Better Than Conscious?
Decision Making, the Human Mind,
and Implications for Institutions

Edited by
Christoph Engel and Wolf Singer

Program Advisory Committee:
Christoph Engel, Paul Glimcher, Kevin McCabe,
Peter J. Richerson, Lael Schooler, and Wolf Singer

The MIT Press
Cambridge, Massachusetts
London, England
How Culture and Brain Mechanisms Interact in Decision Making

Merlin Donald
Department of Cognitive Science, Case Western Reserve University, Cleveland, OH 44106–7068, U.S.A.

Abstract

Decision making is a very private thing, individualized and personal. Yet it has a cultural dimension. The human brain does not acquire language, symbolic skills, or any form of symbolic cognition without the pedagogical guidance of culture and, as a result, most decisions made in modern society engage learned algorithms of thought that are imported from culture.

Mathematical thought is a good example of this: it is cultural in origin, and highly dependent on notations and habits invented over many generations. Its algorithms were created culturally, by means of a slow, deliberate process of creation and refinement. Thus, the algorithms that determine many mathematically based decisions reside, over the long run, in culture. The brains of the individuals making the decisions are, in most particular instances, temporary "carriers" of cultural algorithms, vehicles for applying them in a particular time and place. In principle, this conclusion applies to many examples, such as chess-playing, social judgment, business decisions, the composition of poetry, and so on.

Culturally transmitted algorithms can be learned and made so automatic that they can be executed by the brain without much conscious supervision. Unconscious or "intuitive" decisions are often the best, and many successful decisions occur in an automated manner, in highly over-practiced situations. This does not diminish the larger role of consciousness in cognition, because, when necessary, decision makers retain the option of intervening consciously and deliberately to modify or fix their specific performances. Conscious supervision is thus the ultimate tribunal in cognition, a cutting-edge adaptation that is particularly important in the creative role of generating and changing the existing algorithms of culture that underlie most decisions.
Introduction

Decision making seems to be a very private thing: individualized, personal, and confined to the brain. Yet it has a cultural dimension. Culture defines much about the human brain, especially the so-called "higher-order" cognitive features that constrain and indeed, under some circumstances, mediate decisions. The human brain does not acquire language, symbolic skills, or any form of symbolic cognition without the pedagogical guidance of culture. Through its epigenetic impact, culture is a major determinant of how the brain self-organizes during development, both in its patterns of connectivity and in its large-scale functional architecture.

Individual decisions are made in the brain. Human brains, however, are closely interconnected with, and embedded in, the distributed networks of culture from infancy. These networks may not only define the decision-space, but also create, install, and constrain many of the cognitive processes that mediate decisions. Humans are collective thinkers, who rarely solve problems without input from the distributed cognitive systems of culture. For this reason, it is important to gain some perspective on the cultural and evolutionary context of decision making and its implications for building accurate models of neural and cognitive systems.

The Impact of Culture on Brain Development

The most obvious example of culture's impact on brain development is literacy skill. Literacy is a fairly recent historical change, with no precedent in archaic human cultures. The vast majority of the world's languages have never developed an indigenous writing system. Certain dominant modern cultures, by contrast, are not only literate, but heavily dependent on mass literacy for much of their cognitive work. Mass literacy is only spread by imposing modifications on the developing nervous systems of large numbers of individuals. These modifications are created by "educational" systems, which are basically systems of organized group pedagogy whose origins can be traced back to the beginnings of literate culture.

The cognitive subroutines that enable a person to become literate consist of chains of deeply automatized responses to visual symbols. These are hierarchically organized in functional brain architectures that support specific subcomponents of reading and writing skills, which are typically learned by prolonged immersion in educational systems that are highly idiosyncratic and culture-specific. The algorithms of educational systems are generated and transmitted collectively, and are formed by the governing ideas of the cultural environment. Literacy training is not easy; it takes a considerable amount of time and is not even close to becoming a species-universal skill for biologically modern humans.
Automatization of complex, fast response systems is the key to acquiring literacy skill. Non-automatized responses, such as those of someone who is learning a new language, do not allow the student to concentrate on the meaning of what is written. Automatization of all the stages of literacy training—including word recognition, grammar, vocabulary expansion, and expressive skill—can be achieved only after very extensive practice, to the point of overlearning, in successive stages of competency. During the acquisition phase of such skills, continuous conscious monitoring and corrective feedback is necessary. Once the basic skill has been learned to the point where the entire procedural system is automatic, conscious monitoring of the basic skill-set is no longer needed, and the response of the system becomes mandatory; that is, the reader cannot avoid responding to a visually presented word as a word. At that point, words and sentences can no longer be treated by the brain merely as a series of lines and contrasts; the meaning literally "pops out" of the marks on the page. Yet no one claims that these pop-out experiences are innate; they are culturally arbitrary and learned. They are also one of the most important interfaces with the distributed systems of culture, and they result in real physical changes to the brain, imposed by means of extensive cultural programming.

The physical reality of the culturally imposed automatic brain systems underlying literacy skill can be seen clearly in certain cases of acquired dyslexia and dysgraphia. In such cases, injury to the brain of a literate person selectively destroys a particular cognitive subcomponent of the literacy system, without damaging other closely related brain systems, such as speech and symbolic thought. Literacy-related brain systems thus appear quasi-modular in their organization: they can suffer partial breakdown of certain components, while leaving others intact. For example, one particular lesion might cause a patient to lose the ability to read while retaining the ability to write, and another patient might suffer the reverse. Specific lesions might even eliminate the ability to read irregularly spelled words, while the patient remains able to read words with regular spelling. These cases point to the existence of specificity of function in acquired brain architectures. This is incontrovertible evidence in support of the direct impact of culture on adult brain functional organization.

There are many other similar examples of cognitive skills that require extensive training, originate in culture, and depend upon acquired functional brain architectures (e.g., mathematical, musical, artistic and athletic skills). However, the neuropsychology of literacy skill stands as the strongest evidence that culture can impose radical cognitive reorganization on the brain.

This contrasts with a common alternative view of brain–culture interaction, which argues that the brain provides the basic mechanisms, whereas culture provides specific content. For example, in the theory of sexual behavior espoused by Behaviorism, innate brain mechanisms energize the human mating instinct, while culture shapes and defines the specific details of mating behavior in different times and places through conditioning. In the standard cognitive science approach to perception, the brain provides the innate neural
machinery of perception, which defines the parameters of perceptual experience, and culture simply shapes the norms and expectations that influence specific perceptual experiences. Similarly, the neo-Chomskian view of language holds that language capacity is innate, universal, and brain-based, whereas culture provides the particular details of the native tongue.

These approaches share a common belief, which reduces the role of culture to that of content provider, and holds that cognitive capabilities are direct products of brain evolution. This is largely true of many aspects of common mammalian behavior and cognition. For example, the capacity to shift attention is innate and depends on specific brain systems; in a neurologically normal child, it will develop without cultural input. Culture may bias attention toward certain things and away from others, but the influence of culture is limited to specifying what to attend to, and it does not play a role in creating the capacity itself. The same applies to other basic functions, such as capacities for various kinds of perception and action.

This assumption, however, is not valid in the case of human higher cognition. For example, language does not emerge spontaneously in a socially isolated brain; unlike attention, it does not self-install. The raw capacity for language may indeed be there in the abstract sense that it is latent in every neurologically normal human, but it will remain unrealized unless culture has an opportunity to guide the brain through the very subtle and complex process of language acquisition. In this case, it is culture that enables the capacity itself. This is not a trivial distinction, because it reveals a unique evolutionary phenomenon: the development of cognitive capacities that are qualitatively more powerful than their predecessors, and originate not in a specific brain adaptation, but in a special coevolutionary event that involved a close feedback loop running from culture back to the brain, and vice versa.

It was no accident that, when asked to draw a diagram of the neural basis of language, Saussure drew two brains engaged in a circular interactive loop (Saussure 1908). Two brains constitute the minimal conditions for a culture, and their interaction adds up to more than the sum of the parts. Culture plays a crucial role in actually making language possible, because languages do not originate in individual brains; they emerge only in culture. They are negotiated, like treaties, and are assimilated by individuals. They never emerge in the isolated individual, and the process of language evolution, which started at least two million years ago, perhaps earlier, is literally inconceivable outside of the context of brain–culture coevolution. Thus, although the example of the culturally installed "literacy brain" demonstrates the vulnerability of the human neurocognitive system to cultural input in dramatic fashion, it is far from unique. The human brain has been wiring itself up through culture for a long time, and literacy skills are only the latest case in point.
Cultures as Distributed Cognitive Systems

What adaptive forces drove human cultures to invest so heavily in literacy education and, consequently, in the epigenetic reprogramming of millions of brains at great cost?

Human cultures are unique in their highly cognitive character: ideas and memories can be traded and shared among the members of a cultural group, and intellectual work can be shared. Groups can create cognitive outcomes, make decisions, influence perceptions, and generate worldviews. A useful perspective on this aspect of culture can be taken from computational modeling: culture can be compared in principle to distributed computational networks, in which many computers are interconnected in a network. The network can then acquire properties that were lacking in the individual computers making up the network, such as greater memory resources and a specialized division of cognitive labor. Membership in such a network can make each individual computer look “smarter” than it appeared before joining the network. By extension, this applies to human beings living in culture. Specialization and organization of work can be coordinated in a network, and the cognitive power of the coordinated group system can far exceed the reach of any individual. One could perhaps point to the Manhattan Project as the supreme example of what technologically enhanced cooperative cognitive work (including decision making) can achieve, when performed in distributed systems made up of specialized, symbolically coordinated components.

Distributed cognition is a useful paradigm in which to view the developing brain. From birth, the rapidly growing human brain is immersed in a massive distributed cognitive network: culture. The network “interface” of the brain to culture is usually a social one. It consists of interactions with the unwitting “carriers” of the particular culture in which the infant is raised: parents, relatives, and peers who convey crucial information about where to direct attention, what to notice, and what to remember. The human infant’s brain is biased to seek such input from the start. One might say that it has evolved a specialized adaptation to seek out an early connection with cultural-cognitive networks (Tomasello 1999). Any serious failure to establish this social-cognitive connection can result in delayed development and in some cases, such as autism, in a permanent developmental disability. This early cultural bond is crucial; the human brain has evolved a dependency on culturally stored information for the realization of its design potential.

This dependency applies to the specific content of the knowledge stored in culture, but it applies especially to the process of gaining access to culture in the first place. The first priority of a developing human brain must be to acquire from culture the basic social and attentional tools that it needs to elaborate its cultural connection. Having done this in early infancy, it will then be in a position to acquire a massive amount of specific cultural content, some of which is procedural, in the form of skill, including language skill, and some of which
is semantic. Even episodic and perceptual memories are affected greatly by
culture, in the sense that they are heavily filtered and channeled; however,
skills and many kinds of semantic representations literally cannot exist without
culture, because they are generated there. Without completing the crucial early
phases of connection and sharing of mind, much of the information in culture
will remain unavailable to the brain throughout life. From the viewpoint of
capacity development, social-cognitive skills are especially enabling and empow-
ering in early life: they make possible and expand access to information
stored in subtle and otherwise invisible cultural loci.

One of culture’s most important by-products, technology, has further ex-
tended these prototypically human symbolic capacities by restructuring the
distributed cognitive networks of culture, and opening up new possibilities
for both representing knowledge and remembering it. A typical modern cogni-
tive-cultural distributed network links together many human brains with com-
 munications technology, images, books, papers, and computers. These kinds of
distributed networks perform much of the cognitive work of modern society,
from landing aircraft, to predicting the weather, and planning educational cur-
ricula. Individuals must be attuned to these networks to function effectively in
our society. Decision making occurs within tight network boundaries.

This raises a major scientific question: What are the specific domains in
which the human brain attunes itself to culture? The major interface of the hu-
man brain and its cultures is undoubtedly a cognitive one. The uniquely cogni-
tive nature of human cultures can only be explained in terms of a brain–culture
symbiosis in the domain of cognition. Cognition can be appropriately singled
out as the primary sphere in which culture and brain interact. Human cognition
constitutes a complex core of subcapacities and operations, interconnected by
means of an equally complex array of algorithms, shaped by cultural forces
during development. This applies to both the individual brain and to the wider
distributed systems of culture. The individual is transformed by immersion in
a distributed system. In such systems, memory is distributed in many locations,
and access paths proliferate.

One property of distributed systems is the division of labor across indi-
viduals. In a distributed system, an individual brain no longer has to contain
within itself all of the skills and information needed for individual survival.
Perceiving, remembering, recalling, searching, and attending are managed to
a degree from the outside by means of various symbolic media, as are the
specific learned algorithms of thought. As the division of cognitive labor in
culture becomes more and more specialized, the adaptive task facing a young
mind changes, and this has consequences for the deployment of the brain’s re-
sources. In particular, memory storage and retrieval is divided between brains
and other media in the complex distributed systems of modern culture, as are
many of the algorithms that drive thinking and problem solving. Since this
modifies the habitual use patterns involved in cognition, and brain activity and
growth directly reflect its habitual use patterns, it is reasonable to postulate that
concomitant brain processes, such as synaptic growth and regional localization, are also immediately affected. Unfortunately, although brain plasticity has been well documented in humans, there is not yet very much direct empirical evidence from brain-imaging studies on precisely how habitual, culturally imposed use patterns affect growth and development throughout the life span. We have only begun to collect empirical data on the neuropsychological impact of our close interaction with the external symbolic environment. By collecting more evidence, perhaps we will come to know, more exactly, how early and deep immersion in the distributed cognitive networks of culture affects the development of the nervous system.

One way to refine the questions that need to be answered in this area further is to observe brain–culture interaction over long periods of time. The pattern of emergence of cognitive change and cultural differentiation in human ancestors might prove helpful in conceptualizing how internal cognitive activity, in the brain, is interwoven with cognitive cultural activity, in distributed networks. In turn, this might enable us to ask more telling questions of the brain.

A Model of Human Cognitive and Cultural Coevolution

The most unique innovation of human beings in prehistory was the evolution of distributed cognition to a new level, indeed, to several new levels that had no precedent in other species. The human brain is adapted to the existence of cognizing mind-sharing cultures that far exceed the individual in terms of their ability to store and transmit accumulated knowledge and skill. However, mind-sharing cultures could not have emerged by themselves de novo. They are the product of a spiraling interaction between brain evolution and cultural change. The following is a brief review of a specific model of brain–mind–culture coevolution in hominids (Donald 1991, 1993, 1995, 2001).

The methodology used to derive this model was inherently interdisciplinary, drawing from many fields that could provide relevant evidence. My basic technique was to test every hypothesis, whether it grew out of a single field of research, or several, against evidence from all other relevant fields of research, and to reject any hypothesis that was incompatible with any solid fact, whatever its origin. This tends to produce robust theories, since accidental convergences from quite disparate fields of inquiry are highly unlikely to occur, and multiple accidental convergences are even less likely (Donald 2004).

There was one additional core postulate driving this model: brain–culture coevolution, with cultural-cognitive evolution leading eventually to such innovations as language. If brain and culture coevolved, the result should have produced a universal architecture of cognition—both on the individual and the distributed levels—evident in all human cultures. Such a structure should endure, even in the modern context, because evolution is conservative and systems that are working well do not tend to be replaced. The larger architecture of
distributed cognitive-cultural systems should be a relatively stable and universal structure. A large-scale cognitive-cultural hierarchy of mechanisms should form the basis for cognitive activity within the networks that support mind-sharing cultures.

In this model, there are three hypothesized “stages” of cultural-cognitive change in hominid evolution, during which the nature of hominid culture gradually shifted from the marginally symbolic to the proto-symbolic to the fully symbolic. This process was not conceived solely as a linear, gradualistic series of changes, but rather was characterized by several “punctuations” in an otherwise fairly stable hominid survival strategy. There was an archaic preadaptation about 2 million years ago when Homo first emerged, followed by a much more recent cognitive shift, within the past 400,000 years, that was radical and relatively rapid, and culminated in the fully symbolic cultures of biologically modern humans.

The physical evidence favoring this model came initially from two principal sources: fossils and material culture. An analysis of the fossil remains of human ancestors reveals two periods where there was a relatively rapid increase in hominid brain size and a change in body shape toward the modern pattern: the period from approximately −2 Mya to −1.5 Mya, when the species Homo first appeared, and a second period from −500 Kya to −150 Kya, when the species Homo sapiens first appeared.

Without necessarily conceding that increased brain size or body shape tells us anything in detail about the hominid mind, they do allow for some rough time markers and a partial reconstruction of their way of life. Such reconstructions suggest that these were periods of significant cognitive challenge, with a concomitant change in the survival strategies of hominids. The material cultural record left behind by hominids agrees with this picture. There were major changes in the cultural record during, and following, these two periods. The changes included changes in such things as toolmaking, firemaking and firetending, diet, hunting skill, migration patterns, and the location and construction of home bases and shelters. Cultural and anatomical changes have not always coincided, and there is much debate about such details as the number of hominid subspecies; however, the standard story of hominid emergence has not changed fundamentally during the last two decades.

There are compelling neural and cognitive considerations that greatly enrich this picture. Comparative anatomical evidence is an important clue here. Hominid evolution follows a trajectory from Miocene apes to modern humans. The starting and end points of brain anatomy are well known. Major differences between ape and human anatomy have been subjected to more detailed study, using advanced techniques, during the past decade, and the picture that emerges does not permit as much theoretical leeway as some might assume this field allows.

The cognitive networks that permeate all human cultures evolved in three stages, each of which added a new kind of representational “layer” to human
culture and had its own evolutionary rationale. These networks dominate the brain and mind in epigenesis and impose a hierarchical structure on higher, or symbolic, cognition. Such networks might be labeled, for convenience, "cognitive-cultural networks" (CCNs). They influence significantly the developing brain of a child, through the mediation of parents and community. CCNs co-evolved with changes in various brain structures and cannot exist without the cerebral apparatus that allows the young brain to assimilate these representational systems. On the other hand, it appears that very little detail is specified in the genes at this level. Increasingly, as a result of human evolution, it is the interaction between a highly plastic genetic potential and cultural reality on the ground in any given generation that generates the actual cognitive organization of the individual brain.

Table 9.1 illustrates the key points of this evolutionary theory of human cognitive origins. It begins in Miocene primates who had cognitive capabilities that are assumed to be roughly similar to those of modern apes, and had capabilities that are labeled as episodic. The three successive stages of hominid cognitive evolution proposed in this scenario are labeled as mimetic, mythic, and theoretic. Note that hominid cognitive evolution has here been captured in three cultural stages, because the most radical innovation in the hominid line is distributed cognition, culminating in a system of language and symbolic communication that has cultural origins. The scenario is thus: first generate cognizing cultures of a proto-symbolic nature; then let these become more complex, until they "combust" spontaneously into systems of symbolic convention and, eventually, into full-fledged language.

This proposal may seem unfamiliar to many cognitive neuroscientists, but the "stages" of human cognitive-cultural evolution should not be too unfamiliar, because they were established on a rigorous cognitive criterion: each putative stage involved a novel form of memory representation, and a new style of cognitive governance at the top of the distributed cognitive system that was, quite literally, governing. Each new stage—mimetic, mythic, and theoretic—marked the genesis of a new medium, or domain, of memory representation in the distributed system, or CCN, and also in the individual brain. The latter effect was an epigenetic change due to "deep enculturation." Each CCN domain postulated in this model has a complex internal hierarchical structure dictated by the properties of the shared memory systems available to hominids at that stage. The superordinate descriptive labels (i.e., episodic, mimetic, mythic, and theoretic) express and capture the top, or governing, level of representation within each domain.

I would like to add that this is a "cascade" model inasmuch as it assumes (as Darwin did) a basically conservative process that retains previous gains. As hominids moved through this sequence of cognitive adaptations, they retained each previous adaptation, which continued to perform its cognitive work perfectly well. Mimetic cognition incorporates, and extends, prior gains at the episodic level; mythic, or narrative-based cognition, is built on top of a
Table 9.1  Key points of the evolutionary theory of human cognitive origins.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Species/Period</th>
<th>Novel Forms of Representation</th>
<th>Manifest Change</th>
<th>Cognitive Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episodic</td>
<td>Primate</td>
<td>Complex episodic event perceptions</td>
<td>Improved self-awareness and event sensitivity</td>
<td>Episodic and reactive; limited voluntary expressive morphology</td>
</tr>
<tr>
<td>Mimetic (1st transition)</td>
<td>Early hominids, peaking in H. erectus (4 M to 0.4 Mya)</td>
<td>Nonverbal action modeling</td>
<td>Revolution in skill, gesture (including vocal), nonverbal communication, shared attention</td>
<td>Mimetic: increased variability of custom, cultural “archetypes”</td>
</tr>
<tr>
<td>Mythic (2nd transition)</td>
<td>Sapient humans, peaking in H. sapiens (0.5 Mya to present)</td>
<td>Linguistic modeling</td>
<td>High-speed phonology, oral language, oral social record</td>
<td>Lexical invention, narrative thought, mythic framework of governance</td>
</tr>
<tr>
<td>Theoretic (3rd transition)</td>
<td>Recent sapien cultures</td>
<td>Extensive external symbolization, both verbal and nonverbal</td>
<td>Formalisms, large-scale theoretic artifacts and massive external memory storage</td>
<td>Institutionalized paradigmatic thought and invention</td>
</tr>
</tbody>
</table>

basically mimetic, or gestural, mode of thought and communication; and theoretic cognition evolved slowly out of the classic mythic-mimetic thought strategies of traditional human cultural networks, retaining the latter within it. The first two hominid transitions—from episodic to mimetic, and from mimetic to mythic—were mediated largely by neurobiological change, while the third transition to the theoretic mode was heavily dependent on changes in external, nonbiological, or artificial, memory technology. The fully modern mind retains all of these structures, both in the individual brain as well as in the distributed networks that govern cognitive activity in cultural networks.

Each of these stages was marked by complex modifications in hominid survival strategies that undoubtedly involved many different changes in skeletal anatomy, brain anatomy, emotional responsivity, intelligence, memory, social organization, reproductive strategies, and temperament, among many other factors. Cognitive evolution could not have taken place in a vacuum, and major changes in cognition undoubtedly had implications for many survival-related variables, including diet, intraspecific and interspecific aggression, heat dissipation, metabolic energy, disease resistance, physical size, sexual dimorphism,
and so on. The cognitive stages listed above were derived in that very wide theoretical context. However, the prime driving force behind these changes was a cognitive one.

The reasons for labeling the primate cultures of the Miocene epoch as “episodic” have been spelled out in previous publications (Donald, 1991, 1993, 2001). The theory begins with the assumption that the early hominid brain, like its primate, and most probably australopithecine, predecessors, lacked language or any capacity for generating explicit symbolic representation in the wild. The archaic hominid brain, like most others in the primate line, shared the same basic design features that humans share with all primate brains. This means that the earliest predecessors of hominids would have been very clever social animals, with a remarkable ability to understand fairly complex social relationships, but limited expressive skill. In other words, they could understand social episodes and scenarios, but had no way of expressing this knowledge to one another.

The cognitive capacity that supports episodic intelligence is best described as “event representation.” Events are the “atoms” of episodic cognition. Social life consists of events, clustered in episodes which define alliances, troupe membership, and power relationships. By this definition, primates have excellent event representations, or ERs. They can remember specific events in an episodic manner; that is, they remember vivid details that are specific to a particular episode (e.g., after a fight with a rival, they remember the principal agents, outcomes, and future social implications of the fight). That kind of vivid, detailed event memory in humans is usually called episodic memory, and it is anchored in concrete events. For this reason, the cognitive and cultural style of primates might be labeled “episodic.”

The episodic mind-set of primates is non-symbolic or pre-symbolic in its expressive or representational style. There is no evidence that primates think or communicate in symbols in their natural state. The episodic mind is concrete, analogical, episode-bound, and anchored firmly in the perceived present. It acts largely within the span of working memory, using perceived similarities between situations (and also distinctions between them) as a means of choosing appropriate behavior.

Hominids, who shared an ancestor with chimpanzees about 6 million years ago, evolved beyond this mind-set at some point in their emergence. If we assume a Miocene starting point for hominids that was very close to the cognitive capacities of modern apes (A), and use biologically modern humans as the end point (B), the theoretical exercise becomes one of identifying the most probable sequence of events—neural, cognitive, and cultural—leading from A to B. The three transitions outlined in Table 9.1 constitute a coherent theory of the nature and approximate time course of the path from A to B. This provides a wide cognitive framework for reexamining the process of individual decision making in human beings.
Implications for Theories of Human Decision Making

The act of making a decision might be taken as one major paradigm with which to examine a very wide range of brain–culture interactions. Decisions are the final resolution events of a variety of cognitive scenarios that can engage, in theory, the entire voluntary action repertoire of human beings. Essentially, decisions occur at choice points in a cognitive sequence. Thus, one could, in theory, "decide" which memory to retrieve, which stimulus to attend to, which perceptual set to activate, which emotional attitude to assume toward a social scenario, as well as which pattern of action to pursue in a variety of contexts.

Decision making thus engages so many subroutines and subsidiary systems concerned with memory, symbolic representation, and thought as to constitute an abstract category that cuts across all of cognition. Decisions are sometimes imposed on innate brain systems (e.g., whether to smile in a particular social context) and are sometimes embedded in algorithms and mental habits with purely cultural origins (e.g., decisions involving numbers or other symbolic systems, or those that must obey complex symbol-based rules, such as buying stocks, filling out crossword puzzles, or choosing materials for a tool). Human decision making is most commonly a culturally determined process in which many basic cognitive operations play a part, and the mechanisms of such decisions must be regarded as hybrid systems in which both brain and culture play a role. When the individual "makes" a decision, that decision has usually been made within a wider framework of distributed cognition, and, in many instances, it is fair to ask whether the decision was really made by the distributed cognitive cultural system itself, with the individual reduced to a subsidiary role.

This is not a simple issue to resolve: the individual brain and mind contain within them a great deal of history and structure that can be brought to bear on how decisions are made in specific cases. The brain regions engaged in a specific kind of decision may be determined as much by this history as by innate brain growth patterns, both because of the epigenetic impact of culture on cognitive architecture and because the actual task imposed on the brain by a given decision can be changed by redistributive effects that occur within the networks of culture. Distributed systems are able to change where in the system each component that influences a certain decision is located. This applies to such things as the locus of memory storage for a specific item, of a specialized cognitive operation, and of the choice mechanism itself. When all of these components are located in a particular individual brain, decision making is one thing; when they are distributed across various people and information media, it is quite another, even if the final "decision" is made by one person. For this reason, and because decision making is so wide in its application, we should not predict the existence of a specialized brain region or subsystem that is devoted to resolving decisions in any general sense of the term. Rather, one might
say that decisions can be made in many different ways that might involve different anatomical subsystems of the brain.

**Better than Conscious?**

The question of conscious versus unconscious processing in decision making can be better understood in the wider perspective of distributed CCNs and the brain’s entrainment to them. The conscious mind is the mediator of novelty and learning. It has the capacity to guide mental development, but it is not the mediator of mundane routine, even in the highest aspects of symbolic thought. A professional mathematician does not think about his use of the elementary notations that mediate his creative thought process; if he did, he could not be creative at that level. Similarly, a writer who worried about forming individual letters, or composing correct grammatical sentences, could not focus on the level of narrative or characterization. Human cognitive prehistory is basically a scenario of downloading complex cognitive processes to the automatic mode. By creating a distributed system that carries the framework of collective cognition across generations, humans have reduced the load on consciousness. We have minimized the need for conscious monitoring of most thought and memory processes by forcing mastery in the individual to the point of automatization. This enables a person to move up to another level in the task hierarchy.

The decoupling of consciousness from attention is clear in cases of highly automatized tasks such as reading music. To master this task sufficiently to perform at a professional level, a complex chain of skills must be practiced for many years. This skill-set involves the entrainment of attention at an unconscious level, in the sense that a musician must not be self-conscious about elementary operations such as what a specific symbol on the page might mean. The performer must focus on interpretation, emotion, and coordination with accompanying musicians. The notes and phrasing must take care of themselves, meaning that they must not make demands on conscious capacity.

A musician has the option, however, of intervening consciously at those lower levels when necessary. Conscious attention has a “zoom” feature that allows intervention at many points in the task hierarchy. For instance, if a finger is locked, or the instrument is eccentric in some way, adjustment may have to be made at the level of fingering or some other technical skill. Those adjustments will be made with conscious guidance, because they are novel and unpredictable in outcome. The lesson is simple: the power of conscious intervention is available when needed. If the musician is well trained and in good health, all technical elements of the performance are well maintained, and the focus of conscious effort can be placed where it should be: at the top, where crucial decisions are being made online, as the performance unfolds.

A musician is often embedded in a larger distributed cognitive structure, such as an orchestra. That structure constrains the choices the musicians can
make and dictates much about the performance. Individuals are still in control of their roles, but these roles are framed by a vast web of culturally enforced expectations and coordinated operations. The “zoom” function of consciousness is even more important in such situations, because monitoring must be simultaneously directed internally, at personal performance parameters, as well as externally, at coordination with the group.

The important conclusion is that the possibility of conscious intervention in every decision remains viable. Decisions may be made automatically, without conscious engagement, in highly overpracticed routine situations. Yet even in such situations, when necessary, the performer can intervene consciously at any level in the internal cognitive system. Certain kinds of decisions must be made consciously, especially those involving novelty or learning. However, for the larger distributed systems of culture to operate smoothly, the rule seems to be: the less conscious engagement, the better. Conscious intervention is needed for acquisition and feedback control, but most individual cognitive operations should be made as automatic as possible in such systems. This constitutes a kind of industrialized cultural-cognitive network coordination, with concomitant efficiencies and increased collective power.

At this Ernst Strüngmann Forum, much has been made of the superior powers of spontaneous “intuition” in decision making. Such intuitions are sometimes considered “unconscious”; however, this is a rigged argument. In most examples, cases of superior “intuitions” are clearly the outputs of deeply en-culturated routines that have been acquired by means of conscious rehearsal and refinement. A highly automatized subroutine may indeed function better at times without conscious intervention: the musician example given above is a case in point. This applies, in principle, to many other examples: face recognition (an acquired, highly culture-specific skill), chess playing, various kinds of social judgment, business decisions, and the composition of poetry. In each case, the task hierarchy is typically acquired in the context of a distributed cognitive-cultural system, with extensive pedagogy and training, and highly conscious, or deliberate, practice and rehearsal (sometimes in the form of imaginative play), to the point of automatizing the response, which affords the temporary release of conscious monitoring. In short, one of the main objectives of human conscious supervision is to make itself less important in future performances of the same activity.

As in all things, however, there is an associated caveat: Although there are obvious advantages to abandoning personal conscious control in overlearned performances, under some circumstances (and especially in novel situations), there are equally obvious dangers. The conscious individual is still the ultimate arbiter of choice, and the CCNs that store algorithms in culture, and transmit them to new generations, cannot be constructed without a great deal of conscious deliberation. The short-term advantages of a loss of conscious control in many situations should not be allowed to overshadow the larger role of consciousness in assembling the elaborate, and uniquely human, distributed
cognitive apparatus of culture, keeping it on course, and preventing it from becoming unstable.

References and Further Reading


