

EDITORIAL ESSAY

Do We Have e-Collaboration Genes?

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ABSTRACT

Do we have e-collaboration genes, that is, genes that code for biological adaptations that are well aligned with the demands posed by e-collaboration? A look at our ancestral past through an evolutionary psychology lens generally suggests a negative answer to this question. It seems that our biological communication apparatus, which includes several brain modules, is in fact designed to excel in co-located communication involving face-to-face interaction. Our biological apparatus appears to be ill adapted for e-collaboration, especially in situations where text-intensive and asynchronous interaction technologies (e.g., e-mail) are used for communication. Implications for research and practice of these conclusions are discussed, particularly as they refer to the explanatory and predictive power of the conclusions.

Keywords: communication media; computer-mediated communication; e-collaboration; human evolution; human factors; media richness

EVOLUTIONARY PSYCHOLOGY

Long before Darwin (1859) proposed his theory of evolution by natural selection there has been debate about how much of our behavior is influenced by our “nature” (or our genes) and what types of behavior are particularly affected by our genetic makeup. Behaviors that are strongly influenced by our genes, and that are thus assumed to be more closely related to our biological structure than our cultural backgrounds, are often referred to as “instinctive” behaviors. Thus, from this perspective it

makes sense to say that the compulsion that many of us feel to eat more candy than we need is in fact an instinct, most likely motivated by the scarcity of food containing high-calorie sugars in the ancestral environments in which we evolved, from *Australopithecus* to *Homo sapiens*.

On one extreme of the debate of how much of our behavior is influenced by our genes are those who are often referred to as biological determinists. They believe that nearly all of our behavior is determined by our genes and they often ignore evidence to the contrary. On the other extreme are those who subscribe to the notion that our genetic makeup influences virtually none of our be-

havior, ignoring the many striking similarities in behavior across markedly different cultures, as well as the many studies showing key similarities between identical twins who are raised separately.

Most serious human evolution researchers today adopt a more balanced view than the ones that characterize the extremes already discussed. There is a general belief among most human evolution researchers, that behavioral traits are defined in part by “nature” and by “nurture”. Moreover, most human evolution researchers today subscribe to the epigenetic view (see, e.g., Kuper, 1994; Lickliter & Honeycutt, 2003; Wilson, 2000) that most biological traits, even those believed to be largely inherited through our genes, are the result of an intricate interplay between genetic and environmental influences. This view essentially assumes that only a few biological traits are innate (e.g., blood type), with the majority of those traits being defined by both the genetic structure of the individual and environmental circumstances surrounding that individual (e.g., height, body fat percentage).

Research on the evolution of human instincts is one of the primary subjects of the field of evolutionary psychology (Buss, 1999; Miller, 2000; Tooby & Cosmides, 1992). Two general assumptions underlying the current work of evolutionary psychologists are: (a) that the human brain is functionally identical across different individuals, and (b) that the current human brain is made up of functional modules that incorporate adaptations that maximized survival and/or reproductive capacity in our ancestral past. In other words, even though it is undeniable that different individuals have different brains, evolutionary psychologists generally assume that all human brains have essentially the same functional modules. And, it is also assumed that the human brain incorporates a number of adaptations to survival and mating problems that hominids have faced in the evolutionary path that led to *Homo sapiens*.

THE APE THAT USES E-MAIL

E-collaboration has gone from science fiction speculation to a daily reality for most workers. This occurred in what can be seen as “a second in a lifetime” in evolutionary terms. Given this, the following questions could be posed. Have we evolved adaptations aimed at making us excel at e-collaboration? If not, have we evolved adaptations that are somewhat conducive to e-collaboration, even if not closely matched with it? These questions are relevant because today many of us, especially those employed in knowledge-intensive fields, probably conduct most of our work-related communication electronically. Moreover, current workplace trends in connection with virtual work and communication technologies dissemination suggest that the amount of work-related electronic communication is likely to increase in the future.

When we look at our evolutionary past in order to answer the above questions, the evidence that is presented to us leads to one inevitable conclusion — we likely have genes that code specifically for co-located communication adaptations. During more than 99% of our evolutionary cycle, we communicated either face-to-face or across the short distances that voice and noise can be conveyed. This was simply because no other form of communication had been available to us in that period. Conversely, most of today’s successful e-collaboration technologies support geographically distributed interaction and rely heavily on text, which is a form of pictorial communication that employs written symbols (e.g., letters, ideograms).

The first forms of cave paintings date as far back as 40 thousand years, but most of the evidence in connection with prehistoric cave paintings (as well as other forms of prehistoric art) suggests that they were not used for pictorial communication, at least

in the most literal sense of the word. For example, cave paintings were not generally used as maps to indicate the location of food or water reserves. Instead, it seems that most cave paintings and other forms of prehistoric art were used as a basis for rituals or produced as part of rituals (Chauvet et al., 1996; Gombrich, 1995; Janson, 1997).

Even if cave paintings had been used for pictorial communication, two notions would have to be accepted for us to conclude that our brain is somehow designed to excel in the use of today's text-intensive e-collaboration technologies. Firstly, we would have to accept the notion that, in the 40 thousand years since the emergence of the first cave paintings, the ability to produce pictorial representations (and understand what they were trying to convey) conferred a significant survival and/or reproductive advantage to the individuals who possessed that ability. Secondly, we would have to accept the notion that 40 thousand years of evolution was enough to erase the likely adaptations for non-pictorial, co-located communication that have taken place in the previous 3.5 million years or so since the emergence of the first hominids — the Australopithecines, of which the most famous example is perhaps “Lucy” (see, e.g., Boaz & Almquist, 1997).

While these two notions may be possible, most of the evidence in connection with human evolution suggests that they are unlikely. The most likely scenario is that our brain has been primarily designed to excel in co-located communication, especially where face-to-face interaction takes place, and is ill adapted for text-intensive e-collaboration involving geographically distributed individuals. A substantial amount of empirical research evidence provides support for this scenario (Kock, 2004). This scenario somehow brings to mind the idea that *Homo sapiens* are in fact “the ape that uses e-mail.”

SO WHAT?

Many people are fascinated by evolutionary arguments. We include ourselves in that category, especially regarding arguments that try to explain human behavior toward technology. Nevertheless, it is important to address the “so what” issue. That is, so what if our brain is not particularly designed to use communication media that suppress elements normally present in co-located communication, as most e-collaboration media do? It is still undeniable that the human brain is also among the most plastic of all animal brains, a characteristic that allows us to learn how to use unnatural e-collaboration media through practice to the point that those media become virtually “second nature” to us.

Our answer to the above “so what” question has two facets. One of the facets refers to the predictive power of the evolutionary perspective explored here, which allows us to infer certain causal relationships linking the naturalness of an e-collaboration medium and the amount of mental effort experienced by the individuals using that medium to accomplish a collaborative task. The other facet refers to the explanatory power of the evolutionary perspective explored in this article, which we believe allows us to provide a scientific basis for certain notions purported by a widely cited and much criticized theory generally known as “media richness theory” (Daft & Lengel, 1986).

The Predictive Power of the Perspective Explored Here

The meaning of the statement that “our brain is ill adapted to the use of text-intensive e-collaboration technologies” is essentially that the circuitry in our brain, or the neural networks that make up our brain, are not designed for the use of those e-collaboration technologies. Or, in other words, those neu-

ral networks are designed for co-located communication, the most natural form of human communication (simply because this was the form of communication used during most of the human evolutionary journey). However, what geographically distributed electronic communication may have in common with more ancestral forms of communication is the fact that in both distributed electronic communication and in non-face-to-face but co-located communication without any support of any technology support (such as yelling across an expanse of forest), we may not be able to see one another and pick up on visual cues available, but we can still communicate and accomplish certain tasks successfully. So, there may be some vestigial remnants to build on. Nevertheless, the use of e-collaboration technologies generally requires users to adapt by altering their behavior to fit the new situation because the evolved or “hardwired” brain circuitry is not “in place” for e-Collaborative work.

The above discussion allows us to predict with some certainty that e-collaboration technologies that create communication media which are too different from the form of co-located communication used by our hominid ancestors will generally require more brain effort, or “mental effort” (a more widely used term), to be used. Indeed, it may be easily understood that face-to-face communication is the easiest and most natural form of communication, followed by co-located but non face-to-face communication. The more different the communication medium created is from the face-to-face medium, the more mental effort will be required, a claim that can be substantiated easily by reflection on one’s own experiences in working and communicating across a field or other expanse.

However, additional mental effort may not be a big problem in certain types of collaborative tasks. Say, a group of people trying to develop a new product, and interacting mostly electronically, will probably feel more

mental fatigue after a five-hour e-collaboration session than if they were interacting face-to-face. Yet, that may have an insignificant impact on the quality of the design of the new product they are developing. People adapt by altering their behavior, and as such may work harder to accomplish such a task. We may also expect that their affective reaction to the extra effort expended may be less positive than if they were working face-to-face.

In other types of collaborative tasks, such as tasks that involve business-to-consumer interaction (e.g., a business representative helping a customer perform a financial transaction online), extra mental effort may prompt the customer to go to a competitor who provides a more natural interface for communication. Again, people tend to adapt by altering their behavior, and may do so by seeking out an “easier” Web-based provider of goods or services (see DiClemente & Hantula 2003; Smith & Hantula 2003 for an evolutionary account of this behavior based on foraging theory). Some companies that operate as Web-based facilitators of business-to-consumer interaction have been banking on this notion for a few years already (Gilbert, 1999).

The Explanatory Power of the Perspective Explored Here

The above discussion may prompt some — particularly those who are familiar with media richness theory — to argue that what was said above is basically a restatement of the main tenets of that theory. Hopefully the next few paragraphs will make it very clear that this is not the case, and that the evolutionary perspective explored in this article differs substantially from that espoused by media richness theorists.

Media richness theory (Daft & Lengel, 1986) argues that different communication media possess different degrees of “rich-

ness". This numerical attribute is correlated with the degree to which a medium supports several communication elements; notably the degree of support for the use of non-verbal cues (e.g., tone of voice and body language), and the degree of feedback immediacy afforded by the medium (i.e., fast back-and-forth interaction). Even though media richness theory was devised nearly 20 years ago, it is still contemporarily used as a basis for empirical research published in prestigious journals (Kahai & Cooper, 2003).

Media richness theory has never presented a scientific reason why human beings should prefer communication media with a high degree of support for the use of non-verbal cues and for feedback immediacy. The Darwinian perspective explored in this article does provide a scientific reason for a preference toward a specific benchmark, namely co-located face-to-face communication. It does not rely on medium attributes per se, which could arguably make that benchmark less important, and in consequence weaken the main theoretical pillars that underlie this Darwinian perspective.

Support for the use of non-verbal cues can be enhanced beyond what is available in face-to-face interaction through virtual reality media. The evolutionary perspective taken here would lead us to assume that those artificially enhanced media would also be unnatural, and thus lead to increased mental effort. That would be most likely due to another phenomenon generally known as "information overload", which can be seen as something like the opposite of the non-verbal cue suppression phenomenon associated with the use of certain text-intensive e-collaboration technologies such as e-mail.

Media richness theory, in its original form, also argued that individuals would generally avoid media of low levels of richness for complex and knowledge-intensive tasks (generally called "equivocal" tasks, in media richness parlance). When those users could

not exercise that choice (e.g., in situations where their media choice was limited to one single medium of low richness, like e-mail) media richness theory predicts that the quality of the final outcome of their collaborative task would suffer.

There is plenty of empirical research evidence showing beyond much doubt that individuals may purposely choose media of low levels of richness for complex and knowledge-intensive tasks, and that such choice can lead to even better quality outcomes than outcomes generated through the use of the face-to-face medium (see, e.g., DeRosa et al., 2004; Kock, 1998, 2001). That evidence usually comes together with evidence that the choice of communication media that suppresses many of the elements found in face-to-face interaction leads to a perception that the communication medium is "difficult to use" and "not very user-friendly". While this combined body of evidence is incompatible with media richness theory predictions, it does indeed appear to fit well with the evolutionary perspective explored here.

In most tasks, whether they are collaborative or not, quantify of effort does not necessarily define outcome quality. And this is true for mental effort as well. Let us assume that one individual is asked to build a spear out of a three branch using one hand only (and a sharp tool, used for wood shaping), whereas another individual is asked to accomplish the same task with the same tool, but using both hands. While it is quite possible that significantly more effort (and time) will be required from the individual using only one hand, that does not mean that the spear produced by the individual using both hands will be of better quality. In fact, the opposite may happen, if the individual using both hands is somehow more sloppy at completing the task, which may be motivated by the fact that he or she does not have to spend as much effort as the individual using only one hand. Less effort may lead to less of a sense of

commitment toward completing the task successfully, or use of only one hand may spur additional adaptation in the form of careful checking of the work, again resulting in a superior spear.

This discussion also points out an important cautionary note in the selection and interpretation of dependent variables in e-collaboration research. Media choice, mental effort, individual satisfaction with group/process/results, quality and quantity of performance are all separate and distinct entities. At different times they may or may not correlate with one another, however they are not suitable proxies for one another. Adaptation requires effort, especially early on, and a concomitant decrease in satisfaction with process may not necessarily extend to a similar affective reaction to one or more attributes of the results. Individual affective reaction or media choice may be independent of performance. There has been an unfortunate nudge-nudge wink-wink tradition within psychology of subtly substituting attitudes for behaviors, affective reactions for performance outcomes and the like, much to the long-term detriment of theory and methodology. As we begin to take seriously the implications of an evolutionary analysis of e-collaboration it is critical that reductions of mental effort on the part of researchers do not supersede proper and rigorous research design and analysis.

QUICK INFORMATION EXCHANGE PARADOX

Let us look at the following scenario. Two people, a man and a woman, have agreed to meet on a later date at a particular address, where the house in which the woman lives is located. The woman needs to communicate her home address to the man. Let us also assume that both work in offices that are a short walk from each other. In this situ-

ation, would not it be arguably less mentally demanding for both the woman and the man if she e-mailed him her home address rather than walking to him and conveying the information face-to-face? The answer is probably “yes”, which begs a follow-up question: is this answer consistent with the evolutionary perspective presented in this article? The appearance here is that the answer to this last question is “no”, which characterizes what we refer to here as the “quick information exchange paradox”.

Giving a “no” answer to the latter question above would be consistent with the intuitive notion that e-mail makes quick information exchanges such as the one illustrated above easier, but would also bring us back to “square one” in terms of the evolutionary perspective explored here. Giving a “yes” answer does not, but requires some explaining. The following paragraphs take the second path and argue that the apparent paradox does not really exist.

The mental effort alluded to in the previous section is that associated with the communicative act, not with any non-communicative act that may be directly or indirectly related to the communicative act. For example, if two people are located in different cities, and they want to communicate face-to-face, it is reasonable to assume that a certain (possibly sizeable) amount of mental effort will have to be spent in the act of traveling to a common location. The evolutionary perspective explored here, which refers specifically to the mental effort associated with communication interactions, has nothing to say in connection with the travel-related mental effort. That effort is simply outside the scope of the perspective, and is covered by other theoretical perspectives (see, e.g., Trevino et al., 1990). In other words, the additional mental effort involved in traveling (e.g., driving a car for hundreds of miles, buying plane tickets over the Web) is not included in our evolutionary perspective’s assessment

of the total amount of mental effort involved in the communication interaction.

Communicating to someone a home address, in the scenario used to illustrate the quick information exchange paradox, is not the only thing that the woman did when she sent the man an e-mail message with the information about her home address. She also provided that information to him in such a way that it was already recorded on a non-volatile medium for his future reference, and, most likely, printing. In a face-to-face interaction, the recording of the information by the man on some kind of non-volatile medium (e.g., a piece of paper) would have normally followed the communication of the home address information, so that he would remember the address later. The additional recording of the information is an activity that itself requires some degree of mental effort. That activity would have to be carried out together with the communication of the information. The additional recording activity is essentially what makes the use of the face-to-face medium to appear more cumbersome than the use of the e-mail medium in the quick information exchange scenario used to illustrate the paradox — which, as it can be seen, is not a “true” paradox after all.

A similar paradoxical scenario is that of three individuals (the number of individuals could be higher) who have to e-Collaborate in order to accomplish a common task, namely the task of writing a report about an audit that they performed on an organization’s financial records. Each of the three individuals writes a set of sections of the report, and the sets of sections that each of them write make up three independent parts of the report. The question is: would not it be easier for the individuals to write the report collaboratively using e-mail (with attachments) than face-to-face? The answer is, most likely, “yes”. Is this compatible with the evolutionary perspective discussed in this article? The answer is also “yes”, and the ex-

planation is analogous to the one provided in the previous paragraphs. Essentially, there was little or no communication involved in the e-Collaborative task of putting the audit report together. The e-collaboration technology in question (e-mail with attachments) was quite appropriate for the e-Collaborative task, which required some manipulation of sections of text produced independently by the three writers, and very little communication.

CONCLUSION

This article presents and discusses a Darwinian perspective on electronic communication behavior that suggests that we humans are essentially intelligent primates that use e-collaboration technologies. This statement is not, of course, meant to be shocking or offensive to anyone. It incorporates the notion that our biological communication apparatus is in many ways designed for forms of communication that have been used over millions of years by our ancestors, some of which (e.g., *Australopithecus afarensis*) would be perceived by many today as looking more like apes than modern human beings.

This article is premised on the belief that it is useful for us to understand certain instincts that have been endowed on us by evolution. Many of those instincts make us less adapted to life in urban society, because the developments that have led to urban society occurred too fast (in evolutionary time) to lead to major changes in our genetic makeup. Among those instincts is aggression, which underlies a vast array of behaviors that go from “road rage” to wars. Other examples are the instincts that compel us to consume more fatty foods and salt than we need, which were generally scarce and difficult to obtain in our evolutionary past, but plentiful and easy to acquire in urban society. Clogged arteries and high blood pressure are often the result of these instincts, which can be seen as maladaptations to modern urban life.

Some of the e-collaboration-related instincts that we discussed in this article are not in the same category as those mentioned above in terms of how bad they are for our health (at least that seems to be the case so far). Nevertheless, those instincts reflect the same general situation in which all of us human beings find ourselves today. Unfortunately, most of our species-wide adaptations are better aligned with the demands of prehistoric life than they are with the demands of life in today's cities.

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