13

Cognitive Predispositions and Cultural Transmission

PASCAL BOYER

We call those concepts and norms that seem to be shared within a group and differ from those of other groups "cultural." We call concepts and norms "cultural" if people have them *because* other people in their group have them or had them before. This suggests that transmission of concepts and norms is at the heart of what constitutes human cultures.

To what extent does cultural transmission require memory? The answer of modern cognitive anthropology is slightly surprising. If we understand "memory" in the ordinary sense of information about past situations that we can access and consider explicitly, the answer is that cultural transmission does not actually require as much of *that* kind of memory as we would generally assume. Indeed, a great deal of cultural transmission takes place outside of explicit memories, as I explain here. But memory, for psychologists, includes more than just explicit memories (Roediger, Wheeler, & Rajaram, 1993). It comprises systematic information about the social and natural environment, what is called "semantic memory," as well as the many skills and habits known as "procedural memory." Once we understand memory, as psychologists do, as including all these processes beyond conscious inspection (Roediger, 1990), then memory really is the crux of cultural transmission. In the pages that follow, I will justify these statements on the basis of a few examples of cultural domains where the work of memory (in the wider sense) has been extensively studied.

WHAT IS CULTURAL TRANSMISSION?

Let me start with a few examples of the kind of transmission phenomena anthropologists study. In two different domains, I will provide both a familiar and an "exotic" illustration, as a first indication of the range of variation:

Religious concepts. [a] Some people in the United States and European nations seem to take it for granted that an invisible agent (God) is aware of their actions and *cares* about it, especially the moral aspects of their behavior. [b] Many people in the Solomon Islands have frequent interaction with their dead forebears, to whom they occasionally sacrifice a pig – a goodwill gesture that keeps the ancestors happy.

Ethnic categorization. [a] Most people in the United States know which of a small number of "ethnic" categories they belong to. Although these categories are sometimes defined in terms of a particular phenotype (skin tone, or other physical features), some members of the a group do not look at all like the stereotype of the group. What matters is descent more than external appearance. [b] Many people in West Africa consider that craftsmen (blacksmiths, potters, weavers) are intrinsically impure, so that one should not share food, let alone have sex, with them. Even the members of such groups who do not practice the craft are impure. What matters is descent more than actual occupation.

Ritual behavior. [a] People in religious congregations, for example, at a service in a synagogue or church, engage in a variety of scripted, rigidly prescribed rituals supposed to produce real though unobservable effects. [b] Turkana people in Kenya organize a ritual in which people are enjoined to walk in a procession toward a bull, rub their bodies against the animal's head, kill it, and then carefully tread on its carcass.

How do we understand and explain the fact that these particular concepts and norms, about gods and ancestors and social categories and specific ritual actions, seem to be successfully transmitted, such that they are (at least roughly) shared among most people of a particular group, and often similar to what could be observed several years or generations before? We are often tempted to think that people have the same concepts and norms as other members of their group because they just "observed" and "absorbed" what was "in the air" as they grew up. This, obviously, is less than satisfactory, to say the least, although this type of answer until recently was more or less all that cultural anthropology had to say about cultural transmission. In the last twenty years or so, however, there has been considerable development in research about the evolutionary and cognitive background to the acquisition of culture (Sperber & Hirschfeld, 2004), to which this chapter can serve as an introduction.

CULTURE AS MENTAL EPIDEMICS

Culture is the aggregation of many episodes of individual transmission. Anthropological models of cultural evolution start from the assumption

that what we observe as cultural representations and practices are variants of cultural traits found in roughly similar forms in a particular place or group, because they have resisted change and distortion through innumerable processes of acquisition, storage, inference, and communication (Boyd & Richerson, 1985; Sperber, 1996). In this way, the spread of specific variants of cultural representations (such as a particular belief or concept represented by a human mind) is formally analogous to the spread of alleles in a gene-pool. In particular, the tools of population genetics can be applied to the spread of cultural traits and allow us to predict their spread, given such parameters as the initial prevalence of a trait, the likelihood of transmission and various biases (Boyd & Richerson, 1985). Also, such models allow a formal description of the different possible connections between genetic evolution and cultural transmission (Durham, 1991).

The biologist Richard Dawkins summarized all this by describing culture as a population of *memes* which, like genes, are just "copy-me programs" (Dawkins, 1976). Genes produce organisms that behave in such a way that the genes are replicated – otherwise the genes in question would not be around. Memes are units of culture: notions, values, stories, and so on that get people to speak or act in certain ways that make other people store a replicated version of these mental units. A joke or a popular tune are simple illustrations of such copy-me programs.

To make sense of the transmission of memes, Sperber and colleagues put together an *epidemiological* framework to describe the mechanisms of cultural transmission (Atran, 1990; Boyer, 1994a; Hirschfeld, 1994; Sperber, 1985). An epidemic occurs when a group of individuals display similar symptoms. To explain what happened, you must understand the particular ways in which the human body reacts to the presence of this particular agent. Human minds are inhabited by a large population of mental representations. Most of them are found only in one individual, but some are present in roughly similar forms in various members of a group. To account for this is to explain the statistical fact that a similar condition affects a number of organisms, as, for example, in epidemics.

MEMORY, CULTURAL ENTROPY, AND COGNITIVE PREDISPOSITIONS

Before we proceed, let me underscore what is (as anthropological experience suggests) the wrong way to approach the transmission process. For a long time, cultural anthropologists have followed the recommendations of Emile Durkheim and other founders of modern sociology, that is, to

ignore human psychology altogether and treat cultural facts, for example, American race-concepts or Solomon Island religion, only at the level of the group (see, for instance, Durkheim, 1947; Hertz, 1960). In other words, the relative success of cultural transmission should be considered a given, and the actual processes that support it could be left aside. (To be fair, this position made great sense at a time when our understanding of cognitive development, memory and other neurocognitive processes was extremely rudimentary, and would not have explained much of human cultures.)

More recent models of cultural transmission aimed to replace mythical notions like "collective memory" and "absorbing what's in the air" with a concrete, measurable process of transmission. People communicate with other people, they meet individuals with similar or different notions or values, they change or maintain or discard their ways of thinking because of these encounters, and so forth. What we call their "culture" is the outcome of all these particular encounters.

This, however, also raises a problem. No two minds are alike. When people receive and handle some information, they produce inferences that make sense of that information by bringing to bear all manners of available information from memory, most of which is highly idiosyncratic. This suggests that cultural "memes" undergo mutation, recombination and selection inside the individual mind every bit as much and as often (in fact probably more and more often) than during transmission between minds. We do not just transmit the information we received. We process it and use it to create new information, some of which we do communicate to other people. So how come there is similarity at all, if representations come from so many sources and undergo so many changes? To rephrase this, cultural transmission though individual events of communication should in principle lead to extreme cultural entropy, in which people in a group all entertain very different norms and concepts. What is the source of negative entropy or additional order?

Recent cognitive anthropology has suggested that the answer lay in the wealth of findings and models from experimental and developmental psychology, linguistics, neuropsychology, and the neurosciences. All of these converge to show that all normal human minds share a number of *cognitive predispositions* that make certain kinds of concepts and inferences particularly likely to occur. Even though the contents of memory are different in each individual, some common principles, most of which are not available to conscious inspection, complement and organize incoming information. So some kinds of inferences tend to go in particular directions, no matter where you start from. They constitute statistical "attractors" for cultural

transmission (Claidière & Sperber, 2007). In the following sections, I will document the effects of such predispositions in various domains of human cultures. Cognitive predispositions are not just general *constraints,* for example, on the amount of material that can be acquired, on the capacity of attention and memory. Cognitive predispositions also consist in specific *domain-specific expectations* about the kinds of objects and agents to be found in the world. Human expertise about the natural and social environment, including what is often called "semantic knowledge," is best construed as consisting of different *domains* of competence. Each of these corresponds to recurrent evolutionary problems, is organized along specific principles, is the outcome of a specific developmental pathway and is based on specific neural processes. This domain-specific view of cognition informed by different principles was first popularized by developmental psychologists (Gelman, 1978; Gelman & Baillargeon, 1983) who proposed distinctions among physical-mechanical, biological, social, and numerical competencies as based on different learning principles (Hirschfeld & Gelman, 1994). This way of slicing up semantic knowledge has received considerable support from both developmental psychology and the study of highly specific cognitive impairment (Caramazza, 1998). Neuroimaging and cognitive neuroscience are now adding to the picture of a federation of evolved competencies that has grown out of laboratory work with children and adults.

If cognitive dispositions are domain-specific, this suggests that their effects on cultural transmission will be specific, too. For instance, from an early age, we have particular expectations about how sounds combine to produce speech. This is why children pay attention to some properties of verbal input more than others. In the same way, we seem to have specific expectations about the difference between inert objects and intentional agents, and these guide the way we pay attention to specific information about animals, plants and other natural objects. The notion of domain-specific predispositions explains the very familiar phenomenon, that cultural acquisition in different domains takes different routes. For instance, acquiring language or notions of kinship relations, friendship, or love is effortless and largely implicit; we do not realize that we are learning anything at all. Acquiring table manners or social hierarchies is not difficult either, but it is largely explicit; we know that we are learning something. We also know that what we learn is special to a particular group or society. Finally, acquiring the principles of algebra or theology is both explicit and effortful. All of this signals that different cognitive predispositions are involved and make the transmission of cultural material more or less transparent and more or less difficult.

RELIGIOUS CONCEPTS

Do people know what their religious concepts are? This may seem a rather odd question, but it is in fact an important one, and the true answer is probably in the negative. In most domains of mental activity, only a small part of what goes on in our brains is accessible to conscious inspection. For instance, we constantly produce grammatical sentences in our native tongue with impeccable pronunciation, often without any idea how this is done. Or we perceive the world around us as made up of three-dimensional objects, but we are certainly not aware of the ways in which our visual cortex transforms two retinal images into this rich impression of solid objects out there. The same goes for all our concepts and norms. We have some notion of what they are, but we certainly do not have full access to the way our minds create and sustain them.

In the same way, most of the mental machinery that sustains religious concepts is not consciously accessible. Indeed, experimental tests show that people's actual religious concepts often diverge from what they believe they believe (Barrett, 1998; Barrett & Keil, 1996). This is why theologies, explicit dogmas, scholarly interpretations of religion cannot be taken as a reliable description of either the contents or the causes of people's beliefs. For instance, the psychologist Justin Barrett showed that Christians' concept of God was much more complex than the believers themselves assumed. Most Christians would describe their notion of God in terms of transcendence and extraordinary physical and mental characteristics. God is everywhere, attends to everything at the same time. However, subtle experimental tasks reveal that, when they are not reflecting upon their own beliefs, these same people use another concept of God, as a human-like agent with a particular viewpoint, a particular position and serial attention. God considers one problem and then another. Now, that concept is mostly tacit. It drives people's thoughts about particular events, episodes of interaction with God, but it is not accessible to people as their "belief" (Barrett, 2002; Barrett & Keil, 1996).

To illustrate this and some further arguments about concepts of gods and spirits, let me make use of the anthropologist Roger Keesing's account of the Kwaio religion (Keesing, 1982), see more extensive discussion in (Boyer, 2001). The Kwaio live in the Solomon Islands; most of their religious activities, as described by Keesing, involve interacting with ancestors, especially the spirits of deceased members of their own clans, as well as more dangerous wild spirits. Interaction with these *adalo* (the term denotes both wild spirits and ancestors) is a constant feature of Kwaio life. People

frequently pray to the dead or give them sacrifices of pigs or simply talk to them. Also, people "meet" the ancestors in dreams. Most people are particularly familiar with and fond of one particular *adalo*, generally the spirit of a close relative, and maintain frequent contact with that spirit. Now, Kwaio people need not be told that spirits can perceive what happens, or that they can make a difference between their wishes and reality. People are just told that, for instance, "the spirits are unhappy because we failed to sacrifice a pig for them."

A systematic investigation reveals that notions of religious agency, despite important cultural differences, are highly similar the world over. There is a small repertoire of possible types of supernatural characters, many of whom are found in folktales and other minor cultural domains, although some of them belong to the important gods or spirits or ancestors of religion (Boyer, 1994b, 2000a). All these concepts are informed by very general assumptions from broad categories such as person, living thing, or man-made object. A spirit is a special kind of person, a magic wand a special kind of artifact, a talking tree a special kind of plant. Such notions combine (a) specific features that violate some default expectations for the domain with (b) expectations held by default as true of the entire domain. For example, the familiar concept of a ghost combines (a) socially transmitted information about a physically counterintuitive person (disembodied, can go through walls, etc.), and (b) spontaneous inferences afforded by the general person concept (the ghost perceives what happens, recalls what he or she perceived, forms beliefs on the basis of such perceptions, and intentions on the basis of beliefs).

These combinations of explicit violation and tacit inferences are culturally widespread and may constitute a memory optimum. Associations of this type are recalled better than more standard associations but also better than oddities that do not include domain-concept violations (Boyer & Ramble, 2001). The effect obtains regardless of exposure to a particular kind of supernatural beliefs, and it has been replicated in different cultures in Africa and Asia (Barrett, 1998; Barrett & Keil, 1996; Boyer & Ramble, 2001).

This situation, in which a certain cultural assumption (a) includes counterintuitive aspects and (b) activates an intuitive background, can be conceived as a cognitive optimum for cultural transmission, in that the assumption has both the initial salience and the inferential potential that contribute to its acquisition and use (Boyer, 1994a). This, obviously, applies to the fundamental principles underlying religious representations, not to the specific set of "surface" features that accompany them. For instance, the principle of intentional agents with counterintuitive physical properties is

widespread the world over; but in each cultural environment it is accompanied with detailed, and highly variable explicit notions about the characteristics and behavior of those agents.

To sum up, we can explain human sensitivity to particular kinds of supernatural concepts as a by-product of the way human minds operate in ordinary, nonreligious contexts. Because our assumptions about fundamental categories such as person, artifact, animal, and so on are so entrenched, violations of these assumptions create salient and memorable concepts.

GODS AND MORALITY

The effect of intuitive expectations goes further. Most information about religious matters is about supernatural *agents,* who are described as "interested parties" in our moral choices (Boyer, 2000b). This means that the gods or the ancestors are not indifferent to what we do, and this is why we must act in particular ways or refrain from certain courses of action. As far as anthropologists know, people in most places conceive of some supernatural agents as having some interest in their decisions. This can take different forms. Christians, for instance, consider that God expects some particular kinds of behavior and will react to departures from the norm. People who interact with their ancestors, like the Kwaio, have a much less precise description of what the ancestors want, but it is part of their everyday concerns that the adalo are watching them.

Why are supernatural agents involved in our moral understandings? Some clues can be found in the development of moral understandings, which seem to appear very early in childhood. Indeed, Eliot Turiel has shown that even preschoolers have a good intuitive understanding of the difference between social conventions and moral prescriptions (so that beating up people is wrong even if no one told you so, while being noisy is wrong only if there was an injunction to keep quiet) (Turiel, 1983, 1998). Also, children make a difference between moral principles and prudential rules (do not leave your notebook near the fireplace). They justify both in terms of their consequences, but assume that social consequences are specific to moral violations. So experimental studies show that there is an early developed specific inference system, a specialized moral sense underlying moral intuitions. Notions of morality provide an initial basis on which children can understand adult moral views. This capacity for entertaining abstract intuitions about the moral nature of courses of action (without, of course, being able to explicate them) was found also in children with various amounts of experience with other children, in

different cultures, and even in children with exceptional experiences of abuse or neglect.

Supernatural agents are usually represented as having full access to morally relevant information. That is, people represent a given situation, and represent some information about it that is relevant to social interaction, and they assume that the supernatural agent also has that information. Obviously, all this consists in tacit assumptions. After representing a particular behavior as wrong, and feeling guilty, it seems quite natural to assume that some other agent with full access also feels the behavior was wrong.

To recapitulate, both the notions of supernatural agency and that of religious morality are grounded in intuitive expectations that are not specific to religion. The successful cultural transmission of these norms and concepts requires that cultural information be of a specific format, that triggers activation of intuitive expectations about agency (some of which are violated, most of which are confirmed by religious notions) and about morality (most of which are enriched by the religious tradition). In an important way, the transmission of religion does not reduce to concepts and norms being "downloaded" from cultural elders to novices, and "memorized" by the latter. Memory effects are more specific. Information about religious agents and their moral interests is preserved to the extent that it triggers spontaneous inferences from cultural novices. These inferences are based on semantic, generally implicit memory structures that are similar in all normal minds, leading to the recurrent religious notionsobserved in human cultures.

ESSENTIALIZED SOCIAL CATEGORIES

People the world over *categorize* their social environment. That is, they do not just think they interact with individuals, but tend to see them as members of more general classes like families, social class, ethnic group, caste, race, lineage, or gender (Hirschfeld, 1988). People often categorize social groups by assuming that there are *natural* differences between them (Haslam, Rothschild, & Ernst, 2000).

Assumptions that groups have a common "nature" are particularly salient in the case of racial ideologies. Although "race" concepts have no actual foundation in genotypic similarities (Marks, 1995), they are universally understood as based on some natural principle, on undefined properties transmitted through biological descent rather than tradition or accident (Hirschfeld, 1996). In contrast to their alleged basis in immutable natural differences, these understandings are clearly influenced by power relations

between groups (Stoler, 1991), which explains, for instance, why Jews in the United States, a dominated minority originally considered as biologically different, only recently became "white" in most Americans' understanding of the term (Brodkin, 1998).

In many different places, members of arbitrary social categories are maintained in a low social (and generally economic) status. These may be members of culturally specific groups (Ainu in Japan, tribal people in India) or technical specialists (undertakers or blacksmiths or potters in Africa and Asia). The latter case is particularly interesting in that many members of such groups do not practice or know anything about the trades in question. Most African blacksmiths and potters are still considered such even though no-one in their groups ever makes pots or smelts iron. In such caste systems, people of different groups are said to carry very different "natures," which supposedly explains why they should not intermarry or even come into close contact (Daniel, 1984; Quigley, 1993).

Why are these ideas so "natural" that they are found the world over and seem so intuitively obvious to most people? This is a complex issue, because several different cognitive predispositions are involved, and each coin to the successful transmission of tribute different aspects of "social essentialism."

To begin with, several authors have suggested that social groups may be construed in terms of *biological essentialism*, that is, as analogous to animal species (Atran, 1990; Boyer, 1990; Gil-White, 2001; Rothbart & Taylor, 1990). Essentialist intuitions are very robust and explicit in representations of the natural world. Animal species are intuitively construed in terms of species-specific "causal essences" (Atran, 1998). That is, their typical features and behavior are interpreted as consequences of possession of an undefined, yet causally relevant quality particular to each identified species. A cat is a cat, not by virtue of having this or that external features – even though that is how we recognize it – but because it possesses some intrinsic and undefined quality that one only acquires by being born of cats. This assumption appears early in development (Keil, 1994) so that preschoolers consider the "insides" a crucial feature of identity for animals even though they of course only use the "outside" for identification criteria (Gelman & Coley, 1991).

For this essentialist mode of understanding social categories, input conditions include the following: (a) some living things are presented as having common external features – a prototype; (b) they are all born of other members of the same category; and (c) there is no reproduction outside the category (Atran, 1998). So humans may process ethnic groups and some other social categories as if they were "species" because (a) category-based

endogamy and (b) descent-based membership make them partly similar to living species (Gil-White, 2001).

In this interpretation, the understanding of the social world seems to be parasitic on intuitive biology. Indeed, members of the target group are often said to carry a particular "something" that is (a) undefined, (b) inherited, (c) unchangeable, and (d) causally efficacious. Racist ideology in the United States assumes that black people have "something" that is common to all of them and makes them different from whites, that this something is inherited rather than transmitted by tradition or education or a product of specific circumstances; but the ideology stops at explicating what that "something" actually consists of. Even though modern racial ideology mentions genes, no one *needs* such explicitation to hold the essentialist assumptions. In many places in Africa and Asia castes of craftsmen are explicitly construed as based on natural qualities: the people in question are thought to be essentially different from the rest by virtue of some inherited, internal quality. Blacksmiths in West Africa are supposedly different, they are all descended from blacksmiths – you cannot become a

Biological understandings, however, are not sufficient to explain other features of essentialised social categories, such as the notion that contact with some groups is potentially dangerous (Kurzban & Leary, 2001). Consider the notion of "miscegenation," a truly exotic concept for non-Americans, which denotes the possibility of adulterating white "essence" by mixing it with black. Various forms of the "one-drop rule" in antebellum United States or apartheid South Africa meant that any trace of black ancestry made one person black – although the reverse was never the case. Indeed, it is always the subordinate group that "trumps" other biological descent. Although people may derive pride or status from, for example alliances with or some distant ancestry from royalty or the upper class, this never makes them full-fledged members of these high-status groups. But having one low-caste ancestor, inb caste or "race" ideologies, is enough for membership. Also, in many situations of "essentialized" social categories, people have the intuitions (a) that members of the subordinate group carry some dangerous, invisible substance, (b) that any contact with them can transmit that substance, and (c) that the amount or frequency of contact is irrelevant. In caste systems the world over we find the common assumption that contact of any kind (through sex, food-sharing, in some cases even conversation) can transmit some undefined, dangerous substance that is characteristic of a group.

These principles are very similar to those produced by the *contagion-contamination system*, an set of cognitive predispositions that produces strong

feelings of aversion to (even very remote) contact with likely sources of pathogens (decayed corpses, dirt, excrement, etc.). As Rozin and colleagues have shown, easy acquisition of such disgust reactions is vital to generalists like rats and humans (Nemeroff, 1995; Rozin, Haidt, & McCauley, 1993). More generally, pathogen avoidance is made very efficient by three intuitions: (1) that pathogen presence is usually invisible, (2) that contagion accompanies all sorts of different modes of contact, and (3) that the amount or frequency of contact is irrelevant (Siegal, 1988). Note that these three features exactly

This would explain the intuitive, easy acquisition and strong cultural transmission of such notions. No one needs to be provided with an explicit account of what makes some people dangerous or of why any form of contact is dangerous. These expectations come for free, as it were, in human minds. All that cultural transmission does in this case is transfer them to social categories instead of kinds of animals, plants, and substances.

Finally, the fact that some social categories are essentialised may also activate dispositions for *coalitional thinking*. One of the most solid and famous results of social psychology is that it is remarkably easy to create strong feelings of group-membership and solidarity between arbitrarily chosen groups (Tajfel, 1970). These well-known results demonstrate the extraordinary strength of the human propensity towards group solidarity, what Matt Ridley called "groupishness" (Ridley, 1996). Humans are extremely good at using coalitional affiliation to carry out collaborative endeavors by efficiently allocating trust among cooperators (Kurzban, 2001; Levine & Kurzban, 2006). People will spontaneously form groups where a certain degree of trust ensures co-operation and mutual benefits. Coalitional solidarity presupposes an activity in which joining is (presumably) voluntary, defection is possible, benefits can be accrued by cooperation and there is a notable cost in being a cooperator when others defect. There is now ample psychological evidence for a coalitional psychology, a specific kind of inferences that apply to these trust-based groups but not to other forms of social interaction (Levine & Kurzban, 2006).

In a series of striking experiments, Kurzban and colleagues showed that this coalitional psychology is probably involved in representations of "race" by Americans (Kurzban, Tooby, & Cosmides, 2001). For many years, social psychology experiments had shown that "race" was automatically encoded. No matter what explicit instructions are given, no matter how irrelevant race is, no matter how much extra cognitive work has to be done, participants always seem to recall the racial identity of the faces they saw during an experiment. On evolutionary grounds, Kurzban et al. reasoned that "race" was automatically encoded because it was a proxy for coalitional

affiliation. Indeed, when subjects were required to encode coalitional links, their memory of racial identity was considerably confused.

This coalitional interpretation is also suggested by a more general *social dominance* framework (Sidanius & Pratto, 1999). In this model, ostracism and dominance behaviors result not just from the desire to stay with one's group or to favor one's clan, but also in a more insidious way to favor one's group in a way that maintains the other group's lower-status position. That is, what drives people's behavior is a coalitional structure in which it is actually advantageous to try and keep members of other groups in a lower-status position, with distinctly worse outcomes. This has important consequences. In classical "stereotyping" models, all members of the target group would be equally discriminated against. In the dominance model, males would be the prime targets for prejudice, as they constitute a more salient threat to one's coalitional advantages. This indeed seems to be the case (Sidanius & Pratto, 1999).

To sum up, then, the notion that people belong to a particular "race" or "caste" by virtue of descent, together with its implications for social interaction, seems to recruit various forms of cognitive dispositions, to do with biological essentialism, with contamination and with coalitional affiliation.

RITUALIZED BEHAVIOR IN GROUPS AND INDIVIDUALS

In all human groups one finds some form of ritualized activity. Here is an example from the Turkana of Kenya (Lienard, 2003) of the ritual sacrifice of an ox. The animal must be of a specific color and shine. The animal should ideally be sacrificed by a left-handed twin. In the sequence preceding the sacrifice, ritual participants circumambulate the ritual scene three more times and then gather in a semicircle, facing East. The animal is made to go around the dancers three times counterclockwise. At some point in the ritual, the members of the clan offering the ox approach one at a time the sacrificial ox and carefully rub their body from forehead to loin on the animal's forehead, in a gentle upward thrust, an operation made difficult by the animal's attempts to get loose and to shake its head violently. The ritual officer cuts the animal lengthwise at the level of the diaphragm/upper abdomen. The body is then spread at the center of the ritual scene. During the next phase of the ritual, clans regroup and people line up to cross finally the ritual field from west to east walking right through the ox's split body, being careful to tread on a puddle of chyme – taken from the animal's stomach – in which has been placed the axe used to give the ultimate death blow. Among the crowd of each clan, elders and men are first to pass, followed by adolescent girls and girls in age of marriage, then the mothers with children

and finally the young unmarried men. The sacrificer and his assistants make sure that everyone passing through the carcass steps on the axe placed in the chyme before proceeding.

Why do people perform such behaviors? Naturally, there are all sorts of reasons why one should perform a particular ritual in a particular instance. What I mean here is more general. Ritualized behavior can be defined as by *compulsion* (one must perform the particular sequence), *rigidity* (it must be performed the right way), *redundancy* (the same actions are often repeated inside the ritual) and *goal-demotion* (the actions are divorced from their usual goals) (Bloch, 1974; Humphrey & Laidlaw, 1993; Rappaport, 1999). So what are the effects of ritualized behavior, such that individuals find collective rituals attention-grabbing and participation in such ceremonies compelling? Some general features or effects of this kind of scripted, rigid, and so on, behavior should explain why, all else being equal, it appears with such frequency in human cultures.

To explain this, we must take into account that ritualized behavior can be observed in other circumstances, in particular.

Children's rituals. Most children engage in ritualistic behaviors at a particular stage of development, starting at two, peaking at five and subsiding around seven. The behaviors include perfectionism, attachment to favorite objects, concerns about dirt and cleanliness, preoccupation with just-right ordering of objects, preferred household routines (Evanset al., 1997; Zohar & Felz, 2001).

Obsessive-compulsive disorder. In some people, intrusive thoughts and compulsions can evolve into full-blown obsessive-compulsive disorder, with stereotyped and repetitive activities with no rational justification (American Psychiatric Association, 1995). In most patients, the rituals are a spontaneous response to obsessive thoughts about potential danger, notably contamination and contagion (fear to catch other people's germs, to ingest contaminated substances, to pass on diseases to one's children or others), possible harm to others or to oneself (e.g., handling kitchen utensils and wounding people), as well as social ostracism following shameful or aggressive acts (thoughts about assaulting others, shouting obscenities, exhibitionism, etc.).

In these different contexts, of them we seem to find, not just the same organization of behavior but also a number of *recurrent themes*. Many rituals seem to focus around such themes as: pollution and purification, danger and protection, the possible danger of intrusion from other people, the

required use of particular colors or specific numbers, the need to construct an ordered environment (Dulaney & Fiske, 1994). A ritual space or instruments are described as "pure" or "safe" (or on the contrary as the locus of concentrated "pollution") or the point of the ritual is to "purify" people or objects, to "cleanse" mind or body, and so on. These particular features are by no means universally associated with ritualized behavior, but they are so frequent that their recurrence deserves a special explanation.

On the basis of anthropological and neuropsychological evidence, we proposed a synthetic model of ritualized behavior (Boyer & Lienard, 2006) that focused on the following points:

1. *The Hazard-Precaution Repertoire: potential danger*. Human cognitive structures include a specific "Safety Motivation System" (Szechtman & Woody, 2004) for dealing with *potential* danger, with neural structures distinct from fear-systems responding to *actual* danger (LeDoux, 2003). This system is specifically focused on recurrent hazards such as predation, intrusion by strangers, contamination, contagion, social offence and harm to offspring. The system does not seem to respond in the same way to more recent potential dangers such as tobacco or cars (Mathews, Jang, Hami, & Stein, 2004). We call this system "Hazard-Precaution" system because it also includes some rudimentary descriptions of possible precautions, including avoidance (of other people), contact avoidance and disgust (against contamination), attention to traces and indirect signals (against intrusion and predation), hyper-vigilance and heightened anxiety.
2. *Complex ritual rules and working memory*. Many ritual prescriptions turn usually automatic behavior (speaking, washing, getting dressed etc.) into highly controlled behavior that requires sustained attention. An example is having to tie one's shoe-laces *three* times with the right hand and *four* times with the left hand. In patients' compulsive rituals, this results in "swamping" of working memory, so that the person cannot attend to stimuli and situations outside the ritualized action (Ursu, Stenger, Shear, Jones, & Carter, 2003; Zalla, Verlut, Franck, Puzenat, & Sirigu, 2004). We have argued that the same is true of collective ritualized behavior. The frequent combination of a positive prescription ("do *x* …") and a negative one ("… while avoiding to do *y*") would seem to engage working memory and executive control in a way that is not usually present in everyday action flow.
3. *Working memory and intrusive thoughts*. Many patients state that performing the ritual is one way of inhibiting or repressing unwanted

> thoughts (Salkovskis, 1985). In our view the "swamping" of working memory may constitute a spontaneous and moderately efficient form of *thought-suppression*, with some similarities to the suppression processes studied experimentally by Wegner and colleagues (Wegner & Erskine, 2003; Wegner & Schneider, 2003). So patients with complicated compulsions spontaneously design a kind of activity so demanding in cognitive control that intrusive thoughts can be, at least for a while, pushed away from consciousness.

This would explain the organization and contents of most individual ritualized behaviors, pathological or not. But how does that translate to features of collective rituals? Freud had suggested that these were a form of collective obsessive neurosis (Freud, 1906[1948]), but that is hardly a satisfactory explanation. A more parsimonious model would suggest that the existence of a Hazard Precaution system makes certain kinds of cultural recipes particularly attention-grabbing and compelling (Lienard & Boyer, 2006).

Consider, again, the question in terms of cultural acquisition and transmission. When a ritual such as the Turkana ceremony, described earlier, is organized, cultural novices receive all sorts of information, most of which implicit, about the sequence of actions prescribed. Occasions for ritual are often described in ways that overlap with the Hazard-Precaution Repertoire, for example threats to fitness such as famine or illness, invisible germs or miasma, dangerous invisible pollution present in newborn infants, dead bodies, and menstruating women (Bloch & Parry, 1982; Metcalf & Huntington, 1991). Also, as I said earlier, most collective rituals include such operations as washing and cleaning, checking and rechecking that a particular state of affairs really obtains, as well as creating a symmetrical or otherwise orderly environment (Dulaney & Fiske, 1994; Fiske & Haslam, 1997). All of these items of communicated information should result in some activation of the Hazard-Precaution system, probably less intense than in situations in which people directly encounter clues for potential danger.

Many aspects of collective rituals activate the Hazard-Precaution system by including typical clues for relevant potential dangers. In other words, witnessing or performing the prescribed actions should result in activation of the Hazard-Precaution system. This does not mean that participants in a collective ritual deliberately use the ceremony to express Hazard-Precaution themes, or that participation in such rituals has the anxiety-reducing effects observed in individual ritualized behavior. Collective rituals are culturally successful, that is transmitted from generation to generation, because they enjoy some transmission advantage over other variants. In our model, one important factor is that

cultural ceremonies include various cues that activate the Hazard-Precaution system. Mention of Hazard-Precaution themes (e.g., there is an invisible danger about, there is "pollution," we need to "cleanse" a particular space, etc.) makes these kinds of collective action more attention-grabbing and compelling than possible variants that do not include such themes.

EXTERNAL STORAGE AS A MEMORY AID

So far, we have considered the effect of largely implicit, semantic memory structures, in the form of intuitive expectations, on the acquisition and elaboration of socially transmitted information. People receive some cultural "input" in the form of other people's utterances, gestures, or in the form of various artifacts. Because this input triggers activation of highly similar inferential processes in different people, they result in highly recurrent features of human cultures.

Now these transmission processes are made much more complicated by the development of external information storage. We are used to thinking of this as a feature of modern or at least complex state-based societies, with literacy, specialized scholars and complex teaching institutions. But it may be of help to begin with an example from a simpler form of social organization, to highlight the contribution of cognitive dispositions to this form of external memory.

Before literacy appeared in a few state societies, may groups had developed sophisticated ways of storing information outside individual minds. Familiar examples include the *qipu* of Peru, long strings along which knots would represent particular events and amounts of objects. The system was used almost exclusively for accounting purposes (Ascher & Ascher, 1981). In a more complex manner, various pictographic systems were developed in many different societies, to record particular events or provide an aid to the recitation of myths and the performance of rituals. These systems often comprised hundreds of distinct stylized symbols. They have often been considered as precursors to writing, as a form of "proto-writing" (see for instance Evans, 1908; Gelb, 1963).

As writing, these systems are obviously extremely limited. Each sign stands for a complex concept, but there is no expressive power beyond the limited list of signs (a few hundred at the most) and here is no combinatorial power at all. Juxtaposition is the only way of combining signs, and it is intrinsically ambiguous. Indeed, the only known way to express complex thoughts in writing is to encode *speech* rather than *concepts* (DeFrancis, 1989), and this is precisely something pictographic systems cannot do. However, the perspective may be misleading, and founded on hindsight (knowing how

literacy developed) rather than a proper understanding of the functions of pictographic systems (Severi, 1987). The latter were generally used, not as expressive communication devices, but as efficient memory aids.

Consider, for instance, the sets of pictographic plates used by Cuna shamans (in Panama). Among the Cuna, each of a set of identified conditions is treated by a specific song, chanted by a specialist, a shaman, according to a supposedly rigid ritual sequence (Haya, Holmer, & Wassén, 1947; Reverte, 1968; Severi, 1987). Now, Cuna shamans have long used a highly elaborate system of pictography to provide convenient transcriptions of these chants. Each song corresponds to a series of plates that include dozens or hundreds of specific signs. The plates are not generally used during the rituals themselves but serve as memory-aids in the training of new shamans. This is made all the more indispensable as the long and complex songs are couched in an archaic or esoteric language specific to shamans. Consider, for instance, the *akualel*, a song for restoring departed souls to the body (Nordenskiöld, 1938, p. 557ff.). The song describes evil spirits who made off with the soul of the patient, causing various symptoms and misfortune. The shaman is supposed to send his own tutelary spirits to fight the thieves, bring back the soul and restore it to the patient's body (see Figure 13.1).Each of the signs stands for a verse or fragment of the song, for example:

1	Downstream by the river banks
2	God
3	placed near your houses, for your well-being
4	[the stones called] Nelenusakele
5	Akualele
6	Kunakalele – this I am advising you
7	I am talking about medicines
8	A good medicine I am telling you about …

Note some important characteristics of this use of pictographs as memory aids. First, there is no evidence that Cuna shamans established a common, unambiguous system of signs with standardized forms and conventional reference. Rather, ethnographers such as Nordenskiöld found a whole variety of idiosyncratic systems transmitted along lineages of shamans and apprentices. Second, even in each shaman's plate of drawings, each sign does not stand for a stable set of utterances but rather cues memory to the relevant utterance – one sign may trigger an ingle word in one context and a whole

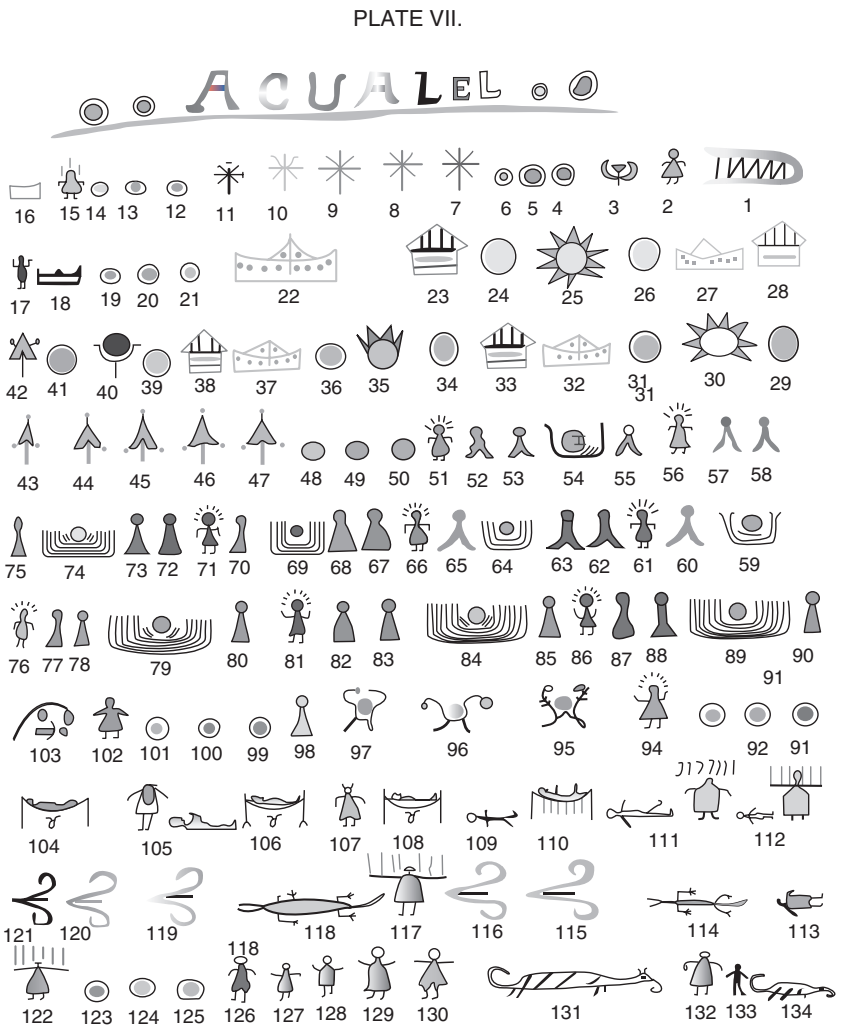

FIGURE 13.1 Pictographs to accompany recitation of the *akualel* song by Cuna shamans. This only shows the first part of the song. Numbers added by the editors. (From Nordenskiöld, 1938 Plate VII).

sentence in another. Third, the pictographs are only used in this ritual context, and the sentences they cue make no sense outside that particular situation (Severi, 2002). The songs themselves are predominantly reflexive, that is, they describe what the healer does as he is doing it, a common feature of shamanistic ceremonies.

The signs in such pictographic systems are used, not as repository of stable meanings, but as memory aids. Now it makes little sense to think of particular information as "stored in" or "expressed by" memory aids. These are powerful and efficient only to the extent that they reliably trigger specific inferences in the minds of their users. A particular mental event reliably occurs when a particular user is confronted with the physical object used as memory aid. This is true of "stickie" notes and knotted handkerchiefs, and applies in the same way to sets of pictographs.

There is a long tradition of such memory aids and techniques of memory, from Classical Antiquity to the Renaissance and modern mnemotechnics. Classical texts such as Cicero's *Ad Herennium* (Cicero & Caplan, 1964) mention such techniques as the famous method of *loci* – associating each item to be recalled with a specific stop on a familiar journey. In Classical culture, the arts of memory were a crucial part of the rhetorical training essential to the civilized life. In the Renaissance, a new development of the arts of memory combined with a mystical view of the many "signs" and "signatures" to be found in the external world – a system of correspondences between all observable aspects of Nature (Spence, 1984; Yates, 1966), see also Carruthers and Ziolkowski (2002) for original documents. Note that these "arts of memory" never assumed that information can be stored without elaboration or transformation. On the contrary, an essential goal was to find ways of combining, ordering and imagining information such that retrieval would be easier. In other words, Classical and Renaissance specialists accepted that memory works by *inferences* triggered by specific cues. Without the inferential system, the cue and the store are useless.

There is a lesson here, not just for the study of these sign-systems but more generally for our views about external storage of information, including in its modern, literate and digital forms. We often assume that external storage is just that, a form of "storage" in which information that may otherwise be in our minds can be downloaded, then retrieved in a similar form as need dictates. In the meantime, some external medium (words in books, pictographs in the Cuna drawings, digital sequences in a computer) "contains" the relevant information. However, information is not a static property of the strings of symbols, but a property of the processes they trigger in the interpretation device – which could be a human agent in the case of writing or a computer program in the case of digital memory. The words are only ink-patterns, the digital sequences are only streams of noughts and ones. To emphasize a trite but important point, it is only through interpretation that they refer to anything at all.

In other words, stored information works as what psychologists call a "cue" to a specific inferential process. The efficiency of the storage system is a function of how predictable these inferentuial processes are. Now, this is where some properties of literacy (and subsequent techniques) may be misleading. Because the physical symbols (words and pictures) are relatively stable, it seems to us that the interpretative work that gives them meaning is highly predictable and not too complicated. Both assumptions are false, as most students of literacy have noted. The physical stability of manuscripts and books never guaranteed the corresponding stability of the works (Maybin, 1994), as books convey meaning only against a background of mostly tacit, often historically specific assumptions.

LITERACY AND MEMORY IN RELIGION

For some time now, anthropologists have emphasized the specific aspects of literate cultures and the contrast with oral transmission, based on face-to-face contact between (generally) personally known interlocutors (Ong, 1977, 1982). Literacy seems to introduce an entirely new way of communicating and organizing information, first by allowing commmunication between distant individuals, also by making communication impersonal, and finally by introducing forms of representations (lists, tables, graphs) that are just not available to oral communication (Goody, 1968, 1977).

How does that interact with the kind of cognitive predispositions described in the previous sections? This would be the subject of a whole treatise, so I will only mention a single domain, that of religious thought and practices. Literate religion generally occurs in the context of large polities with a fair measure of social stratification, such as kingdoms or city-states (Maryanski & Turner, 1992). Such polities, kingdoms, and city-states, gradually provided specific economic niches for individuals and groups specialised in the provision of specific services, such as lineages or castes of specialized craftsmen, servants, functionaries, and scribes (Greif, 2006) but also religious specialists (Goody, 1986). A religious guild is a group that derives its livelihood, influence, and power from the fact that it provides particular services, in particular the performance of rituals (Boyer, 2001).

Services provided by such institutionalized groups differ from those of informal, generally orally based religious groups centered on shamans or mediums. The literate version generally constitutes a specific *brand*, that is, a kind of goods and services that is (a) clearly distinct from what others could provide, (b) similar regardless of which member of the guild provides it, and (c) exclusively provided by one organization. A Catholic

priest offers rituals that are quite different from the ancestor-based rituals his African congregation were used to; but Catholic rituals are also quite stable from one priest to another; some observable features make it easy for most observers to distinguish between say a Catholic mass and what is offered by rival churches. The fact that literate religious institutions develop such brandlike identification is probably an optimal way for such grops to compete with the informal, more shamanistic version of religion. The latter always survives even when institutionalized religion dominates. The alternative is always available and often tempting as apparently more dramatic and efficacious than priest-based religion (Whitehouse, 2000).

In this competition, literacy is particularly important, as a technique that supports the kind of surface uniformity and stability that is necessary to developing and identifying a brand. By using a standard text (a scripture) and training literate specialists (priests), religious groups can survive because they offer predictable and distinctive services. In this sense, the presence of literacy does change the contents and organization of cultural concepts and norms (Goody, 1977). It supports, for instance, religious ontologies that include universally relevant, highly abstract gods or a god rather than locally bound ancestors and spirits. It also supports the notion that ritual specialists are replaceable technicians rather than medium-like persons with exceptional qualities.

IS THERE A CAPACITY FOR CULTURE?

Humans receive vast amounts of information from cultural elders and peers. They use that information to build conceptual structures, some aspects of which are group-specific and form the basis of what we usually call "cultures." It is convenient to date the appearance of modern-type cultures at the symbolic "explosion" that occurred some time between 100,000 and 50,000 years BP, with an abrupt change in the number and quality of artifacts produced by modern humans, with a great variety of new objects, some of which of no practical utility, the use of ochre, the first cave-paintings, elaborate burial practices, etc. An important difference with earlier cultural manifestations lies in the diversity of objects and representations, which may indicate the emergence of those group-level similarities and between-group differences that are typical of human cultures.

It is tempting to think of modern humanization as some kind of cognitive breakthrough that made human minds became more flexible, more capable of novelty, in a word more open. For some scholars, the crucial event is the appearance of complex verbal communication with a recursive syntax

(Bickerton, 1990) – but note that we do not know much about the date of this putative transition between early pidginlike idioms and modern language. Other scholars see cultural explosion as the effect of a new capacity for symbolic reference and a newly acquired flexibility in "off-line" mental representations (Donald, 1991), although again this is difficult to gauge from the archaeological record. Finally, the appearance of episodic memory in the form of "mental time-travel" has been hailed as the major development that allowed modern social and cultural phenomena (Tulving, 2001).

To go further than speculative proposals, one should think of this question in a properly evolutionary-psychological framework. First, we should describe the appearance of modern human cultures in terms of the specific neurocognitive capacities involved in cultural transmission – as documented by experimental evidence in the domain. As we saw earlier, people do not have a capacity for "absorbing what's in the air" – acquiring cultures is a complicated, domain-specific process. Second, we should consider neurocognitive systems that were and are plausibly affected by small, incremental genetic changes. Natural selection most likely did not result in a massive leap from "nonsymbolic" to "symbolic" minds but only in slow changes towards the modern form. Third, we must have some strong evidence that these gradual changes would have incrementally positive consequences for the organisms' fitness. It is not at all self-evident in what sense a more "cultural" organism is more fit than another – the advantages of this type of information transmission must be documented rather than taken for granted. We are still very far from such an evolutionary picture of early cultural evolution.

Some proposals however do make sense in terms of both the archaeological record and the experimental psychology evidence. Steven Mithen offers for instance a cognitive interpretation of the cultural explosion of the Upper Paleolithic (Mithen, 1996). Evolution resulted in the accretion and complexification of a large number of pan-specific cognitive capacities geared to task-specific problem solving. These "Darwinian algorithms" have clear input conditions, that is, they only attend to and handle information in a particular domain, such as intuitive physics, "theory of mind," but also more limited domains such as cues for parental investment, mate-choice, coalition-building, living-kind categorization, and so on (Tooby & Cosmides, 1992). Mithen argues that cultural explosion is the effect of significant changes in cognitive architecture, in particular of multiple information exchanges between modular capacities. The difference between early and modern Humans is not so much in the operation of each specialized capacity (intuitive biology, theory of mind, tool-making, intuitive physics)

but in the possibility to use information from one domain in the course of activities monitored by another domain. So artifacts are used as body-ornaments, serving social purposes; biological knowledge is used in visual symbols; tool-making develops local traditions and makes efficient use of local resources, tapping information from "natural history intelligence." Most strikingly, this is the period when visual symbols take a "religious" appearance.

This makes good sense of the archaeological record – and in particular of the successes and limitations of early humans – it leaves open the question of what drives and more importantly what limits "cognitive fluidity" and the exchange of information between specialized systems. Indeed, a mind with such features runs the risk of belief-promiscuity, that is, the creation of a wealth of irrelevant or harmful associations and conceptual combinations (Cosmides & Tooby, 2000). An important contribution to cultural evolution may lie, precisely, in the capacity to limit fluidity, to select conceptual associations on the basis of relevance.

This is why Michael Tomasello and colleagues have argued that other aspects of human cognition are required for the evolution of cultures (Tomasello, Carpenter, Call, Behne, & Moll, 2005). Cultural transmission requires intuitive psychology (or "theory of mind) abilities. For instance, human tool-making requires sophisticated perspective-taking capacities that are beyond the abilities demonstrated in apes (Tomasello, 2000; Tomasello, Kruger, & Ratner, 1993) and this applies *a fortiori* to the transmission of complex norms and concepts. This, however, may be insufficient. As Tomasello and colleagues have demonstrated, some rudiments of this understanding of goals in present in other apes (Warneken & Tomasello, 2006). So a crucial component that is distinctly human may be a particular *motivation* to engage in coordinated action by monitoring other agents' goals and trying to adjust one's own behavior to these goals. This motivation, which appears very early in normal human infants, is strikingly absent in experimental and observational studies of non-human apes. It may also underlie the specific social and cultural deficits of autistic children (Tomasello et al., 2005).

Finally, and most important, successful cultural transmission requires successful human communication. The inferential processes described in this chapter reflect a general property of human communication, namely the ostensive-inferential transfer of information. Human communication does not work by downloading information (as a code system, e.g., honey bee dancing) but by demonstrating communicative intentions (Grice, 1975; Sperber & Wilson, 1995). That is, even banal conversations require

that listeners construct by inference an optimally relevant interpretation of utterances, which cannot be directly decoded from what is said.

This feature is so fundamental to communication in humans that some authors see it as the most important stone on the road to modern culture (Sperber, 2006a, 2006b). Ostensive-inferential communication is necessary for language to acquire its expressive power but may have predated sophisticated, syntax-based language in human evolution. Organisms with some rudiments of relevance-based inferential communication can easily create stable communicative idioms (Hurford & Kirby, 1995) although the converse is less plausible. This view receives some support from developmental evidence of the very early development of relevance-driven, inferential communication in infants (Csibra, 2007; Gergely, Egyed, & Király, 2007).

To sum up, we now have at least a tentative list of those specific capacities that made cultural evolution possible, although it is probably sterile to look for the "magic bullet" that triggered the transition from other-animal cultures and traditions (Avital & Jablonka, 2000) into full-blown cumulative human cultures (Boyd & Richerson, 1996). Humans differ from other apes in many of their capacities, and most of them are involved in the appearance and transmission of cultures.

EPILOGUE: TWO ROLES FOR MEMORY

In the different domains surveyed here, cultural transmission involves a variety of memory processes, beyond what we generally call "memories," that is, explicitly represented information about past scenes. Indeed, I have mostly focused on memory processes that do not belong to the familiar domain of explicit, episodic memory, what is commonly called "memory." I emphasized a variety of processes that are, by their very nature, outside conscious inspection, yet prove to be crucial in the selection and organization of cultural material.

Naturally, this is only half the story, as far as memory in culture is concerned. I said that people produce spontaneous inferences on the basis of particular gestures and utterances – but that requires that people first attend to and then remember the utterances and gestures in question. For instance, I described the fact that people infer a straightforward "psychology of ancestors" as intentional agents, from the facts that people sacrifice to the ancestors and apparently talk to them. But to do that people have to recall what happened during those rituals. More generally, the material that triggers most relevant utterances is material that has been transmitted and recalled.

So there are two important roles for memory in cultural transmission:

a. Given particular input, people also recall the *surface features* of that input – the particular gestures and words used, the specific shapes of the visual patterns used, etc. This recall is obviously strongly constrained by the operating principles of episodic memory, a topic that I did not consider here (but see a through survey in Rubin, this volume);
b. Given particular cultural input, people build group-specific norms and concepts by inference – these inferences are strongly constrained by what I called cognitive dispositions, in other words stable features of semantic memory.

In the domains described here, there is a constant interplay between the workings of explicit episodic memory and the largely implicit processes that govern knowledge acquisition and belief fixation. For instance, in most religious traditions people explicitly transmit a variety of statements about supernatural agents; but the tacit counterpart of these statements, the fact for example, that agents have perceptions and memories, is supplied by our intuitive, largely tacit psychological assumptions. The same goes for morality, or for concepts of ethnic groups as based on essential qualities. In all these domains, I tried to suggest that we can replace the traditional assumption of "cultural downloading" with a more precise cognitive model. We can construe the various physical objects and events that people experience as so many *cues* that trigger specific *inferences*. As inferential processes are substantially similar in different minds, human groups can maintain a (rough) similarity in concepts and norms among a particular social group, what we call a culture.

REFERENCES

American Psychiatric Association. (1995). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Publishing, Inc.

Ascher, M., & Ascher, R. (1981). *Code of the quipu: A study in media, mathematics, and culture*. Ann Arbor: University of Michigan Press.

Atran, S. A. (1990). *Cognitive foundations of natural history. Towards an anthropology of science*. Cambridge: Cambridge University Press.

(1998). Folk biology and the anthropology of science: Cognitive universals and cultural particulars. *Behavioral & Brain Sciences*, *21*(4), 547–609.

Avital, E., & Jablonka, E. (2000). *Animal traditions: Behavioural inheritance in evolution*. Cambridge, UK; New York: Cambridge University Press.

Barrett, J. L. (1998). Cognitive constraints on Hindu concepts of the divine. *Journal for the Scientific Study of Religion*, *37*, 608–619.

(2002). Smart Gods, dumb Gods, and the role of social cognition in structuring ritual intuitions. *Journal of Cognition and Culture, 2*(3), 183–193.

Barrett, J. L., & Keil, F. C. (1996). Conceptualizing a nonnatural entity: Anthropomorphism in God concepts. *Cognitive Psychology*, *31*(3), 219–247.

Bickerton, D. (1990). *Language & species*. Chicago: University of Chicago Press.

Bloch, M. (1974). Symbols, song, dance, and features of articulation: Is religion an extreme form of traditional authority? *European Journal of Sociology*, *15*, 55–81.

Bloch, M., & Parry, J. (Eds.). (1982). *Death and the regeneration of life*. Cambridge: Cambridge University Press.

Boyd, R., & Richerson, P. J. (1985). *Culture and the evolutionary process*. Chicago: University of Chicago Press.

(1996). Why culture is common, but cultural evolution is rare. In W. G. Runciman, J. M. Smith & R. I. M. Dunbar (Eds.), *Evolution of social behaviour patterns in primates and man* (pp. 77–93). Oxford, England: Oxford University Press.

Boyer, P. (1990). *Tradition as truth and communication: A cognitive description of traditional discourse*. Cambridge: Cambridge University Press.

(1994a). Cognitive constraints on cultural representations: Natural ontologies and religious ideas. In L. A. Hirschfeld & S. Gelman (Eds.), *Mapping the mind: Domain-specificity in culture and cognition* (pp. 391–411). New York: Cambridge University Press.

(1994b). *The naturalness of religious ideas: A cognitive theory of religion*. Berkeley, CA: University of California Press.

(2000a). Cultural inheritance tracks and cognitive predispositions: The example of religious concepts. In H. Whitehouse (Ed.), *Mind, evolution and cultural transmission* (pp. 57–89). Oxford: Berg Publishers.

(2000b). Functional origins of religious concepts: Conceptual and strategic selection in evolved minds [Malinowski Lecture 1999]. *Journal of the Royal Anthropological Institute*, *6*, 195–214.

(2001). *Religion explained. Evolutionary origins of religious thought*. New York: Basic Books.

Boyer, P., & Lienard, P. (2006). Why ritualized behavior in humans? Precaution systems and action-parsing in developmental, pathological and cultural rituals. *Behavioral & Brain Sciences*, *29*, 1–56.

Boyer, P., & Ramble, C. (2001). Cognitive templates for religious concepts: Cross-cultural evidence for recall of counter-intuitive representations. *Cognitive Science*, *25*, 535–564.

Brodkin, K. (1998). *How Jews became white folks and what that says about race in America*. New Brunswick, NJ: Rutgers University Press.

Carruthers, M. J., & Ziolkowski, J. M. (2002). *The medieval craft of memory: An anthology of texts and pictures*. Philadelphia, PA.: University of Pennsylvania Press.

Cicero, M. T., & Caplan, H. (1964). *Ad C. Herennium de ratione dicendi (Rhetorica ad Herennium)*. London, Cambridge, MA: W. Heinemann; Harvard University Press.

Claidière, N., & Sperber, D. (2007). The role of attraction in cultural evolution. *Journal of Cognition and Culture*, *7*(1–2), 89–111.

Cosmides, L., & Tooby, J. (2000). Consider the source: The evolution of adaptations for decoupling and metarepresentation. In D. Sperber (Ed.), *Metarepresentations: A multidisciplinary perspective* (pp. 53–115). New York: Oxford University Press.

Csibra, G. (2007). Teachers in the wild. *Trends in Cognitive Sciences*, *11*(3), 95–96.

Daniel, E. V. (1984). *Fluid signs: Being a person the Tamil way*. Berkeley: University of California Press.

Dawkins, R. (1976). *The selfish gene*. New York: Oxford University Press.

DeFrancis, J. (1989). *Visible speech. The diverse oneness of writing systems*. Honolulu: University of Hawaii Press.

Donald, M. (1991). *Origins of the modern mind*. Cambridge, MA: Harvard University Press.

Dulaney, S., & Fiske, A. P. (1994). Cultural rituals and obsessive-compulsive disorder: Is there a common psychological mechanism? *Ethos*, *22*(3), 243–283.

Durham, W. H. (1991). *Coevolution. Genes, cultures and human diversity*. Stanford: Stanford University Press.

Durkheim, E. (1947). *The elementary forms of the religious life*. New York: Collier Books.

Evans, A. (1908). *The european diffusion of pictography and its bearings on the origin of script*. Oxford: At the Clarendon Press.

Evans, D. W., Leckman, J. F., Carter, A., Reznick, J. S., Henshaw, D., & Pauls, D. L. (1997). Ritual, habit, and perfectionism: The prevalence and development of compulsive-like behavior in normal young children. *Child Development*, *68*(1), 58–68.

Fiske, A. P., & Haslam, N. (1997). Is obsessive-compulsive disorder a pathology of the human disposition to perform socially meaningful rituals? Evidence of similar content. *Journal of Nervous & Mental Disease*, *185*(4), 211–222.

Freud, S. (1906[1948]). Zwangsbehandlungen und Religionsübungen. In A. E. A. Freud (Ed.), *Gesammelte Werke von Sigmund Freud, chronologisch geordnet* (Vol. 7, pp. 107–116). London: Imago Publishing.

Gelb, I. J. (1963). *A study of writing*. 2nd ed. Chicago: University of Chicago Press.

Gelman, S., & Coley, J. (1991). Language and categorisation: The acquisition of natural kind terms. In S. Gelman & J. P. Byrnes (Eds.), *Perspectives on language and thought: Interrealtions in development*. Cambridge: Cambridge University Press.

Gergely, G., Egyed, K., & Király, I. (2007). On pedagogy. *Developmental Science*, *10*(1), 139–146.

Gil-White, F. (2001). Are ethnic groups 'species' to the human brain? Essentialism in our cognition of some social categories. *Current Anthropology*, *42*, 515–554.

Goody, J. (1968). *Literacy in traditional societies*. Cambridge: Cambridge University Press.

(1977). *The domestication of the savage mind*. Cambridge: Cambridge University Press.

(1986). *The logic of writing and the organization of society*. Cambridge: Cambridge University Press.

Greif, A. (2006). *Institutions and the path to the modern economy: lessons from medieval trade*. Cambridge; New York: Cambridge University Press.

Grice, H. P. (1975). *Logic and conversation*. In P. Cole & J. L. Morgan (Eds.), *Speech acts* (pp. 41–58). New York: Academic Press.

Haslam, N., Rothschild, L., & Ernst, D. (2000). Essentialist beliefs about social categories. *British Journal of Social Psychology*, *39*(1), 113–127.

Haya, G., Holmer, N. M., & Wassén, H. (1947). *Mu-Igala, or the way of Muu; a medicine song from the Cuna Indians of Panama*. Göteborg: Elanders boktryckeri aktiebolag.

Hertz, R. (1960). *A contribution to the study of the collective representation of death*. London: Cohen & West.

Hirschfeld, L. A. (1988). On acquiring social categories. Cognitive development and anthropological wisdom. *Man*, *23*, 611–638.

(1994). The acquisition of social categories. In L. A. Hirschfeld & S. A.Gelman (Ed.), *Mapping the mind: Domain-specificity in culture and cognition*. New York: Cambridge University Press.

(1996). *Race in the making: Cognition, culture and the child's construction of human kinds*. Cambridge, MA: The M.I.T. Press.

Humphrey, C., & Laidlaw, J. (1993). *Archetypal actions. A theory of ritual as a mode of action and the case of the Jain puja*. Oxford: Clarendon Press.

Hurford, J. R., & Kirby, S. (1995). Neural preconditions for proto-language. *The Behavioral and brain sciences*, *18*(1), 1.

Hutchins, E. (1995). How a cockpit remembers its speeds. *Cognitive Science*, *19*(3), 265–288.

Keesing, R. (1982). *Kwaio religion. The living and the dead in a Solomon Island society*. New York: Columbia University Press.

Keil, F. C. (1994). The birth and nurturance of concepts by domains: The origins of concepts of living things. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 234–254). New York: Cambridge University Press.

Kurzban, R. (2001). The social psychophysics of cooperation: Nonverbal communication in a public goods game. *Journal of Nonverbal Behavior*, *25*(4), 241–259.

Kurzban, R., & Leary, M. R. (2001). Evolutionary origins of stigmatization: The functions of social exclusion. *Psychological Bulletin*, *127*(2), 187–208.

Kurzban, R., Tooby, J., & Cosmides, L. (2001). Can race be erased? Coalitional computation and social categorization. *Proceedings of the National Academy of Sciences of the United States of America*, *98*(26), 15387–15392.

LeDoux, J. (2003). The emotional brain, fear, and the amygdala. *Cell Molecular Neurobiology*, *23*(4–5), 727–738.

Levine, S. S., & Kurzban, R. (2006). Explaining clustering in social networks: Towards an evolutionary theory of cascading benefits. *Managerial & Decision Economics*, *27*(2–3), 173–187.

Lienard, P. (2003). *Le comportement rituel: Communication, cognition et action. Générations, âges et territoire: contribution à l'ethnographie de deux populations du Cercle Karimojong (Les Turkana du Kenya et les Nyangatom d'Ethiopie)*. Université Libre de Bruxelles, Bruxelles.

Lienard, P., & Boyer, P. (2006). Why cultural rituals? A cultural selection model of ritualized behaviour. *American Anthropologist*, *108*(4), 814–827.
Marks, J. (1995). *Human biodiversity: Genes, race, and history*. New York: Aldine de Gruyter.
Maryanski, A., & Turner, J. H. (1992). *The social cage. Human nature and the evolution of society*. Stanford: Stanford University Press.
Mathews, C. A., Jang, K. L., Hami, S., & Stein, M. B. (2004). The structure of obsessionality among young adults. *Depression & Anxiety*, *20*(2), 77–85.
Maybin, J. (1994). *Language and literacy in social practice: A reader*. Clevedon, Avon, England; Philadelphia: Multingual Matters Ltd. in association with the Open University.
Metcalf, P., & Huntington, R. (1991). *Celebrations of death. The anthropology of mortuary ritual (2nd ed.)*. Cambridge: Cambridge University Press.
Mithen, S. J. (1996). *The prehistory of the mind*. London: Thames & Hudson.
Nemeroff, C. J. (1995). Magical thinking about illness virulence conceptions of germs from "Safe" versus "Dangerous" others. *Health Psychology*, *14*(2), 147–151.
Nordenskiöld, E. (1938). *An historical and ethnological survey of the Cuna Indians [arranged and edited by Henry Wassén]*. Göteborg: Göteborgs Museum, Etnografiska Advelningen.
Ong, W. J. (1977). *Interfaces of the word: Studies in the evolution of consciousness and culture*. Ithaca, NY: Cornell University Press.
(1982). *Orality and literacy: The technologizing of the word*. London; New York: Methuen.
Quigley, D. (1993). *The interpretation of caste*. Oxford; New York: Clarendon Press; Oxford University Press.
Rappaport, R. A. (1999). *Ritual and religion in the making of humanity*. Cambridge, UK; New York: Cambridge University Press.
Reverte, J. M. (1968). *Literatura Oral de los Indios Cuna*. Panama.
Ridley, M. (1996). *The origins of virtue* (1st ed.). London; New York: Viking.
Roediger, H. L., III. (1990). Implicit memory: Retention without remembering. *American Psychologist*, *45*(9), 1043–1056.
Roediger, H. L., III, Wheeler, M. A., & Rajaram, S. (1993). Remembering, knowing, and reconstructing the past. In L. M. Douglas (Ed.), *The psychology of learning and motivation. Advances in research and theory,* (Vol. 30, pp. 97–134): Academic Press, Inc, San Diego, CA.
Rothbart, M., & Taylor, M. (1990). Category labels and social reality: Do we view social categories as natural kinds? In K. F. G. Semin (Ed.), *Language and social cognition*. London: Sage Publications.
Rozin, P., Haidt, J., & McCauley, C. R. (1993). Disgust. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (pp. 575–595). New York: The Guildford Press.
Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behav Res Ther*, *23*(5), 571–583.
Severi, C. (1987). The invisible path. Ritual representation of suffering in cuna traditional thought. *Res. Anthropology and Aesthetics*, *14*, 66–85.
(2002). Memory, reflexivity and belief reflections on the ritual use of language. *Social Anthropology*, *10*(1), 18.

Sidanius, J., & Pratto, F. (1999). *Social dominance. An intergroup theory of social oppression and hierarchy*. Cambridge: Cambridge University Press.
Siegal, M. (1988). Children's knowledge of contagion and contamination as causes of illness. *Child Development*, *59*, 1353–1359.
Spence, J. D. (1984). *The memory palace of Matteo Ricci*. New York: Viking Penguin.
Sperber, D. (1985). Anthropology and psychology. Towards an epidemiology of representations. *Man*, *20*, 73–89.
(1996). *Explaining culture: A naturalistic approach*. Oxford: Blackwell.
(2006a). Conceptual tools for a naturalistic approach to cultural evolution. In S. C. Levinson & J. Pierre (Eds.), *Evolution and culture: A Fyssen foundation symposium*. Cambridge, MA: MIT Press.
Sperber, D. (Ed.). (2006b). *An evolutionary perspective on testimony and argumentation*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers.
Sperber, D., & Hirschfeld, L. A. (2004). The cognitive foundations of cultural stability and diversity. *Trends in Cognitive Sciences*, *8*(1), 40–46.
Sperber, D., & Wilson, D. (1995). *Relevance. Communication and cognition* (2nd ed.]. Oxford: Blackwell.
Stoler, A. L. (1991). *Sexual affronts and racial frontiers: National identity, 'mixed bloods' and the cultural genealogies of Europeans in colonial Southeast Asia*. Ann Arbor: University of Michigan.
Szechtman, H., & Woody, E. (2004). Obsessive-compulsive disorder as a disturbance of security motivation. *Psychological Review*, *111*(1), 111–127.
Tajfel, H. (1970). Experiments in inter-group discrimination. *Scientific American*, *223*, 96–102.
Tomasello, M. (2000). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.
Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences*, *28*(5), 17.
Tomasello, M., Kruger, A. C., & Ratner, H. H. (1993). Cultural learning. *Behavioral and Brain Sciences*, *16*, 495–510.
Tulving, E. (2001). Origin of autonoesis in episodic memory. In H. L. I. Roediger & J. Nairne (Eds.), *The nature of remembering: Essays in honor of Robert G. Crowder* (pp. 17–34). Washington, DC: American Psychological Association.
Turiel, E. (1983). *The development of social knowledge. Morality and convention*. Cambridge: Cambridge University Press.
(1998). The development of morality. In W. Damon (Ed.), *Handbook of child psychology* (5th ed., Vol. 3, pp. 863–932). New York: Wiley.
Ursu, S., Stenger, V. A., Shear, M. K., Jones, M. R., & Carter, C. S. (2003). Overactive action monitoring in obsessive-compulsive disorder: Evidence from functional magnetic resonance imaging. *Psychological Sciences*, *14*(4), 347–353.
Warneken, F., & Tomasello, M. (2006). Altruistic helping in human infants and young chimpanzees. *Science*, *311*(5765), 1301–1303.
Wegner, D. M., & Erskine, J. A. K. (2003). Voluntary involuntariness: Thought suppression and the regulation of the experience of will. *Consciousness & Cognition: An International Journal*, *12*(4), 684–694.

Wegner, D. M., & Schneider, D. J. (2003). The white bear story. *Psychological Inquiry*, *14*(3–4), 326–329.

Whitehouse, H. (2000). *Arguments and icons. Divergent modes of religiosity*. Oxford: Oxford University Press.

Yates, F. A. (1966). *The art of memory*. Chicago: University of Chicago Press.

Zalla, T., Verlut, I., Franck, N., Puzenat, D., & Sirigu, A. (2004). Perception of dynamic action in patients with schizophrenia. *Psychiatry Research*, *128*(1), 39–51.

Zohar, A. H., & Felz, L. (2001). Ritualistic behavior in young children. *Journal of Abnormal Child Psychology*, *29*(2), 121–128.