Memory and Mystery:
The Cultural Selection of Minimally Counterintuitive Narratives

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Abstract

We hypothesize that cultural narratives such as myths and folktales are more likely to achieve cultural stability if they correspond to a minimally counterintuitive cognitive template that includes mostly intuitive concepts combined with a minority of counterintuitive ones. Two studies tested this hypothesis, examining whether this template produces a memory advantage, and whether this memory advantage explains the cultural success of folktales. In a controlled laboratory setting, Study 1 found that a minimally counterintuitive template produces a memory advantage after a 1-week delay, relative to entirely intuitive or maximally counterintuitive cognitive templates. Using archival methods, Study 2 examined the cognitive structure of Grimm Brothers folktales. Compared to culturally unsuccessful folktales, those that were demonstrably successful were especially likely to fit a minimally counterintuitive template. These findings highlight the role of human memory processes in cultural evolution.
1. Introduction

What makes a narrative culturally successful? Within any culture, religious tales, folktales, and other narratives are generated by the thousands; but only a few of these tales actually achieve sustained popularity. (We all know *Cinderella*, for instance; but *Hefty Hans* never quite caught on). Of the many ecological and psychological factors that influence the extent to which any such narrative achieves cultural success, the mnemonic resilience of ideas may be one of the most important. Memorability places necessary constraints on the cultural transmission of ideas. In oral traditions that characterize most of human cultures throughout history, an idea cannot be transmitted and achieve cultural success unless it stands the test of memory (Rubin, 1995; Sperber, 1996). Therefore, all else being equal, a more memorable idea has a competitive advantage over a less memorable one. Because any cultural idea is likely to go through several generations of repeated transmission and recall, this advantage, even if small at the start, accumulates from generation to generation leading to massive differences in eventual cultural success.

The psychology of cognition in general, and memory in particular, is thus of great relevance to the anthropological study of how cultural belief systems emerge. Knowledge structures are not acquired and transmitted through a process by which culture “impinges” on a passive human mind. Rather, the minds of recipients of cultural materials selectively represent, retain, transform, and transmit information. Thus the ordinary biases and transformations in human memory can constrain the content of cultural beliefs. In this article, we examine one specific cognitive factor that can influence the cultural transmission of knowledge. We hypothesize that a cognitive template that renders a narrative to be "minimally counterintuitive”—combining mostly intuitive concepts with a minority of
counterintuitive ones—endows the narrative with a memory advantage, and as a result contributes to its cultural success.

1.1 Intuitive and Counterintuitive Ideas in Cultural Narratives

What makes a concept "intuitive" or "counterintuitive"? The key is whether the concept is consistent with, or violates, ontological assumptions about the properties of ordinary objects.

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 core assumptions about the basic categories of existence, such as intentional beings, animals, inanimate objects, and 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”—of mind, biology, and physics—that provide common sense expectancies 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., Lillard, 1998; Wellman, Cross, & Watson, 2001), biology (e.g., Medin & Atran, 1999), and physics (e.g., Peng & Nisbett, 1998). 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, for example, 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 across 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; Wellman, 1990).

Unlike everyday natural concepts with properties consistent with ontological expectations, there are many other concepts that violate those expectations. Ghosts that walk through walls, frogs that talk, mountains that are invisible to the human eye—these and many other fanciful concepts are inconsistent with intuitive theories of mind, biology, and physics. They are "counterintuitive." Interestingly, despite their obvious incompatibility with ontological expectations--or assumptions about what is actually possible in the real world--these kinds of counterintuitive concepts appear regularly in religious traditions, folk tales, myths and legends around the world.

Although counterintuitive concepts do appear in popular cultural narratives, the sheer number of counterintuitive concepts in any cultural narrative is typically dwarfed by the number of more mundane, intuitive concepts. Indeed many successful narratives appear to follow a similar template, consisting primarily of intuitive concepts, punctuated by a very small number of counterintuitive concepts. This "minimally counterintuitive" template may be no accident. Indeed, we propose that it may be a recipe for cultural success: Compared to narratives that fit other templates (e.g., no counterintuitive concepts at all; many
counterintuitive concepts), those that are minimally counterintuitive may be especially memorable, and therefore especially likely to become culturally widespread as well.

1.2. Past Research on the Cognitive Optimality of Minimally Counterintuitive Ideas

One of the earliest accounts of memorability and the transmission of counterintuitive cultural narratives 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. Interestingly, 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. But Bartlett’s striking finding was that the very notion of the ghosts—so central to the original story—was gradually eliminated from the retellings, suggesting that counterintuitive elements are at a cognitive disadvantage.

In recent years, there has been growing empirical work on the cognitive factors that constrain the cultural success of beliefs, and this research yields a more complex perspective (Boyer, 1992; 1994a; 1994b; 2003; see also Atran, 1990, 1996; Sperber, 1975, 1996). In this view, spirits and other supernatural concepts found in culturally successful narratives (such as religious mythologies) have properties that are partially, but not entirely, counterintuitive. Spirits may be invisible or may pass through solid objects; but otherwise they possess the intuitive properties of ordinary intentional agents. Supernatural agents may have supernatural abilities of perception, but they also obey many of the mundane laws of folk physics and folk biology (e.g., they cannot occupy more than one physical location at a time; they get hungry). Indeed, it appears that people assume a substantial set of intuitive properties even for beings that are putatively supernatural: controlled experiments indicate that people spontaneously anthropomorphize God in their reasoning, even if doing so contradicts their stated theological beliefs (e.g., Barret & Keil, 1996). Other research also indicates that culturally successful
materials favor minimal rather than large violations of ontological expectations. In a content analysis of Ovid’s *Metamorphoses*, Kelly & Keil (1985) found 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, than a conscious being to be transformed into an inanimate object. Transformations that occur across wide swaths of ontological distance may be just too counterintuitive to be psychologically appealing.

If indeed minimally counterintuitive concepts are cognitively optimal, they should enjoy a cognitive advantage in memory and transmission advantage in communication. Recent studies have supported this conclusion. In a series of experiments, Barrett and Nyhoff (2001) asked participants to remember and retell stories containing intuitive, intuitive but bizarre, and counterintuitive events or objects. After three generations of retelling the story, the proportion of items recalled in each category was measured. Results indicated that both counterintuitive and intuitive but bizarre items were remembered in greater proportions than intuitive items. Furthermore, the same recall advantage of minimally counterintuitive items was found after a 3-month delay; this is an important finding, given that in most natural settings in which cultural narratives evolve, recall after a long delay is the critical factor. An idea that is memorable immediately, but fades over time could not be culturally successful.

Another important finding is that the effect of counterintuitiveness on recall is not linear. Too many ontological violations render a concept too counterintuitive to be comprehensible and memorable. Boyer and Ramble (2001) found that concepts with too many violations were recalled less well than those that were minimally counterintuitive. These results are not only observed immediately after exposure, but also after a 3-month delay – and in cultural samples as diverse as the Midwestern United States, France, Gabon,
and Nepal. Consistent with the idea that this memory advantage is related to cultural success, the anthropological literature confirms that religious concepts with too many ontological violations are rather rare (Boyer, 1994a). Contrary to the apparent conclusion from Bartlett’s classic experiments, these more recent empirical results confirm the idea that minimally counterintuitive concepts are better recalled and transmitted than intuitive ones.

1.3. Cognitive Optimality at the Level of Narratives

This existing body of evidence focuses on the extent to which specific narrative elements (e.g., supernatural agents or events) are counterintuitive, and the memorability and transmission of those elements. The results imply that minimally counterintuitive elements are especially likely to proliferate in cultural narratives. This implication, however, is inconsistent with the apparent structure of culturally important narratives. If minimally counterintuitive narrative elements enjoy better long-term recall than other concepts, they should dominate religions, folktales, and myths at a much greater rate than is actually observed. However even a casual perusal of culturally successful materials reveals that counterintuitive narrative elements are in the minority. The Bible, for example, is a succession of mundane events interspersed with a few counterintuitive occurrences, such as miracles and the appearance of angels. In the Grimm Brothers’ 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 (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 such violations (the Beast as an animal with human properties, the magic mirror, and the transformation from beast to human). Why don’t minimally counterintuitive concepts dominate the narrative structure of religions, folktales, and myths?
The answer to this apparent puzzle may lie in examining the memorability of a narrative as a single unit of transmission, rather than the individual ideas that are embedded in these narratives. The unit of cultural transmission is often, but not always an individual idea. Under many conditions, a series of events or ideas are transmitted together as a single unit of culture (Rubin, 1995). Furthermore, recall of individual items is influenced by the narrative context in which the items are embedded (Thorndyke, 1977). Therefore, cognitive optimality might be at work not only at the level of individual narrative elements, but at the level of whole narrative structures as well.

Just as specific narrative elements are especially memorable if they are minimally counterintuitive, so too whole narratives are likely to be especially memorable if they are minimally counterintuitive—if they contain a small number of minimally counterintuitive ideas. If indeed minimally counterintuitive narratives enjoy a memory and transmission advantage (relative to narratives with no counterintuitive elements, or those that have an abundance of counterintuitive elements), then cognitive selection would prevent minimally counterintuitive ideas from taking over entire narratives.

Previous research has not addressed cognitive optimality at the narrative level. For instance, in prior studies, equal proportions of intuitive and counterintuitive concepts were used in each story (Barrett & Nyhoff, 2001; Boyer & Ramble, 2001). The research reported in this article was designed explicitly to test the hypotheses that minimally counterintuitive narratives are more memorable, and that they therefore enjoy more cultural success than narratives fitting alternative cognitive templates. Study 1 examined whether minimally counterintuitive narratives enjoy better recall after a 1 week delay than all-intuitive or maximally intuitive narratives. In Study 2, we examined whether this memory bias explains the cultural success of folktales in the Grimm Brothers collection, such that minimally counterintuitive folktales are more likely to attain sustained popularity than those that do not.
In both studies we expected the relationship between minimal counterintuitiveness and cognitive or cultural success to fit a non-linear inverted U-shaped curve.

2. Study 1: Memory for Minimally Counterintuitive Narratives

2.1. Overview

We conducted an experiment to examine the memorability of minimally counterintuitive belief sets. To create belief sets with different proportions of counterintuitive elements, we first created individual intuitive and counterintuitive items. The latter were created by transferring a property from its intuitive domain to a novel domain (e.g., thirsty door). Recall was measured after a 3-min delay, and after a one-week delay. This latter measure was the central one, as it reflects the proper role of recall in the cultural evolution of narrative structures. This study differed from previous ones in a number of important ways. One difference is of primary interest: narrative structures were used that varied in the relative proportion of intuitive (INT) and minimally counterintuitive (MCI) elements. This allowed us to test the cognitive optimality hypothesis at the level of narrative structures, as well as at the level of individual narrative elements.

Several other methodological differences are notable as well. First, the INT and MCI elements were rigorously matched, such that each word served as its own control. In addition, 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 provided as neutral a context as possible to measure recall, eliminating any effects due to participants’ notions of what would be conversationally 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 and events, with little or no story structure. Our experimental format simulated the degraded
Two questions were examined: (1) At the level of individual narrative elements, which elements enjoy better recall: minimally counterintuitive elements or their intuitive counterparts? (2) At the level of the entire narrative, what proportion of intuitive to minimally counterintuitive elements maximizes recall of the narrative itself? It was expected, consistent with prior research, that individual minimally counterintuitive elements would enjoy a recall advantage over intuitive elements. More central to this research, it was expected that at the narrative level, minimally counterintuitive narrative structures would enjoy the highest rate of recall (compared to narratives with equal proportions of intuitive and minimally counterintuitive elements, those comprised entirely of intuitive elements, and those comprised primarily of minimally counterintuitive elements).

2.2. Method

2.2.1 Generation of Intuitive and Counterintuitive Items

Two-word statements that represented INT and MCI items were generated. Each statement consisted of a concept and one property that modified it. INT statements were created by using a property that was appropriate to the ontological category (e.g., closing door). MCI statements were created by modifying the concept by a property that was transferred from another ontological category (e.g., thirsty door). This procedure explicitly operationalizes minimal counterintuitiveness as the transfer of a property associated with the core conceptual domains of folkphysics, folkbiology, folkpsychology, from an appropriate ontological category of person, animal, plant, substance, to an inappropriate one (Atran & Norenzayan, in press). For example, a “thirsty door” transfers a folkbiological property (thirst) from its proper category (animal or plant) to an improper category (inert object/substance).
For each INT statement, a matching MCI statement was generated (e.g., closing cat). Similarly, for each MCI statement, a matching INT statement was generated (e.g., thirsty cat). This resulted in a set of four statements that achieved a counterbalanced design, each word in each statement serving as its own control. Thus, “cat,” “door,” “closing,” and “thirsty” were equally likely to appear in a INT item as in a MCI item. Table 1 shows examples of the statements used in the study.

To ensure that the INT and MCI statements were successfully created, ten pretest participants were asked to rate the statements on a 5-point scale anchored by the labels “ordinary” and “out of the ordinary.” Of those, 36 pairs of INT, and 36 pairs of MCI that received mean ratings less than 2 (for INT) or mean ratings more than 4 (for MCI) were retained (for a total of 18 items). As a second manipulation check, a separate group of 28 participants (13 men, 15 women, age \( M = 26 \)) who were blind to the purpose of the study rated the 18 items in four different item versions, on a 6-point scale anchored by the labels "very natural" and "very supernatural." MCI items were rated to be substantially less natural than INT items, \( F(1, 24) = 45.57, p < .001 \), and this effect did not interact with the counterbalanced item type, \( F < 1 \).

2.2.2. Participants

One hundred and eight undergraduate students in an introductory psychology class at a large Midwestern American university participated in this study. Of those 108, 14 spoke English as a foreign language, and therefore were dropped from the analysis. Of the remaining 94 (58 female, 36 male) participants, 82 took part in the second recall task after a 1-week delay.

2.2.3. Experimental Manipulation

Two experimental manipulations were constructed. The first was a (within-participants) manipulation of the intuitive content of each item: some items were INT, others
were MCI. The second was a (between-groups) manipulation of the proportion of INT and MCI items on the full list of narrative elements. Participants were randomly assigned to one of four experimental conditions:

1. Entirely Intuitive (18 INT items, 0 MCI items).
2. Minimally Counterintuitive (13 INT items, 5 MCI items)
3. Equal Frequencies (9 INT items, 9 MCI items)
4. Mostly Counterintuitive (5 INT items, 13 MCI items)

In the “Equal Frequencies” condition, four different narrative lists were created, each of which included one of the four possible concept + modifier combinations: for example, closing door (INT), thirsty cat (INT), thirsty door (MCI), closing cat (MCI). Thus the “Equal Frequencies” condition controlled for any possible baseline differences in the memorability of these concepts and modifiers. For the other three experimental conditions, two different narrative lists were created, by randomly selecting a subset of the INT and MCI items from those used in the “Equal Frequencies” condition.

2.2.4. Procedure

Participants were tested in a classroom setting, using questionnaires. They were timed for each part of the study. The first page of the questionnaire contained instructions: they were asked to study the items on the list in the next page in order to recall them later. After spending 5 minutes studying the list, the experimenter signaled them to turn to the following page, on which they spent 3 minutes completing a distractor task. Then they turned the page and listed as many of the items as they could remember on a blank sheet. They were given 5 minutes to complete this recall task. After exactly 1 week, the same experimenter gave the same participants a surprise recall task. In 5 minutes, they wrote down on a blank sheet of paper as many of the statements as they could recall from the week before.

2.2.5. Dependent Measures
Three dependent variables were assessed. Free recall after a 3-min distractor task, delayed free recall again after a 1-week, and memory degradation (immediate recall minus delayed recall). Recall was measured as follows: participants received a score of 2 for recalling the 2-word statement fully, a score of 1 for recalling only one of the two words in the statement, and a score of 0 for failing to recall any part of the statement. Remembering words or statements that did not appear on the list was considered failure to recall and given a score of 0.

2.3. Results

Based on this formula, a percentage measure of recalled items was computed in each condition. In addition, an INT percent score was calculated by adding up the scores for each statement, and dividing the sum by the number of INT statements that appeared on the given list. Similarly, an overall MCI percent score was calculated for each participant (except in the Entirely Intuitive condition). Thus, for both immediate and delayed recall, each participant had an overall recall score, an INT score and an MCI score. Comparisons of overall recall across the four experimental conditions, as well as the memory degradation (immediate minus delayed) measure tested the novel hypothesis that minimally counterintuitive narrative structures are more memorable. Direct comparison between INT and MCI indices within each condition tested the hypothesis (supported in previous research) that MCI elements are more memorable.

2.3.1. Immediate Recall

Figure 1 presents the results for overall recall, broken down according to experimental condition. Across the four experimental conditions, a linear contrast indicated that overall recall levels increased as the proportion of counterintuitive elements decreased, the differences approaching significance, \( t(90) = 1.60, p = .11 \). The three experimental conditions containing counterintuitives did not differ from each other, all \( t < 1 \). As to narrative elements,
contrary to previous findings, a paired-samples t-test revealed a recall advantage associated with INT elements over MCI elements, $M=62.82$ ($SD=23.18$) vs. $M=53.74$ ($SD=24.10$) respectively, $t(68) = 3.49$, $p<.001$. (These analyses exclude participants in the Entirely Intuitive condition.) This mean difference was observed within all three conditions containing counterintuitive elements ($p < .05$).

2.3.2. Delayed 1-week Recall

Delayed recall is the central focus of this study, since it plays the primary role in cultural transmission. Figure 2 reveals that there were effects of the experimental manipulation on overall delayed recall, and these effects are consistent with the hypothesized superiority of narratives that fit a minimally counterintuitive template, and the hypothesized curvilinear effect of counterintuitive elements on recall. A planned comparison indicated that recall was higher in the minimally counterintuitive condition compared to the combined mean in the other three conditions, $t(78) = 1.88$, $p = .05$.

As one might expect, there was a massive overall memory degradation from the immediate recall context ($M=60.67$, $SD=22.03$) to delayed recall after a week ($M=25.20$, $SD=16.70$), $t(81) = 18.97$, $p<.001$. Nevertheless, the memory advantage associated with intuitive elements persisted, $M=28.38$ ($SD=20.43$) vs. $M=22.39$ ($SD=17.41$), $t(59)=2.93$, $p<.005$ (except there was no effect within the Mostly Counterintuitive condition, $t<1$).

2.3.3. Memory Degradation

Subtracting delayed recall from immediate recall produced a measure of memory degradation. This is yet another measure of the cultural resilience of cognitive templates. Such a measure is conceptually distinct from delayed recall, and captures the extent to which a cognitive structure, once encoded, degrades for a given period of time. As Figure 3 indicates, the minimally counterintuitive cognitive template had the least memory degradation compared to the combined mean of the three other conditions, $t(78) = 1.93$, $p =$
As to individual narrative elements, no overall differences were found between intuitive and minimally counterintuitive elements across the three conditions, \( t(59) = 1.18, p = ns \). Nor were there differences in each condition (all \( ps = ns \)).

### 2.4. Discussion

Consistent with the central hypothesis in this article, the results confirmed that cognitive optimality at the level of entire narrative structures is important. While immediate recall, if anything, was a linear function of proportion of counterintuitives, and did not favor minimally counterintuitive narratives, delayed recall did. Minimally counterintuitive narratives thus were the most cognitively resilient. Thus, while minimal counterintuitiveness may not always enhance the memorability of specific narrative elements, at a different level of analysis it does appear to enhance the memorability of entire narrative structures. This may provide the recipe for a successful cultural knowledge structure; indeed it is the cognitive template that characterizes many popular narratives, including religious accounts, myths, fables, and folktales.

As to narrative elements, a complex pattern of recall emerged. Unlike the findings of Barrett and Nyhoff (2001), and Boyer and Ramble (2000), but consistent with the early classic experiments of Bartlett (1932), intuitive elements showed better recall rates than minimally counterintuitive elements. 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 elements, in which case there were no differences in delayed recall rates. Also there was no advantage for intuitive elements in memory degradation. Because the two kinds of elements were rigorously matched (i.e., each word in each element was equally likely to occur in intuitive and minimally counterintuitive elements), this recall advantage is clearly attributable to intuitiveness, rather than to other variables related to word recall. Subsequently we have replicated this finding showing a long-term recall advantage for intuitive elements.
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(after 1 week and also after 3 months), using more stringent criteria for counterintuitiveness, with American college students, as well as Itzaj Maya villagers in the Mexican Yucatan (for summaries, see Norenzayan & Atran, 2005; Atran & Norenzayan, in press).

How can we account for the superiority of intuitive items in recall? There are two important methodological differences between our study and the prior experiments of Barrett and Nyhof (2001) and Boyer and Ramble (2000). In those experiments, participants were given descriptions of counterintuitive objects or events in the abstract (“a person who was at two places at the same time”), whereas in our experiment we provided basic-level descriptions (Rosch et al, 1976) that are typically found in supernatural narratives (“talking frog”).

Second, in earlier studies participants were primed to expect counterintuitive events (as in listening to a science fiction tale), or they were motivated to tell an interesting story (as in the serial transmission paradigm). Such contexts are indeed important vessels of cultural transmission, as in storytelling events or religious rituals. On the other hand, they have the disadvantage that they do not provide the ideal context in which the impact of recall, controlling for other psychological or social variables, can be examined. This experiment used a simple memory task that minimized the role of social or communicative factors that are related to, but distinct from the processes of memory. 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 items that are consistent with intuitive assumptions.

3. Study 2: Cultural Success of Minimally Counterintuitive Narratives in Folk Tales

3.1. Overview

Study 1 revealed that minimally counterintuitive knowledge structures enjoy a recall advantage over time. This finding has implications for interpersonal transmission of these knowledge structures, and for their consequent popularity across a cultural landscape.
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(Sperber, 1996). Memorable knowledge structures are more likely to be transmitted, and so they may enjoy a relative advantage in the marketplace of cultural beliefs; ultimately, they are likely to become and remain more popular. To test this hypothesis, we examined the narrative features of folk tales that have had varying degrees of cultural success.

Our study focused on one of the most culturally important folktales in the Western tradition—collected by the Brothers Grimm. We empirically assessed the cultural success of each folk tale, and selected 42 tales for deeper analysis; 21 were relatively successful and 21 were demonstrably less successful. Two trained raters, unaware of our hypotheses, read each tale and counted the number of counterintuitive elements in each folk tale. In addition, 65 university students read these folk tales and rated them on a number of characteristics, including memorability and ease of transmission. These procedures allowed us not only to test the hypothesis that minimally counterintuitive tales are more likely to be culturally successful, but also to examine whether perceived memorability mediates the relationship between minimal counterintuitiveness and cultural success.

3.2. Method

As a source, we used Manheim’s (1977) English translation of the 1857 edition of the Grimm Brothers’ collection (published originally in German). This collection contains 200 folk tales, some of which are currently very well known by many European peoples (e.g., Rapunzel, Hansel and Gretel, Cinderella) and many more stories that are relatively unknown (e.g., Brother Scamp, The Donkey Lettuce, Hefty Hans).

3.2.1. Culturally Successful and Unsuccessful Folktales

To obtain a measure of cultural popularity, we conducted 400 searches of the World Wide Web, using the search engine Google. Each search included as keywords the exact title of each folk tale, along with the word “Grimm” (e.g., “Hefty Hans” + Grimm). Half the searches used original German titles, and half used English translations of the titles (when
necessary, we searched for multiple English-translated titles). We added the word “Grimm”
to all title searches to ensure that the content of found web sites was relevant to the folk tales
of interest. For each search, we counted the number of web page "hits" as a rough indicator of
cultural popularity. The English and German searches yielded convergent but not identical
results, \( r(41) = .49, p = .001 \).

Not surprisingly, there was great variability in the number of web page "hits" across
the 200 different folk tales (ranging from 34,430 for Cinderella to 12 for The Ditmarsh Tale
of Lies). We used these numerical results as a basis for selecting a sample of culturally
successful tales. We identified a list of the 20 folk tales whose German titles produced the
most hits, and another list of the 20 tales whose English titles produced the most hits.
Together, these lists were comprised by 30 different folktales. We eliminated from further
consideration 9 folktales whose titles consisted simply of one or two common words (e.g.,
The Moon), as these tales were especially likely to have produced spurious hits. Twenty-one
tales remained, and these defined our sample of culturally successful folktales (see Table 2);
the mean number of hits across these 21 tales was 8404.

To select a comparison group of culturally unsuccessful folktales, we excluded from
consideration any tale that was among the 50 most-popular identified by either the German-
language or English-language Google searches. This exclusion criterion left 126 relatively
unsuccessful folktales. From this set, we selected 21 tales (see Table 2), attempting to ensure
that they were of approximately the same length as those in the culturally successful sample
(for both samples, the mean length was slightly greater than four pages). Aside from this
attempt to match on length, selection was random. The mean number of Google hits across
these 21 unsuccessful tales was 148.

3.2.2. Counterintuitive and Bizarre Narrative Elements
Two trained raters, unaware of our hypotheses, judged the number of counterintuitive elements in each of the 42 folk tales. Raters counted as counterintuitive any narrative element that defies intuitive assumptions about the ontological properties of the everyday world, such as the categorical and relational properties that people in all cultures appear to spontaneously ascribe to intentional agents (folk psychology), biological kinds (folk biology) and inert bodies (folk physics) (see Atran & Norenzayan, in press; Boyer, 2003). Recurring counterintuitive characters, objects, or events were counted as single counterintuitive elements (e.g., a talking mirror may appear multiple times in the same story, but counts as a single counterintuitive element). The same raters also judged the number of bizarre elements. Narrative elements were counted as bizarre if they were fancifully out-of-the-ordinary, but did not fit the strict definition of counterintuitive as an ontological violation (e.g., a house made of gingerbread).

Across all 42 tales, inter-rater reliability was very high for counterintuitive elements (Cronbach's alpha = .92), and somewhat less high for bizarre elements (alpha = .70). For subsequent analyses, indexes of counterintuitive and bizarre elements were created by calculating mean judgments across the two raters.

3.2.3. Memorability and Other Psychological Variables

Sixty-five students (age $M = 20$, 52 women and 13 men, 14 European Canadian, 36 East Asian Canadian, and 15 other) at the University of British Columbia read six folk tales apiece. Each set of 6 was selected from the total sample of 42 folktales. Each rater read a different combination of tales. Consequently, each folktale was read and rated by at least 7 different raters (21 tales were rated ten times, 16 were rated nine times, 1 was rated eight times, and 4 tales were rated seven times).

After reading each tale, raters completed a questionnaire assessing their impressions. They first indicated simply whether they were familiar with the folk tale or not. Participants
then rated each tale on a number of attributes on 7-point scales (anchored by endpoints labeled “Strongly Disagree” to “Strongly Agree”). One rating assessed understandability (“This story was easy to understand”). Another rating assessed ease of transmission (“If I wanted to tell this story to other people, I could do so quickly and easily”). Two items assessed perceived interest-value (“This story was interesting” and “Children would find this story interesting”). Two items assessed memorability (“Right now if someone asked me to tell them the story that I just read, I think I could recall all or most of the critical elements of the story” and “One month from now if someone asked me to tell them the story that I just read, I think I could recall all or most of the critical elements of the story”). Two items assessed likelihood of transmission to peers (“I would talk about this story with my friends” and “If I told a friend this story, he or she would tell it to other friends”). Two more items assessed likelihood of transmission to children (“I would talk about this story with a 7-year-old child” and “If I told a 7-year-old this story, he or she would tell it to other 7-year-olds”). Finally, participants indicated their agreement with the statement “This story contains a moral lesson.”

Raters then completed one additional measure designed to assess the communicability of each folktale. They were asked to consider a situation in which they were given an opportunity to tell only a few of the stories to others, and they then ranked the stories to indicate their relative motivation to communicate each story to others. (A ranking of 1 was given to the story they deemed most highly communicable; higher values indicate lower communicability).

Data were collapsed across raters so as to treat folktale as the unit of analysis. Thus, each datum was comprised by the mean of seven or more independent ratings of each story. Four constructs were assessed by two items apiece, and results on these items were combined
to create 2-item composite indices (for interest-value, memorability, transmission to peers, and transmission to children; Cronbach’s alphas > .67).

3.3. Results

3.3.1. Manipulation check of cultural success variable

University students' judgments of folktale familiarity provides a check on the Web-search-based categorization of tales as successful or unsuccessful. Reassuringly, these raters were more familiar with folktales categorized as successful, $t(40) = 4.46, p < .001$. On average, culturally successful stories were familiar to 41 percent of raters, whereas unsuccessful stories were familiar to only 5 percent of raters. In subsequent analyses we treat cultural success as a dichotomous variable.

3.3.2. Are Minimally Counterintuitive Folktales More Culturally Successful?

The hypothesized relation between counterintuitive elements and cultural success is nonlinear. While there is no necessary implication for differences in mean numbers of counterintuitive elements (and no meaningful mean differences were observed), the hypothesis predicts that there will be different shapes to the distributions of counterintuitive elements within the samples of successful and unsuccessful folktales: Compared to unsuccessful folktales, the distribution within the sample of successful tales should be more clearly unimodal, and variability around that central tendency should be relatively low. The two frequency distributions are displayed in Figure 4. As hypothesized, variability within the successful sample ($sd = 1.65$) was lower than within the unsuccessful sample ($sd = 2.19$), $F(1, 20) = 3.92, p = .05$ (using Levene’s test for equality of variances). Visual inspection reveals that, among culturally unsuccessful tales, the distribution is relatively flat and there is no single modal number of counterintuitive elements. In contrast, among culturally successful tales, there is a clear mode: The majority of these tales had a counterintuitive score between 2 and 3, inclusive. Using this range (2 to 3) to define a set of minimally counterintuitive
folktales, it is revealed that 76.5% of minimally counterintuitive tales are in the culturally successful sample. In contrast, among stories with few or no counterintuitive elements (scores < 2), only 30% were culturally successful. Similarly, among stories with excessive numbers of counterintuitive elements (scores > 3), only 33% were culturally successful. Thus, minimally counterintuitive folktales were more likely to be culturally successful, $\chi^2(N=42) = 8.00, p = .005$. Minimal counterintuitiveness correctly predicted cultural success of folktales 71.4% of the time.

Whereas the two sample distributions clearly differ in terms of counterintuitive elements, investigation of bizarre elements revealed no apparent differences. Within both samples, the number of bizarre elements in each story was relatively low ($M's = 1.17$ and $1.36$ for successful and unsuccessful tales), and there were no meaningful differences in the shape of the distributions (e.g., variability was very similar; $SD's = 1.10$ and $0.98$ for successful and unsuccessful folk tales, respectively). Thus, while the results indicate that cultural success is predicted by the number of counterintuitive elements, success is not predicted by unusual narrative elements more broadly.

3.3.2. Are Minimally Counterintuitive Folktales Psychologically Different?

The preceding set of results provided an empirical criterion for defining a folktale as minimally counterintuitive or not, which then allowed us to test whether minimally counterintuitive folktales are perceived to be more memorable, and more psychologically appealing in other ways as well. We divided the total sample of 42 folktales into 2 categories: Those that were minimally counterintuitive and those that were not. Folktales were counted as minimally counterintuitive if the mean number of counterintuitive elements fell between 2 and 3, inclusive ($N = 17$). All other folktales (with scores less than 2 or greater than 3) were placed in the comparison category ($N = 25$). Table 3 summarizes mean ratings on
memorability and other psychological variables, and also provides inferential statistics pertaining to mean differences.

Consistent with the hypothesis, these results reveal that minimally counterintuitive folktales were perceived to be more memorable. They were also perceived to be more understandable, and easier to transmit than folktales containing either too few or too many counterintuitive elements. No differences were found for interest value, transmission value, and moral lesson. The difference approached significance for communicability (see Table 3).

3.3.3. Are Culturally Successful Folktales Psychologically Different?

These methods also allowed us to test whether culturally successful folktales also differ from unsuccessful ones on ratings of memorability and other psychological variables (Table 4). Results revealed mean differences on most rated characteristics, indicated that culturally successful folktales were overall psychologically privileged. Culturally successful tales were judged to be relatively more memorable, understandable, interesting, and easier to transmit. In addition, all three indices assessing likelihood of transmission revealed that compared to demonstrably unsuccessful tales, culturally successful folktales are more likely to be communicated to others.

3.3.4. Does Memorability Mediate the Relation Between Minimal Counterintuitiveness and Cultural Success?

The preceding results are consistent with the following chain of reasoning: Minimally counterintuitive folktales are more memorable and easier to understand and transmit to others. As a result of their superior memorability and understandability (but not necessarily other characteristics), they are more likely to become culturally popular. If indeed a folktale’s memorability mediates the relationship between its status as a minimally counterintuitive narrative and cultural success, then the observed relation between minimal
counterintuitiveness and cultural success is likely to be reduced or eliminated when controlling for the alleged cognitive mediator.

To investigate this possibility, folktales were categorized as either minimally counterintuitive or not (coded as 1 and 0, respectively), and as successful or not (coded as 1 and 0, respectively), according to the categorization criteria described above. The zero-order correlation between these two variables was $\phi = .44$, $p = .005$. The two memorability items, understandability, and ease of transmission were strongly intercorrelated and showed very high internal reliability ($\alpha = .94$), as a result, they were combined to reflect a composite “cognitive facility” variable. Results from a logistic regression analysis revealed that, when cognitive facility was included along with minimal counterintuitiveness as predictors of cultural success, the predictive impact of minimal counterintuitiveness was reduced from $B = 1.93$, $Wald \chi^2 (N=42) = 7.31$, $p = .007$, to $B = 1.45$, $Wald \chi^2 (N=42) = 2.60$, $p = .12$. The cognitive facility variable continued to exert an impact on cultural success, $B = 3.22$, $Wald \chi^2 (N=42) = 9.03$, $p = .003$. This result suggests that the cognitive facility variable partially (but not completely) mediated the relationship between a folktale’s status as minimally counterintuitive and its eventual cultural success.

3.4. Discussion

As hypothesized—and consistent with previous findings—minimally counterintuitive folktales were rated as especially memorable. They also were rated as more understandable, and easier to transmit to others. These cognitive features can have cultural consequences as well. The cultural success of a folktale—defined by its popularity—was predicted by the number of counterintuitive elements. Success was not predicted by the number of intuitive but bizarre elements. Moreover, there was evidence that the cognitive features of a folktale—specifically its memorability, understandability, and ease of transmission—mediated the relation between minimal counterintuitiveness and cultural success. Although the inferences
we can draw from the mediational analysis are limited by the small sample size and the self-report based measures, it is reassuring that these measures appropriately distinguished the cognitive templates of folktales from their cultural success. Whereas the minimal counterintuitiveness of a folktale predicted specific cognitive characteristics related to memorability, understandability, and ease of transmission, the cultural popularity of a folktale predicted a general favorability on most of the assessed psychological measures. Minimally counterintuitive narrative structures are not only more memorable as found in Study 1, but also that this memorability accounts in part for their cultural success over time.

4. General Discussion

Religious and supernatural narratives, including partly counterintuitive narratives that are found in myths, legends and folktales are extraordinarily resilient aspects of human cultures around the world. Most of these narratives have been transmitted orally through generations, and have come to shape beliefs, values, and behaviors of people everywhere. What accounts for the persistence of such narratives? No doubt many cognitive, emotional and ecological variables likely contribute to the cultural stability of such widespread belief structures. These include cognitive (Rubin, 1995), emotional (Heath, Bell, & Sternberg, 2001), and ecological (Anderson & Schooler, 1991; Berger & Heath, in press) variables. In this article we examined one very important cognitive factor—the memorability advantage that minimally counterintuitive narratives enjoy in the minds of cultural members. We found that minimally counterintuitive knowledge structures that contain only a few counterintuitive elements degrade less over time and produce superior recall in the long term (but not in the short term) over other templates that are either entirely intuitive or excessively counterintuitive (Study 1). We further found that such cognitive advantage selectively predicts the cultural success of one type of culturally important narratives, that of folktales (Study 2).
Elaborating on early insights by Sperber and others (1975; 1996, Lawson & McCauley, 1990), supernatural beliefs are being examined from a natural science perspective within what has come to be known as the cognitivist program of religion (e.g., Atran, 2002; Barrett, 2000; Boyer, 1994a, 2003; Pyysiainen & Antonnen, 2002). In recent years, growing research has been examining the cognitive and communicative processes that shape and constrain cultural and religious beliefs (e.g., Boyer & Ramble, 2001; Barrett & Nyhoff, 2001). Whereas previous studies focused primarily on the cultural selection of discrete supernatural ideas, here we examined the cultural selection of knowledge structures or narratives that contain counterintuitive elements and often act as a coherent unit of transmission across minds.

We propose that minimally counterintuitive narratives are culturally successful partly because they enjoy a stronger cognitive advantage in recall than other narrative templates. While the specific computational properties of this memory advantage remain an open question, the advantage is most likely attributable to the fact that such narratives deviate from ordinary expectations systematically but not excessively. A minimal amount of counterintuition is attention arresting, evokes a sense of opaqueness or mystery, and therefore encourages further cognitive processing over time and aids in the cognitive stabilization of narratives. But only if the ensuing impossible worlds remain largely connected to the everyday world can supernatural narratives be mentally represented, rehearsed, and transmitted. This highlights the importance of examining cognitive optimality at the level of narratives. If cognitive optimality were operating at the level of distinct ideas only, and if the narratives in which they are embedded did not have any cognitive effect, we would expect that the cognitive or cultural success of a knowledge structure would increase as a linear function of the proportion of minimally counterintuitive concepts. However this was not the case. In Study 1, only knowledge structures with a few counterintuitive ideas facilitated long
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term recall. Similarly in Study 2, only folktales with a few counterintuitive elements facilitated cultural success. In both studies, the effect of the number of counterintuitive elements on cognitive or cultural success was a curvilinear function.

Importantly, counterintuitiveness is distinct from bizarre conceptual features that otherwise do not violate core expectancies rooted in core domain-specific theories. Although Study 1 did not examine bizarreness as distinct from intuitive violations, evidence for this was found in Study 2, in which the number of bizarre elements had no predictive power in accounting for the cultural success of folktales, whereas number of counterintuitive elements did. This is consistent with prior findings indicating that intuitive violations and strangeness are two distinct processes and only the former reliably affects the recall of supernatural ideas (e.g., Boyer & Ramble, 2001).

Our findings were robust, observable whether in a controlled laboratory context, or in the content analysis of naturally occurring cultural narratives. However, one limitation regarding the present studies needs mention. In both studies the samples were representative of Western culture. It would be important to examine the extent to which minimally counterintuitive narratives are also found to favor cultural success in non-Western cultural contexts. In addition to laboratory experiments, the rich traditions of folktales and myths of diverse cultures, such as Hindu Vedic tales, or the Mayan Popul Vuh, could be examined in search of the minimally counterintuitive cognitive template described in this paper. Such cross cultural extensions also could shed light on culture-specific cognitive structures that no doubt contribute to their cultural success.

Finally, we emphasize that we do not claim that human memory was “designed” to favor minimally counterintuitive narratives such as the ones we observe in religious and mythical traditions. Quite the contrary, such narratives were most likely culturally selected because they successfully exploited the already existing cognitive architecture of human
Memory and mystery

memory, which was naturally selected to solve adaptive problems that were quite unrelated to the propagation and cultural stabilization of counterintuitive narratives. Thus, memorability is a necessary, but not sufficient factor in the cultural selection of such narratives.

Once minimally counterintuitive narratives pass the test of long term memorability, the supernatural elements in such narratives are further culturally exploited to play a motivational function. Supernatural elements externalize and emotionally relieve core existential human problems, including death, deception, meaninglessness, and other problems that are factually and rationally intractable (Atran & Norenzayan, in press; Norenzayan & Atran, 2004). For example, there is evidence that supernatural beliefs relieve the human awareness of mortality. Controlled motivational experiments show that mortality awareness causes stronger religiosity, heightened belief in the divine, and more faith in the efficacy of supernatural interventions (Norenzayan, Hansen, 2005). Moreover this effect emerges even when the supernatural agents are culturally alien, such as Christians who are faced with belief in a supernatural Buddha or in shamanic spirits. Thus mortality awareness does not merely cause people to reinforce the beliefs of their own social group (or “worldview defense,” e.g., Greenberg, Solomon, & Pyszczynski, 1995). Rather, such anxieties spur an orientation towards counterintuitive worlds even at the cost of rupturing emotional bonds with cultural beliefs. Cognitive factors alone cannot explain the cultural success of supernatural ideas and narratives. It is the convergence of cognitive and motivational vectors that overdetermine the overwhelming presence and resilience of supernatural narratives in cultures around the world.


Footnotes

1 Including those participants who spoke English as a foreign language produced very similar pattern of results, although the statistical tests yielded marginal effects in some instances.

2 An alternative method of analyzing the effect of experimental condition of varying proportions of counterintuitives would be to assess recall of intuitive items only. Such an analysis was conducted and yielded the same pattern of results for the planned comparison of the mean in the minimally counterintuitive narrative condition against the combined mean of the three other conditions, \( t(78) = 1.80, p = .07 \).
Author Note

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Table 1. Selected examples of intuitive statements (INT) and their minimally counterintuitive (MCI) counterparts, in a counterbalanced design.

<table>
<thead>
<tr>
<th>INT</th>
<th>MCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Closing door</td>
<td>Thirsty door</td>
</tr>
<tr>
<td>Thirsty cat</td>
<td>Closing cat</td>
</tr>
<tr>
<td>2. Four-legged table</td>
<td>Confused table</td>
</tr>
<tr>
<td>Confused student</td>
<td>Four-legged student</td>
</tr>
<tr>
<td>3. Drying coat</td>
<td>Mischievous coat</td>
</tr>
<tr>
<td>Mischievous comment</td>
<td>Drying comment</td>
</tr>
<tr>
<td>4. Clenched fist</td>
<td>Impatient fist</td>
</tr>
<tr>
<td>Impatient man</td>
<td>Clenched man</td>
</tr>
<tr>
<td>5. Sleeping dog</td>
<td>Contrived dog</td>
</tr>
<tr>
<td>Contrived parable</td>
<td>Sleeping parable</td>
</tr>
</tbody>
</table>
Table 2. Culturally successful and unsuccessful folktales.

| Culturally successful \((N=21):\) The Frog King (Iron Henry) \((1),\) Little Brother and Little Sister \((11),\) Rapunzel \((12),\) Hansel and Gretel \((15),\) The Fisherman and his Wife \((19),\) The Brave Little Tailor \((20),\) Ashputtle \((Cinderella)\) \((21),\) Mother Holle \((24),\) Little Red Cap \((Little Red Riding Hood)\) \((26),\) The Musicians of Bremen \((27),\) The Devil with the Three Golden Hairs \((29),\) Brier Rose \((Sleeping Beauty)\) \((50),\) King Thrushbeard \((52),\) Snow White \((53), Rumpelstiltskin \((55),\) Thousandfurs \((65),\) Jorinde and Joringel \((69),\) Hans in Luck \((83),\) The Lilting, Leaping Lark \((Beauty and the Beast)\) \((88),\) The Goose Girl \((89),\) Snow White and Rose Red \((161).\) |


Note. Included in brackets following each title is the order number where each folk tale appeared in the 1857 Grimm Brothers collection.
Table 3

*Mean ratings on psychological variables, as a function of whether a folktale is minimally counterintuitive or not.*

<table>
<thead>
<tr>
<th></th>
<th>Minimally Counterintuitive</th>
<th>Yes</th>
<th>No</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorability</td>
<td></td>
<td>4.89</td>
<td>4.37</td>
<td>2.42</td>
<td>.02</td>
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<tr>
<td>Understandability</td>
<td></td>
<td>6.24</td>
<td>5.74</td>
<td>3.19</td>
<td>.003</td>
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<tr>
<td>Ease of Transmission</td>
<td></td>
<td>5.46</td>
<td>5.02</td>
<td>2.02</td>
<td>.05</td>
</tr>
<tr>
<td>Interest-Value</td>
<td></td>
<td>5.03</td>
<td>4.83</td>
<td>0.97</td>
<td>.34</td>
</tr>
<tr>
<td>Transmission to Peers</td>
<td></td>
<td>2.80</td>
<td>2.68</td>
<td>0.80</td>
<td>.43</td>
</tr>
<tr>
<td>Transmission to Children</td>
<td></td>
<td>4.05</td>
<td>3.81</td>
<td>0.95</td>
<td>.35</td>
</tr>
<tr>
<td>Communicability (Rank)</td>
<td></td>
<td>3.27</td>
<td>3.71</td>
<td>1.58</td>
<td>.12</td>
</tr>
<tr>
<td>Moral Lesson</td>
<td></td>
<td>4.59</td>
<td>4.43</td>
<td>0.50</td>
<td>.62</td>
</tr>
</tbody>
</table>
### Table 4

Mean ratings on psychological variables, as a function of whether a folktale is culturally successful or not.

<table>
<thead>
<tr>
<th>Culturally Successful</th>
<th>Yes</th>
<th>No</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorability</td>
<td>5.03</td>
<td>4.13</td>
<td>4.95</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Understandability</td>
<td>6.29</td>
<td>5.60</td>
<td>4.72</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ease of Transmission</td>
<td>5.61</td>
<td>4.78</td>
<td>4.30</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Interest-Value</td>
<td>5.20</td>
<td>4.61</td>
<td>3.00</td>
<td>.005</td>
</tr>
<tr>
<td>Transmission to Peers</td>
<td>2.83</td>
<td>2.63</td>
<td>1.46</td>
<td>.15</td>
</tr>
<tr>
<td>Transmission to Children</td>
<td>4.41</td>
<td>3.40</td>
<td>4.97</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Communicability (Rank)</td>
<td>3.01</td>
<td>4.04</td>
<td>4.41</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Moral Lesson</td>
<td>4.76</td>
<td>4.23</td>
<td>1.67</td>
<td>.10</td>
</tr>
</tbody>
</table>
Figure Captions

Figure 1. Immediate recall by proportion of intuitive and minimally counterintuitive beliefs.

Figure 2. Delayed 1-week recall by proportion of intuitive and minimally counterintuitive beliefs.

Figure 3. Memory degradation (immediate minus delayed recall).

Figure 4. Frequency distribution of counterintuitive elements contained in samples of culturally successful and unsuccessful folktales.
Immediate Recall

Percent Recall

Equal Entirely Intuitive Minimally Counter-intuitive Equal Maximally Counter-intuitive

Delayed Recall—1 Week

Percent Recall

Equal Entirely Intuitive Minimally Counter-intuitive Equal Maximally Counter-intuitive
Memory Degradation

![Memory Degradation Graph](image)

Frequency

![Frequency Graph](image)

Number of Counterintuitive Elements