COGNITIVE AND EMOTIONAL PROCESSES IN THE CULTURAL TRANSMISSION OF NATURAL AND NONNATURAL BELIEFS

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Cognitive and Emotional Processes in the Cultural Transmission of Natural and Nonnatural Beliefs

What makes an idea culturally successful, such as the widespread notion in many societies of ancestor-spirits, a haiku, or the recipe for apple pie? To be sure, not all ideas are culturally successful. Some ideas are never represented in minds. Some are represented, but never communicated to others. Yet other ideas are successfully communicated to enough people that they become fashionable for a short time, but quickly fade away. But a small number of ideas are culturally successful: they permanently invade a group of minds. According to an epidemiological approach to explaining culture, then, "contagious" ideas and their material effects, such as texts, tools, buildings, artwork, constitute what we call culture. According to this view, an idea is "cultural" to the extent that it is widespread in a group (Cavalli-Sforza & Feldman, 1981; Sperber, 1990, 1996; see also Campbell, 1974, Dawkins, 1982; Boyd & Richerson, 1985).

Many factors are important in determining the extent to which ideas achieve a cultural level of distribution. Some are ecological, including the rate of prior exposure to an idea in a population, physical, as well as social facilitators and barriers to communication and imitation, and institutional structures that reinforce or suppress an idea. Others are psychological, including the ease with which an idea can be represented and remembered, the intrinsic interest that it evokes in people so that it is processed and rehearsed, and the motivation and facility to communicate the idea to others. Of all the psychological factors, the mnemonic power of an idea is one of the most important. In fact, Sperber (1996) puts forth memorability as a "law" of the epidemiology of representations, as a necessary (but of course not sufficient) condition for cultural success. The memorability test has two components:

(1) Memorability places severe constraints on the cultural transmission of ideas. In oral traditions that characterize most of human cultures throughout history, an idea that is not memorable cannot be transmitted and cannot achieve cultural success.

(2) Furthermore, even if two ideas pass a minimal test of memorability, a more memorable idea has a transmission advantage over a less memorable one (all else being equal). This advantage, even if small at the start, accumulates from generation to generation of transmission leading to massive differences in cultural success at the end.

The psychology of cognition in general, and memory in particular, is of great relevance to the anthropological study of how cultural belief systems emerge. This is true in two senses. First, memory plays a central role in how communicators of cultural materials transmit their messages. Historically, cultural innovators such as storytellers and religious leaders have been known to have remarkable mnemonic abilities in transmitting massive amounts of information to their audiences. More importantly, they have been adept at making their messages memorable to others. It is no coincidence that the minds of great cultural innovators of all time, such as Homer, were also the minds of great mnemonists and communicators as well. Second, memory is central to how the audience processes, recalls, and in turn transmits cultural materials to others. Ideas are not acquired and transmitted through a process by which culture "impinges" on a passive human mind. Rather, the minds of the receivers of cultural materials selectively represent, retain, transform, and transmit information. Thus the ordinary biases and transformations in human memory can constrain and sometimes even determine the content of cultural beliefs.

Natural and Nonnatural Beliefs

What sorts of beliefs are especially good at passing the test of memorability? One way to answer this question is by considering culturally successful beliefs actually known to us–

the reverse of the analysis presented to far. These are beliefs that should be especially memorable, since they could not have achieved cultural success unless they passed the test of memorability. In examining what kinds of beliefs are widespread in societies around the world, one observation is inevitable: most beliefs in all human societies known to anthropologists seem to be made of common sense notions about the world (Atran & Sperber, 1991; Geertz, 1975). Intuitive concepts such as "rock," "bird," and "person" form the bulk of the beliefs that people in different cultures entertain on a daily basis. These concepts, and the beliefs they support, are for the most part grounded in direct experience and observation, and are in principle accessible to every competent adult in a community. Moreover, these concepts and beliefs are part of common sense in that they are supported by intuitive "theories" about objects and events widely shared by everyone. Conversations, child rearing, subsistence, rituals, and even religion would be impossible without these intuitive concepts and theories.

Intuitive concepts are "intuitive," because built into them are implicit inferences about their properties. These intuitive inferences are rarely articulated explicitly. Rather, they are assumed, and make the concepts comprehensible and communicable. For example, the concept "bird " involves the implicit inferences that birds fly, that they grow and die, that they drink when thirsty. These inferences are guided by intuitive ontology (Keil, 1989), or peoples' assumptions about the basic categories of existence, such as intentional beings, animals, inanimate objects, events. Ontology is psychologically important, because it determines the appropriateness of inferences. For example, knowing that birds belong to the ontological category ANIMAL affords "automatic" inferences about biological properties, but not necessarily intentional agent properties. These inferences are possible because ontology is in turn governed by domain-specific "theories"-- theories of mind, biology, and

physics--that provide intuitive beliefs and explanations for the workings of each ontological category.

There are important cultural variations in many aspects of domain-specific theories: theory of mind (e.g., Choi, Nisbett, & Norenzayan, 1999; Lillard, 1998), biology (e.g., Medin & Atran, 1999), and physics (e.g., Peng & Nisbett, 1998; Lloyd, 1996). However, certain core elements of these theories appear so early, and are so widespread across human societies, that they may turn out to be psychological primitives that make cultural learning possible. For example, babies as young as four months already possess a "theory of physics," having a notion of what counts as a solid object, and assuming that an object cannot be in different places at the same time, or that a solid object cannot pass through another solid object (Baillargeon, 1998; Carey & Spelke, 1994; Leslie, 1982; Spelke, 1990). Similarly, preschoolers and adults in most cultures known to anthropologists have a "theory of biology" which dictates that species have biological "essences" and that superficial transformations performed on an animal do not alter its species-specific essence (Atran, 1990, 1998; Berlin, 1992; Berlin, Breedlove, & Raven, 1973; Gelman & Hirschfeld, 1998; Keil, 1994). Preschoolers and adults in many disparate cultures also have an elaborate "theory of mind," which entails, among other things, the attribution of beliefs and desires to people, and the appreciation that people may have false beliefs (Avis & Harris, 1991; Flavell, Zhang, Zou, Dong, & Qui, 1983; Gardner, Harris, Ohmoto, & Hamazaki, 1988; Leslie, 1994; Wellman, 1990).

These universal causal frameworks, or "intuitive theories," render different aspects of the world comprehensible, and provide a common set of assumptions that facilitate linguistic communication. A speaker who describes a pet bird does not need to enumerate all the assumed properties of birds. Listeners automatically infer that the bird is an animal, hence has biological properties, that it necessarily obeys the laws of physics, and that it does not

necessarily share the properties of conscious beings. It is little surprise, then, that the beliefs supported by these theories are at the heart of everyday culture around the world.

Yet a second observation about widespread beliefs is that culturally important materials, such as myths, legends, folk tales, and religious belief systems invariably center on nonnatural concepts, such as supernatural agents and non-human animals with anthropomorphic properties. Unlike everyday natural concepts such as rock, bird, and person that are consistent with domain-specific theories and are verifiable through experience--ghosts, fairies, talking frogs, and invisible mountains do not refer to observable entities accessible to everyone, violate ontological structures, and are inconsistent with theories of mind, biology, and physics that are at the base of these structures. Despite their incompatibility with intuitive ontologies, however, they are culturally ubiquitous. They consistently appear in every religious tradition, and in folk tales and myths that are instrumental in socializing children around the world.

This chapter has three goals. First, we review experimental evidence regarding the relative cultural success of natural and nonnatural beliefs in terms of their memorability. Second, we review the results of an experiment we conducted that examined not only the memorability of individual beliefs, but also whether there is an optimal combination of natural and nonnatural beliefs that maximizes cultural success of a set of beliefs as a whole. In the last part, we go beyond memory processes and consider the role of emotions that may guide the transmission of natural and nonnatural beliefs.

Cognitive Optimality

It is necessary to bring together the two components of our discussion so far—the fact that memorability constrains and directs the cultural transmission of beliefs, and that many cultural belief systems consist of some mix of natural as well as nonnatural beliefs. Natural and nonnatural beliefs, and the way the two interact, may involve distinct patterns of

memorability and transmission, and hence cultural success. This of course is not the argument that human memory is "designed" to produce certain kinds of natural and nonnatural beliefs. Rather it is the opposite. Ideas that achieve cultural success must be those that happen to be the more successful at exploiting the peculiarities of the human memory system that evolved to solve problems having little to do with the propagation of culture. Thus there may be a cognitively optimal level of the naturalness of beliefs. One of the most elaborate accounts of how this is accomplished is that of the cognitive anthropologist Pascal Boyer (Boyer, 1994a).

According to Boyer (1991; 1992; 1994a ; 1994b; see also Atran, 1990, 1996; Atran & Sperber, 1991; Sperber, 1975, 1996), religious and quasi-religious concepts (including those in folk tales and myths) are fundamentally similar to other, mundane concepts in that they are grounded in theories of mind, biology, and physics. There is growing evidence that the same intuitive theories that guide much of thinking about mundane concepts also lie behind thinking about religious concepts. A telling example comes from a study by Barret & Keil (1996), in which the authors demonstrated that even religious people implicitly rely on their intuitive theory of intentional agents to reason about God, much as they would reason about human beings. For example, in recalling a story in which God saved the lives of people about to drown, participants made implicit inferences consistent with intentional agents—for example that God cannot be in two places at the same time. This is despite the fact that they explicitly denied to the experimenter that they anthropomorphize God!

Despite this psychological commonality, religious concepts are different from mundane concepts in an important way: religious concepts possess a small number of features that violate the ontological assumptions of the concept. Thus religious concepts are minimally counterintuitive: they are largely consistent with the ontological assumptions of the concept, while a few of their features are inconsistent with these same assumptions. An

example of a minimally counterintuitive religious concept that is cross culturally widespread is that of a ghost (Boyer, 1993). A ghost satisfies most of the ontological assumptions of an intentional agent (it is conscious, has beliefs and desires, has biological needs, may die), yet it violates a few features of the physical ontology of intentional agents (which people everywhere intuitively expect to be embodied as animate beings): a ghost is invisible and can pass through solid objects.

According to Boyer, minimally counterintuitive concepts are cognitively optimal. The few counterintuitive features render the concept more salient and more interesting, while the implicitly represented intuitive features assure that the concept is comprehensible in terms of existing ontological structures. Concepts that have no ontology-violating features at all are not interesting. A man walking down a hill is not a particularly potent cultural idea. Concepts that have too many ontology-violating features are not easily comprehensible. A ghost that behaves according to the opposite of its beliefs, can be in multiple places at the same time, and has 100 lives is a very difficult ghost to comprehend, let alone remember and transmit. Religious concepts, if minimally counterintuitive, are more memorable, and hence enjoy a transmission advantage over mundane or highly counterintuitive concepts. This would help to account for the widespread nature of religious concepts, such as ghosts, animals that speak, and statues that cure diseases. It would also predict that religious and mythical traditions make significant and reliable use of minimally counterintuitive concepts.

Indeed this seems to be the case. For example, in a study of Ovid's Metamorphoses, Kelly & Keil (1985) showed that the ontological transformations experienced by the characters followed a distinct pattern: the number of transformations of one ontological category to other ontological categories decreased as the distance between the two categories increased. Thus, it was far more likely for a conscious being to be transformed into an animal (closer in ontological distance, resulting in few ontological violations), than a conscious

being to be transformed into an inanimate object (farther away in ontological distance, resulting in too many ontological violations). Transformations that occur across wide swaths of ontological distance are just too counterintuitive to have cultural value. The anthropological literature in general supports the claim that most concepts in religions and folktales in different cultures that violate ontological assumptions are of the minimally counterintuitive kind.

Memorability of Minimally Counterintuitive Beliefs: Experimental Evidence

One of the earliest accounts of the effects of memorability on the transmission of natural and nonnatural concepts was Bartlett's (1932) classic study of "The war of the ghosts." Bartlett examined the ways by which British university students remembered, and then transmitted a culturally unfamiliar story, in this case a Native American folk tale. One of the interesting findings was that, over several generations of retelling the story, some culturally unfamiliar items or events were dropped from the retelling. Other unfamiliar items were distorted, being replaced by more familiar items. For example a canoe (an unfamiliar item) was replaced by a rowboat (a familiar one). Bartlett reasoned that items inconsistent with the cultural schema of British students were harder to represent, harder to recall, and therefore were less likely to be transmitted than schema-consistent items (see also Kintsch & Greene, 1978, for evidence that culturally familiar information is better remembered).

Bartlett's other striking finding was that the very notion of the ghosts—so central to the story—was gradually eliminated from the retellings. If Boyer's hypothesis is correct--that a concept like "ghost" has a transmission advantage--this is a problematic finding. However, this finding may be explained by the idea that the effect of memory on cultural transmission also operates at the level of belief sets, such that the elimination of the ghost from the retellings contributed to the overall cultural survival of the story as a whole. We return to this issue later in the chapter.

Recent experiments have followed up on Bartlett's seminal study, directly testing the cognitive optimality of natural and nonnatural beliefs. The available evidence suggests that, under some conditions, minimally counterintuitive beliefs are indeed better recalled relative to intuitive beliefs, beliefs that are too counterintuitive, and beliefs that are bizarre but not counterintuitive.

In a series of experiments, Barrett & Nyhof (2001) asked participants to remember and retell stories containing natural as well as nonnatural events or objects. In one experiment, participants read three of six different Native American folk tales, and then remembered as much of each as they could. A content analysis of what they remembered was revealing. Participants remembered 92% of minimally counterintuitive items, but only 71% of intuitive items.

In another experiment, Barrett & Nyhof constructed a more tightly controlled narrative in which an intergalactic ambassador was visiting a museum on a planet where various objects, animals, and conscious beings indigenous to the planet were exhibited. Each item consisted of a description of an ontological category (living thing, physical object, intentional agent), plus a description of a feature. Participants were instructed to recall and retell as many of the items as possible. One-third of the items in each story were intuitive ("an object that is easy to see under normal lighting conditions"). One third were minimally counterintuitive with one ontological violation ("a single object that can be completely in more than one place at a time"). The final third were items that had one bizarre feature, but did not violate any ontological assumptions ("an object that can be passed through openings in solid objects considerably smaller than it is" (for example, a compressible rubber ball).

After three generations of retelling the story, the proportion of items recalled in each category was measured. Results indicated that both counterintuitive and bizarre items were remembered in greater proportions than intuitive items. An examination of the memory

distortions was also revealing. The most common distortions were bizarre items becoming counterintuitive (37.5%), whereas the least common distortions were from counterintuitive to bizarre (7.2%). Subsequent experiments demonstrated that the same recall advantage of minimally counterintuitive items over intuitive, as well as bizarre items emerges after a 3-month delay. This is crucial, because in most natural settings in which cultural narratives evolve, recall after a long delay plays a more important role than recall immediately following exposure to an idea. An idea that is memorable immediately, but decays over time could not be culturally successful. Overall then, the results of Barrett and Nyhoff confirm the idea that minimally counterintuitive beliefs are better recalled than intuitive ones.

It is important to note that counterintuitiveness and bizarreness are orthogonal. Something can be counterintuitive but may not necessarily feel unfamiliar or evoke bizarre imagery (an invisible chair); or something can be bizarre without being counterintuitive (a giant gorilla in an Opera house). The cognitive optimality hypothesis predicts that the transmission advantage of minimally counterintuitive beliefs over intuitive beliefs is a function of their minimal counterintuitiveness-- not a function of bizarreness or unfamiliarity. In a study comparing recall of minimally counterintuitive and bizarre items, Barrett & Nyhoff (2001) demonstrated that this is indeed the case. A salient but not counterintuitive object (e.g., a bright, pink newspaper flying in the wind) is remembered less well than a minimally counterintuitive object (e.g., a carrot that speaks). Furthermore, ratings of "familiarity," a measure of strangeness or bizarreness, do not predict recall as well as ratings of how "different" an item is from ordinary things, a measure of expectancy violation, or counterintuitiveness (Boyer & Ramble, 2000).

Thus, minimal violation of ontological assumptions and cultural familiarity are two distinct factors that contribute to recall. While familiarity is a mechanism that is bounded by a particular culture, ontological violation is not. Intuitive ontology, supported by intuitive

theories of mind, biology, and physics appear to emerge at a very early age and are likely to have universal components. As a result, it is possible to expect that the recall advantage that minimally counterintuitive concepts enjoy may be cross culturally widespread. Boyer and Ramble (2000) tested this idea in three different cultures: Tibetan Buddhist monks in Nepal, West African participants recruited from a farmers' market in Gabon, and French university students. Unlike the secular environment in which French students live, Gabonese folk and Nepalese monks have greater exposure to supernatural concepts. Nevertheless, the same advantage for minimally counterintuitive concepts emerged for all three groups.

Another important finding that is consistent with the cognitive optimality hypothesis is that the effect of counterintuitiveness on recall is not linear. Too many ontological violations render a concept too counterintuitive to be memorable. Using stories similar to the " intergalactic ambassador," Boyer and Ramble (2000) demonstrated that concepts with too many violations were recalled less well than those that were minimally counterintuitive. They also observe, for example, that among many Catholics there is the belief in an artifact with cognitive properties (e.g., a statue of the Virgin that listens within proximity). Similarly, there is the belief that God can hear distant sounds. Yet the belief that a statue of the Virgin can hear distant sounds is uncommon. The anthropological literature also confirms that religious concepts with too many ontological violations are rather rare (Boyer, 1994a). Such concepts may be less memorable because of a poorer fit with ontological categories and intuitive theories. Another reason why such concepts are rare may be that its numerous violations " block " its inferential potential, and undermine its usefulness as a concept.

To summarize, the available experimental evidence indicates that concepts that are minimally counterintuitive have a transmission advantage over concepts that are intuitive or those that are too counterintuitive. This advantage can be observed immediately after

exposure, as well as after a 3-month delay, in cultures as diverse as the Midwestern United States, France, Gabon, and Nepal.

Cognitive Optimality of Beliefs versus Belief Sets

There is, however, a mismatch between this evidence and the apparent structure of culturally important narratives. If, as the evidence we reviewed suggests, minimally counterintuitive concepts are more successful than other concepts, they should dominate religions, folktales, and myths. The memory advantage they enjoy over intuitive and extremely counterintuitive concepts should be observed in naturally occurring culturally successful materials. However even a casual perusal of culturally successful materials such as the Bible and some of the popular folktales in the Grimm Brothers' collection-- suggests that counterintuitive concepts and occurrences are in the minority. The Bible, for example, is a succession of mundane events—traveling by foot, fishing, eating, sleeping, preaching, funerals and weddings, rainstorms, drought--interspersed with a few counterintuitive occurrences, such as miracles and the appearance of supernatural agents such as God, angels, and ghosts.

In the Grimm Brothers' German folktales, the tale of the Little Red Riding Hood -- one of the most celebrated folk tales in Western culture -- is mostly a series of mundane occurrences, seasoned with only two counterintuitive ones, i.e., the talking wolf, and Grandmother and the little girl coming out of the wolf's belly alive. Similarly, the Beauty and the Beast has only three violations—the Beast as an animal with human properties, the magic mirror, and the transformation from beast to human. If minimally counterintuitive concepts are indeed more memorable than mundane concepts, one would expect that the proportion of minimally counterintuitive concepts would increase as a function of the cultural success of the folktale. The Bible and the popular Grimms' folk tales would consist of nothing more than a succession of minimally counterintuitive concepts and events. But this is not the case.

One great advantage that common sense beliefs have over counterintuitive ones is that the former are supported by everyday experience and intuitive theories. Perhaps this accounts for why they are the majority of cultural beliefs, despite being at a transmission disadvantage relative to counterintuitive beliefs. This may explain why common sense beliefs are generally easy to think. But it fails to explain the prevalence of specific common sense beliefs. Somehow, the specific mundane events of the Little Red Riding Hood—mother telling her to go and visit Grandmother, the walk in the forest, carrying a basket of strawberries, talking to a stranger, etc.—must be successfully remembered and transmitted if this tale is to survive the test of time.

The answer to this apparent puzzle may lie in examining the memorability of an entire set of beliefs as a single unit of transmission, rather than individual beliefs. The unit of cultural transmission is often, but not always an individual idea. Under many conditions, a series of events or concepts are transmitted together as a single unit of culture. Therefore, cognitive optimality might be at work not only at the level of individual beliefs, but at the level of belief structures as well. Boyer's theory does not address the cognitive optimality of belief structures. However one can apply the same logic to this level.

Applying the principle of cognitive optimality to belief sets, we would expect that minimally counterintuitive belief sets—those that contain a small number of minimally counterintuitive beliefs--would be more memorable than all intuitive belief sets or belief sets with too many minimally counterintuitive beliefs. Interestingly, cognitive optimality at these two levels may come into conflict. What is good for a belief set may not be good for each individual belief that makes up the belief set. The most salient case of such conflict is when a belief set is made of mostly minimally counterintuitive beliefs. A folk tale with many minimally counterintuitive concepts will be at a disadvantage if cognitive optimality is more

important at the level of belief sets. Each minimally counterintuitive concept in this tale will be at an advantage if cognitive optimality is more important at the individual belief level.

As suggestive as the groundbreaking studies of Barrett & Nyhof (2001) and Boyer & Ramble (2000) are, they leave unresolved a number of issues. First is the problem of incompatibility of this finding with existing cultural materials. Why do we not see minimally counterintuitive concepts take over most of the narrative structure of religions, folktales, and myths? One possibility is that cognitive optimality may also operate at the level of belief sets, such that minimally counterintuitive belief sets enjoy a transmission advantage. This would lead to a state of affairs not unlike what we observe in real life: a successful belief system would be mostly intuitive, containing only a few minimally counterintuitive elements. This possibility has not been explored before. In earlier studies, an equal number of natural and nonnatural concepts were used in each story.

A second issue is that the materials used in these studies were constructed such that they may have encouraged participants to privilege the counterintuitive concepts over the intuitive ones. This could have happened in two ways. First, most studies used a "storytelling" format, in which participants were asked to memorize the story with the expectation of telling it to another person. The great advantage of using a storytelling format is that many instances of cultural transmission in real life occur in a storytelling context. Its drawback, however, is that it is not a clear test of the memorability criterion. Participants may have remembered any combination of intuitive and counterintuitive concepts, but reported more counterintuitive concepts because the latter would make a better story.

Other studies used a story that is about an intergalactic ambassador visiting a museum in another world. This may have encouraged attending to counterintuitives by suggesting to participants that the researcher is interested in extraordinary, science-fiction type events, rather than mundane occurrences. While both storytelling and stories suggesting

extraordinary events clearly have counterparts in natural settings (e.g., telling and retelling of folktales in a village), they are not the only form of cultural transmission, and may particularly favor transmitting counterintuitive ideas.

Second, commonsense beliefs usually must be relevant to the listener to be successfully communicated and remembered (Sperber & Wilson, 1986). They must inform the listener of something that should be known or made salient, but was not before. The commonsense items in the experiments fail to meet such minimal criteria for relevance. For example, Barret and Nyhof (2001, p. 79) list as commonsense items, "a being that can see or hear things that are not too faraway;" "a species that will die if it does not get enough nourishment or if it is severely damaged." Indeed, such items fall so far below the ordinary expectation that items communicated should carry some new or salient information, that Barret and Nyhof report: "That common items were remembered so poorly relative to other items is particularly surprising given the reaction of some participants to these items.... In some instances of retelling these items, participants tried to make the common property sound exciting or unusual" (pp. 82-83). In other words, some subjects apparently tried to meet minimum conditions of relevance. For the most part, however, it appears that communication of common items failed these minimum standards.

Memorability of Intuitive and Minimally Counterintuitive Beliefs and Belief-sets

"The war of the ghosts" (Bartlett, 1932) was one of the earliest accounts of the effects of memorability on the transmission of belief sets containing natural and nonnatural concepts. Bartlett found that the notion of the ghosts was gradually eliminated from the retellings. A possible explanation for this finding is that cultural transmission operates at the level of belief sets, such that the elimination of the ghost from the retellings contributed to the overall cultural survival of the story as a whole.

As Barrett & Nyhof (2001) note, however, Bartlett's finding is difficult to interpret. First, he did not directly compare the memorability of " ghosts " to control items. Second, the study was based on a single story, and idiosyncratic aspects of the story (such as its cultural unfamiliarity) may have contributed to the findings. More studies, with better experimental control and wider sets of information, are needed.

We conducted a study to examine the memorability of intuitive (INT) and minimally counterintuitive (MCI) beliefs and belief sets over a period of a week. Participants were 107 undergraduate students at a large American university in the Midwest. MCI beliefs were generated by transferring a property from its intuitive domain to a novel domain (e.g., thirsty door, closing cat). For each MCI belief, there was a corresponding INT belief (thirsty cat, closing door). Thus, each word--"cat," " door, " " closing, " and " thirsty "--were equally likely to appear in an INT item as in a MCI item. This resulted in a set of four statements that achieved a counterbalanced design, each word in each statement serving as its own control. Recall was measured in two ways: planned free recall after a 3-min delay, and a surprise free recall after a one-week delay. This latter measure was the more important one, as it better reflects the role of recall in oral traditions.

This study differed from previous ones in a number of important ways. First, the cognitive optimality hypothesis was tested on 2 levels: at the level of individual beliefs, and at the level of structures of beliefs containing different proportions of INT and MCI beliefs. To examine recall at the level of structures of beliefs, participants were randomly assigned to one of four proportions of INT and MCI items on each list: All INT, Mostly INT, Equal, and Mostly MCI. Second, the INT and MCI items were matched, such that each word served as its own control (as can be seen in the examples above). This procedure ruled out any possible effects of the prior recall probabilities of the concepts in each belief.

Third, participants were told that they were in an experiment about memory, and were given a list of items to remember, without providing a story context. This served two purposes. First, this list-learning format was meant to provide as neutral a context as possible to measure recall, rather than participants' notions of what is interesting to report. Second, while stories are an important part of culturally successful materials, many of these stories often begin their life as a set of discrete images, events, and beliefs, not unlike lists of items, with little or no story structure (for example, consider the sketchy nature of early Christian beliefs about the life events of Jesus of Nazareth, which cohered into a single chronological narrative centuries after the actual events). This format simulated the degraded informational context of nascent cultural materials.

Finally, unlike previous studies, basic-level concepts were used, such as door, cat, infant. The basic level is where: (1) many common features are listed for categories, (2) consistent motor programs are used for the interaction with or manipulation of category exemplars, (3) category members have similar enough shapes so that it is possible to recognize an average shape for objects of the category, (4) the category name is the first name to come to mind in the presence of an object: for example, "table" versus "furniture" and "kitchen table," or "dog" versus "mammal" and "collie" (Rosch et al., 1976).

Two questions were addressed: (1) At the level of individual beliefs, which kinds of beliefs would enjoy better recall and lower memory degradation (measured as loss of information from immediate to delayed recall): minimally counterintuitive beliefs or their intuitive counterparts? (2) At the level of belief sets, what proportion of INT to MCI beliefs would maximize recall of the entire set? It was expected, consistent with the cognitive optimality hypothesis, that the belief set with mostly INT beliefs, combined with a few MCI beliefs would enjoy the highest rate of recall and lowest rate of memory degradation, followed by the belief set with equal proportions of INT and MCI beliefs. The set with All

INT beliefs would be third, and the one with too many MCI beliefs would generate the lowest rate of recall and the highest rate of degradation.

A complex pattern of recall emerged for intuitive and minimally counterintuitive beliefs. First we consider the recall rates at the level of individual beliefs. Unlike the findings of Barret and Nyhof (2001), and Boyer & Ramble (2000), intuitive beliefs showed better recall rates than minimally counterintuitive beliefs. This was the case immediately, as well as after a one-week delay. The only exception to this pattern was when counterintuitives made up the majority of beliefs, in which case there were no differences in recall rates. Because the two kinds of beliefs were matched, i.e., each term in each belief was equally likely to occur in an intuitive and counterintuitive belief, we can conclude with relative confidence that it was the intuitiveness factor, not other unknown factors left to vary, that contributed to the recall advantage of the intuitives.

We have subsequently replicated this finding with a different set of ideas (Norenzayan & Atran, 2001a) where a sharper distinction was made between counterintuitive ideas and ideas that are intuitive but bizarre, and between degrees of counterintuitiveness. Participants received ideas that were (1) intuitive and ordinary (2) intuitive but bizarre (3) minimally counterintuitive (4) maximally counterintuitive. Results revealed a linear effect of intuitiveness on recall-- immediately as well as a week later: intuitive ideas enjoyed the highest rate of recall, and maximally counterintuitive ideas received the lowest rate of recall. An analogous experiment is underway with Yucatec Maya participants who live in a traditional, semi-literate society in rural Mexico. This experiment will allow us to test the cross cultural generality of these findings, as well as to examine possible cultural variation in the cognitive processes of cultural transmission.

How can we account for this pattern of results? Note that one important difference between our experiments and those of Barrett & Nyhof (2001) and Boyer & Ramble (2000) is

that in this study, participants were not led to expect nonnatural events (as in listening to a science fiction tale), and were not motivated to tell an interesting story. In such a context in which people expect that information will conform to a natural course of events, they are likely to attend to and remember beliefs that are consistent with ontological assumptions. This process would break down when the majority of the to-be-remembered beliefs are minimally counterintuitive. In such a situation, it is possible that people develop the expectation that the task is about recalling nonnatural events, or about reporting the "interesting stuff". As a result, intuitive beliefs would loose their privileged status and recall would be no different for intuitive and minimally counterintuitive beliefs. Under such conditions, it may even be possible to reverse the phenomenon, such that minimally counterintuitive beliefs are better recalled, as we saw earlier. This explanation has the virtue of accounting for both the findings of Barrett and Nyhof and Boyer and Ramble, and the findings of the current study. But it remains a speculation waiting to be tested experimentally.

An intriguing finding that converges with the findings of Barrett and Nyhof (2001) and Boyer & Ramble (2000) was that minimally counterintuitive beliefs were more cognitively resilient than intuitive ones, in that they degraded at a lower rate after immediate recall. This is despite the fact that overall, the former had a lower recall rate than the latter. Thus, minimally counterintuitive beliefs may have a potent survival advantage over intuitive beliefs: once processed and recalled, they degrade less than intuitive ones. It is easy to see how this difference in cognitive resilience may be a significant factor in cultural survival. The disadvantage in recall (at least under the conditions set in this study) may be offset by resilience, so that over numerous generations of transmission, an idea that is less remembered, but also less degradable, can, in some situations, prevail over an idea that is initially remembered well, but then eventually dies out because of a higher rate of degradation.

The picture that emerged at the level of belief sets confirmed that cognitive optimality at this level is at least as important as at the individual belief level. The effect of belief proportions on delayed recall followed an inverted U-shaped curve. The belief set that was mostly intuitive, combined with a few minimally counterintuitive ones had the highest rate of delayed recall and the lowest rate of memory degradation over time. This is the recipe for a successful cultural belief system, and it is the cognitive template that characterizes most popular folktales and religious narratives. The "equal proportions" belief set had moderate memorability. Critically, the belief set with a majority of minimally counterintuitive beliefs had the lowest rate of delayed recall, and the highest level of memory degradation. Indeed, this is a cognitive template that is rarely encountered in culturally successful materials. We suggest that narratives with such template may have been introduced by cultural innovators, but failed to pass the test of memorability. As a result they faded from culture. Thus, the way natural and nonnatural beliefs are combined is crucial to survival of a belief system.

Even though the concern of this chapter is not to elucidate memory processes per se, but to examine the role of memory in generating culturally stable materials, it is possible to offer some informed speculation about the cognitive processes that might render the majority intuitive belief set more memorable and resilient. One explanation is that minimally counterintuitive beliefs, because of their minimal incongruity with ontological assumptions, are surprising and interesting. Despite the fact that they themselves are not as memorable as intuitive beliefs, they may serve the purpose of drawing attention to the entire belief set in which they are embedded. They encourage paying more attention to the belief set as a whole, and to think about it more often over time. The majority intuitive beliefs, supported by ontological assumptions and theories, then do the actual conceptual work by enhancing overall recall. Thus, a cognitive bootstrapping may be in operation between a minority of

counterintuitives and a majority of intuitives. The former draw interest, the latter ensure recall over time.

However this process is highly dependent on the particular mix of beliefs. It works as long as minimally counterintuitive beliefs exist in small proportions. Once their proportion increases to very high levels, the belief set becomes too incongruent. It looses its capacity to arouse surprise and interest. In addition, because of the massive inconsistency with ontology, it also becomes harder to recall and transmit. If this reasoning is correct, then we can make the following prediction: assuming that immediate recall is a rough measure of initial "interestingness," immediate recall (interestingness) of the counterintuitives should predict delayed recall of the intuitives, but not when the counterintuitives are in the majority. This was indeed the case. Immediate recall of the minimally counterintuitive beliefs predicted delayed recall of the intuitive beliefs in the "majority intuitive" condition, and in the "equal proportions" condition, but not in the "majority counterintuitives" condition.

Beyond Cognition: The Role of Emotions in the Transmission of Cultural Beliefs

So far in our discussion, we have been treating the transmission of beliefs in folktales, myths, and religious systems, as if the psychological processes that guide such transmission are the same for all culturally important materials. In fact, our discussion has been based on the proposal that folktales, religions, and other cultural beliefs are continuous on the cognitive dimension. That is, we have reviewed evidence that these cultural beliefs exploit the same cognitive operations based on intuitive ontologies and domain-specific theories of physics, biology, and mind.

This may indeed be the case, but we believe that a critical psychological difference still exists between religious and non-religious cultural materials. Nonnatural religious beliefs seem to draw emotional commitment like no other beliefs. People feel deeply committed to them. In fact, the purely cognitive analysis of belief transmission that we have presented so

far would lead us to conclude that ontological violations in the Road Runner or in Beauty and the Beast are indistinguishable from those in a religious narrative. But Moses receiving the word of God, the Immaculate Conception, and the Prophet Mohammad ascending to Heaven do not seem to have the same psychological status as Wile E. Coyote being suspended in air, the Magic Mirror in the Beauty and the Beast, or a prophet holding an ordinary conversation with his people. Unlike nonnatural beliefs in folktales and cartoons, or natural occurrences in religious narratives, nonnatural religious beliefs evoke profound epistemological and emotional commitment, and coordinate group emotions to such an extent that people may even sacrifice their lives for these beliefs. How can we explain this phenomenon?

We propose that a possible explanation for the emotional grounding of nonnatural religious beliefs may lie in the way the human mind and human cultures have coevolved to resolve one of the most intractable problems that has been with us since we attained self-consciousness: awareness of mortality. As has been argued extensively elsewhere (Greenberg, et al., 1990; Solomon, Greenberg, & Pyszczynski, this volume), many aspects of culture and commitment to group life seems to be organized to a large extent so that people are able to manage the debilitating consequences of the awareness and fear of death. Thus, experimentally inducing mortality salience leads to more positive evaluations of ingroup members, more negative evaluation of outgroup members, and leads to a heightened sensitivity to threats to one's own cultural worldview (Greenberg et al., 1990). Awareness and fear of death may also be an emotional foundation of religion (Feuerbach, 1843/1972, Freud, 1915/1957, Bloom, 1992). The scholar of ancient religions Walter Burkert (1996, p. 31) thinks so, when he writes, "the utmost seriousness of religion is linked to the great overriding fear of death. The value of religion, manifest in the forms of religion's cultural transmission and in the insiders' confessions, is that it deals with the "ultimate concern" and thus fits the biological landscape."

Consistent with this idea, recently we have found that inducing mortality salience directly affects religious commitment as well. Compared to control group participants who were asked to reflect on their favorite foods, experimental group participants who were asked to reflect on their own death reported to be more religious and were more likely to say that they believe in God (Norenzayan & Atran, 2001b).

We speculate that nonnatural beliefs, unlike those grounded in intuitive ontologies, offer a seeming causal resolution to the existential fear of death by evoking possible worlds of avoidance. Thus, nonnatural beliefs may be psychologically privileged under conditions where peoples' everyday common sense fails, as when people are faced with the reality of their and their family members' imminent mortality. Because the ordinary causal understanding of intuitive ontologies fails to deliver a resolution to this existential problem, people construct and accept a psychological realm that goes beyond the ordinary and appeals to the extraordinary. To reprieve cognition from constant attention to the factually unresolvable and attention-arresting anxieties of everyday life, there must be a countervailing emotional faith that people share in counterfactual and counterintuitive resolutions.

We propose the hypothesis that awareness of mortality -- and perhaps other emotionally eruptive existential anxieties for which there appears to be no rational expectation of resolution, such as vulnerability (to injustice, pain, dominance), loneliness (abandonment, unrequited love) or catastrophe (disease, sudden loss) -- should cause people to become cognitively susceptible to seek, encode, recall, and transmit information that goes beyond rational or intuitive understanding. This includes beliefs in supernatural entities that intervene to solve (the humanly insolvable) problems of humankind.

Conclusion: Alternative Scenarios of Cultural Transmission

We have found that under ordinary conditions and over at least a one-week period, natural beliefs enjoy a recall, and hence transmission advantage over nonnatural beliefs that

are minimally counterintuitive. This raises the question as to why narratives that have achieved a cultural level of distribution--tales, myths, religious beliefs--invariably contain nonnatural beliefs? Is there a psychological explanation for the success of this form of cultural beliefs?

One answer is provided in the data we described above. Nonnatural beliefs, as long as they come in small proportions, help people remember and presumably transmit the intuitive statements. A small proportion of nonnatural beliefs give the story a mnemonic advantage over stories with no nonnatural beliefs at all or with far too many nonnatural beliefs, just like moderately spiced-up dishes have a cultural advantage over bland or far too spicy dishes. Just as spices in and of themselves may have little nutritional value but help one consume nutritious food, nonnatural beliefs may have little psychological value, but may help one remember and transmit beliefs that do have psychological value. This represents the first alternative scenario of cultural transmission: the cognitive route. Here, cultural innovators start with natural propositions, then spice up their narratives with nonnatural propositions making the narratives culturally attractive. Over multiple generations of trial and error, those belief systems that evolve this cognitive form enjoy a transmission advantage over others and eventually achieve cultural stability. This route may describe how folktales evolve in a culture. The typical cultural innovator of the cognitive route is the storyteller; its setting is around the campfire or the dinner table, and its ontological violations are for cognitive effect.

The second scenario of cultural transmission is the reverse of the first. This second possibility is that under some conditions, nonnatural beliefs (of the minimally counterintuitive kind) enjoy a transmission advantage, for example when consumers of cultural materials have reason to expect that the cultural narratives will follow a nonnatural course (Barret & Nyhof, 2001; Boyer & Ramble, 2000). This may also happen if it turns out that even though nonnatural beliefs are less memorable in the absolute sense, they degrade at

a slower rate, as hinted by the evidence we have. More importantly, in this second emotional route to cultural transmission, cultural innovators, faced with powerful existential anxieties of their group members, invoke nonnatural narratives that "transcend" common sense and offer seeming resolutions to these fears. Then the cultural innovators embed their nonnatural narratives within intuitive causal understandings, making the narratives comprehensible and communicable. Over multiple generations of trial and error, those belief systems that evolve this second cognitive form enjoy a transmission advantage over others and eventually achieve cultural stability. We speculate that this process may be a critical functional motivation for religious thought. The typical cultural innovator of the emotional route is the shaman and the prophet. Its setting is death as a result of disease, natural disasters, and war. Its ontological violations are for emotional effect.

Both routes—the cognitive and the emotional—may occur independently in the way all kinds of cultural beliefs emerge. Moreover, even though the outcome they produce may look cognitively similar in the way natural and nonnatural beliefs are combined, the origin, emergence, and the underlying psychological processes that support these routes may be quite different.

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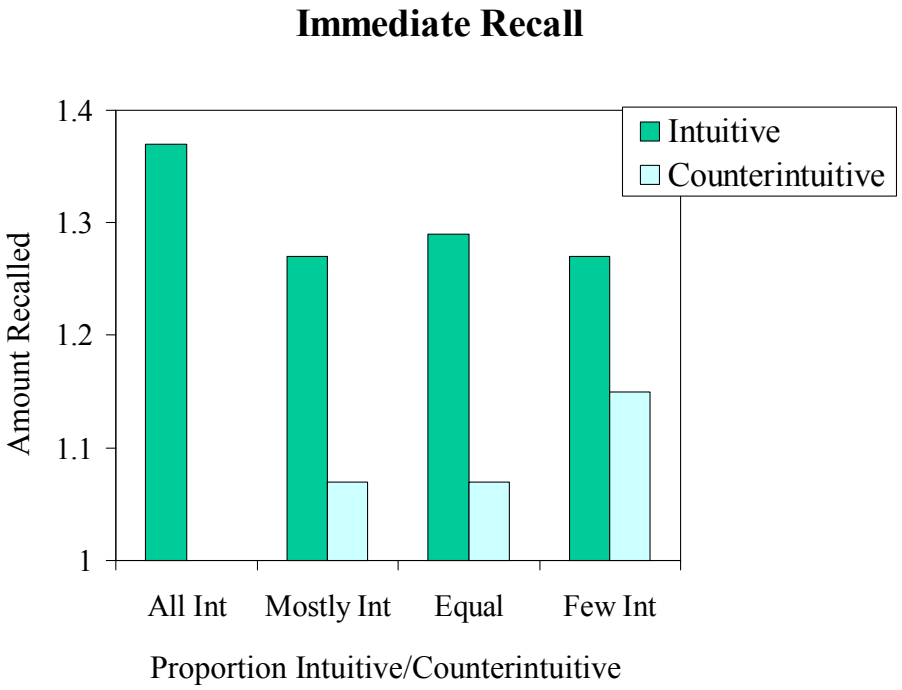
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Amount Recalled
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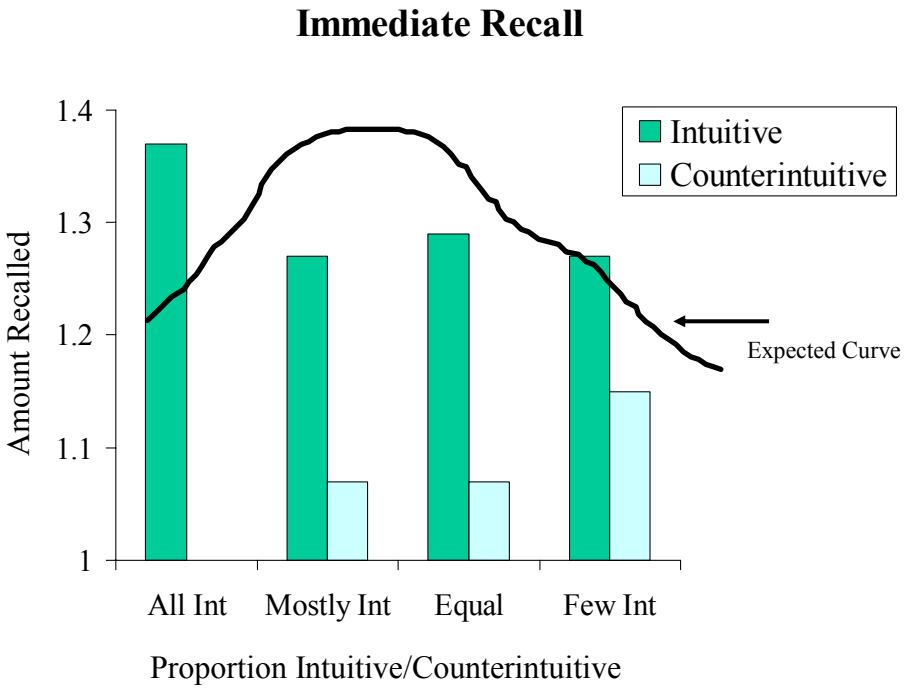
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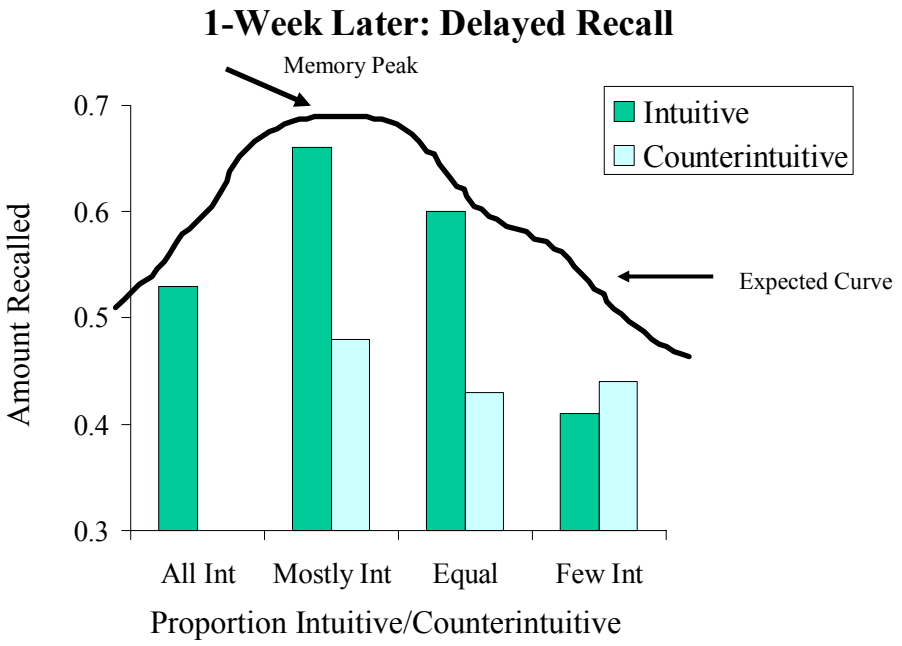
1-Week Later: Delayed Recall
Memory Peak
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Counterintuitive
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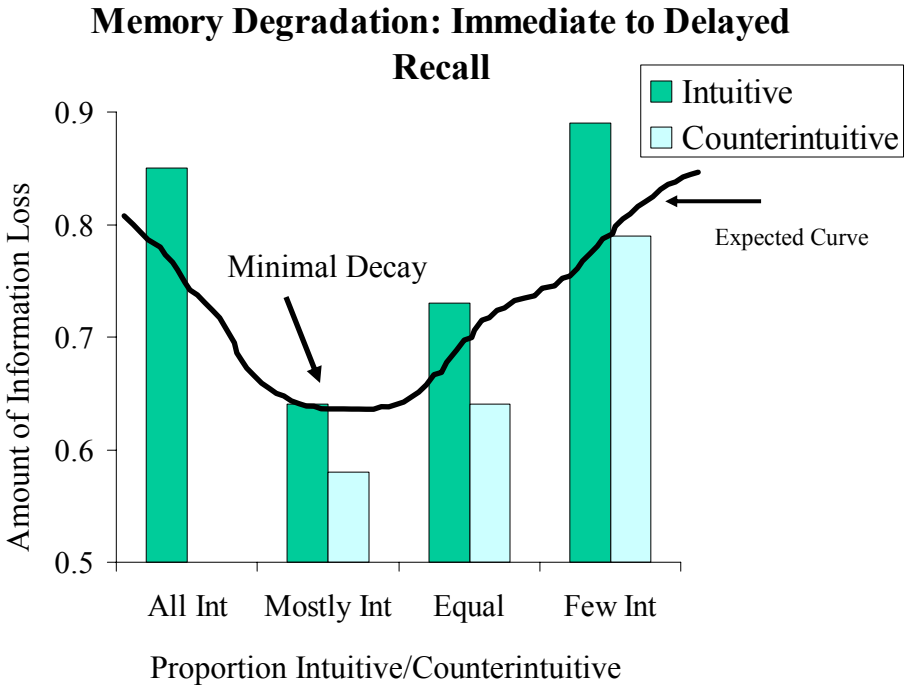
Proportion Intuitive/Counterintuitive


Memory Degradation: Immediate to Delayed Recall
Intuitive
Counterintuitive
Expected Curve
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Proportion Intuitive/Counterintuitive