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RESEARCH

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ABSTRACT

This article reviews theoretical research on e-communication behavior, identifying two main types of theories – technological and social. This review provides the rationale for developing a new theory, based on Darwin's theory of evolution, that is neither technological nor social. Three theoretical principles are developed from evolution theory: media naturalness, innate schema similarity, and learned schema variety. The article concludes by illustrating how the theoretical principles can be used as a basis for developing a simple predictive model in the context of an online broker.

Keywords: Computer-mediated communication, media richness theory, evolution theory, biological influences, social influences

I. INTRODUCTION

Given the title of this article, it is prudent to begin it with a clarification. This article is not about a chimpanzee or gorilla that used email. No chimpanzee or gorilla has ever been shown to have been able to speak intelligently, much less send and receive emails. It is about a much more modest yet important topic, namely the multimillion year development of our biological apparatus for communication and how it affects electronic communication (e-communication) behavior. The

sidebar below defines 'e-communication' and 'e-communication behavior' as used in this article.

DEFINITIONS

The "e" in "e-communication" stands for "electronic". The term "**e-communication**" refers to, essentially, any form of computer-mediated communication and to more traditional forms of electronic communication, such as telephone communication (since the telephone is also an electronic device). The term e-communication includes computer-mediated communication over the Internet as well as over other computer network infrastructures. Thus it includes computer-mediated communication that takes place through group decision support systems and local area network-based communication tools.

"**E-communication behavior**" refers to the behavior of users toward e-communication technologies. For example, individuals in groups engaged in knowledge-intensive tasks and interacting primarily over email tend to take 5 to 15 times longer on average to prepare and make individual contributions (i.e., electronic postings) than if they were interacting face-to-face only (Kock, 1998; 1999). In this case, what could be called "decreased contribution speed", where contribution speed (measured in words per minute) is a component of e-communication behavior. Behavior toward e-communication tools is described in two main ways:

(1) By contrasting the behavior of people using e-communication tools with behavior of people interacting face-to-face); and

(2) By contrasting behavior of people using e-communication tools that incorporate different elements (e.g., asynchronous versus synchronous electronic conferencing).

E-communication's roots are in the 1960s, when the first email systems emerged, largely running on mainframe computers. In those early days, only a tiny minority used computers for communication, mostly people who spent their working days in front of a computer screen (Sproull and Kiesler, 1991). For the majority, face-to-face (FtF) conversation, telephone calls, and paper-based documents were the communication media of choice.

The interconnection of first mainframes, and then desktop computers through networks and the Internet changed the picture significantly, making e-communication an alternative choice for many business and social interactions. Significant technological innovations made this choice even more attractive, such as the "group" sense fostered by features of computer conferencing systems, the synchronicity and facilitation features of group decision support systems, and "virtual presence" features of video-enhanced media spaces. These interactions were made feasible by extensive applied research and the advent of cheaper technology and increasing bandwidth and connectivity.

Increased use of e-communication media has led to intensive empirical and theoretical research in the 1980s and 1990s. Several theories were developed that can be classified into two main groups, technological and social. These theories were essentially in a "tug-of-war" for many years. Technological theories are traditionally deterministic, in the sense that they try to provide a basis for predicting e-communication behavior based on a finite number of variables. In many cases, social theories were developed to overcome supposed oversimplifications of technological theories. Nevertheless, social theories more often than not were unable to provide a useful basis on which to predict e-communication behavior. Technological theories provide a simplified view of e-communication, usually focusing on communication media and collaborative task as predictive factors. Social theories try to understand e-communication as a social and very complex phenomenon, and more often than not, end up being more "explanatory" and "descriptive" than predictive.

Rather than joining the argument between technological and social theories, perhaps a desirable alternative line of action would be to try to "think outside the box" and devise a theoretical model that is neither purely technological nor social. This choice is made in this paper, which uses evolution theory (i.e., a biological theory) to explain e-communication behavior. In doing so, it provides a logical basis on which the implicit assumption made by technological theories that individual behavior is uniform and predictable can be understood. However, instead of arguing that individual behavior is uniform, this article shows that there are biological influences that induce individuals to present similar behavior. Moreover, these influences are isolated from social influences, the latter being seen as also strong and equally important. This article provides a basis for a unified understanding of e-communication behavior as a combination of biological and social influences, as well as constraints posed by communication media and collaborative tasks.

This paper is organized as follows. Section II provides a brief review of research on e-communication behavior. The review identifies two main types of theories, technological and social, and provides the rationale for the development of a new theory that is neither technological nor social. Section III, titled "The Evolution of our Biological Apparatus for Communication", discusses how communication evolved over millions of years in the human species. This discussion focuses on traits that are relevant for the understanding of behavior toward e-communication technologies. In Section IV, key theoretical principles are developed from evolution theory that have a direct application to our understanding of e-communication behavior. Section V applies the theoretical principles to predict the behavior of customers of an online broker. The example illustrates how the theoretical principles can be used as a basis for developing a simple predictive model that ties media naturalness to customer satisfaction and revenues at an online broker.

II. E-COMMUNICATION BEHAVIOR 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 was quite influential among e-communication tools developers and researchers (Jackson and Purcell, 1997; Kock, 1998; Lee, 1994; Markus, 1994). Media richness theory was developed before the advent of most of the e-communication tools in use today. This 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 FtF interaction at the top of the list and printed documents at the bottom. E-communication media are somewhere in between (Lee, 1994; Markus, 1994). A key hypothesis of media richness theory is that rich media are more appropriate to support "equivocal" 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 emphasize the role of the social environment and socially constructed information processing schemas (i.e., mental information processing structures) 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 theory (DeSanctis and Poole, 1994; DeSanctis et al., 1993; Poole and DeSanctis, 1990), and the technology metastructuration model (Orlikowski et al., 1995).

A historical analysis of theoretical developments in e-communication suggests that many social theories were developed to fill a gap arguably left by the technological theories. An influential study by Markus (1994) conducted at a large risk management service provider illustrates this link. The study builds on the social influence model, and shows that social influences can shape individual behavior toward e-communication media in ways that are inconsistent with media richness theory predictions (Daft et al., 1987; Markus, 1994). Markus convincingly questioned the rigidity of the richness scale proposed by media richness theory, by showing that social pressures can change some attributes of e-communication media seen as static by the theory. For example, the study showed that pressure from senior managers on their subordinates to reply promptly to email sent to them increased feedback immediacy, a feature of the email medium that media richness theory claimed to be static, and therefore shifted email up from its relative position on media richness' scale.

By focusing on communication medium and task, technological theories implicitly assume that behavior and outcomes are determined only by those factors, and not by specific characteristics of the individuals interacting through the communication medium. That is, technological theories implicitly assume that, for each specific combination of communication medium and task, individuals will behave in very similar and predictable ways. This assumption is probably the main target of criticism from social theoreticians, who argue that social characteristics of the individuals interacting through a communication medium to perform a task and of the environment surrounding those individuals are as important, if not more, to determine behavior and task outcomes as are medium and task characteristics.

There are pros and cons to the technological versus social theories debate. On the positive side, the debate provided an impetus for research. Technological and social theorists published many research papers, often with new and

interesting points. On the negative side, it led to a generalized perception that, since all theories that incorporate strong predictive elements are attacked and their flaws uncovered, e-communication behavior is to a large extent unpredictable (DeSanctis et al., 1993; Postmes et al., 1998; Trevino et al., 2000; Zigurs et al., 1999).

To be sure, joining the conflict between technological and social theories is not necessarily a bad thing, and is probably better than ignoring theory altogether. But if we try to "think outside the box" (i.e., from a perspective that is neither technological nor social) about this conflict and its underlying assumptions, we may be able to make significant progress toward a unified theory of e-communication.

A key assumption made by the proponents of technological theories is that individual behavior is not only predictable but also uniform. Social theories argue otherwise, based on the assumption that a complex web of social factors and interactions influences individual behavior. Perhaps the solution to the problem is to try to isolate those influences that are uniform across individuals from those that are not. While social theories established that social influences are not uniform but depend on social background and culture, technological theories failed to identify the source of uniform influences implicit in their hypotheses. This source, this paper argues, is our biological communication apparatus.

III. THE EVOLUTION OF OUR BIOLOGICAL APPARATUS FOR COMMUNICATION

One of the fundamental premises of evolution theory, whose foundations were laid out by Darwin (1859), is that all living organisms evolved from one common ancestor through a process that follows a few simple laws (Boaz and Almquist, 1997; Campbell, 1992; Dawkins, 1986; 1990; Dozier, 1992; Gould, 1977; Isaac, 1993; McCrone, 1991; Wills, 1993; Wilson, 1998):

The inheritance law. Offspring inherit a large proportion of their parents' biological characteristics through their genes. The similarity between the combined genetic code of the parents and that of the offspring is very high.

The mutation law. When members of a species generate offspring, natural genetic mutations occur that lead the offspring to develop biological characteristics that differ from those of their parents. These genetic mutations are usually incremental and arbitrary.

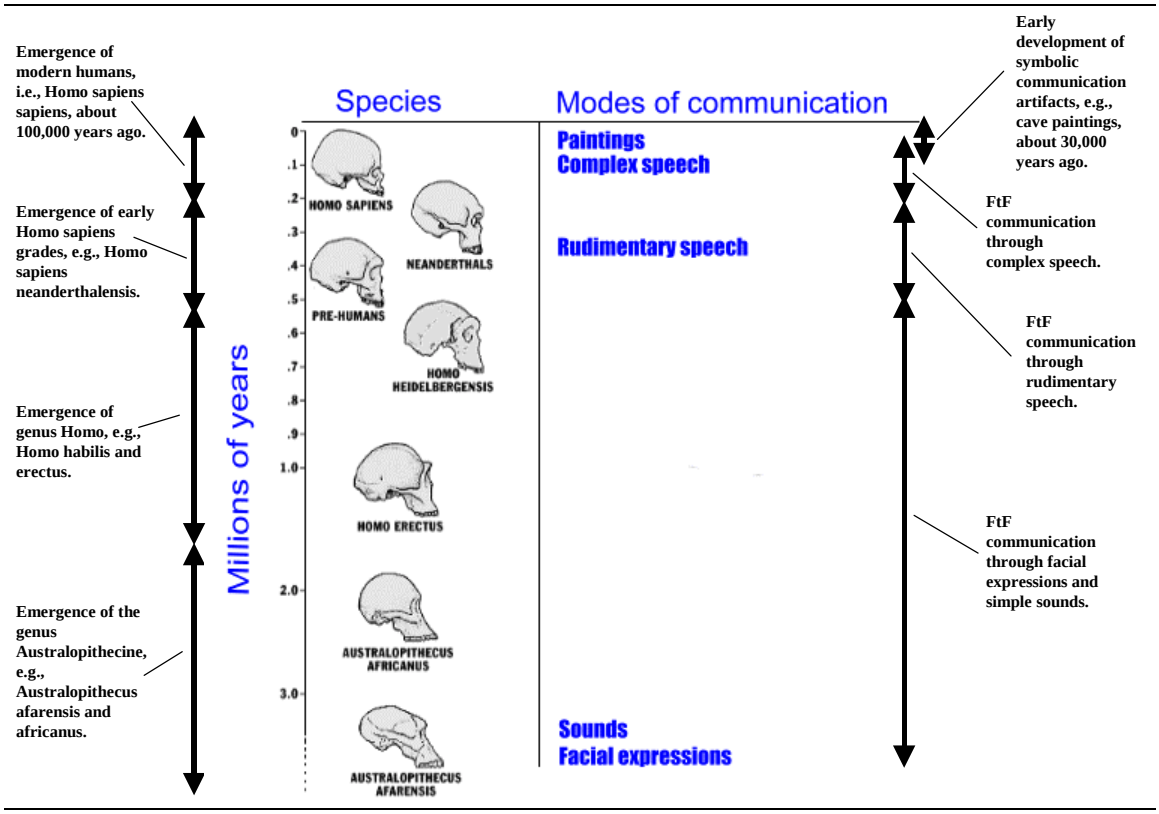
The natural selection law. Those offspring whose new biological characteristics give them an edge for survival and mating over others are the most likely to pass the genes responsible for those biological characteristics to their own offspring.

According to evolution theory, the human species also evolved according to the above laws over millions of years. The theory suggests that humans share certain biological characteristics with all living beings, particularly those closer to it in evolutionary terms such as the great apes (e.g., gorillas and chimpanzees). The evolutionary pace set by evolution laws 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. These periods may span thousand or 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 modifications in the last 100,000 years (Campbell, 1992; Dawkins, 1986; Dozier, 1992; Wills, 1993; Wilson, 1998).

Figure 1 shows the evolutionary stages, and respective human ancestors, that led to the human species on the left side of the figure. Predominant modes of communication are shown on the right side of the figure. It is clear from the figure that during the vast majority of the evolutionary process that lead to the human species, human beings and their ancestors communicated FtF. Research

evidence suggests that facial expressions and simple sounds were used extensively for communication as early as 5 to 2 million years ago, by Australopithecus afarensis and africanus, who were members of the australopithecine genus (Boaz and Almquist, 1997). This behavioral trait, also found in modern primates and many other mammals, was refined over millions of years, leading to the appearance of first some rudimentary forms of speech, and later complex speech (Isaac, 1993; Laitman, 1993). Only very late in the evolutionary process that led to the human species is there 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).

A comparison between the left and right sides of Figure 1 suggests that the development of a sophisticated biological apparatus to communicate through facial expressions and sounds was an important element in our evolution. Such apparatus includes a complex web of facial muscles, nerves, and specialized brain functions that, research shows, could not have been developed for any purpose other than communication (Lieberman, 1998). For example, while only a small subset of our facial muscles is used for chewing, a much larger number is used for expression of thoughts and feelings. Also, the development of a larynx located relatively low in the neck, a key morphological trait that differentiates human beings from their early ancestors, considerably increased the variety of sounds that we can generate yet, at the same time, significantly increased our chances of choking on ingested food and liquids (Laitman, 1993; Lieberman, 1998).



Skull drawings adapted from Chang, (1998)

Figure 1: Modes of communication at different evolutionary stages

Based on the foregoing discussion, it is reasonable to assume that sounds were not frequently used alone for communication (e.g., only sounds, without gestures and facial expressions). Also, asynchronous (i.e., time-disconnected) communication would have required some form of sound or symbol (e.g., a pictorial representation) storage artifact. Paintings (mostly in caves), which are probably the most rudimentary of such storage artifacts, appeared late in the human evolutionary cycle, after complex speech was developed. Sound storage artifacts appeared only much later, after civilization was well established. Therefore, one can conclude that synchronous FtF communication, with the use of discrete sounds (which later developed into complex speech) and visual cues, has been the predominant mode of communication used by human beings over millions of years of evolution, and that our biological communication apparatus

has been optimized for it. Our brain, in particular, seems to have been structured to excel in FtF communication (Lieberman, 1998; McCrone, 1991; Wills, 1993), by allowing us, for example, to derive a wealth of accurate information and meaning from facial expressions and tone of voice even when they contradict what is being said (e.g., when a person is lying or speaking in a delirious way).

IV. KEY THEORETICAL PRINCIPLES

The previous section provides the basis for developing principles that can help us understand e-communication behavior in ways that are significantly different from those presented by technological and social theories. In this section, information processing schemas (Bartlett, 1932; 1958; Cossete and Audet, 1992; Lord and Foti, 1986), which are mental information processing structures, are referred to only as "schemas". The goal of this paper is to highlight the potential of evolution theory as a lens for understanding e-communication behavior, not to develop a detailed theory. Thus, we develop and discuss applications of only three principles, even though many other principles could be developed based on a more in-depth review of evolution theory as it relates to the evolution of our biological communication apparatus.

> **The media naturalness principle.** Innate communication schemas bias an individual's perception of media naturalness. Media that incorporate all the elements of unencumbered FtF interaction (e.g., physical presence, ability to see and hear others, synchronicity) will be perceived as more natural for communication than other media. Therefore, they are perceived to require less individual cognitive effort (due to cognitive adaptation) to be used for communication than other media. The extent to which a communication medium incorporates actual FtF interaction elements defines its degree of naturalness.

The innate schema similarity principle. Innate communication schemas are very similar across different individuals. Therefore they bias media naturalness perceptions of different individuals in similar ways.

The learned schema diversity principle. Since the human brain is adaptable, learned communication schemas (i.e., those that are not inherited, but acquired through interaction with the environment surrounding an individual, including the social environment) also influence media naturalness perceptions. However, this influence is not as uniform across different individuals as that of innate communication schemas. Therefore, learned communication schemas bias media naturalness perceptions of different individuals in different ways.

These three principles illustrate both the power and likely limitations of evolutionary theory-based e-communication theories. The media naturalness principle and the innate schema similarity principle are complementary, whereas learned schema variety principle highlights the fact that biology alone cannot explain the full complexity of e-communication behavior.

The media naturalness principle is a first step in the direction of developing and an entirely new theory (or theories) that could replace media richness theory and other similar technological theories. For example, the link between decreased naturalness and increased cognitive effort can be used to explain why people prefer to conduct certain collaborative tasks using media that incorporate elements of FtF communication. In FtF communication, people are able to use gestures and tone of voice to aid communication, as well as provide and obtain immediate feedback during the communication interchange (Daft et al., 1987). This link can also be used to explain why better outcomes can be generated through media of lower naturalness through compensatory adaptation (Kock, 1998), by providing a basis on which to hypothesize that low naturalness poses cognitive obstacles that individuals engaged in collaborative tasks may be able to

overcome. This hypothesis is incompatible with media richness theory yet has been strongly supported by empirical evidence (Kock, 1998; 1999).

The innate schema similarity principle highlights one of the most important reasons why evolution theory should be used to explain and predict e-communication behavior, namely, its potential to explain innate influences that are common to all individuals, independent of cultural and social background. As the Internet "makes the world smaller" by bringing together people with completely different cultural and social backgrounds into virtual communities based on shared personal interests and common business purposes, it is important to develop a predictive theoretical model that can help us understand and anticipate, at a certain level and with perhaps a limited degree of certainty, behavioral traits of all of the members of those virtual communities. The innate schema similarity principle stresses the potential of evolution theory as a basis for the development of such predictive theoretical models.

Finally, the learned schema diversity principle underscores evolution theory's inability to "explain everything". That is, while it is important to be able to isolate the influence of innate schemas from that of learned schemas on e-communication behavior, which helps us apply the Cartesian "divide and conquer" method of scientific inquiry, e-communication behavior will always be the result of a combination of the innate and learned schema influences. For example, individuals who learned schemas related to the use of email by using it to perform equivocal tasks during many years would tend to see email as a more natural medium to perform tasks of high complexity than other individuals who have not gone through the same experiential schema development process. The influence of learned schemas, in this example, would partially suppress the influence of innate schemas, even though the innate schemas would still exist and have the same configuration as in other individuals.

V. USING THE THEORETICAL PRINCIPLES TO PREDICT THE BEHAVIOR OF CUSTOMERS OF AN ONLINE BROKER

To illustrate the three principles discussed in Section IV, consider the case of an online brokerage and its customer support process. This example is based on an action research study previously conducted by the author involving one mutual fund management firm and two online brokers (Kock, 1999). The goal of this illustration is to provide an example of how the theoretical principles can be used as a basis for developing a simple predictive model that ties media naturalness to customer satisfaction and revenues. The predictive model refers to the generic customer support process performed by the online broker, and can be extended to most online brokerages.

The main goal of the customer support process is to help customers buy investment "products", which usually include money market instruments, stocks, bonds, mutual funds, and derivatives. The customer support process is implemented by a set of short interactions (i.e., with a duration that goes from a few minutes to a few hours) between customer and online broker through communication media.

For a customer to buy or sell an investment product through the online broker he or she must engage in a set of interactions with the online broker using one or more media. Thus, it can be said that the customer and the online broker engage in a set of interactions using N different media that we may call M_1, M_2, M_3 … M_N, where N is the number of different media used to complete the task. For example, for the task of buying shares of a mutual fund, a customer may first obtain basic information about mutual funds from the broker's Web site (which is primarily text-based), then conduct a live text-based chat online with one of the broker's customer representatives to understand how mutual funds operate, then go back to the Web site to understand the steps involved in making the purchase, then call the broker and chat with a customer representative over the

telephone to clarify some issues regarding the purchase transaction steps, and then, finally, perform the purchase online using the broker's Web site. In this example, three main media – the Web site, a live text-based chat system, and the telephone – were used in five communication interactions. Based on the media naturalness principle, it could be argued that these three media can be sorted in the following order of decreasing degree of naturalness: Telephone, live text-based chat, and Web site. The telephone medium is the most natural of the three because it incorporates synchronicity and the ability to convey non-verbal cues, both present in the FtF medium. The live text-based chat medium is the second most natural medium because it incorporates synchronicity, but not the ability to convey non-verbal cues. The Web site (which is primarily text-based) is the least natural of the three because it does not incorporate either synchronicity or the ability to convey non-verbal cues.

The three principles - i.e., media naturalness, innate schema uniformity and learned schema variety - can be used to derive hypotheses related to the use of different media for the provision of customer support services by the online broker. These hypotheses refer to each of the customer support interactions. Hypothesis H1 is a direct application of the media naturalness principle:

> **H1:** There is a negative causal link between the degree of naturalness of the medium used for communication between customer representative and customer and the cognitive effort perceived by the customer in connection with the customer support interaction.

Previous computer-mediated communication studies that investigated perceived cognitive effort and satisfaction (Graetz et al., 1998; Nunamaker et al., 1991) provide the basis on which to hypothesize that increased perceived cognitive effort is likely to lead to increased customer dissatisfaction with the service provided by the online broker, and thus increased likelihood of using the services of a competing online broker. This is compounded by the low cost associated

with opening an account at a competing online broker and the weak bond that ties providers and customers in the online brokerage industry (Spiro and Baig, 1999). This can be summarized in two hypotheses:

> **H2:** There is a positive causal link between the cognitive effort perceived by the customer and his or her degree of dissatisfaction with the customer support provided by the online broker.
>
> **H3:** There is a positive causal link between the degree of dissatisfaction experienced by the customer during a customer support interaction with the online broker and the probability that the customer will use the services of a competing online broker.

The innate schema uniformity principle suggests that hypotheses **H1**, **H2** and **H3** are likely to hold for the majority of customers since it is primarily based on the influence of innate schemas possessed by all the members of the human species[1].

The learned schema variety principle, on the other hand, suggests that learned schemas are also likely to play a role in how customers perceive their communication interactions with the online broker. The learned schemas moderate the causal link established in hypothesis **H1** between media naturalness and cognitive effort. That is, the less the customer "knows" about buying and selling investment products using the services provided by the online broker, the stronger will be the negative effect of media naturalness on cognitive effort. This observation leads to hypothesis **H4**:

[1] This statement could be expressed as a hypothesis (which would in fact be a “meta-hypothesis”, as it refers to the other hypotheses) but is omitted in this illustration for simplicity.

H4: The mismatch between the knowledge possessed by the customer and that required to perform the task (i.e., buy or sell an investment product) strengthens the negative causal link between the degree of naturalness of the medium used for communication between customer representative and customer and the cognitive effort perceived by the customer in connection with the customer support interaction.

The four hypotheses can be summarized through the simple causal model (Bagozzi, 1980; Davis, 1985) shown in Figure 2. Each hypothesis is represented by a causal link, and is indicated next to its causal link in Figure 2. The causal model represents "media naturalness" (from hypothesis **H1**), "perceived cognitive effort" (from hypothesis **H1**), "dissatisfaction with customer support" (from hypothesis **H2**), "likelihood to use a competitor" (from hypothesis **H3**), and "knowledge mismatch" (from hypothesis **H4**) as interconnected variables. "Media naturalness" is the independent variable of the causal model, and refers to the degree of naturalness of the medium used in a customer support interaction. "Knowledge mismatch", the only moderating variable in the causal model, refers to the mismatch between the knowledge possessed by the customer and that required to perform the task of buying or selling an investment product. Knowledge mismatch is likely to vary according to the amount of customer experience buying and selling investment "products" and using the services of the online broker (which allows for simple categorizations of users according to how much knowledge they possess, such as that of "new users" versus "seasoned users", as indicated in Figure 2). "Perceived cognitive effort" and "dissatisfaction with customer support" are intervening variables of the causal model. Finally, "probability of using competitor", the dependent variable of the causal model, refers to the probability that the customer will use the services of a

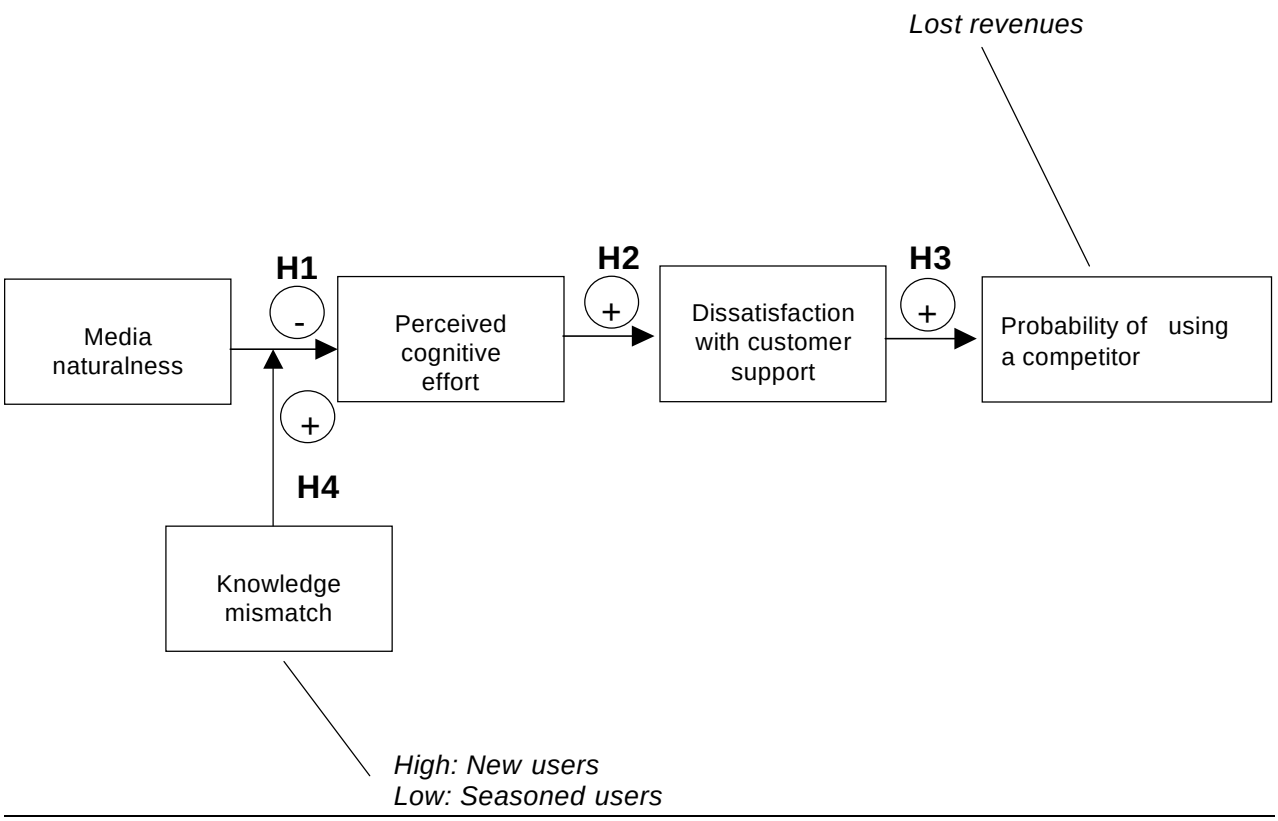


Figure 2. A Predictive Model for the Online Brokerage Industry

competing online broker to buy or sell investment "products" (which means lost revenues for the online broker). All the variables can be measured on a Likert scale of perceptions and the results triangulated with actual measures of use of different media by customers of the online broker and their continued use of the services provided by the broker.

Given that the causal model shown in Figure 2 refers to each customer support interaction, it is implicitly assumed that each interaction will have an impact on the probability that the user will move to a competing online broker. Previous studies on the nature of customer-provider relationships in the financial service industry (Macdonald, 1995; Walkins, 1992) suggest that it is also reasonable to assume that the impact of each interaction will be both incremental and

cumulative in most cases (an exception, for example, would be a single interaction in which extreme dissatisfaction leads the customer to leave the broker at once).

Since each of the four hypotheses presented in this section are clearly negative in form, they (as well as the causal model that summarizes them) can be tested and therefore disproved or shown to appropriately explain the results obtained from the study. Hypothesis testing can be accomplished through positivist case and action research studies, or, less ideally, through laboratory experiments or surveys of online brokers. Current trends in the use of communication media in the online brokerage industry provide support for the four hypotheses because they suggest a link between customer satisfaction and loyalty and the use of communication media that incorporate elements of FtF interaction (e.g., synchronicity, the ability to see and hear the other party) to support customers (Dodson, 2000).

VI. CONCLUSION

This paper provides a brief theoretical review of research on e-communication behavior. It identifies two main types of theories (technological and social) and the rationale for developing a new theory that is neither technological nor social. This new theory is based on evolution theory, whose foundations were laid out by Darwin. The theory relates to how communication evolved over millions of years in the human species. Finally, key theoretical principles are developed from evolution theory, which have a direct application to our understanding of e-communication behavior. These principles can be used to develop a new theory of e-communication behavior. An application of these principles is provided through the development of a simple predictive model tying media naturalness to customer satisfaction and revenues at an online broker.

Why is it important to try to understand e-communication behavior based on evolution theory? Two main answers can be given to this question:

1. Evolution theory provides a scientific basis on which to ground key hypotheses of technological theories. For example, media richness theory proposes a richness scale but does not explain why different media are perceived according to that scale. This paper shows that the richness scale proposed by media richness theory is partly supported by evolution theory. If one assumes that some technological theories need to be refined, not replaced by a new theory, which may well be the case, evolution theory can be very useful in their refinement and scientific grounding.

2. Evolution theory can be used as a basis for the development of an e-communication behavior theory that, while perhaps incorporating some of the hypotheses of certain technological theories, will be free from their previously identified flaws. Again, using media richness theory as an example, the media naturalness principle replaces, with advantages, the static richness scale hypothesis of media richness theory. As noted in Section II, several studies succeeded in showing fatal flaws in this hypothesis. Markus (1994) showed, for example, that the media richness scale is not static. Lee (1994) found that richness is not inherent in a communication medium and can vary depending on who is involved in the communication act (Lee, 1994). In fact, the static richness scale hypothesis proposed by media richness theory proved to be its main weakness.Also, the static media richness scale hypothesis opens the door for the argument that a medium richer than FtF (e.g., a “super-rich” virtual reality-based medium) will be even “better” than FtF for tasks involving intense communication. What is argued here, in contrast, is that any non-FtF medium will be *perceived* as *less natural* than FtF. One of the reasons for this perception is that our biological apparatus for communication was optimized by Darwinian evolution for FtF communication. This finding implies that the users of a “super-rich” virtual reality-based medium will also perceive it as less natural. If they do, users would require more cognitive effort for communication (because, e.g., the medium may induce perceived information overload), than in the FtF medium.

The widespread use of e-communication technologies today is accompanied by increasing uncertainty about the effects of these technologies on humans. As a result, the search for reliable theories that help predict e-communication behavior is strongly warranted. This paper is a first step in that search and a small one toward the final goal of e-communication researchers: develop a grand theory that can be used to explain e-communication behavior in its full complexity. Evolution theory alone does not lead to such grand theory, but it will be instrumental in its development.

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EDITOR'S NOTE: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
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