Counterintuitiveness in Folktales: Finding the Cognitive Optimum

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Abstract

The present study sought to (1) determine whether Barrett's counterintuitives coding and quantifying scheme (CI-Scheme) could be applied to cultural materials with sufficient inter-coder reliability, (2) provide evidence concerning just how counterintuitive is too counterintuitive for a concept to be a recurrent cultural idea, and (3) test whether counterintuitive intentional agent concepts are more common in folktales than other classes of counterintuitive concepts. Seventy-three folktales from around the world were sampled from larger collections. Using Barrett's CI-Scheme, two independent coders identified 116 counterintuitive objects and scored them for degree of counterintuitiveness with very high inter-rater concordance. Seventy-nine percent of folktales had one or two counterintuitive objects. Of the counterintuitive objects 93 percent had a counterintuitiveness score of only one. Ninety-eight percent of counterintuitive objects were agents. Results suggest the CI-Scheme may have utility for analyzing cultural materials, that the cognitive optimum for cultural transmission falls around one counterintuitive feature, and that counterintuitive agents are more common than other types of counterintuitive objects in folktales.

Key Words

cognitive architecture; communication; concepts; culture; representation

Running Header

Counterintuitiveness in Folktales

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Exploring the transmission of cultural ideas and the underlying cognitive mechanisms that generate and maintain these ideas continues to be a popular area of research. Cultural ideas or concepts are those that are shared or transmitted within a group and are largely spread through human interaction and behavior via human cognitive architecture (Sperber & Hirschfeld, 2004). Examining this conceptual architecture in relation to cultural transmission is central to understanding which ideas are likely to stabilize as cultural forms and become common across cultures. Pascal Boyer's theory of transmission of counterintuitive ideas, here termed the Minimal Counterintuitiveness (MCI) theory, suggests that ideas that are counter to our intuitive expectations (including many religious, mythical or fictional ideas) strike a balance between being readily understood because of a sturdy intuitive conceptual foundation and being attention demanding because of their novelty and unusual inferential potential (Boyer, 2003; Boyer & Ramble, 2001; Sperber, 1996). As a result, these minimally or modestly 'counterintuitive' ideas are likely memorable and have a cultural transmission advantage over other concepts (Boyer & Ramble, 2001). Boyer hypothesizes that concepts with a small number of counterintuitive properties are better remembered than both wholly intuitive concepts (because they are typically too mundane to attract attention) and extremely counterintuitive concepts (because they are difficult to represent) (Boyer, 2003; Boyer & Ramble, 2001).

Several studies using memory experiments have examined Boyer's prediction that slightly or 'minimally' counterintuitive ideas are generally remembered better than completely intuitive ideas (e.g. Barrett and Nyhof, 2001; Boyer & Ramble, 2001; Gonce et al., 2006; Pyysiäinen, Lindeman, & Honkela, 2003; Upal et al., 2007). Though the earliest experiments

found the predicted mnemonic and transmission advantage for minimally counterintuitive ideas (e.g. with only a single counterintuitive feature) over non-counterintuitive control items (Barrett & Nyhof, 2001; Boyer & Ramble, 2001), more recent experiments have yielded mixed results. These experiments have raised the possibility that the MCI advantage either operates only on the level of narratives (Norenzayan et al., 2006), is dependent upon embedding the concept in narrative structures (Gonce et al., 2006), or is a product of inferential potential rather than counterintuitiveness *per se* (Gregory & Barrett, forthcoming). It may be that inconsistency in findings is due to inconsistency in how counterintuitive ideas and concepts are operationalized (e.g., Gonce et al., 2006; Norenzayan et al., 2006; Tweney et al., 2006).

Even if one end of the proposed cognitive optimum has only modest psychological support, the other tail is indubitable: extremely complex, massively counterintuitive ideas are difficult to remember and transmit faithfully. Nevertheless, the proposed cognitive optimum theory certainly leaves open an important question regarding implications for cultural transmission: Where does the cognitive optimum of counterintuitiveness fall? How many counterintuitive features are too many to be successfully remembered, transmitted, and become a recurrent, shared *cultural* representation?

The present study attempts to advance research concerning the cognitive optimum/MCI theory in two ways. First, we present and attempt to validate Barrett's recently-advanced counterintuitiveness coding and quantification scheme (the CI-Scheme, henceforth) (Barrett, 2008). For the MCI theory to continue to be fruitful in the study of cognition and culture, the ambiguity regarding how to identify (or generate) public representations of counterintuitive concepts must be resolved. Barrett has offered a scheme for resolving this ambiguity, but if the

scheme cannot be successfully applied to actual cultural materials with an acceptable degree of inter-coder reliability, the scheme's utility is limited.

In the present study, two coders with minimal training in the relevant concepts and no particular cultural expertise applied the CI-Scheme to a cross-cultural sampling of recorded folktales to test the CI-Scheme's utility. Second, through the resulting analysis of coded counterintuitive concepts represented in the folktales, we provide evidence concerning the degree of counterintuitiveness beyond which a concept is unlikely to become a widely recurrent cultural representation.

Subsequent to Boyer's development of the standard cognitive optimum/MCI theory, Boyer suggested that some counterintuitive ideas have more "inferential potential" than others. That is, they readily generate inferences, explanations, and predictions with little effort. He identifies counterintuitive *intentional agent concepts* such as invisible or immortal persons as having particularly strong inferential potential (Boyer, 2001, 2003). Boyer hypothesizes that these concepts rich in inferential potential are more memorable and likely to be successfully transmitted than other counterintuitive concepts. If so, we might expect counterintuitive intentional agent concepts to be an overrepresented sub-category of counterintuitive concepts in cultural materials. We test this prediction against the coded data from the sampled folktales: are counterintuitive agent concepts more common than other counterintuitive concepts?

To summarize, the three primary aims of the current study are to:

(1) Determine whether Barrett's CI-Scheme can be applied to cultural materials (specifically written records of folktales) with sufficient inter-coder reliability,

(2) Provide evidence concerning just how counterintuitive is too counterintuitive for a concept to be a recurrent cultural idea, and

(3) Test whether counterintuitive intentional agent concepts are more common in these cultural materials than other classes of counterintuitive concepts.

To test the CI-Scheme, we used a sample of folktales from around the world. Myths, folktales, religious tales and similar narratives represent a common type of cultural representations that often feature counterintuitive items and, hence, are a good source of material to test the CI-Scheme. As a cultural medium these tales are likely to contain concepts that have achieved 'success' by being passed down through various generations and if Boyer's theory is correct, are likely to have maintained counterintuitive concepts at or near the hypothesized conceptual optimum.

Folktales are also cultural forms that, instead of relying on considerable cultural scaffolding (e.g. writing, rituals, or repeated teachings), have been successfully communicated and solidified through oral transmission. Verbal transmission is likely to be most successful if that which is spread, in this case folktales, is memorable and not extremely complicated. If the material is too complex, intricate, counterintuitive or difficult, it is unlikely that it will be accurately told, understood by an audience and retold. Thus, the stabilizing and distilling of folktales into oral traditions and replicable cultural forms would have most likely required that the stories not be exceedingly complex, or exceedingly counterintuitive.

Method

Selecting Folktales

Oxford University's library database (OULS) was searched for collections of folktales. Inclusion criteria for collections were established *a priori*. Collections were included if they contained between forty and 100 folktales from one of the following geo-cultural regions: North America, South America, Mediterranean, Pacific, East Eurasia and Sub Saharan Africa. This was to ensure that the sample selected was balanced and represented culturally diverse populations.

Once the collections were assembled, a representative sample of stories from each collection was selected. Stories were randomly chosen by putting their titles into a hat and blindly picking them. A sample of twenty percent of total stories was selected from each collection. Some collections were organized thematically, in which case a quasi-random sampling method was used to ensure that stories from each theme were represented. For the quasi-random sampling, titles from each theme, as opposed to all titles, were put into a hat and blindly picked and this was repeated until all themes were represented. In total, 73 folktales were sampled: 12 from Russia (Smith 1873), 11 from Finland (Jones, Kropf et al. 1889), 10 from Chile (Pino-Saavedra 1968) and 8 each from North America (Lum 1973), China (O'Brien 1990), South Africa (Brownlee 1938), the South Pacific (Hames 1969), and North Africa (Ashbranner and Davis 1959). Table 1 lists the number of folktales by region.

Table 1

Book Title	**Number of Folktales**	**Region**
Folk Tales from Chile	10	South America
Russian Folk Tales	12	East Eurasia

Magyar Folk Tales	11	Mediterranean
Lion & Jackal with other Native Folk Tales from South Africa	8	Sub-Saharan Africa
Chinese Myths and Legends	8	East Eurasia
The Lion's Whiskers: Tales from High Africa	8	Saharan Africa
Folk Tales of North America	8	North America
Folk Tales of the South Pacific	8	Pacific

After selecting the folktales two researchers who had read Barrett's Counterintuitive Coding scheme (2008) but were otherwise unfamiliar with MCI theory, coded and quantified the counterintuitive properties of objects within each folktale.

Coding Folktales

The following is a description of methods used by researchers to code counterintuitive objects in folktales. This description focuses on detailing coding procedures more than explicating the rationale and justification for the procedures. A more in depth discussion of how and why these procedures were developed may be found in Barrett (2008).

The Simplicity Rule

Coders applied what Barrett deemed 'The Simplicity Rule' to each of the following six steps when coding objects' counterintuitive properties. This rule, underpinned by evidence that human cognitive systems generally strive for representational and computational efficiency and simplicity (Sperber & Wilson, 1995), states that *when coding concepts, assume the simplest (i.e., least counterintuitive) conceptual representation that captures the object's properties.* Examples of how the simplicity rule was applied to the six coding steps are described below.

Step 1: Identify the basic level of membership

In the first step, coders identified a counterintuitive object's basic level of membership. The basic level was the object categorization that minimized differences within members of the category and maximized differences between categories (Rosch et al., 1976).

Coders used the following heuristic for identifying the basic level, asking themselves "In one word, what is this object called?" This one-word label (in English) became the object's basic level. Researchers recorded the object's basic level word in all capital letters. Examples included "LADDER," "FOX," "HUMAN," and "WIND." If the basic level could not be identified initially, coders proceeded to Step 2, gathering information from the narrative to help determine the object's basic level of membership.

Step 2: Identify the ontological category or categories

After determining the object's basic level, researchers determined in which of the following categories the object belonged: *Spatial Entities*, *Solid Objects*, *Living Things* that do not appear to be self-propelled, *Animates*, and *Persons*.[1]

The five intuitive ontological categories were developed out of five *expectation sets* (Spatiality, Physicality, Biology, Animacy, and Mentality), which capture intuitive assumptions that cognitive developmentalists have identified as being held by young children (e.g., see Spelke & Kinzler, 2007; Sperber, Premack & Premack, 1995). Table 2 lists assumed properties for each expectation set.

Table 2[2]

Intuitive Expectation Set *(with coding abbreviation)*	*Properties Assumed*
Spatiality (s)	Specifiable location in space and time
Physicality (p)	Cohesion: move as connected whole Contact: physical contact required for launching or changing direction of movement Continuity: movement is continuous in space Solidity: cannot pass through or be passed through by other solid objects Tangibility

[1] These are intuitive ontological categories and do not necessarily map on to genuine ontological distinctions. For the justification of these five categories as separate and different categories, please refer to Barrett (2008).
[2] Table 2 is adapted from Barrett, 2008.

	Visibility
Biology (b)	Growth & development Like begets like Natural composition Nourishment needs and processes to satisfy those needs Parts serve the whole to sustain life Vulnerability to injury & death Kind-specific essence
Animacy (a)	Goals "Self-propelled"
Mentality (m)	Reflective & representational mental states and standard relationships among them and limitations of them Self-awareness and consciousness Understand language & communication
Universals (u)	Consistency: assumptions apply continuously; past was like present, future will be like present Time and causation are unidirectional

Differential activation of these five intuitive expectation sets break up each object into categories of Spatial Entities, Solid Objects, Living Things, Animates, and Persons. The relationship between expectation sets and intuitive ontological categories is not strictly hierarchical. Solid objects assume and extend the properties of Spatiality but things intuitively

categorized as Animates do not necessarily activate the same expectations as Living Things. Robots, for example, can be conceptualized as goal-directed, self-propelled Animates but do not activate Biology assumptions. Barrett's proposed relationship of expectation sets to ontological categories is summarized in Table 3.

Table 3[3]

	Spatial Entities	Solid Objects	Living Things	Animates	Persons
Expectation Sets: (with coding abbreviation)					
Universals (u)	Assumed	Assumed	Assumed	Assumed	Assumed
Spatiality (s)	Assumed	Assumed	Assumed	Assumed	Assumed
Physicality (o)	N/A	Assumed	Assumed	Assumed	Assumed
Biology (b)	N/A	N/A	Assumed	Optional	Optional
Animacy (a)	N/A	N/A	N/A	Assumed	Assumed
Mentality (m)	N/A	N/A	N/A	N/A	Assumed

[3] Table 3 is adapted from Barrett, 2008.

Once researchers determined the ontological categories of an object, they proceeded to step three. If neither the basic level membership nor the ontological categories could be determined after step two, researchers stopped the coding process for that object.

Step 3: Code transfers as superscript, capitalized prefixes, joined by + if necessary

After determining the basic level membership and ontological category of an object, researchers coded counterintuitive transfers, or properties attributed to the object that came from a non-native expectation set(s). To illustrate, a talking broom would have received a transfer of mentality as brooms, being Solid Objects and not Persons, are not intuitively able to talk. Researchers noted transfers with superscript, capitalized prefixes so a talking broom would have been coded:

^{M}BROOM

Researchers applied the simplicity rule as needed when coding transfers. Following the simplicity rule (that the least counterintuitive or "simplest" representation should be assumed), a TREE that both listened empathetically (a property from Mentality) and verbally communicated (another Mentality property) would have been coded ^{M}TREE as the entire set of Mentality expectations would have been transferred, not just one mental ability. Unless the narrative explicitly renounced certain properties from the same expectation set, researchers assumed the entire set had been transferred.

Some transfers were also simplified because, as mentioned above, certain expectation sets presume others. For example, a flower that could sing (a property from Mentality) and dance

(an Animacy property) would have been coded ^{M}FLOWER instead of $^{M+A}$FLOWER because Mentality presumes Animacy.

Step 4: Code breaches as superscript lowercase suffixes, joined by + if necessary

Next researchers coded counterintuitive violations, or breaches of native expectation sets. A breach occurred when an object did not possess all of the properties associated with its ontological expectation set. For example, an invisible ladder would have had a breach of physicality, as ladders are intuitively visible and visibility comes from the physicality expectation set. Breaches were coded with superscript, lowercase suffixes, so the invisible ladder would have been coded LADDER^{p}

Unlike transfers, a breach of one property did not necessarily presume that the entire intuitive expectation set had been violated. In the case of the invisible ladder, it would not necessarily have been intangible as well as invisible. If the ladder were intangible as well as invisible, it would have been coded LADDER^{p+p}.

As with transfers, researchers applied the simplicity principle as necessary when coding breaches. If an object had numerous breaches, the ontological category was occasionally revised in keeping with the simplicity rule. To illustrate, if researchers had encountered an intangible, invisible brick that was able to pass through solid objects, the item perhaps initially conceived of as BRICK with three breaches of physicality, would have been more simply represented as VAPOR with a transfer of physicality properties (brick-like boundaries and shape).

Step5: Code Breaches within Breaches using Parentheses

After coding breaches and transfers, researchers coded breaches of breaches. These always involved violations of universal rules and were coded with parentheses. For example, a corpse that only came alive at night would have been coded $(HUMAN^{b})^{u}$. The lowercase *b* would have denoted a breach of biology as the human broke with intuitive biological expectations of mortality. The lowercase *u* would have denoted that the biology breach violated universal rules of consistency because the human only came back to life at night. In sum, the final coding notation, $(HUMAN^{b})^{u}$, would have demonstrated that the human had a breach of biology and that the biology breach violated universal rules.

Step 6: Quantify Counterintuitiveness by totaling the number of symbolic letters

In the final step, researchers determined the counterintuitive score of each object by adding the superscript letters attached to the object. Each letter added one point to the overall counterintuitive score. Please see Table 4 for examples from the folktales.

Table 4

Concept (public representation)	Coding	Counterintuitiveness Score
A woman with jet black hair and eyes	HUMAN	0
A dead woman	HUMAN	0
A dead woman who comes back to life	$HUMAN^{b}$	1
A dead woman who comes back to life only at night	$(HUMAN^{b})^{u}$	2
A dead woman who comes back to life and takes off her head only at night	$HUMAN(^{b+b})^{u}$	3
A brown horse with four legs and a long tail	HORSE	0
A horse that talks	$^{M}HORSE$	1
A talking tiger that gives birth to domestic cats	$^{M}TIGER^{b}$	2
An axe that can move on its own	^{A}AXE	1
An invisible ladder	$LADDER^{p}$	1

Results

A total of 73 myths were used to examine the reliability and effectiveness of Barrett's coding scheme for counterintuitive properties in objects. Two coders independently applied the coding scheme to each folktale and noted objects and persons with counterintuitive features. Data was collected at two different time points. The first time point included all regions except North America and South America. In the second time point, data was collected using the folktales

from North America and Chile (South America). Using the coding system, coders quantified each object by identifying the level of membership and also the ontological categories that were counterintuitive.

Intercoder reliability

Concordance between coders was high at 92.6 percent agreement. To calculate the consistency between coders, Kendall's Tau-b was used because the coding scale contained ordinal data (Svensson, 2001). The reliability between the two coders was highly consistent for the first data collection, $\tau = .875$, $p = .0001$ (2-tailed, $N = 86$ counterintuitive objects). Likewise, the second data collection yielded high inter-coder reliability, $\tau = .856$, $p = .001$(2-tailed, $N = 35$ counterintuitive items). This high concordance gives us confidence of the utility of the CI-Scheme for analyzing written cultural materials.

Between coders, there were nine items that were in disagreement; seven of the disagreements occurred in the first trial and two in the second trial[4]. All nine disagreements involved dead humans with varying breaches of biology, physicality, and universals[5]. Application of the Simplicity Rule typically resolved disagreements. For instance, in the case of a skull that spoke, by appealing to the Simplicity Rule coders decided that this object would be better coded as an Object with a transfer of mentality than as a human with breaches of biology

[4] Five of these inconsistencies were due to objects involving a corpse/dead person/object coming to life with breaches and transfers of various ontological categories. The largest proportion of disagreements concerned the use of universals, specifically surrounding the ambiguity of time e.g. when dead corpses/objects would appear and disappear.

[5] Broadly, universals were difficult to code because mythic tales were not explicit whether, for example, a dead corpse could be 'alive' during the day, rather than solely at night just after the cock crowed at midnight. Due to this ambiguity, the raters' responses varied. The decision was made that under circumstances where there were explicit times when objects/persons appeared and disappeared and these correlated with an event (e.g. a crow from a cock at midnight), a universal breach was given.

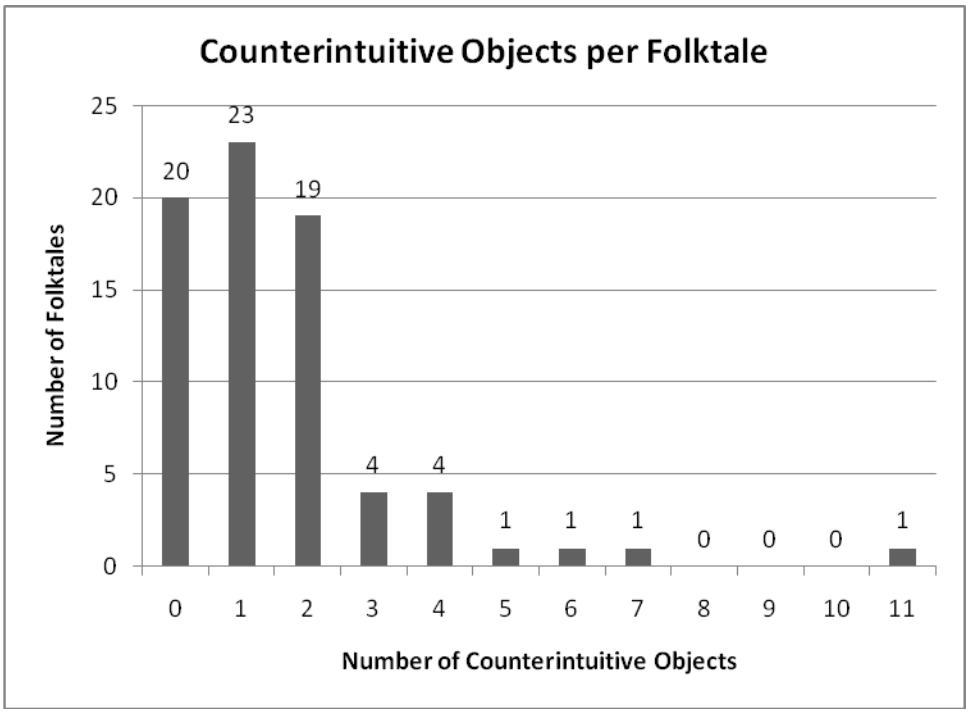
and physicality. To further clarify, the disagreements were not in the coding of these figures as much as in how to interpret a counterintuitive figure in an ambiguous folktale; both coders agreed that if the myth were interpreted one way, the coding would have been in agreement[6].

Counterintuitive objects per folktale

Independently, the two coders found 101 counterintuitive objects in common and an additional 15 objects were detected by one or the other coder. Upon discussion coders agreed on all 116 objects. The number of counterintuitive objects per folktale ranged from zero (20 stories, 27.4 percent, had no counterintuitive objects[7]) to eleven,[8] with a mean of 1.59 counterintuitive objects per tale (*SD* = 1.83). Twenty-three stories (31.5 percent) had one counterintuitive object and 18 myths (24.7 percent) had two counterintuitive objects. So for the 53 tales that contained counterintuitive objects, 79.2 percent (*N* = 42) contained 1 or 2 counterintuitive objects. Figure 1 illustrates this distribution.

Figure 1

[6] In an ethnographic context many such disagreements could be resolved by further questioning of informants.
[7] There were 19 myths without any coded counterintuitive object between raters. After the raters completed individual coding, the number rose to 20 myths without any counterintuitive objects. The latter issue surrounded a myth that included cannibalism. After debating the definition of counterintuitiveness, raters agreed that eating one's own species was shocking (and disgusting, perhaps) but not counterintuitive.
[8] The largest proportion of myths contained 1 counterintuitive item (31.5 percent, *N*=23), no items (27.4 percent, *N*=20), or 2 items (26 percent, *N*=19).



Counterintuitiveness Scores of Objects

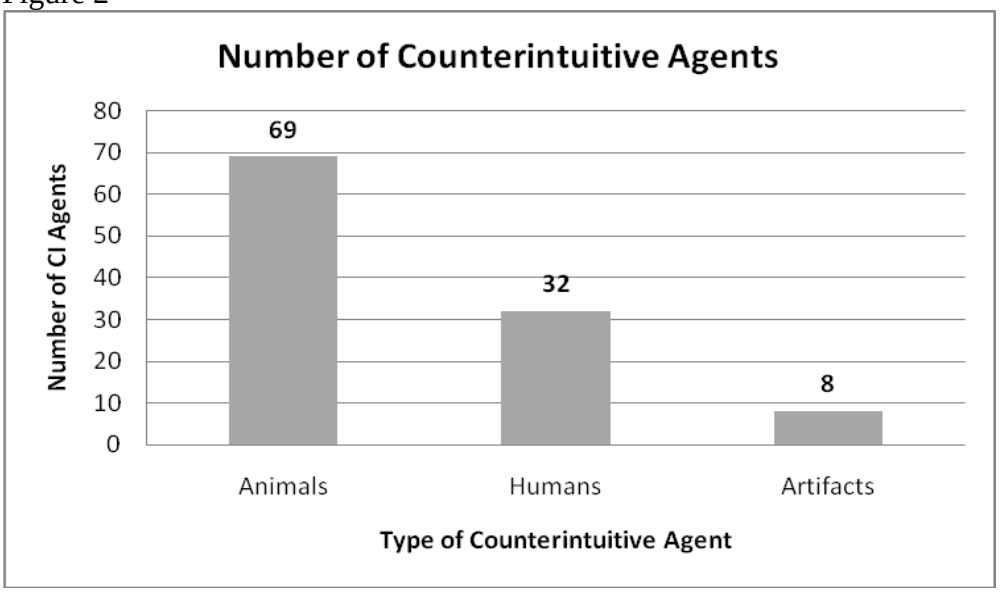
The majority of counterintuitive objects (99.0 percent, $N = 115$) had a counterintuitive score of 1 or 2. Specifically, 108 objects had a counterintuitive score of 1, seven had a counterintuitive score of 2, and only one object had a counterintuitive score of 3. There were no objects with a score higher than three.

Most Frequent Types of Counterintuitive Objects

Nearly all counterintuitive objects (98.2 percent, $N = 114$) were agents, that is, objects that activated either Mentality or Animacy expectations. Most counterintuitive agents (61.0 percent, $N = 69$) were animals with a transfer of mentality, which were coded with 100 percent agreement

between coders. Other types included people with counterintuitive properties and artifacts that acted intentionally in goal-directed ways. Please see Figure 2.

Figure 2



Discussion & Conclusion

The aims of the present study were (1) to determine whether Barrett's CI-Scheme could be reliably applied to cultural materials, (2) to better determine the location of the cognitive optimum predicted by Boyer and also (3) to determine whether counterintuitive agents were more common in folktales than other types of counterintuitive concepts.

The CI-Scheme was able to be applied with high agreement between the two coders without special expertise or extensive training. These results suggest that the CI-Scheme may be used as a common strategy for indentifying counterintuitive objects and quantifying counterintuitiveness at least in written materials. The demonstrated inter-rater reliability with written materials further suggests the CI-Scheme's application to generating and evaluating materials developed for and used in experimentally testing the MCI Theory (see Gregory &

Barrett, forthcoming, for an example). Previous studies investigating Boyer's theory have produced inconsistent results possibly because the experiments have lacked a common, systematic method for determining the degree to which tested objects were counterintuitive (Gonce et al., 2006; Norenzayan et al., 2006; Tweney et al., 2006). Due to the ambiguity and weak agreement in operationalizing 'counterintuitiveness' in past research, it is hard to evaluate the evidence to date. Using a standard measure of counterintuitive properties could reduce such variation between studies and advance the empirical investigation of MCI theory and other theories related to counterintuitive concepts.

The present findings also bear upon where the 'cognitive optimum' predicted by Boyer lies. Similar to Lisdorf (2004), the majority of counterintuitive concepts classified had only one counterintuitive property, that is, a counterintuitiveness score of 1. Of the 116 counterintuitive objects that were classified only seven items scored 2, and only one had a score of 3. Thus, it seems that for folktales, there is a cognitive optimum level of one counterintuitive property and those concepts with more than one property (or a counterintuitiveness score greater than 1) are less likely to become widely-recurrent cultural representations.

Boyer has argued that counterintuitive intentional agent concepts in particular enjoy a transmission advantage over other counterintuitive concepts (2001). In the collections of folktales, myths, and legends sampled, this is precisely what was found. Of the 116 objects coded, 114 objects were agents of which the most common classification was animal with a transfer of a human-like mind. Further, these were the most reliable to code, as there was 100 percent agreement between coders. Perhaps these concepts were easier to code and widespread in folktales because of Boyer's suggestion that there is minimal inferential effort when

conceptualizing a counterintuitive agent. Attributing an animal with a human-like mind seems almost a natural property as we can easily imagine that animals have some mental states already. Further, agents may have an additional advantage because they can be used to explain or bring about many different states of affairs and hence, can help to move stories along. Agents initiate and can cause these things to happen rather than only being recipients of action.

Similar to Norenzayan et al. (2006), we did not find that folktales typically included a large number of counterintuitive objects. Norenzayan et al. (2006) questioned the relatively low frequency of counterintuitive objects in their results, wondering why counterintuitive items that have proposed transmissive advantages did not dominate folktales. They proposed that a folktale may be a single unit of transmission and, hence, there may be a cognitive optimal number of counterintuitive objects per myth. Norenzayan et al. (2006) found that two to three counterintuitive objects seemed to be the cognitively optimal number for stories, suggesting that MCI narratives could be more culturally successful. Our results showed that over three-fourths of the folktales contained only 1 or 2 counterintuitive objects. As Norenzayan et al. (2006) proposed, perhaps there is a cognitive optimal number for whole narrative structures as well. That is, even if an object with a counterintuitiveness score of one balances attention-demanding salience with ease of representation and communication, too many of these minimally counterintuitive objects in the same narrative could cumulatively produce conceptual difficulty. One or two MCI objects may be optimal in a narrative as a whole. Narratives with a small number of MCI objects may have mnemonic advantage as they activate our inferential systems with little cognitive effort and also contain concepts that minimally violate our intuitive

expectations sets so that these ideas are interesting and provoke further interpretation and likely, further transmission (Boyer, 2001; Sperber & Wilson, 1986).

The current study only examined counterintuitive objects in folktales. We chose folktales largely because they were likely to contain concepts that have achieved 'success' by being passed down through various generations and they were likely to contain MCI concepts. Nevertheless, researchers acknowledge that as written distillations of oral stories, these folktales could have over-estimated the amount of counterintuitiveness in the stories because the written versions could have combined several oral versions of the tales and such amalgamations would not have been subject to the same mnemonic constraints of verbal storytelling. Even so, the CI-Scheme could be applied to other cultural texts, for example religious writings, or to images to generate comparisons. Results regarding the optimum number of counterintuitive properties per text and the optimum number of counterintuitive properties per object may vary depending on the type of text in which they occur. For example, it may be that cultural materials with more cultural scaffolding differ in terms of the amount of counterintuitive concepts they contain compared to materials with less cultural scaffolding. It is likely that oral transmission selects for folktales that are minimally counterintuitive and it may be that texts transmitted in written forms or in images are not subject to such selection pressure. Additionally, the findings of the current study, while theoretically consistent with some tenants of MCI theory, should be replicated before they are taken to be representative of successfully transmitted cultural materials or, even, of all folktales.

The CI-Scheme could also be applied to ethnographic texts. A systematic method for quantifying the counterintuitive concepts and counterintuitive properties per concept within a

culture could allow for more scientific comparisons of different cultures. Application of the CI-scheme to ethnographic materials could also allow for the tracking of counterintuitive concepts within a culture across time.

At least for folktales, it seems, the CI-Scheme can be reliably used to code for counterintuitive objects as demonstrated by high inter-coder reliability. Using the CI-Scheme, the results of this study suggest that the cognitive optimum Boyer predicts falls at a score of one: one counterintuitive feature or being *minimally* counterintuitive appears optimal for successful cultural transmission. Further, as predicted, we found counterintuitive agent concepts—particularly intentional agents—to be overrepresented among counterintuitive concepts.

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