Chapter 2

The Central Role of Culture in Cognitive Evolution: A Reflection on the Myth of the "Isolated Mind"

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Human symbolic culture constitutes a distinctive, species-universal trait, usually thought to be the result of our having evolved special cognitive capacities, such as language. Seen from this vantage point, the flow of influence runs from cognition to culture, in that order, and the task of evolutionary psychology should be to decide how and when the basic cognitive foundations of modern culture came into being. According to this doctrine, the coevolutionary brain–culture spiral that characterized hominids must have been driven primarily at the cognitive level. Thus, cognitive evolution triggers cultural evolution, which triggers further brain evolution, and so on. This is the conventional meaning of brain–culture coevolution.

However, the interaction between culture and cognition is more complex, and the influence sometimes runs in the other direction, from culture to cognition. Our brains and minds can be deeply affected by the overwhelming influence of symbolic cultures during development. I mean this, not in the superficial sense intended, for instance, by the Whorfian hypothesis about the influence of language on the way we think, but on a much deeper, architectural, level. Some cultural changes can actually remodel the operational structure of the cognitive system. The clearest example of this is the extended and widespread effect of literacy on cognition. In this case, we know that the brain's architecture has not been affected, at least not in its basic anatomy or wiring diagram. But its functional architecture has changed, under the influence of culture.

In this modified view, brain–culture interactions can cut both ways. Undoubtedly, certain brain modifications are a precondition of the emergence of complex culture and must precede its evolution. This order of precedence is confirmed by the archaeological record, which shows that cultural change often followed anatomical change, sometimes by many generations. This was true of advances in both toolmaking and the domestication of fire, which only emerged hundreds of thousands of years after the increased brain size of archaic *Homo* became a reality. But, at the same time, certain uses to which the human brain is put, such as literacy and distributed symbolic cognition, cannot occur without an appropriate level of cultural evolution and in this case, the brain is drawn along by cultural change. This is achieved by influencing development.

The resources of the infant brain can be radically redeployed under the guidance of cultural change, which can gain its own momentum. In turn, this phenomenon, rapid cultural change generation after generation, is made possible by the extreme plasticity of the human brain in epigenesis. This crucial characteristic has allowed the human brain to adapt to the ever-faster rates of change that have become typical of modern society. It may appear self-evident that our brains have proven sufficiently plastic to have allowed us to come this distance, but it is not clear how far this trend can continue. We undoubtedly have cognitive limitations as a species, both individually and collectively, and will come up squarely against them at some time or another.

Meanwhile, it is clear that, by means of this second kind of brain–culture interaction, our brain–cultural dynamic has become an integral part of the replicative machinery of the human species. Culture is the storehouse of crucial replicative information for certain aspects of our collective cognitive matrix, without which we cannot reproduce the cognitive systems by which we now function as a species. The memory repositories of culture allow our species to transmit across generations the codes, habits, institutional structures, and symbolic memory systems that are needed to operate a significant portion of the processes of modern cognition in human culture. This applies especially to the collective aspects of cognition, including the distributed storage and retrieval systems we deploy, but it also affects the functional architecture of the individual mind and brain.

But cognitive science still proceeds as if culture did not matter. The only major exception to this is developmental psychology. Developmental research is one of the few places in cognitive psychology where the impact of culture on cognition has been fully acknowledged and integrated into theory. Perhaps this happened because culture simply cannot be avoided or ignored when observing children in the real world. Whatever the reasons, this has been fortuitous for cognitive research and theory.

COGNITIVE SOLIPSISM

My own realization of culture's formidable epigenetic role came slowly and late, only after I had realized that neuropsychology, my home discipline, was saddled with the solipsistic assumptions that are common in standard-plan cognitive science. The central assumption of cognitive solipsism is that the mind may be, indeed must be, conceptualized as a system that is contained entirely inside a box. In the case of vertebrates like ourselves, that box happens to be the brain. The infant's mind is seen as a relatively self-sufficient entity, with a predetermined architecture consisting of various processors, capacities, and built-in preferences. Equipped with this, it faces the world as an autonomous entity, its hardware (and firmware) fixed in stone. Culture could not play a particularly important role in shaping the operational structure of such a cognitive system because, given normal development, its basic design and architecture are preset by its genes. Its unfolding is influenced by conventional epigenetic forces such as nutrition, sensory stimulation, and stress. Culture is just another of these forces, capable of depriving the system, or stimulating it, but not able to set any of its basic parameters. The infant's mind looks out on the surrounding culture and gradually deciphers it, learns from it, and influences it. But all the while, it is alone.

This isolated-mind doctrine contains some important truths, but as with all good things, it can be carried too far. The strong form of this doctrine holds that the mind exists and develops entirely in the head, and that its basic structure is a biological given, structured according to a set of innate neuropsychological universals. Within this framework, culture is necessarily assigned a secondary role. Culture fills in the blanks, giving a distinctive form to the mind's preset structures. For instance, it can provide specific grammars within the context of Universal Grammar, but cannot influence the basic operational structure of the language device. Culture reshapes the trivial details of mental life, such as the particular language one speaks, one's tribal identity, habits, customs, and beliefs, and the episodic specifics of personal experience. It might even influence the way we think, in the sense that it can train us in the strategies of rhetoric, for instance. But its influence stops there. It is restricted to providing what cognitive researchers would call *noise*. For them, the signal is the component structure of the mind. It is not for culture to determine.

Although this myth predominates in cognitive science and neuroscience, it has never been completely accepted in developmental psychology. This fact can be attributed largely to the influence of two individuals: Lev Vygotsky, who was one of the first to recognize the symbiosis of the developing mind with culture, and Jerry Bruner, who carried this important realization into the modern era. The legacy of their work is the wide acceptance of the idea that many of the operations and functions of the developing mind, including many of the actual operational algorithms of thought itself, develop only if the child has a close, continuous interaction with culture. Moreover, the nature of the cultural environment has a determining influence on the nature of the child's operational skills. Culture thus provides much more than the incidental details of mental life. It actually forms and structures the mind on a fundamental level. Fully realized, this idea challenges the myth of the isolated mind. This is not to say that it encourages group-think or a mysterious melding of individual minds into a collective mind. Rather, it suggests a change of emphasis in our theorizing. In accepting that culture plays a major role in the development of cognition, our focus must be widened permanently to include the cultural environment. The aloof, solipsistic Aristotelian mind, magnificent in its Olympian contemplation of the outside world, is dragged into the cultural streets, and forced to acknowledge that much of the representational machinery with which it contemplates the cultural world, and represents reality, had its humble beginnings in culture itself.

This idea has interesting implications when applied to human phylogenesis because it transforms the traditional elaborative role assigned to culture into a replicative one. If culture is essential in establishing the basic structure of the adult mind, it thereby becomes part of the mechanism of evolutionary replication and natural selection. Replicative mechanisms are central to evolutionary theory because natural selection acts on the entire process of replication, including its nongenetic components. The replicative mechanism of the human mind is, by definition, responsible for transmitting our cognitive architecture across generations. It determines the blueprint of the human mind. Modify it, and the blueprint of cognition is modified. In most species, culture, insofar as it exists at all, does not factor into the evolutionary picture in this way. But the modern mind depends upon a unique symbiosis of brain and culture, and in this context, traditional solipsism is unworkable. It is also unworkable in the sense that humans have constructed elaborate systems of distributed cognition, but this is a secondary aspect of the argument. The prehistory of the human mind, even at the earliest stages of hominid emergence, must acknowledge the evolution and role of symbolic culture as an integral part of cognitive evolution. This idea is fundamental to my own theory of human cognitive origins (Donald, 1991; 1993a, 1993b; 1995; 1997; 1998a, 1998b, 1998c).

THE INFLUENCE OF CULTURE ON COGNITIVE ARCHITECTURE: THE "LITERACY BRAIN"

What do I mean by the "replicative" role of culture in evolution? Many species need some form of early social interaction or facilitation to develop normally. But that does not imply anything more than a supporting role for social life in ontogenesis, similar to the role of, say, nutrition or sensory stimulation in development. However, unlike any of the latter, culture can have a qualitative impact on the component structure of cognition. Culture does not merely facilitate the development of a standard-plan cognitive profile. If culture can be shown to be primarily responsible for some truly novel aspects of human cognition, then, ipso facto, it is implicated in the reproduction of those novel features in future generations. It thereby becomes a carrier of essential replicative information, without which certain components of the system cannot be reproduced.

Are we just talking about memes here? Emphatically, no. This is not at all the same as the claim made by Dawkins (1989) when he proposed his concept of the meme. Memes are representational memory records—ideas and images—that move through cultures in waves. Ideas, such as democracy, nationalism, honor, and heroism, and images, such as the swastika, the ideal body shape, or the decorative trappings of class, are typical memes. They influence what we think and perceive and have a tremendous effect on behavior. For example, the meme "dying for one's country" has led to joyously suicidal behavior on the part of thousands of young men. But memes do not define the component structure of the mind. On the contrary, they are the natural products of conventional mental structure. Thus Dawkins remains a traditional cognitive solipsist.

I have made a much stronger claim for the impact of culture. Culture is a replicator, not only of memes, as Dawkins suggested, but of some of the key features of the operational system that generated the memes in the first place. Culture actually configures the complex of symbolic systems needed to support it by engineering the functional capture of the brain for this purpose in epigenesis. To be clear, I am using the word *culture* to refer to the entire interactive symbolic environment in which humans live and communicate. By the capture of neural structures, I mean simply that areas of the brain that would, in preliterate culture, have been dedicated to other use, have been appropriated by the demands of literacy. This has been mediated by basic neural-developmental processes such as synaptogenesis, displacement, and Hebbian learning (the strengthening of specific synapses by experience). Under some circumstances, these processes can establish, in the brain of the developing child, operational systems that make it possible to interact with, and use, the cognitive instruments of literate culture.

This principle has a great impact on human epigenesis, even though the basic wiring diagram of the nervous system has been largely predetermined in the genes. The central tenet of Edelman's notion of Neural Darwinism (1987) was that the functional capture of brain regions, especially of areas, such as the neocortex, which are far removed from the shaping influence of the peripheral nervous system, is governed by epigenetic events. This idea has been confirmed many times in the literature on developmental plasticity. For example, in the congenital absence of eyes and the active stimulation they mediate, those parts of the brain that normally form the visual system are not captured by vision, and they come "on the market," so to speak. Their functional fate is decided by a kind of local natural selection that takes place within the individual nervous system. Pathways that are normally encumbered for vision might be diverted in this case and employed by competition and displacement for other cognitive functions.

This process of capture and redeployment is much more flexible in the case of higher cognition, which is heavily dependent on recently evolved brain areas such as the tertiary areas of the frontal and parietal neocortex and the perisylvian regions. The brain is so plastic at this level that it is reasonable to expect that the functional capture of these areas might be subject to considerable individual variation. This confers a great benefit on humanity: extreme developmental plasticity and adaptability to many different environments. It also leaves human developing brains much more open to cultural influence because culture determines so much about the way we structure our system of skills, including some seminal skills that play a direct operational role in cognition.

Thus, by changing the kinds of cognitive environments to which infants are exposed, symbolic cultures can have a major epigenetic impact on the mind. In fact, over a period of many millennia, the pedagogical intervention of symbolic culture has undoubtedly evolved and institutionalized many novel skill structures in the human brain. The most obvious case in point is the complex of advanced literacy skills that are essential to running modern society. These skills demand a tremendous share of brain resources. Symbolic literacy simply cannot exist without installing, in thousands of developing children, an elaborate complex of lexicons, use rules, automated component subskills (such as decoding letters and symbols, finding words, and forming letters), and a number of memory management and attentional algorithms, each of which must be entrenched in its own neural architecture. This type of architectural redeployment of the brain, whereby an elaborate series of cognitive operations is formulated, trained, and structured by culture, is not unique, by any means, to the case of literacy. Literacy is just the most dramatic example. Most distinctively human skills depend on the existence of novel functional modules in the brain, with clinically dissociable components. This is true of most skill complexes that drive the modern world, including mathematical, musical, scientific, artistic, and managerial skills, all of which are functional impositions of culture that must be implemented in brains. As are mainstream literacy skills, they are part of a large hierarchy of automatic subroutines that are essential for a host of scaffolded intellectual operations whose existence is contingent on them.

Thus, brain and culture do not simply "coevolve" in modern humans, in the usual sense of that word. Conventional coevolutionary theories allow only for a tight, inflexible fit between brain and culture, in which the two have coevolved so closely that the form of each is greatly constrained by the other. This kind of theory is much favored by sociobiologists. In their view, humans are stuck with the fixed cognitive repertoire they evolved during the late middle and lower Paleolithic period (cf. Tooby & Cosmides, 1989). I do not deny the existence of such cultural and cognitive universals and species-wide adaptations, which characterize us as human, but it paints an incomplete picture to give them exclusive jurisdiction over cognitive architecture. There is an additional factor that affects brain–culture interactions, and it results from the juxtaposition of a super-plastic brain with our highly innovative symbolic cultures. Future generations can adjust to their drastically changed epigenetic environments without genetic change, through massive cultural intervention in their development. This greatly affects the deployment of our cerebral resources and changes the way our various cognitive games are played. The long-term outcome is a restructuring of cognitive skill that is so fundamental, when contemplated in purely cognitive terms, that we would normally expect such drastic changes only after changes to the human genome. Yet they were mediated entirely by culture.

Literacy, as we know it, is historically very new. It is about 5,000 years old, at most, and is still far from species universal. The spread of literacy has been so rapid that the human brain could not possibly have evolved an adaptation for it. Many individuals born into the New Stone Age have become highly literate in a single generation, and this surely negates the possibility of a special brain adaptation behind literacy skill. However, it is a mistake to underestimate the cognitive revolution brought about by literacy. In terms of its cognitive structure, full literacy involves an enormously intricate web of skills that have some novel properties. These skills must be assembled in hierarchies, largely automated in their operation, in the individual brain. This constitutes a very tangible functional brain system, and its dissociable subsystems can break down in clinical neurological syndromes, just as perception and language can. Yet the subtle architecture of the literacy brain is entirely a cultural imposition. All that complexity and exquisite structure is a product of cultural programming. In principle, if that kind of structure can be installed by culture, we cannot dismiss the possibility that language itself might be installed by similar developmental principles.

The breakdown of the literacy brain has been analyzed in neurological patients with acquired disorders of reading and writing, the so-called dyslexias and dysgraphias. This analysis has revealed a hierarchy of automatized component subroutines, including a very sophisticated control system for eye movements; a dedicated temporary buffer in short-term memory, sometimes called the graphemic buffer; and, depending on how many languages the reader has, input and output lexicons, each with its own automatic look-up addresses for thousands of words and each leading into a vast semantic system where the reader's knowledge is stored, sometimes semi-independently from the sound-based semantic system. It also includes several specialized output lexicons that control the operations involved in writing via different motor paths. There are many other features, such as the phoneme-to-grapheme mapping process that is needed to read certain languages.

These are all scaffolded systems with many layers of embedded production schemas and a hierarchy of memory "readout" systems that map the form of a planned phrase or sentence to actual production algorithms, for each letter of each word, in exactly the correct motor sequence. This enables the writer to produce a coherent text rapidly, without much deliberate thought on any level other than the semantic one. Early in acquisition, when readers are still without these automatic subsystems, they act like helpless neophytes, deliberating about every feature of every letter of every word, with a concomitant slowing of the thought process. But, after endless hours of rehearsal and pedagogical supervision, the process gradually becomes automatized, and thus fully "installed" through the functional capture of available brain resources.

In any normal childhood in a literate society, the child's brain must acquire many similar interconnected component subsystems. Music and mathematics demand a similar and parallel set of components, and most occupations, from chess playing to aeronautical engineering, involve decades of specialized training to establish an even more complex concatenation of complex systems in the brain. With practice, these become the well-worn paths of the expert, woven into an elaborate structure that mediates the rapid lexical, semantic, and syntactic reactions that any experienced reader needs. These connection patterns, which seem to be rather variable when compared across individuals, form the greater part of the real functional architecture of adult cognition in literate society.

These symbolically driven functional architectures have some very special properties. They are different from many other functional architectures of the brain, such as those for vision, hearing, somatic sensation, locomotion, long-term memory storage, arousal, and so on. These basic systems have their origins in genetic events with a very deep evolutionary history and associated neural structures that are dedicated to them. They are also neuropsychologically universal in any given species that has them. Although experience and stimulation may be needed to nudge them into development, culture plays no major role in actually setting them up. Accordingly, no one suggests that culture determines anything fundamental about vision or basic memory capacity. However, this is obviously not true of the functional architecture of literacy, and probably not of language. Enculturation is the actual source and replicative carrier of their architecture. And this is not to mention the large distributed cognitive systems of society that are also cultural in origin. These systems tie together individuals, machines, and external symbols into cognitive megastructures, whose novel properties have been described elsewhere (Donald, 1991; 1993b; 1998a). These are important and constitute another major contribution of culture, but are quite a different matter from the structuring effects of culture on individual brains.

APES, SYMBOLS, AND THE PROCESS OF ENCULTURATION

Our greatest intellectual accomplishments, and the ones that we tend to identify with the conscious representation of reality, are language and formal thought. They are both closely dependent upon culture and could not have evolved independently of it. I mean that literally. They could not have preceded culture, because their specific organization is entirely a product of culture. Although our brains have undoubtedly evolved a capacity for symbolic thought, this capacity is only vaguely defined in the nervous system itself. The brain is not, on its own, a symbolizing organ. The brain depends entirely on culture for the exploitation of its symbolic capacity, and some of its most impressive functions have a purely cultural origin. Symbolizing minds, as we know them, are not self-sufficient neural devices, as are eyes. They are hybrid products of a brain–culture symbiosis. Without cultural programming, they could never become symbolizing organs. They would become something else, very powerful perceptual-motor systems, like those of a superprimate, perhaps, but not truly symbolic.

To a cognitive neuroscientist like myself, it seemed very odd at the time I wrote my first book to propose that the most distinctive cognitive achievements of the human mind should be defined primarily in terms of an evolving symbiosis with culture. This places the human species in a completely unique position. Indeed, when it first occurred to me, the idea seemed too eccentric to bother pursuing. After all, I was trying to construct an account of cognition, not of culture. I was trying to establish a clear link between symbolic cognition and brain function. Any attempt to include culture as a major factor in cognitive evolution meant that we were looking at a very tangled causal chain that stretched all the way from neuron to culture and back again. But the idea endured, because it opened up an interesting possibility: that the rudiments of culture might actually have come first in our evolution, while symbolic thought, as we know it, came second, perhaps even a distant second, drawn into existence by a burgeoning cultural process whose roots were not primarily symbolic.

This contradicted the common assumption that cultural evolution is secondary to the evolution of symbols and languages. We tend to think that culture must be an invention of evolving minds, rather than vice versa. As with so many conventional ideas, this assumption seems solid enough. Surely we could not have evolved any kind of expressive culture without first having a capacity for symbolic communication. But this common assumption falls apart under careful scrutiny, because our best evidence suggests that symbol systems are always acquired through enculturation and are always simpler than the totality of the surrounding culture. Despite this, enculturation has been neglected as a possible formative process in its own right, a process that had a tremendous influence on cognition, while following, to some degree, its own evolutionary trajectory. Perhaps our neglect of enculturation is due to our great difficulty in objectifying our own intellectual dependency on culture, embedded as we are (especially scientists) in it. Given this bias, it is not surprising that the most striking evidences of the raw power of enculturation, data that we cannot ignore or deny, have come not from studying ourselves but from studying another species, the chimpanzee.

Chimpanzees that are raised in artificial ape/human cultures are often referred to as "enculturated" apes. They hold up a mirror to our own predicament. Like us, they are strangers in a strange land, raised in a culture that differs radically from their original, or natural, environment. The best-known studies of these extraordinary creatures have been carried out by Duane Rumbaugh and Susan Savage-Rumbaugh on a quasi-naturalistic reserve just outside of Atlanta, Georgia. They have raised bonobos (a distinct species of pygmy chimpanzee) as well as common chimpanzees in captivity, exposing these animals from infancy to the regular use of symbols. Some of these animals have acquired considerable symbolic skills without specific instruction, simply by cultural immersion. In the process of becoming symbol users, they have entered a sort of cognitive limbo, inasmuch as they have become exceptional in their natural habitat but remain strangers to human culture as well. They have achieved things that were believed, until the 1990s, to be beyond the reach of chimpanzees and bonobos. Their star bonobo, Kanzi, picked up a large working vocabulary and, without direct training, acquired a significant understanding of spoken English (Savage-Rumbaugh et al., 1993). This was an amazing achievement, and even though his linguistic skill appears to be quite limited when compared to a human adult, Kanzi can match 2½-year-old children in most tests of language comprehension. He can understand sentences such as "Can you put your shirt on? Can you put your shirt in the refrigerator? Do you want some more Perrier?" And so on. This shows that he understands the meaning of nouns, verbs, and prepositions, as well as word order. He has difficulty with more elaborate constructions, such as sentences with embedded clauses that separate the verb from its object. But even so, his understanding of English is sufficient to be quite useful to him in his daily life.

Based on these studies, some very strong claims have been made about a hypothetical ape language capacity; I do not agree with many of them. But, I cannot avoid making at least one major concession. Kanzi can do things that he was not supposed to be able to do, according to traditional doctrine. Moreover, this outcome is entirely the product of his special cultural environment. His biological inheritance has not been tampered with. He has exactly the same brain design as his wild-reared cousins. Yet, in some respects, he behaves like a different species. Many of his remarkable skills are completely absent in wild-reared bonobos. His capacity to use symbols and understand some spoken language could not have evolved directly in a species that lacked these skills in the wild. They were implanted in his brain by the cultural influence of another species, our own. This demonstrates convincingly that the enculturation process can successfully uncover and exploit cognitive potential that had remained untapped for millions of years.

The point is, a symbol-using culture can become an active, exploitative force in shaping the primate mind and can introduce apparently human cognitive features into the profile of nonhuman primates. Kanzi has learned to manufacture simple stone tools that are similar to the ones associated with the first hominids, present more than 2 million years ago. Moreover, he can use and manufacture them purposively and appropriately. For instance, if he breaks off a flake in order to cut a rope and it is not sharp enough, he will break off another one until he gets a cutting edge that actually works. Watching Kanzi make a stone tool, one has the feeling of witnessing a primordial scene that was first played out by our distant ancestors. Yet he is not human. He has none of the features—erect posture, changed vocal anatomy, increased brain volume, and so on—that define our direct line of ancestors.

Some of these enculturated apes have learned to use visual symbols to communicate with one another, although only under special circumstances. This was first shown by the Rumbaughs in the 1980s, when they demonstrated symbol-coordinated tool use in two chimpanzees named Sherman and Austin, who had earlier learned to use half a dozen tools, including keys, and to name them using symbol boards. Sherman and Austin were allowed visual contact with one another through a window, and were able to communicate using their symbol boards. They were also able to "mail" objects back and forth, from one room to the other, through a drawer that could be pulled through the wall. They shared a food locker, which was located in one room, while the key to the locker was kept in the other room. When one of them wanted to eat, he had to flash a request, using the visual symbols, to the other chimpanzee, who was the temporary caretaker of the locker. The caretaking chimpanzee would read the message, get the key, and send it through the porthole. Then, the requesting chimpanzee would open the locker and get the food, sharing with his colleague. They managed to coordinate their behavior in several different scenarios, involving several different tools, even though they were never explicitly trained to perform these specific exchanges. This was an impressive demonstration of symbolic communication between two members of a species that supposedly lacked any capacity for doing such things.

Kanzi's achievements have often been challenged and are regarded by many as a clever illusion, precisely because they do not occur naturally in the wild. Let us start by accepting this oft-heard comment at face value. In some respects, Kanzi is undoubtedly an illusion. In fact, he is from outer space, as far as most other bonobos are concerned. This is an important challenge, rather than a substantive criticism of the Rumbaughs' research, and it has very serious implications for our own species. Certainly, to our archaic forerunners, most of us would also appear to be from outer space. Our modern intellectual armamentarium has been constructed on the scaffolding of many previous cultures and has traveled a great distance. Thus, just as Kanzi, we are also illusory creatures, products of an incessant process of cultural revolution that has kept raising the intellectual bar higher and higher, pushing us toward cognitive heights that we were not really designed to reach (keep in mind that evolution is blind; it has no foresight).

There might be a hint about the nature of human cognitive evolution in the failure of enculturated apes to generate actual cultures. In some ways, apes have come close to human symbolic cognition as individuals, but they have failed completely on the cultural side of the equation. Despite the brilliant efforts of researchers such as the Rumbaughs and many others before them, apes continue to use symbols only for a pragmatic personal agenda. If symbolic skills alone had been enough to generate a truly symbolic culture, many apes would be much farther down the human road by now and would be moving toward collective representational systems. But they are not. Although individual apes have made significant advances, collectively they have never been inclined to construct their own symbolic cultures, not even on the small scale of, say, a small working or family group. Sherman and Austin, who could use symbols effectively to communicate with one another for pragmatic reasons, never extended their use of symbols to hold anything resembling a conversation. There is no evidence that they modified any of their traditional social behaviors, using symbols. In their case, competence in the use of symbols was not sufficient to generate a cultural revolution, not even a very small one. This negates any notion that symbolic skills have an immediate, transformative power to generate culture.

In short, there seems to be more to generating culture than a sprinkling of words and a smattering of grammar. This leaves us with a tricky chicken-and-egg question when examining our own origins. Which came first in human emergence, symbolic skill, or culture itself? Kanzi's symbolic skills are exclusively due to enculturation. So, obviously, are many of our own, the best example being all the skills associated with literacy. There were no true writing systems until about 5,000 years ago, and we have never had time to evolve a specialized capacity for reading and writing. All of what neuropsychologists know as the "literacy brain" is a product of culture (I mean that quite literally, as we shall see). The same principle applies to the neural origins of mathematics and musical skill, two very recent cultural innovations. These skills are products of cultural opportunism, not evolution. They illustrate the successful exploitation of raw cognitive potential that could not have been evident in the primordial cognitive profile of our species. Of course, there are individuals who have extraordinary talents in these areas, and this might mislead us to think that they must have special brain modules for musical talent, mathematics, and literacy. But they do not. Such modules never had the time to evolve, in the biological sense. These talents are simply products of genetic variation, happy convergences of factors that occur in a small minority of people. Rare convergences of genes can create the occasional Mozart. But these scarce opportunities have to be seized on by a culture that is positioned to exploit them. Without this exploitation, such talents would never become evident.

Unthinkable as it may seem, we are not even certain that spoken language, as we know it, was part of our primordial profile as a species. We have no firm empirical evidence by which we can dismiss the notion that language itself might be, especially in some of its most esoteric semantic and grammatical features, just another product of our deep symbiosis with culture.

THE OUTSIDE–INSIDE PRINCIPLE

However, the exploitative power of enculturation runs up against a wall at one point. We cannot invoke the power of symbolic culture to explain its own beginnings. The mystery of its origins deepens when we consider the brain design we have inherited. Unlike computers, which are physically open to a larger wired world, our nervous systems are private entities, physically isolated from one another. Our minds are thus locked up inside little boxes that cannot be wired directly to other minds. We can escape from those little boxes and from our intellectual isolation in only one way—through action. Our isolated nervous boxes can communicate only by projecting symbols into the world, by contracting muscles, and by waving limbs. The problem is that our brains can never produce truly symbolic acts unless they are imposed from the outside.

We can see this in the communicative helplessness of people who have grown up in isolation from culture. No matter how fiendishly clever they may later prove to be, they never invent symbols, not even for their own use, in isolation. The mental skills of isolated children are amazingly limited, and this situation can be reversed only by intense cultural immersion. We know this from studying the lives of deaf-blind children like Helen Keller, who lost both vision and hearing as an infant. Her later life revealed an extraordinary talent for language, but this talent was hidden during her period of isolation. She stagnated throughout the normal critical period for language and made no progress toward acquiring language until she was provided with a system of symbols by her famous teacher, Annie Sullivan (cf. Lash, 1980). Annie re-established that vital link with culture, first by giving Helen a system of simple hand signals, and then through a variety of other symbols, including several systems of raised print and Braille. After that momentous step was taken, Helen made good progress and eventually acquired not only English but other languages as well. In achieving this, she was totally dependent on constant contact with the surrounding world. Culture liberated her mind. It let her out of prison, allowed her to think, and gave her the equipment she needed to develop a more complex mental apparatus. All her depth and richness as an adult came through the liberating effect of culture.

The point is that isolated brains, even linguistically clever ones such as Helen Keller's, never invent languages, not even a "language of thought," for their own use, even though such a skill would obviously be highly adaptive. We know from the post hoc testimony of many other late-learning deaf signers (see, for instance, Schaller, 1991) that, prior to someone successfully establishing symbolic contact with them, they never even suspected the existence of language. They had no names for things and, thus, no labels to aid their memories, analyze their societies, organize their thoughts, or plan their lives. They had no notion of naming, even as a possibility. Names, symbols, and languages always come from the outside, from the individual's absorption into a symbolic culture of some kind, even if it is a very small culture of two people. Left to themselves, isolated human brains do not act as symbolizing or language-generating devices, any more than do the brains of other primates.

Thus, we arrive at the perennial catch-22 in theories of human cognitive origins: symbolic cultures cannot function without languages, and brains cannot generate languages without pre-existing symbolic cultures. Natural selection has somehow locked these two players into a strange symbiosis. But how could our brain's unique relationship with culture have started? There is only one possible solution. Short of invoking an evolutionary miracle, expressive culture must have taken the first step. Moreover, this step could not have depended upon any built-in tendency to symbolize reality. Some archaic cultural leap, deep in our prehistory, must somehow have set the stage for our later transition toward a symbolizing mind.

I have stated my own hypothesis elsewhere about the nature of that archaic first step (Donald, 1991), and I will not repeat it here. It involves a brain capacity that allows us to map our elementary event perceptions to action, thus creating, at a single stroke, the possibility of action-metaphor, gesture, pantomime, re-enactive play, self-reminding, imitative diffusion of skills, and proto-pedagogy, among other things. I call this complex "mimetic" skill and its cultural aspects *mimetic culture*. The rationale behind this notion derives from a principle first proposed by the Russian psychologist Lev Vygotsky in his pioneering studies of children, the so-called "Outside–Inside" principle. Vygotsky observed that children always copy the externals of language first and do not initially have inner speech, or silent forms of symbolic thought (see Vygotsky, 1986). The rule is that symbolic thought is first played out in action and only later internalized. Young children externalize every thought in action and carry out their verbal thinking out loud. Only much later are they able to think in silence or, in the case of deaf signers, without moving their hands. Symbolic thought thus originates in externalized acts and only gradually migrates inside the head to perform its magic in apparent solitude. The picture in adults can be deceiving; they might have acquired their skills in a solipsistic manner. But children give away the store. When they are first acquired, our own symbolic performances are completely public, even to ourselves. Only later do they become internalized. The direction of flow is clear: from the culture to the individual mind, that is, outside–inside.

In principle, the evolution of human symbolic skills might have emerged in an analogous manner, migrating from outside to inside. The analogy is a loose one because there was no symbolic behavior to imitate 2 million years ago, when the process probably began. But it must have started in this way because, if fully equipped modern human brains still cannot internalize symbolic skills without an externalizing phase, this principle would have been even more applicable 2 million years ago. Thus our symbolic origins must have been impressed on our brains from out there. Some of the externals of intentional action came first, before we had any form of inner language or any symbolizing system to mediate silent thought. Mimetic action is the best candidate for this. Thus, we find the deepest origins of our capacity for symbolic thought in action—in fact, in a primal, extraverted expressive process, mimesis, that was based entirely in externalized actions.

What mimesis achieved was nothing less than an escape from the isolation of the mammalian nervous system. In collective mimetic action, humanity created the cognitive fundamentals of culture, the communicative glue that still holds human society together on the most basic communicative level. These must have been in place, in externalized patterns of action, long before any form of internalized symbolic thought could have evolved. The action patterns of archaic humans must have originated in group action patterns, reflecting back on one another, creating ripple effects, novel variants, shared skills, conventions, customs, and protorituals, for a very long time before any truly symbolic processes emerged. And by extension, only much later, after further evolution, could these processes have been internalized.

CONSCIOUSNESS AND SELF-CONSTRUCTION

Before we can understand what this statement means, we need to know more about the nature of action and about culture. But above all, we need to pay attention to what we have discovered about consciousness. Consciousness has never gained a respectable place at the table in our long debate over human origins, but it is a key player, and it is time to give it the seat of honor. Our tangled phylogenetic history has given us a *hybrid* consciousness, that is, a multilayered, complex, and quite unique central process. In 1991, I had accepted that human consciousness was probably an outcome of our evolution and not so much a part of the process. At that point, I had not yet realized that consciousness might be the engine of our cognitive evolution. But I am now convinced that it is. Note that I am defining *consciousness* here in a pragmatic, inclusive sense, as conscious capacity. My reason can be stated very simply: this is the most useful definition that I can find.

Human conscious capacity is the generative core of symbolic culture and of all our distinctively human styles of cognition. When we evolved our very large brain, we acquired a much more powerful apparatus of consciousness. Thus, our capacity is useful and adaptive. It did not emerge as a mere evolutionary afterthought, as some have suggested. Nor was it an epiphenomenon, an inconsequential byproduct of other evolutionary events. Rather, it was the main event. Instead of evolving a specialized language brain, or an apparatus designed to build a symbolic thought capacity into the fabric of the brain, we evolved two more fundamental things: expanded conscious self-governance and a burgeoning cultural environment. As cultural knowledge structures became more complex, our coevolving conscious capacity reflected that complexity, triggering a coevolutionary spiral that eventually culminated in high-speed modern language and all the spectacular cognitive pyrotechnics of the modern human mind. Ever since it began, our community of increasingly conscious brains has coexisted with an exploding process of enculturation. All else followed from this elemental brain–culture chemistry.

One might reasonably ask, why? Why would conscious capacity be essential to cultural survival? The primary reason that conscious capacity is so important is that complex symbolic cultures are not easy to read. Symbol-using cultures hide their secrets from all but the most curious and attentive mind. Their surface appearance is highly deceiving. On the surface, humans appear to go about their business like any other social mammal, and, if this were true, human culture should be no more difficult to understand than any other. But on a deeper level, human culture is exceedingly tricky, devious, and resistant to discovery. Moreover, it is invisible. None of its major patterns are immediately present in perception. Without a powerful intellectual guide, it remains impenetrable, remote, and opaque. The cultural neophyte will find it full of blind alleys, deceptions, indirect threats, tricks of memory, and shifting agendas. Above all, it showers the observer with blizzards of encrypted messages.

Human society is daunting enough even to those of us who are already skilled at surviving in it. But it must be terrifying to any creature with limited mental equipment. Even to a human child, adult culture must be revealed only gradually, layer upon layer, with extensive mentoring. Learning a culture is not unlike deciphering the intentions of a group of alien beings that one is forced to live with but whose actions and intentions are seldom what they seem. Because of the survival value of the incessant plotting and scheming that is the normal business of human beings, every child needs an internal guidance system to enable its self-assembling little mind to navigate these daunting cultural labyrinths. Our children are normally well-equipped to handle this challenge. For most, childhood is a protracted Alice-in-Wonderland adventure, an exploration of fantastic cultural worlds replete with what might appear, to lesser minds, as unpredictable chaos.

To achieve a successful adaptation to this demanding cultural world, human beings are aided by powerful capacities that were specially evolved for living in culture. These are known in experimental psychology as executive capacities. They constitute a central guidance system that allows human beings to manage and supervise their own cognitive activities while analyzing the second- and third-order patterns of culture. In this regard, we are much better equipped than apes. In fact, the major difference between ape and human brains rests precisely on these capacities. If the reader can tolerate a bad pun which I found nevertheless irresistible, I have labeled our unique complex or suite of executive adaptations as "the executive suite" (Donald, 1998b).

There are many components to the executive suite. They include memory, directional, and evaluative components. In the jargon of experimental psychology, all these components are identified with our conscious capacity. The *memory component* of human conscious capacity involves a greatly expanded working memory, a place in the mind where we can hold the images and ideas that may be relevant to whatever challenges we may be facing at any given moment. We need a great deal of working memory to learn something as complex as a language. The *directional component* gives us a certain cleverness in directing our attention selectively toward some of the least obvious features of the environment while ignoring others that are more perceptually attractive. This is needed to penetrate the intricate weave of social interactions and signals that characterize human society. The *evaluative component* involves cross-relating ideas in a highly efficient manner, across both time and space. This is needed very early in life, for instance, just to understand how a mother's actions today might follow from how she acted yesterday under quite different circumstances. This kind of cross-referencing is a tall order, and often impossible, for any nonhuman species. There are other components in the executive suite, but this will suffice to illustrate what it implies about autonomous cognitive self-regulation.

The kinds of functions that I have described, whether mnemonic, directional, or evaluative, are traditionally identified with consciousness, or more specifically, with what we call conscious capacity. They are essential for the mind to find its way through culture because human cultural environments are remarkably unpredictable at birth, and therefore a growing human mind must be maximally flexible and able to generalize rapidly from concrete instances and partial information. Our conscious capacity allows us to decipher the unpredictable forms of a surrounding culture. This is a critical skill, from the viewpoint of survival. If a child cannot make an initial connection with culture, the child cannot acquire the central skills that any symbolizing mind must have. My central thesis here revolves around that idea: conscious capacity is the key evolutionary feature of the human mind. It provides our connection with culture. At the same time, it is also the mediator for acquiring and assembling all our complex symbolic skills.

But its clinching achievement is an ability to generate a virtual infinity of skills. One culture invents sailing, another throat singing. One culture insists on a capacious oral memory to remember entire pharmacopoeias, whereas another demands great dexterity with external symbols to manage an electronic universe. We are asked to handle now broadswords, now biplanes, now remote microsurgical hands. Here we are asked to manage the politics of a tribal village with a memory that reaches back 10 generations, and there we live in a global culture with an infinity of instant information but no collective memory. All these specialized skills take years to acquire, under close conscious supervision and with deliberate instruction. Pedagogy and interaction are both essential to the process, because these skill complexes are always the product of more than one conscious mind. Specialized skills result from deep cognitive interactions between brains and constitute the cognitive core of any given human culture.

Indeed, such interactions constitute our main intellectual work. Our vital skills are watched, monitored, and worked over endlessly by the group. They are almost never species universal, automatic, or stereotyped, as are those of most species. Our expanded conscious capacity is essential for the self-assembly of all complex hierarchies of skill, including our most essential and most controversial skill, language. The latter has some universal features, as do many other skills, and these universals have to be explained. But in almost every important way, languages are culture specific. This reflects the most important fact governing our existence: unlike most species, we are self-invented to the core, peripatetic self-assemblers of minds.

This capacity for deliberate self-assembly is a direct product of our expanded executive brain. It allows us to supervise our acquisition of complex hierarchies of skill, including language. Without this, humanity would need to fall back on the evolutionary strategy of most other species, evolving a large number of innately programmed skills, built into our brains at birth, each with its own special modules. I do not deny that we have evolved some such programming, but it plays a much smaller role in the human case than in the case of other species. We get by with less fixed programming because we have added a new twist to the traditional Darwinian machinery of self-replication: a symbiotic relationship with culture and a conscious capacity to self-assemble cognitive architectures in our own brains. This relationship has liberated us from the cognitive isolationism of other species, and, to end on an optimistic note, may have given us the potential to eventually become masters of our own fate.

REFERENCES

Dawkins, R. (1989). *The selfish gene* (2nd ed.). Oxford, England: Oxford University Press.

Donald, M. W. (1991). *Origins of the modern mind: Three stages in the evolution of culture and cognition.* Cambridge, MA: Harvard University Press.

Donald, M. W. (1993a). Human cognitive evolution: What we were, what we are becoming. *Social Research, 60*, 143–170.

Donald, M. W. (1993b). Précis of *Origins of the Modern Mind* with multiple review and author's response. *Behavioral and Brain Sciences, 16*, 737–791.

Donald, M. W. (1995). The neurobiology of human consciousness: An evolutionary approach. *Neuropsychologia, 33*, 1087–1102.

Donald, M. W. (1996). The role of vocalization, memory retrieval, and external symbols in cognitive evolution. *Behavioral and Brain Sciences, 19*, 155–164.

Donald, M. W. (1997). The mind considered from a historical perspective: Human cognitive phylogenesis and the possibility of continuing cognitive evolution. In D. Johnson & C. Ermeling (Eds.), *The future of the cognitive revolution* (pp. 355–365). Oxford, England: Oxford University Press.

Donald, M. W. (1998a). Hominid enculturation and cognitive evolution. In C. Renfrew & C. Scarre (Eds.), *Cognition and material culture: The archaeology of symbolic storage* (pp. 7–17). Cambridge, England: Monographs of The McDonald Institute for Archaeological Research.

Donald, M. W. (1998b). Mimesis and the Executive Suite: Missing links in language evolution. In J. R. Hurford, M. Studdert-Kennedy, & C. Knight (Eds.), *Approaches to the evolution of language: Social and cognitive bases* (pp. 44–67). Cambridge, England: Cambridge University Press.

Donald, M. W. (1998c). Preconditions for the evolution of protolanguages. In M. C. Corballis & I. Lea (Eds.), *The descent of mind* (pp. 120–136). Oxford, England: Oxford University Press.

Edelman, G. (1987). *Neural Darwinism*. New York: Basic Books.

Lash, J. P. (1980). *Helen and teacher: The story of Helen Keller and Anne Sullivan Macy*. New York: Delacorte Press/Seymour Lawrence.

Savage Rumbaugh, E. S., Murphy, J., Sevcik, R. A., Brakke, K. E., Williams, S. L., & Rumbaugh, D. (1993). *Language comprehension in ape and child.* Chicago: Society for Research in Child Development (Research Monograph, Vol. 58).

Schaller, S. (1991). *A man without words*. Berkeley: University of California Press.

Tooby, J., & Cosmides, L. (1989). Evolutionary psychology and the generation of culture, part 1. *Ethology and Sociobiology, 10*, 29–49.

Vygotsky, L. (1986). *Thought and language* (A. Kozulin, Trans.). Cambridge, MA: MIT Press. (Original work published 1934).