-face (FtF) interaction at the top and printed documents at the bottom, with e-communication media somewhere in between (Lee, 1994; Markus, 1994). A key hypothesis of media richness theory is that rich media are more appropriate to support "equivo-

cal" communication (which is likely to occur in complex tasks) than lean media, and that aggregate data about rational individual media choices would consistently support this hypothesis.

Social theories of e-communication place emphasis on the role of the social environment and socially constructed information processing schemas in defining behavior toward e-communication technology. Examples of these theories are the social influence model (Fulk et al., 1990), critical mass theory (Markus, 1990), adaptive structuration

behavior. Since social influences occur only after birth, shaping the behavior of an individual throughout her lifetime, it follows that innate behavior (which is primarily defined by innate schemas) is not at all affected by social influences. Instincts can no doubt be curbed by social influences, but their source is primarily innate (or genetic). Pure innate behavior is rarely found in society today, due to the multitude and strength of social influences. Yet, innate behavior is never completely suppressed and clearly surfaces depending on the circumstances. For example, individuals deprived from food for several days will react
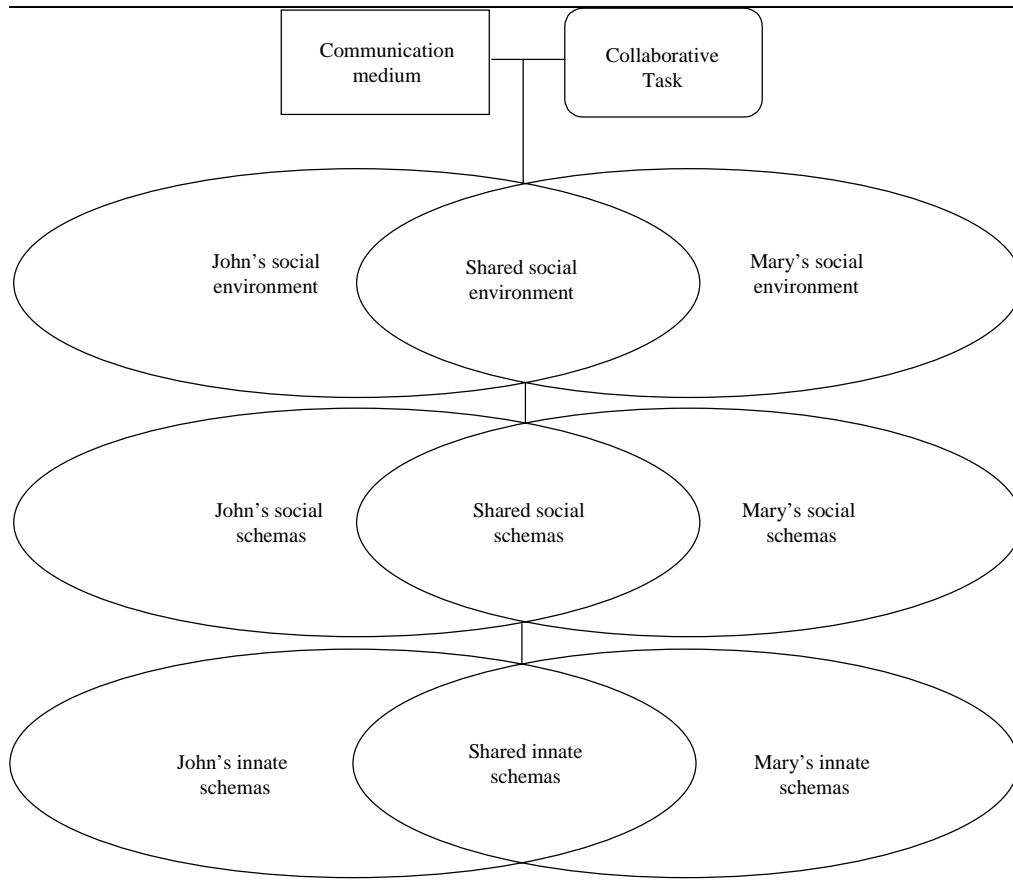

Figure 1: Key factors influencing e-communication behavior

theory (DeSanctis and Poole, 1994; DeSanctis et al., 1993; Poole and DeSanctis, 1990), and the technology metastructuration model (Orlikowski et al., 1995).

Social theories are seen by many as representing a major step in our understanding of e-communication phenomena. However, the emphasis of social theories on social influences has prevented them from contributing to the understanding of innate influences on e-communication

to it in very similar and instinctive ways. Their behavior would be more socially determined if they were not so hungry, and would not be similar if their social schemas related to eating were significantly different (e.g., individuals from different national cultures whose eating costumes are entirely different). Innate behavior is a result of biological mechanisms developed by human beings through Darwinian evolution, mechanisms that have been

largely ignored by both technological and social e-communication theories.

The forgotten role of biology on e-communication behavior

The relevance of studying the effect of innate influences on e-communication behavior comes from one important hypothesis: Human beings have been "engineered" by evolution to communicate FtF, and FtF only. The human species evolved through natural selection, a process in which random genetic mutations introduce individual traits that were selected based on their usefulness for survival and mating (Darwin, 1859; Dawkins, 1989). The evolutionary pace set by natural selection is usually very slow (Boaz and Almquist, 1997; Lorenz, 1983), leading to the development of physical, behavioral and cognitive traits over long periods of time (which may span thousand or

As indicated in Figure 2, research evidence points at the use of facial expressions and a simple set of discrete sounds for communication as early as 5 to 2 million years ago, by members of the australopithecine genus such as Australopithecus afarensis and africanus (Boaz and Almquist, 1997). This behavioral trait, also found in modern primates and many other mammals, has been refined over millions of years, leading to the appearance of rudimentary forms of speech, and later complex speech (Isaac, 1993; Laitman, 1993). Only late in the human evolutionary cycle there is evidence of communication through pictorial representations, mostly in the form of cave paintings, which can be seen as early manifestations of written communication (Campbell, 1992).

It can be concluded from Figure 2 that the development of sophisticated innate biological schemas to communicate through facial expressions and sounds was an important
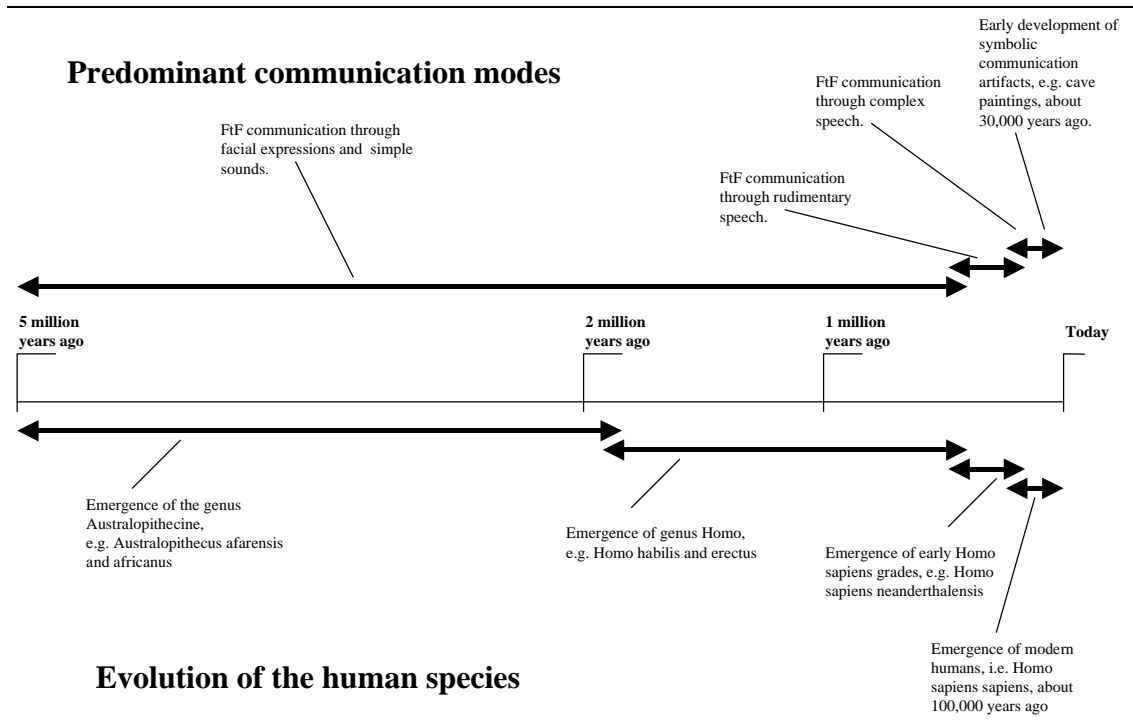

Figure 2: Communication modes at different evolutionary stages

millions of years, and are contingent on breeding speed and mortality rates). In the case of the human species, this process is not believed to have led to significant physical and cognitive changes in at least the last 30,000 years (Campbell, 1992; Dozier, 1992). During the vast majority of this process, human beings and their ancestors communicated FtF (see Figure 2).

element in the evolution path that led to the human species. Such apparatus includes a complex web of facial muscles, nerves, specialized brain functions, and what Laitman (1993) believes to be a key morphological trait that differentiates human beings from their early ancestors (and modern primates). This morphological trait is a larynx lo-

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cated relatively low in the neck, which considerably increases the variety of sounds that can be generated.

Given the highly developed sense of vision already present in members of the australopithecine genus (Boaz and Almquist, 1997), it is reasonable to assume that sounds were not frequently used alone for communication (e.g., only sounds, without gestures and facial expressions). Media other than FtF interaction would require some form of sound or symbol (e.g., a pictorial representation) storage artifact. Paintings (mostly in caves) are probably the most rudimentary of such artifacts yet they appeared relatively late in the human evolutionary cycle, after complex speech is believed to have emerged. Sound storage artifacts appeared only much later, after civilization was well established. Therefore, it follows that FtF communication, with the use of discrete sounds and visual cues, has been the predominant mode of communication used by human beings over millions of years of evolution.

The absence of studies and theoretical frameworks incorporating the impact of evolutionary forces on e-communication behavior contrasts with evidence of the strong effect that these forces have on human behavior in general (Lorenz, 1970; 1983). This is evidence of what we refer here to as the forgotten role of biology in e-communication research, illustrated by the fact that neither technological nor social theories paid much attention to the role of innate schemas in defining behavior toward e-communication systems.

A theoretical model of biological influences

In spite of the longstanding academic focus on technology, task and social influences, the previous evolutionary discussion suggests the important role that biology may play in influencing behavior toward technology. The perceived adequacy of communication media for a given task is likely to be at least partially moderated by their fit with the communication apparatus endowed on us by evolution. This does not deny that such perceived adequacy is also likely to be moderated by social influences. However, our goal here is to clarify the influence of biological traits on these perceptions. This is formalized in the two media adequacy propositions below.

> **P1:** Biological traits present in the human species bias an individual's perception of a preferred communication medium toward FtF interaction for

most tasks, particularly those requiring intense communication.

> **P2:** E-communication media that incorporate elements of actual unencumbered FtF interaction (e.g., physical presence, ability to see and hear others, synchronicity) will be perceived as more adequate for communication than other media devoid of those elements, and therefore as demanding less individual cognitive effort to be used, particularly in tasks requiring intense communication.

The two propositions above are closely related and incorporate one of the basic hypotheses of media richness theory, which states that different communication media are perceived by users according to a richness scale (Daft and Lengel, 1986). Such richness scale features FtF interaction at the top, as the richest medium. Other media that are not as capable of conveying non-verbal cues and allowing for immediate feedback, both key capabilities of the FtF medium, are placed lower in the media richness scale (Daft and Lengel, 1986; Daft et al., 1987; Lengel and Daft, 1988).

Several studies succeeded in showing some of media richness theory's flaws, by providing evidence, for example, that the media richness scale is not static (Markus, 1994), and that "richness" is not inherent in a communication medium and can vary depending on who is involved in the communication act (Lee, 1994). However, the hypothesis that individuals *perceive* media according to a scale of richness featuring FtF interaction at the top of the scale has been more often than not supported by empirical evidence (Markus, 1994; Rice, 1992; Webster and Trevino, 1995). This hypothesis cannot be ignored and its relevance is underlined by the simple fact that perceptions affect behavior. Not only are propositions **P1** and **P2** consistent with this hypothesis, but they also provide a foundation on which to understand it. Moreover, since the propositions isolate the influence of innate from social schemas, they provide a robust theoretical foundation that is not contradictory with previous studies that showed the flaws of media richness theory (e.g., Markus, 1994 and Lee, 1994).

Conclusion

It is undeniable that, differently from less evolved animal species, much of the behavior displayed by human beings is a result of the interplay between biological and social influences. In inspecting the biological influences model's

propositions, one may argue that such interplay is not accounted for. Whether this is seen as true or not depends on how the model is interpreted. The biological influences model proposed here isolates biological from social influences and their impact on behavior. As such, it takes an analytical approach to the problem of explaining media adoption and use. Yet, it does not try to explain how the combination of innate and socially constructed schemas affects behavior. There is a fundamental reason for that. Since social influences have been demonstrated to often have a fairly unpredictable effect on behavioral aspects of technology adoption and use in socially diverse groups (DeSanctis et al., 1993), those behavioral traits induced by a combination of innate and socially constructed schemas are also likely to incorporate a certain degree of unpredictability. The biological influences model proposed here addresses this problem by isolating behavioral traits that seem to be largely due to biological influences. These, the model argues, are simpler, more predictable, and somewhat independent from social influences. In doing so, the model contributes to the predictability of social phenomena involving technology use.

Given the massive and growing deployment of information technology in organizations today and the increasing uncertainty about the effects of this technology on humans, we believe that the search for predictability in human-computer interaction is strongly warranted. This paper is a first step in that search. The real challenge for the future, beyond expanding, validating, and refuting or refining the biological influences model proposed here, is to develop a theory that can be used to explain e-communication behavior in its full complexity. The biological influences model is not and never will be such grand theory, but we believe it can be useful in its development.

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