

A Scientific Debate

Preface: The Nature of Culture

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Cognitive neuroscience is the study of how the brain enables the mind. The field has exploded in recent years, and although we have much to learn, the methods of cognitive neuroscience have illuminated the biological underpinnings of many aspects of mental life. In recent years cognitive neuroscientists have begun to investigate the interactions between biology and human culture. This is a mammoth undertaking, and it is fair to say that there are still far more questions than answers. Is culture biologically determined in some way? Conversely, does a culture influence the biology of its members? That there is some interaction between the two seems obvious to the most casual observer, but the nature of this interaction is elusive. The following papers provide two perspectives on the relationship between biology and culture.

Amar Dhand '01 argues that genetic adaptations have played a critical role in cultural differentiation. He argues that many psychological mechanisms that contribute to culture—language, for example—are, to some extent, genetically determined. He also presents lactose intolerance as a case study in the influence of genetics on cultural differentiation. Most humans are lactose intolerant. Some people, notably those of Northern European origin, have a genetic mutation that enables them to produce lactase—the enzyme that allows the digestion of lactose. Dhand argues that this mutation laid the foundation for the domestication of cattle and the development of a settled agricultural culture in early European civilization.

Erin Loback '99 takes the opposite view. She argues that cultural change operates on a much shorter time scale than biological change. She notes that human genetics have remained more-or-less constant for thousands of years, during which time cultural changes have occurred at a breakneck pace. Some of these cultural changes have not been "biologically correct"; they may be detrimental to long-term species survival. She argues, therefore, that cultural differentiation is largely independent of biology.

Obviously, the nature of the interaction between biology and culture is a contentious one, with many social and political implications. I regard this as more provocative than problematic. The dialogue between the various parties in this debate, properly conducted, will no doubt challenge many widely held assumptions and reveal surprising new truths. This is the stuff of intellectual life!

Culture as a Biological Construct

Amar Dhand '01

Scientists currently employ numerous approaches to examine culture and its origin. Specifically, studies in the fields of sociology, anthropology, and archeology focus on illuminating different aspects of the cultural phenomenon. Although these traditional approaches provide much knowledge of the elements that constitute culture (e.g. value definitions, patterns of behaviors, artifacts), they are limited in their ability to examine the human mechanisms that truly enable culture. In order to reveal the basic building blocks of cultural development in human society, a new perspective is needed. This perspective is found, at least in part, in the scientific realms of cognitive neuroscience, genetics, and molecular biology. By combining the principles being established in these dynamic fields, we find that the human psyche and the biological and genetic processes that shape cognition underlie culture and influence its differentiation.

The definitions of culture extend in a great number of directions (Lumsden, 1989). These diverse reference points allow for a comparison among the various approaches into this subject. A sociologist and an anthropologist define culture in terms of patterns of behavior and the resulting interactions between an individual and society. An archaeologist defines culture by the artifacts that provide a window into the societies of the past.

Lumsden notes that these definitions and treatments of culture are limited because they do not delve into the root of the concept: "Artifacts and behaviors are, after all, the products of mental activity, of people's ability to make sense of and act within the world" (Lumsden, 1989). Moreover, although culture is usually viewed as the practices of a group of individuals, it is the individual's actions and mental activity behind those actions that enable the group's cultural expression. Therefore, the first step towards a greater understanding of the mechanisms underlying culture is to focus on the individual's mental activity—his psyche.

Tooby and Cosmides have developed the following definition: "Culture is the ongoing product of evolved psyches of individual humans living in groups" (Tooby & Cosmides, 1989). By using this definition, we focus on the elements of cultural development that are cognitively definable. Therefore, the goal is to be able to examine the "private culture" within the minds of individuals. In this framework, the emergent properties described by sociologists, anthropologists and archaeologists are regarded as the cultural products of the human psyche. However, what factors contribute to and shape the psyche? This question is the source of much debate and research in contemporary neuroscience. There are no clear-cut answers that emerge from any single investigation

at this point in time, but it has been shown in numerous ways that the biology and chemistry of the brain are involved. Let us start with two key cognitive functions with fairly well understood genetic and biological backbones: language and vision.

Language is the most significant advancement in human evolution. It is unique to the human species and it enables the dominant form of communication within society. In fact, there is no doubt that language enables culture and the many other interactive characteristics of human society. Due to these qualities, much attention has been focused on the nature of language and its functional-anatomical organization in the brain (Gazzaniga, 1998). One of the most significant findings from studies in the field suggest that language is innate (Liberman, *et al.*, 1967; Eimas, *et al.*, 1971; Eimas, 1985). Supportive evidence indicates that infants without essential learning of the mechanics of language have the innate ability of speech perception and facilitation of language (Eimas, *et al.*, 1971; Eimas, 1985). Further, many researchers have confirmed that distinctions in voicing are automatically classified into phoneme clusters (Miller, *et al.*, 1996). These clusters form the innate channels that guide language development (Lumsden, 1989). We may extrapolate from this finding that there is a genetic code that determines the boundaries or constraints on language development before the process of learning even occurs in the human infant. Researchers have gone as far to say that the acquisition of language requires the genetic code that pre-programs language development (Chomsky, 1980; Pinker, 1981). Therefore, it follows that if these constraints are innate, we should logically accept that language is initially *established* by genetic factors.

The acquisition of language is essential to our study of culture because as stated above, language enables culture. I concede that it would be an oversimplification to suggest that genes are the foundation of culture because of the innate characteristics of language. There are far too many external variables that have not been considered in detail, such as an infant's exposure to speech at a young age (Miller, 1994). However, the role of genes must be recognized in their function as the *initial markers* of language. The implications of this role are extremely relevant to the development of culture. As Lumsden states (Lumsden, 1989):

...it appears likely that the ontogeny of linguistic knowledge structures is the result of mental operations carried out on cultural cues under the guidance of a rich set of innate developmental instructions.

In the cognitive analysis of language and its innate abilities, genes obviously play a significant role. However, a more molecular model would be advantageous in structurally correlating the neurons of the brain to culture. An examination of the visual system and its color-coding functions opens up this opportunity.

Vision is one of the best understood processing systems in the research world today. Especially in the last fifty years, major breakthroughs have laid down the foundation for researchers to correlate basic cognitive processes (e.g. color vision, perception, etc.) to organizational units of brain matter and biochemical cir-

cuits of neurons. One interesting field of study focuses on the abilities of the brain to recognize color and associate it to a certain label. Culture is inherently related to this concept by the question: do different cultures code a series of labels that break up the spectrum of colors into different categories? Early studies established a hypothesis on this issue that proposed the idea that cultures code in a unique manner independent of other factors (Berlin & Kay, 1969; Ray, 1952). For example, one culture may correlate a spectrum of hues under the same color label whereas another culture would arbitrarily distinguish them into two or more different colors. Therefore, no connection is possible between color classifications across different cultures. This would seem reasonable based on the belief that cultural development is independent of universal mechanisms such as biology or genetics. However, science is full of surprises and subsequent researchers challenged this independence theory of cultural terminology.



In 1969, Berlin and Kay reported findings that suggested that there was, in fact, a high degree of correlation between the color boundaries established by different cultures. Moreover, they found increased concordance with the relative positions of the central focal points of the color spectrum (Berlin & Kay, 1969). This led to a dramatic new model called the "implicational hierarchy" which

suggested a type of universal coding of color that was prevalent across all cultures. Further research by many scientists supported this model by confirming constrained and orderly categories of color that were similar in hundreds of cultures with few exceptions (Durham, 1991; Kay & McDaniel, 1978). What could possibly cause the development of such constraints or guidelines for the cultural coding of color? Researchers began integrating the most recent work in the physiology and biology of the visual system. The result was an incredible association between the cultural coding and neurobiological coding of color.

The nervous system codes the light spectrum according to its wavelength, thereby creating a type of biological categorization of color during early development (De Valois & De Valois, 1975; Livingston, *et al.*, 1984). This initial set of guidelines in turn direct the consequent development of the neural circuitry that determines color identification and classification. Researchers suggest that the color terms whose foci and boundaries correspond best to these neurobiological categories are the ones that exist in all cultures today (Kay & McDaniel, 1978). As Durham states (Durham, 1991),

the initial response patterns—dependent on genetically variable properties of the visual pathway—function as an influential set of primary values that govern the fate of alternative color-term definitions.

Therefore, similar to the innate phonemes of language, there is a genetically-mediated, biological neural code for color differentiation that determines the "cultural fitness" of color terms in nearly every culture. In essence, the definition of different colors that many thought could only be culturally transmitted is, in fact, biologically determined by the neural circuitry of each individual in

any culture.

Although a genetic and biological influence on culture is apparent in these last two examples regarding language and vision, there are still opponents who do not agree with conceptualizing culture as influenced or determined by molecules or genes. Many of these theorists propose the “Coevolution Model” of genes and culture which forwards the idea that culture is a distinct, but parallel second pathway of information transmission within populations (Durham, 1991). They believe that culture evolves in much the same way that genetic evolution takes place. Therefore, culture acts as a vehicle of transmitting information from one generation to the next without assimilation into a biochemical or genetic code. I believe there is one major ideological problem with this framework: can we be sure that cultural transmission of information is truly a cultural transmission?

Earlier we focused on the example of color-coding in different cultures. Before research had elucidated the innate mechanisms responsible for the neural coding of colors, color terminology was one of those “untouchable” formations of culture. Were it not for current knowledge of visual processing, coevolution theorists would still claim that the characteristics of the color blue are defined and transferred from one generation to the next via cultural transmission, not biological transmission. Today, we may understand the molecular basis of colors in different cultures, and thus realize the true biological mechanism behind the transmission of this cultural phenomenon. Color differentiation is just one example that is used because recent breakthroughs have enabled this detailed analysis. Other more complex features of culture such as behavior patterns, value structures, and artifacts continue to be the elements of cultural transmission. However, are they truly transmitted only through cultural interaction or do they have a molecular basis that we have just not discovered? It is simply too easy to claim that a certain pattern of behavior or interaction between individuals is culturally learned and transmitted only through cultural means. We must not be satisfied by this surface explanation. There are mechanisms that enable these cultural phenomena and we must strive to find them!

The molecular basis of language and vision illustrates a level of culture beyond the social transmission of information. There are biological substrates underlying these aspects of cultural development. We must now ask the question: do differences in these substrates or any other theoretical substrates cause differences among cultures? In other words, is there a biological influence on the differentiation of culture among human populations? The answers to these questions are difficult for obvious reasons. First of all, the social implications of proposing that genes or molecules be the root of cultural differences between human populations are troubling to most individuals. Secondly, our preliminary knowledge of the substrates associated to cultural phenomena is limited by our general lack of understanding of the biological and cognitive mechanisms of human beings. However, we must not regress from investigating this theory. Biological and genetic factors are obviously at work at some level of cultural interaction. We must now explore how influential these factors are in shaping cultural differences.

An analysis of the influence of dairy products on biological and cultural patterns is an interesting example. Nearly all mammals cease milk consumption during adulthood because of a weaning of lactase, an enzyme needed to break down lactose

found in dairy products (Rozin, 1998). In humans, there is a similar story. Nearly the entire world is incapable of digesting milk as adults. The small portion of the population who can are mostly Caucasians (Durham, 1991). Many theories have been proposed to explain this obvious cultural difference among human populations. Currently, all hypotheses reflect a type of genetic difference between those who have lactase and those who lack it during adulthood. Therefore, this model depicts the drawing of a *genetic line* separating a small population who can digest milk from the larger population who cannot. The cultural implications of this division are truly remarkable. On the one hand, Western culture has popularized an entire social ideology on the “milk for all ages” concept. This is reflected in many forms of cultural expression such as the media. On the other hand, the rest of the cultures in the world has adopted a solution to the lactose intolerance problem by creating products such as yogurt and cheese to compensate for the inability to drink milk (Rozin, 1998). Therefore, here we have an exemplary model of how a genetic difference directly influences and, in fact, determines the cultural difference between populations.

Lactose intolerance and its cultural response is one instance of the biological influence on culture. Other examples include the predisposition for West Africans to acquire a genetic mutation causing Sickle-Cell Anemia which in turn induces a recognizable cultural response (Durham, 1991). It should be mentioned that this paper does not refute the possibility of a cultural influence on biology. In fact, there are elements of a cultural effect on biological substrates in both the lactose and the Sickle-Cell Anemia examples. However, this evidence only strengthens the fact that biology and culture interact in many directions on many different channels. Although there are relatively isolated cases for genetic and biological mediation of culture, they are pieces of strong evidence that lead to some provocative thoughts. Specifically, one philosophical consideration is particularly pertinent.

It is widely accepted that culture is fairly rigid in its ability to resist change from social factors. Particularly, an individual’s personal values and beliefs are not easily modified by many external social influences. In essence, culture—both at an individual level and a group level—is very stubborn. This characteristic promotes continuity among populations. However, a problem arises when there is an inability to be able to change the negative aspects of culture such as crimes. Although the justice system works hard at socially reforming criminals through punishment and social programs, there are relatively few success stories in changing the criminal culture. On the other hand, genes are becoming just the opposite—very flexible to change. Current advancements in mapping and manipulating genes have taken a front seat in the scientific world. The abilities of genetic engineering to change and create new genetic sequences are becoming more and more feasible everyday. Therefore, the question arises: are genes easier to change than culture?

A critical examination of this concept has some profound implications. In this paper, I have proposed the existence of biological and genetic substrates underlying particular cultural phenomena such as color-coding. Through the lactose model, it has also been shown that cultural differences may be influenced and determined by these biological substrates. From these arguments, one may infer that if further research continues to elucidate the cognitive mechanisms of the human psyche, a more complete

molecular basis of culture is conceivable. Specifically, biological and genetic substrates may be identified to be the enabling mechanisms behind negative aspects of culture. This brings us back to our original question: are genes easier to change than culture? If they are, and there is a molecular basis to culture, perhaps we can change “cultural evils” by modifying the genes responsible for these behaviors. Of course, stringent measures must be employed in order to ensure the corruption of such an idea. However, why spend so much effort and money in trying to change a stubborn culture through social means, when there is the possibility of an easier and, perhaps, more effective method using genetic means?

Understanding culture is an interdisciplinary endeavor that requires the participation of cognitive neuroscientists, geneticists, and molecular biologists. By focusing on the mechanisms of the psyche that enable cultural phenomena, research by these scientists provides a molecular basis to culture. This foundation influences, and, in some ways, determines the differences among various cultures. The molecular model also provides some interesting implications for cultural reformation through genetic means. Culture is no longer a purely social construct. The interaction of genes, biological substrates, and cognition plays a significant role in the creation and maintenance of the cultural phenomenon.

References

- Berlin, B. & Kay, P. (1969). *Basic Color Terms: Their Universality and Evolution*. Berkeley: UC Press.
- Chomsky, N. (1980). *Rules and Representation*. New York: Columbia University Press.
- De Valois, R.L. & De Valois, K.K. (1975). Neural coding of color. In E. C. Carterette & M.P. Friedman (Eds.), *Seeing: Handbook of Perception*, vol.5. New York.
- Durham, W.H. (1991). *Coevolution: Genes, Culture, and Human Diversity*. Stanford: Stanford University Press.
- Eimas, P.D. (1985). The perception of speech in early infancy. *Scientific American*, 252:46-52.
- Eimas, P.D., Siqueland, E.R., Jusezyk, P., & Vigorito, J. (1971). Speech perception in infants. *Science*, 171:303-306.
- Gazzaniga, M. S., Ivry, R. B., & Mangoun, G. R. (1998). *Cognitive neuroscience: The biology of the mind*. New York: W. W. Norton & Co.
- Kay, P. & McDaniel, C.K. (1978). The linguistic significance of the meanings of basic color terms. *Language in Society*, 4:257-270.

- Liberman, A.M., Cooper, F.S., Shankweiler, D.P., & Studdert-Kennedy, M. (1967). Perception of speech code. *Psychological Review*, 74:431-461
- Livingstone, M.S. & Hubel, D.H. (1984). Anatomy and physiology of a color system in the primate visual cortex. *Journal of Neuroscience*, 4:309-356.
- Lumsden, C. (1989). Does Culture Need Genes? *Ethology and Sociobiology*, 10:11-28.
- Miller, J.L. (1994). On the Internal structure of phonetic categories: a progress report. *Cognition*, 50:271-285.
- Miller, J.L. (1996). Internal structure of voicing categories in early infancy. *Perceptual Psychophysiology*, 58:1157-1167.
- Pinker, S. (1981). What is language, that a child may learn it, and a child, that he may learn language? *Journal of Mathematical Psychology*, 23:90-97.
- Ray, V.F. (1952). Techniques and problems in the study of human color perception. *Southwestern J. Anthropology*, 8:251-259.
- Rozin, P. (1998). Evolution and development of brains and cultures: some basic principles and interactions. In M.S. Gazzaniga & J.S. Altman (Eds.), *Brain and Mind: evolutionary perspectives*. Strasbourg Cedex, France.
- Tooby, J. & Cosmides, L. (1989). Evolutionary psychology and the generation of culture, Part I. *Ethology and Sociobiology*, 10:29-49.

ABOUT THE AUTHOR

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Culture as a Social Construct

Erin Loback '99

Culture shapes human society, therefore human evolution occurring today is cultural in nature rather than biological. Do genetics—that is, predetermined biology—figure into these cultural changes? I argue no. Culture itself is a social construct; one's own genetic makeup in no way specifies his or her culture. A baby born in one culture can be transplanted immediately after birth to any other culture and grow to think and behave as the people in the adopted culture do. Although biology endowed the human race with superior intellectual capacities and the ability to create social structures and socially propagated constructs, it does not mandate the existence of culture, nor does it influence cultural differences.

Defined anthropologically, culture is “behavior that is learned and socially transmitted” (Relethford, 1997). A more psychological definition incorporates the “total lifestyle of people from a particular social grouping, including all the ideas, symbols, preferences, and material objects that they share” (Franzoi 1996). Culture is based upon social exchange, and therefore is highly dependent upon language. Leda Cosmides and John Tooby (1989) outline five cognitive capabilities upon which social exchanges are built—the abilities to recognize different individuals, remember one's history of interaction with these individuals, communicate one's values to others, model one's values after another's, and recognize the biological significance of objects. Language is critical for many of these. One theory of the origin of culture is that it came about as cranial capacities increased, which resulted in less-developed babies upon parturition because of the constraints of the female pelvis. In this light, socialization and inter-generational cultural transmission became necessary as a “specific niche” for infancy was created, necessitating prolonged interaction between parent and child (Sinha, 1996). Regardless of whether culture emerged as a result of social exchange dependent upon language or developed concurrently with language as brains grew larger and babies were born underdeveloped and in need of shaping, culture and language are intertwined.

The capabilities for human language as we know it are based on two physiological structures: the larynx and the brain. The larynx must be positioned low in the throat in order to vocalize a wide range of sounds. The brain must be able to abstractly represent ideas, process grammar and vocabulary, and produce motor speech. Cranial fossils of australopithecines, human ancestors who lived 3 to 4 million years ago, show a larynx higher in the throat, like that of apes (Relethford, 1997). The best known example of this characteristic is the world famous remains of Lucy (an *Australopithecus afarensis*). Although the larynx slowly descended in successive evolutionary relatives, the morphology of the throat to make all the sounds needed for human language was not in place until about 100,000 years ago. The brain structures and neurological substrates for language, however, appear to have been in place much earlier, suggesting language first began as gestures and developed into guttural sounds before developing com-

plex sounds and syntax.

Once language was in place, humans were left with a standard set of capacities that enabled them to interact socially. Human evolution put together a brain capable of “creating the social and cross-generational interactions anthropologists lump together as ‘culture’” (Tooby & Cosmides, 1989), but it did not specifically create culture. One such example is the universality of facial expressions, as outlined by Paul Ekman and discussed by Pinker (1997). Ekman showed photographs of Berkeley students modeling six different facial expressions to Papua New Guinea natives, and all subjects recognized and could produce faces expressing happiness, sadness, anger, fear, disgust, and surprise. Cosmides and Tooby (1989) noted that even though “adaptive participation in social exchange depends upon the correct solution of complex, highly structured, and highly specialized information-processing problems, humans in all cultures of virtually all ages both understand and successfully participate in such social exchanges with ease.” However, no specific cultural differences are programmed into individual brains, and culturally transmitted behaviors observed in different societies represent “the adaptively flexible expression of genetic material which is basically the same from one human to another” (Irons, 1979b). “The human mind functions the same everywhere,” write J. Anthony Paredes and Marcus Hepburn (1976), “but the way it ‘behaves’ in response to any particular stimulus is culturally determined.”

Biologically, humans have been the same for around 90,000 years, yet culture has advanced swiftly—in fact, it appears “cultural evolution has taken over from biological evolution” (Pinker, 1997). In biological terms, humans are still hunters and gatherers, however social evolution has changed our cultural development since the era of hunting and gathering. One example is the invention of agriculture, which changed the way nearly all humans eat (Relethford, 1997). Therefore, as Pinker says “the torch of progress has been passed on to a swifter runner” (Pinker, 1997). Richard Alexander (1979) describes how cultural change can be described “in a fashion parallel to that used for evolutionary change”. He outlines three major principles of organic evolution — inheritance, mutation, and selection — and how they can be applied to cultural change. Cultural traits are heritable in that they can be imitated or taught, mutations can occur through “mistakes, discoveries, inventions, or deliberate planning,” and some cultural traits are selective in that they “reinforce their own persistence and spread,” while others do not and therefore disappear. Tooby and Cosmides (1989), however, think the processes of cultural change and organic evolution are more different than similar. Most importantly they believe cultural change moves far too quickly to be paralleled to evolution.

Another view of the relationship between biological and cultural evolution is that “cultural success [in most human societies] consists of accomplishing those things which make biological success (that is, inclusive fitness) probable” (Irons, 1979a). Although people are conscious of cultural success, they are not

often aware of “the biological consequences of their behavior” (Irons, 1979a). Wealth is a social status symbol in many cultures, if not most cultures, and a case study of Turkmen in Persia in 1973-4 by William Irons (1979a,) showed the male age-specific fertility rates were higher for the wealthier half of the population than for the poorer half, and wealthier males had lower mortality rates for the first 20 years of life. It appears in this case that cultural success confers biological benefits. Indeed, lower mortality rates among higher-status individuals is common in many cultures, although elaborating the relationship between fertility and status is difficult because of the advent of birth control (Irons, 1979a). Irons also writes, “the capacity for culture could be favored by natural selection only if accompanied by a propensity to behave *as if* the individual were weighing both innovative and established modes of behavior in terms of their effect on his or her inclusive fitness and adopting only those behaviors which increase inclusive fitness the most” (Irons, 1979b). Cultural innovations such as conferring status to those with wealth (which can be means to better survive) make culture appear favored by natural selection, according to Irons. However, some cultural developments can affect the overall gene pool, and they do not always increase inclusive fitness. In fact, they can be contrary to evolutionary development.

One such example is the ban against cousin marriages in many Western societies. Such a ban serves the interest of the rulers who created the law, as it prevents the accumulation of wealth within a single family (Pinker, 1997), yet evolutionarily, incest is not all bad. Incest prevents deleterious genes from spreading to the population at large and leads to their swifter eradication (Neel, 1983). Other genetic implications of recent cultural changes are the loss of human diversity as a result of more inter-ethnic marriages (Neel, 1983) and medical advances that allow genes that would not otherwise have been selected for to be passed on. In addition, agriculture was invented about 12,000 years ago—not long ago on the evolutionary scale. Agriculture was a cultural innovation, yet it is not necessarily beneficial to the species. The human body is still biologically a hunter and a gatherer, and eating foods for which the body was not designed is certainly not optimal for survival. Whoever invented agriculture clearly did not behave as if he “were weighing both innovative and established modes of behavior and adopting only those which increase inclusive fitness the most.”

Culture affects biology on the individual level, particularly since humans are so underdeveloped at birth and postnatal development is subject to environmental (meaning cultural) pressures. One such example is the lateralization of brain function and the development of different cognitive strategies. Geoffrey Samuel (1990) writes:

It seems unlikely that specialization is ‘hard-wired’ within the brain. There is some evidence that lateralization is absent at birth and develops as the child grows and acquires specific learning strategies ... There are also indications of differences in lateralizations between populations ... and extensive evidence of the brain’s ability to compensate for damage ... the exact specialization of function would be a question of ‘culture’ as well as biology.

Kathleen Baynes (1990) describes a case of a boy who was cyanotic at birth and hemiparetic by five months of age. He underwent a left hemispherectomy at age five, yet tests later in life (his verbal IQ was 126) and his ability to perform well in college suggest normal language abilities. His right hemisphere took on all the functions of a normal whole brain, suggesting the brain is more equipotent and plastic at young ages and develops as we grow—that is, lateralization is not “hard-wired.”

If the brain is not fully lateralized at birth and later develops, perhaps different cultural values can “shape” the lateralization. Each hemisphere extracts different information from a stimulus, and they “manifest two distinct systems of information-processing” (Paredes & Hepburn, 1976). Popular science has promoted the notion of separate spheres of knowledge belonging to each hemisphere, and cultural differences in valued thinking styles have been described using lateralization theories. Different cultures give more value to different cognitive problem-solving strategies (Paredes & Hepburn, 1976). Gladwin’s 1964 study with the Trukese of Micronesia described by Paredes and Hepburn (1976) demonstrates these different ways of thinking. Using boat navigation to study approaches to problem solving, Gladwin found that the Trukese think more in a successive continuation, whereas Europeans’ navigation is more “abstract” and utilizes a pre-thought-out, step-by-step plan towards an overall goal. The Trukese style of thinking is relational, and the European style is analytic. Relational, or self-centered thinking, is more common in group-oriented societies. It is characterized by labeling only the whole and not the parts, subjectivity and impulsivity, a lack of verbal explicitness, and concrete and context-specific word meanings. Analytic thinking is more common in societies where tasks depend on individual status. It is characterized by a use of verbal labels for both parts and the whole, verbal explicitness, objectivity, and an awareness of abstract and nonobvious features (Cohen, 1969; Paredes & Hepburn, 1976). High achievement in schools in the United States requires more analytic thinking, and this type of cognitive processing is more valued overall in most Western societies (Cohen, 1969). Relational thinking, like that of the Trukese, has been considered a right-hemisphere-dominated strategy, while analytic thinking, like that of the Europeans, has been considered a left-hemisphere-dominated strategy (Paredes & Hepburn, 1976).

The primary method of studying the cognitive capacities of each hemisphere is the split-brain study, and subjects are extremely limited. The corpus callosum is disconnected only in severe cases of intractable epilepsy, and patients from a variety of cultures have not been studied. In a 1998 *Scientific American* article which follows up one written on the same topic 30 years previously, Gazzaniga writes, “[I]t appears that the inventive and interpreting left hemisphere has a conscious experience very different from that of the truthful, literal right brain ... the left brain’s consciousness far surpasses that of the right” (Gazzaniga, 1998). Based on the split-brain studies so far, this certainly appears to be true. The left brain houses a mechanism known as “the interpreter,” which seeks explanations for why events occur, makes inferences, and draws conclusions (Gazzaniga, *et al.*, 1998). The right brain, on the other hand, is much more truthful (Gazzaniga, 1998).

Linking culture to the collaborating functions of the right and left hemispheres of the brain is one approach taken by scientists.

Sagan forwards the idea that the most significant creative activities of culture, such as legal and ethical systems, art and music, and science and technology, are the collaborative work of both hemispheres together (Springer, 1989). His conclusion is that "...human culture is the function of the corpus callosum" (Springer, 1989). In response to this, another neuroscientist, Sally Springer responds, "This may be true, not so much because the corpus callosum interconnects 'analytic' with 'intuitive' thinking, but because every structure in the brain plays a role in human behavior, and human culture is a function of human behavior" (Springer, 1989). I believe this concept is incorrect for two reasons. First of all, culture is not a function of human behavior, rather the behavior of an individual is shaped by the genes he or she is made of as well as the culture with which he or she is indoctrinated. Secondly, seeing as split-brain subjects still possess culture, it cannot reside in the structure connecting the brain's two hemispheres.

Culture is an entirely social construct, and there exists no molecular basis for its existence. Culture is a socially transmitted phenomenon, but since the brain is not fully developed at birth, culture may possibly shape the development of the brain of an individual. Perhaps the most important piece of evidence suggesting that culture is not an inherent biological construct is that the capacity for culture does not confer a selective advantage on an individual, nor does it increase one's inclusive fitness. In fact, sometimes cultural developments are harmful to the species. Certainly if culture had a molecular basis, cultural inventions would not be maladaptive in nature. The aforementioned reasons are all convincing elements to the argument that culture is not a biologically based construct, but rather depends on social interactions to develop.

References

- Alexander, R.D. (1979.) Evolution and culture. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior* (pp. 59-78). Duxbury Press: North Scituate, Mass.
- Baynes, K. (1990.) Language and reading in the right hemisphere: Highways or byways of the brain? *Journal of Cognitive Neuroscience*, 2, 159-79.
- Cohen, R. (1969.) Conceptual styles, culture conflict, and non-verbal tests of intelligence. *American Anthropologist*, 71, 828-56.
- Cosmides, L. & J. Tooby. (1989.) Evolutionary psychology and the generation of culture, Part II. *Ethology and Sociobiology*, 10, 51-97.
- Franzoi, S. (1996.) *Social psychology*. Brown and Benchmark Publishers: Dubuque, Iowa.
- Gazzaniga, M. S. (1998.) The split brain revisited. *Scientific American*, 279, 34-9.
- Gazzaniga, M. S., R. B. Ivry, & G. R. Mangoun. (1998.) *Cognitive neuroscience: The biology of the mind*. W. W. Norton & Co.: New York.
- Irons, W. (1979a.) Cultural and biological success. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior* (pp. 257-72). Duxbury Press: North Scituate, Mass.
- Irons, W. (1979b.) Natural selection, adaptation, and human social behavior. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior* (pp. 4-38). Duxbury Press: North Scituate, Mass.
- Neel, J. V. (1983.) Some base lines for human evolution and the genetic implications of recent cultural developments. In Ortner, D. J. (Ed.), *How Humans Adapt* (pp. 67-93). Smithsonian Institution Press: Washington, D.C.
- Paredes, J. A. & M. J. Hepburn. (1976.) The split brain and the culture-and-cognition paradox. *Current Anthropology*, 17, 121-7.
- Pinker, S. (1997.) *How the mind works*. W.W. Norton and Company: New York and London.
- Relethford, J. H. (1997.) *The human species: An introduction to biological anthropology*. Mayfield Publishing Company: Mountain View, Calif.
- Samuel, G. (1990.) *Mind, body and culture*. Cambridge University Press: Cambridge.
- Sinha, C. G. (1996.) The role of ontogenesis in human evolution and development. In A. Lock & C. R. Peters (Eds.), *Human handbook of symbolic evolution* (pp. 400-6). Clarendon Press: Oxford.
- Springer, S. (1989.) *Left brain, right brain*. Retrieved February 26, 1999 from the World Wide Web: http://www.dolphinstitute.org/isc/text/rs_sprin.htm.
- Tooby, J. and L. Cosmides. (1989.) Evolutionary psychology and the generation of culture, Part I. *Ethology and Sociobiology*, 10, 29-49.

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