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# Negatively-Biased Credulity and the Cultural Evolution of Beliefs

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**Abstract**

The functions of cultural beliefs are often opaque to those who hold them. Accordingly, to benefit from cultural evolution's ability to solve complex adaptive problems, learners must be credulous. However, credulity entails costs, including susceptibility to exploitation, and effort wasted due to false beliefs. One determinant of the optimal level of credulity is the ratio between the costs of two types of errors: erroneous incredulity (failing to believe information that is true) and erroneous credulity (believing information that is false). This ratio can be expected to be asymmetric when information concerns hazards, as the costs of erroneous incredulity will, on average, exceed the costs of erroneous credulity; no equivalent asymmetry characterizes information concerning benefits. Natural selection can therefore be expected to have crafted learners' minds so as to be more credulous toward information concerning hazards. This negatively-biased credulity extends general negativity bias, the adaptive tendency for negative events to be more salient than positive events. Together, these biases constitute attractors that should shape cultural evolution via the aggregated effects of learners' differential retention and transmission of information. In two studies in the U.S., we demonstrate the existence of negatively-biased credulity, and show that it is most pronounced in those who believe the world to be dangerous, individuals who may constitute important nodes in cultural transmission networks. We then document the predicted imbalance in cultural content using a sample of urban legends collected from the Internet and a sample of supernatural beliefs obtained from ethnographies of a representative collection of the world's cultures, showing that beliefs about hazards predominate in both.

Key words: cultural evolution; negativity bias; credulity; urban legends; supernatural beliefs

## 1.0 INTRODUCTION

Cultural evolution resembles biological evolution in some respects, and differs in others. As in biological evolution, the impact of information on the fitness of individuals and groups carrying it is a central determinant of the extent to which that information succeeds or fails in the arena of competing variants. However, the pathways for information transmission in cultural evolution are more diverse than in biological evolution [1,2]. As a consequence, in addition to being driven by the fitness of information carriers, cultural evolution is also shaped by the extent to which a given variant is attractive to, retained by, and transmitted by human minds. The attractiveness, retainability, and transmissibility of a given cultural variant do not hinge solely on its utility, as they are also products of the extent to which the variant is congruent with features of learners' minds. Patterns evident in a culture at a large scale thus in part reflect features common to the minds of those who hold the given culture, as such patterns are the result of the aggregated propensity of learners to acquire, retain, and transmit some beliefs and practices more than others [3-7].

Although a variety of features of learners' minds have been explored in regard to their impact on cultural evolution, with only a few exceptions [8,9], the attributes examined are not central to information acquisition and use, and hence their effects on cultural evolution are incidental [e.g., 10-12]. We propose that cultural evolution is importantly influenced by two linked features of learners' minds—general negativity bias and its uniquely human extension, negatively-biased credulity—that play key roles in information acquisition and use. Here, we describe these features, present additional evidence of the existence of negatively-biased credulity, then demonstrate that, consistent with the expected effects of these biases writ large,

74 beliefs about hazards predominate in domains in which information is exclusively social in
75 origin.

76 Subjective reactions largely track fitness relevance, with fitness-reducing events typically
77 being experienced as negative, i.e., eliciting aversive affective experiences and concomitant
78 cognitions [13]. *Negativity bias* refers to the manner in which, compared to positive events,
79 negative events more readily capture attention, are stored more readily in memory, are linked to
80 a larger set of cognitions, and have greater motivational impetus [14,15]. Negativity bias can be
81 understood as reflecting an overarching pattern wherein the avoidance of imminent fitness
82 decrements typically has a greater effect on fitness than does the pursuit of fitness enhancements,
83 as, in general, the latter can be pursued only after the former have been addressed [14,15].

84 Existing evidence suggests that negativity bias plays a role in the social transmission of
85 information. News reports that induce fear are judged by viewers to be more important and
86 relevant than those that do not [16]. Public opinion regarding economic outlooks is more
87 strongly influenced by negative reports than by positive ones, even after controlling for the
88 frequency of negative reporting [17-19], a pattern paralleled by the asymmetric effects of bad
89 and good news regarding consumer sentiment on the stock market [20,21]. At the affective
90 level, eliciting negative emotions and related states should facilitate social transmission.
91 Correspondingly, disgust, a negative emotion, figures prominently in past research: participants
92 report greater likelihood of transmission for both non-social [22,23] and social [24] information
93 that elicits disgust, and they pursue information as a function of disgust content [22]. Disgust
94 elicitation correspondingly predicts the distribution of urban legends [23], and is implicated in
95 the longevity of etiquette rules [25]. More broadly, rumors reporting undesirable events spread
96 more rapidly and more widely than those reporting desirable events, even when they are of equal

97 importance and believability [26]. Arousal is a determinant of willingness to transmit
98 information [27], and negative events generally elicit greater arousal than positive events
99 [14,15]. News reports that evoke high-arousal emotions are more likely to 'go viral' on the
100 Internet, and anxiety is a principal driver in this regard [28]. Likewise, as both a state and a trait,
101 anxiety is linked to the propensity to acquire and transmit rumors [29-34].
102 Evaluating pragmatic considerations such as impression management and informational
103 utility, rumor researchers have also explored the positive contribution of credulity – how much
104 the information is believed – to social transmission [31,33,35,36]. Although not generally
105 framed in these terms by students of rumor, the question of credulity can be seen as intimately
106 linked to negativity bias. Contemplating the proximate cognitive mechanisms that contribute to
107 credulity, Hilbig [37-39] proposed that negativity bias should extend to this realm, i.e., what he
108 terms "negative information" should be more readily believed than "positive information". It is
109 important to underscore that most work on negativity bias concerns salience, memorability, and
110 motivational impact – all factors that are logically distinct from credulity per se.
111 Building on previous basic research on negativity bias, investigations regarding
112 communication about risks posed by technology indicate that people are indeed more likely to
113 believe reports indicating that products are dangerous than they are to believe reports indicating
114 that they are safe [40-43]. However, while noteworthy, such research does not reveal the extent
115 to which these effects generalize beyond the topic of product safety. In multiple studies
116 employing information concerning a broad range of topics, Hilbig [37-39] has demonstrated that,
117 as predicted, negatively-framed information (much of which concerns the possibility of adverse
118 outcomes) is believed at a higher rate than is positively-framed information. Follow-up studies
119 reveal that this effect is not due to differences in the retrieval of prior knowledge, but instead

likely stems from differences in processing fluency, and thus constitutes a true response bias [39]. Hilbig concludes by briefly noting that this bias may be functional, as fluency "often yields ecological validity" [39]. To the extent that Hilbig's negatively- and positively-framed stimulus statements can respectively be construed as concerning hazards or opportunities, his suggestion of a functional bias articulates well with broader approaches that explain negativity bias as reflecting an evolutionary history characterized by the greater exigency of situations having the potential to decrease fitness relative to that of situations having the potential to enhance fitness [14,15].

Consonant with the ubiquity of the asymmetrical fitness implications of hazards versus benefits, negativity bias occurs in many species [15]. Humans, however, diverge from other organisms in our reliance on culture, an attribute that has plausibly shaped the extension of negativity bias into the domain of social information transmission. Specifically, we argue that a consideration of the asymmetry in the costs attending credulity and incredulity across different categories of socially transmitted information provides an ultimate explanation for what we term *negatively-biased credulity,* an account that complements Hilbig's proximate model of this phenomenon.

Humans are unique in both (a) their reliance on cultural information in addressing environmental and social adaptive challenges, and (b) the extent of their ability to acquire, use, improve, and transmit information from conspecifics, processes that, aggregated over time, generate a progressively larger corpus of useful cultural information. Importantly, if learners are to take advantage of the power of cultural evolution to solve fitness-relevant problems, they must be credulous. This is because not only is the utility of a belief or practice often not self-evident, but, moreover, it is frequently opaque to adherents, who often provide functionally extraneous

143 rationales for their actions [44,45]. However, credulity is accompanied by multiple costs. First,
144 self-interested actors may deceive learners in order to exploit them [46]. Second, credulity
145 increases the likelihood that non- or dys-functional beliefs and practices will be acquired, with
146 subsequent declines in individual fitness [44].

147 The above considerations indicate that natural selection can be expected to have shaped
148 the psychological mechanisms that play a role in culture acquisition so as to maximize the
149 benefit/cost ratio of credulity [46]. An important factor in this equation will be the relative costs
150 of two different types of errors, namely erroneous incredulity (failing to believe information that
151 is true) and erroneous credulity (believing information that is false). Viewed in the larger
152 context of issues of signal detection, these errors can be conceptualized, respectively, as false
153 negatives and false positives. Whenever decision-making systems must act on the basis of
154 imperfect information, a critical consideration is whether the relative costs of these two types of
155 errors differ. By way of analogy, consider the design of household smoke detectors [47,48]. It is
156 prohibitively expensive to create smoke detectors that are perfectly accurate (i.e., devices that
157 never sound an alarm in the absence of an actual fire, and always sound an alarm when a fire
158 occurs). Smoke detectors should therefore be set to produce the less-costly error, namely false
159 positives – we suffer the irritation of false alarms whenever we burn a piece of toast in order to
160 enjoy the security of knowing that we will be alerted if a fire breaks out. The same
161 considerations apply in the case of decision-making machinery crafted by natural selection, such
162 that investigators should observe a consistent bias in the direction of whatever constitutes the
163 less-costly error [47-55].

164 To understand how the above considerations apply to the question of credulity, consider
165 two classes of cultural information, namely information concerning fitness-reducing hazards

(e.g., which animals are dangerous, which plants are poisonous, which outgroups are hostile, etc.), and information concerning fitness-enhancing benefits (e.g., which animals are meaty, which plants are edible, which outgroups are friendly, etc.). With regard to cultural information concerning hazards, erroneous incredulity (i.e., a false-negative reaction) entails the costs suffered upon encountering the given hazard, while erroneous credulity (i.e., a false-positive reaction) entails only the costs of having taken unnecessary precautions. In the environments in which ancestral human populations evolved, ignoring accurate cultural information regarding hazards will often have led to serious injury or death, outcomes far more dire than the loss of time, energy, and opportunities resulting from having taken unnecessary precautions. Accordingly, in regard to cultural information concerning hazards, the costs of false negatives will have been larger on average than the costs of false positives. However, the situation is very different with regard to cultural information concerning benefits, as a false negative in this context (i.e., not believing cultural information that is, in fact, true) entails the costs of failing to exploit a useful opportunity, while a false positive (i.e., believing cultural information that is false) entails the costs of fruitlessly pursuing a spurious possibility. These respective costs will vary substantially from instance to instance; as a consequence, in contrast to the case of information concerning hazards, no overarching asymmetry is likely to have characterized this ratio in ancestral environments.

Given the greater costs of incredulity toward information concerning hazards relative to the costs of credulity toward such information, we should expect natural selection to have crafted a bias toward enhanced credulity. Because no equivalent asymmetry exists with regard to information concerning benefits, credulity in the latter domain should simply reflect the degree to which social learning is more advantageous than trial-and-error learning [45,56]. Negatively-

biased credulity can thus be understood as the output of a functional mechanism that enhances credulity toward socially transmitted information concerning hazards relative to the baseline level of credulity with which the individual approaches socially transmitted information concerning benefits.

### 1.1 Overview of studies

In order to provide an independent test for the existence of negatively-biased credulity, we conducted an initial investigation (Study 1) in which participants judged the likelihood that statements concerning hazards or benefits were true, predicting that the former should be believed more than the latter. Given that the utility of negatively-biased credulity is a function of both the prevalence of hazards and the extent to which the individual is able to cope with them, we posit that negatively-biased credulity may reflect the degree to which the individual views the world as dangerous. We tested this possibility in a second investigation (Study 2), combining the above methods with measures of individual differences. Having verified the existence of negatively-biased credulity and identified a key feature of individuals who exhibit it most strongly, we then moved from the individual level to the collective level, hypothesizing that, aggregated across individuals and information-transmission events, general negativity bias and negatively-biased credulity should together result in a predominance of beliefs concerning hazards in bodies of cultural information. We tested this prediction first in a set of urban legends circulating in the West (Study 3), then in a set of supernatural beliefs collected from a representative sample of the world's cultures (Study 4).

### 1.2 Ethics Statement

Studies 1 and 2 were examined and approved by the University of California, Los Angeles Institutional Review Board (Studies 3 and 4, which do not involve individual participants, were deemed exempt from review). Following the protocol approved by the Institutional Review Board, in both Study 1 and Study 2, participants were first presented with a web page describing the study procedures, any potential risks or discomforts, the identity and contact information of the first author, and the absence of compensation; participants then indicated their consent to participate by clicking a link to the study. The protocol approved by the Institutional Review Board dictated that consent be given anonymously.

### 1.3 Data Archiving

Data for all studies described in this paper are archived at www.escholarship.org/uc/item/6v42v897.

## 2.0 STUDY 1

Study 1 sought to test the negatively-biased credulity hypothesis using a broad sample of U.S. Internet users; the study thus provides a cross-cultural point of comparison for Hilbig's [37-39] German Internet, university, and community samples. Moreover, rather than framing the information presented to participants in broadly positive or negative terms, we sought to overtly manipulate the extent to which this information addressed hazards or benefits. We predicted that participants would evince greater credulity toward information framed as potential hazards than toward information framed as potential benefits.

### 2.1 Methods

### 2.1.1 *Participants*

Unpaid volunteers were recruited via advertisements, posted on Craigslist.org in major U.S. cities, for an online study titled "Truth or Trash? How Believable is the News Today?". As we were relying on unpaid online volunteers, and thus were unsure as to the level of noise to expect in the data, a relatively large sample was recruited. Data were analyzed for 202 participants (129 females) ranging in age from 18 to 75 ($M$ = 37.29, $S.D.$ = 14.02).

### 2.1.2 *Materials and procedure*

Unaware of Hilbig's [37-39] research (see Introduction, above) at the time that we conducted our investigations, we independently converged on a method very similar to his (albeit with different contents), namely the use of differential framing to emphasize either the potential for losses from hazards or the potential for gains from beneficial opportunities. Kahneman and Tversky [57] pioneered this technique in their studies of loss aversion, the pattern wherein potential losses have greater motivational power than potential gains – a phenomenon that can itself be understood as a manifestation of general negativity bias [15]. Although Kahneman and Tversky were not concerned with issues of credulity, their technique is nevertheless valuable in the present context because it affords holding objective truth value constant across stimuli, thereby minimizing any effects of prior knowledge on judgments of believability (see also [39]).

Of particular applicability in the present context, the framing effects predicted to occur when logically equivalent statements are presented as concerning either hazards or benefits likely do not merely reflect limitations of human rationality [58]. Rather, we can understand these framing effects as due in part to the recipient's assumption of communicative relevance [59,60]. Statements that foreground hazards should reasonably be understood by the recipient as

intentional warnings, while those that foreground benefits should be understood as intentional tips. Hence, while at first glance it may appear irrational to respond differently to the statements "X percent of people pursuing a benefit B via activity A suffer a cost C" and "(100-X) percent of people engaged in activity A obtain a benefit B without suffering a cost C," the logic of discourse dictates that these are, in fact, very different statements – a speaker uttering the former is implicitly steering the listener clear of dangers that could befall her, while a speaker uttering the latter is implicitly encouraging the listener to exploit an opportunity that could benefit her. Thus, given our functionalist perspective on negatively-biased credulity as a mechanism to aid in the exploitation of socially transmitted information, statements akin to those employed by Kahneman and Tversky fall squarely within the proper domain of the postulated psychological system.

We first identified ten diverse facts that could be framed as either hazards or benefits. For each, we created two parallel statements, one emphasizing the hazard aspect, another emphasizing the benefit aspect. The statements were divided into two sets, one consisting of four statements regarding benefits and six regarding hazards, the other having the reverse ratio; these uneven ratios reduced cues as to the goals of the study. Only one of the two statements addressing a given topic appeared in a given set. To reduce attention to the details of the key statements, we then expanded both sets with six similarly worded distracter statements, subsequently excluded from analysis (see Appendix). Underscoring the communicative nature of these statements, we presented our study to participants as involving items excerpted from news media. Participants, randomly assigned to view one of the two sets, were asked to judge the likelihood that each statement was true using a 7-point scale (1=Not at all True; 7=Totally

True). Item order was randomized and counterbalanced. The study ended with demographic items.

### 2.2 Results

Participants' net judgments of the believability of each message type (hazards versus benefits) were operationalized as the mean "true/not true" score for each domain. Participants were more likely to believe statements about hazards ($M$=4.74; $S.D.$= 0.85) relative to statements about benefits ($M$ = 4.34, $S.D.$=0.81), a significant difference ($t_{201}$=5.596, $p < 0.0001$, $d$= *0.55*). This result was robust to the exclusion of any one of the statements — no single statement was driving the significant difference between hazard credulity and benefit credulity.

## 3.0 STUDY 2

Our agenda links the individual-level phenomena of general negativity bias and negatively-biased credulity with the group-level phenomenon of patterns in the cultural evolution of belief. The results of Study 1 provide independent support for the existence of negatively-biased credulity, a psychological mechanism that can be expected to operate as an attractor in cultural evolution [6], giving beliefs regarding hazards a competitive advantage in the marketplace of ideas. The social dynamics of information transmission constitute an intermediate level between individual psychology and cultural evolution, as it is in part via these dynamics that the former affects the latter. In turn, social dynamics are plausibly influenced by a number of features of individuals.

In assessing the differential impact of various individuals on social transmission, network researchers frequently consider social attributes, such as centrality in a network, frequency of

contact with others, and so on [61]. However, in addition to social attributes, psychological features can plausibly also contribute to the degree to which individuals play differentiated roles in social transmission. We hypothesize that, while negatively-biased credulity is a species-typical trait, people will differ in the extent to which they evince this bias. Although here we limit our investigation to psychological differences, and do not explore transmission behavior, we suspect that such differences may influence the social dynamics of information transmission, as individuals characterized by high levels of negatively-biased credulity may act as important nodes in a network, accepting and broadcasting an above-average number of beliefs about hazards.

If negatively-biased credulity reflects the greater costs of erroneous incredulity relative to erroneous credulity regarding information about hazards, then the utility of negatively-biased credulity is in part conditional on the base rate of fitness-reducing hazards in the individual's local environment: if the individual lives in a relatively safe environment, then much socially transmitted information regarding hazards will be false, shrinking the net cost of incredulity and enlarging the net cost of credulity; the converse will be true if the individual lives in a relatively dangerous environment. This raises the possibility that the postulated mechanism is subject to adjustment such that individuals will differ in negatively-biased credulity as a function of the level of danger in their environment.

The costs of encountering any given hazard depend in part on the personal and social resources that the individual brings to bear in coping with the hazard. Importantly, individuals differ in these attributes. As a consequence, the incredulity/credulity cost asymmetry will vary as a function of both the level of danger in the environment and the individual's capacity for coping with that danger. Subjective perceptions of the level of danger in the world can plausibly

be viewed as in part reflecting the combination of past encounters with hazards and self-assessed capabilities for addressing them [62]. Accordingly, if negatively-biased credulity is facultatively adjusted, then this trait should be positively correlated with the extent to which the individual perceives the world to be dangerous. Alternately, framed in proximate terms, whether as a result of experience, personality, or both, individuals who believe the world to be full of hazards will find novel statements concerning hazards to be more plausible than will individuals who expect hazards to be few and far between, as such statements will be consistent with the former's expectations, and inconsistent with the latter's. Importantly, the relationship between perceptions of the world as dangerous and the degree of negatively-biased credulity evinced should be independent of the extent to which the individual is credulous in general (i.e., outside of issues of hazards or benefits). At the ultimate level, this is because the utility of adjusting credulity as a function of the level of danger in the environment is limited to information regarding hazards. At the proximate level, expectations of danger should shape reactions to new information concerning hazards, but should be orthogonal to information concerning benefits, as the frequency of benefits is generally independent of the frequency of hazards. To test these predictions, we replicated Study 1, adding measures intended to gauge (a) individuals' perception of their environment as dangerous, and (b) their general credulousness. As the goal of this study was to explore individual differences not examined in Study 1, we increased the target sample size five-fold (n = 1000) compared to the prior study, as we presumed that such a large increase would maximize the likelihood of capturing a substantial range of variation across participants.

### 3.1 Methods

### 3.1.1 *Participants*

Recruitment and framing were identical to Study 1. Data were analyzed for 977 participants (578 females) who answered all questions presented; participants ranged in age from 18 to 81 (M = 39.06, S.D. 14.34).

### 3.1.2 *Materials and procedure*

In addition to the materials employed in Study 1, participants also responded to items taken from a measure designed to assess perceptions of danger in one's environment [63], evaluated on a scale of 1 (Strongly Disagree) to 9 (Strongly Agree). Four items, employing similar scales, then assessed both credulity in general, and credulity toward news sources in particular (see Appendix). Demographic items followed.

## 3.2 Results and discussion

Replicating the results of Study 1, participants were more credulous toward statements concerning hazards (M = 4.59, S.D. = 0.93) than toward statements concerning benefits (M = 4.16, S.D. = 0.88), $t_{976} = 12.72$, $p < 0.0001$, $d=.58$), a difference again robust to the exclusion of any single statement.

To test the extent to which negatively-biased credulity is linked to subjective perceptions of the level of danger in the world, we conducted a multiple, multivariate regression analysis where hazard credulity, benefit credulity, and their difference score (M = .43, S.D. = 1.06) were the dependent variables, and subjective perception of danger ($M = 4.20$, S.D. = 1.98) and general credulity ($M = 4.22$, S.D. = 1.74) were the independent variables. The analysis revealed that subjective perception of danger was significantly linked to hazard credulity, $\beta = .08$, $t_{974} = 2.48$,

$p = .013$, but not to benefit credulity, $t_{974} < 1$, while general credulity was linked to benefit credulity, $\beta = .07$, $t_{974} = 2.48$, $p = .02$, but not to hazard credulity, $t_{974} < 1$. As expected, subjective perception of danger was positively associated with the difference score measuring a bias of hazard credulity relative to benefit credulity, $\beta = .08$, $t_{974} = 2.85$, $p = .004$, but general credulity was not, $\beta = .03$. $t_{974} = -1.54$, $p = .123$. A cross-equation contrast confirmed that the hazard credulity/subjective perception of danger slope differed significantly from the benefit credulity/subjective perception of danger slope, $F(1, 974) = 8.12$, $p = .005$. Controlling for gender and age did not significantly affect these relationships.

In addition to replicating the results of Study 1 regarding the existence of negatively-biased credulity, consistent with our predictions, Study 2 revealed that the belief that the world is dangerous correlates with credulity toward statements concerning hazards, but not with credulity toward statements concerning benefits, a pattern that is independent of general credulousness. This suggests that individuals who believe the world to be dangerous may constitute important nodes in cultural transmission processes, as congruence between their priors and information concerning hazards may lead them to be particularly prone to differentially retain and propagate hazard information.

## 4.0 STUDY 3

Both negatively-biased credulity and more general negativity bias operate at the level of individual minds. Iterated over many individuals and many transmission events, the differential propensity to acquire, hold, act on, and transmit different belief variants entailed by these biases should shape the content of culture. The conjunction of negatively-biased credulity and more general negativity bias thus predicts that, all else being equal, beliefs regarding hazards should be

more common than beliefs regarding benefits. We can expect this effect to be most marked in those cultural domains that are removed from an objective basis, as, in such domains, it will be more difficult for forces in cultural evolution favoring accuracy to undercut the effects of the dual biases. Consonant with this supposition, observers have long speculated that folk beliefs appear to be dominated by harmful rather than helpful entities [64]. To test for the imbalance among folk beliefs of the frequency of hazard information relative to that of benefit information predicted by the bias hypothesis, we first examined urban legends circulating on the Internet.

**4.1 Methods**

Drawing on prior work on this subject [65,66], we define urban legends (henceforth 'ULs') as untrue accounts of events that a) ostensibly occurred in the present or recent past, in settings familiar to the audience, b) are intended to be both believable and believed, c) circulate widely in a social environment, and d) have a wide audience that does indeed believe them to be true or likely to be true. ULs were collected between July 15 and August 22, 2008 from the six principal web sites, as ranked by Google, devoted to the subject (see Appendix). ULs were selected on the basis of frequency of circulation, as indexed by the following criteria: a) categorized by one or more of the web sites as "most popular"; b) present on two or more of the six web sites (when duplicates occurred across web sites, the more detailed version was retained). Because political campaigns actively disseminate negative information about rivals, to avoid biasing the result in the predicted direction, ULs concerning political candidates were excluded.

Seven undergraduate students (five anthropology majors, and two biology majors) were recruited to serve as coders; all were naïve to both the specific hypothesis at issue and the

general question of factors that might determine the frequency of different types of information in ULs. The coders evaluated a sample of 220 ULs, determining whether each UL described a hazard (defined as "something that imposes harm or other costs on those who encounter it") and/or a benefit ("something that provides resources, opportunities, or other good things"). Each UL was coded in a binary fashion (Yes/No) on both items, with hazard and benefit category ratings being non-exclusive, producing 1,540 ratings for each question. Inter-rater reliability was validated in a two-way random effects model for absolute agreement, and yielded an intra-class correlation coefficient (ICC) for a between-rater mean of .77 across hazard ratings and .87 across benefits ratings. Coders also determined whether the UL addressed the physical environment (44.0% of ULs), animals (8.4%), supernatural forces (4.3%), and/or the social world (43.2%).

**4.2 Results**

The benefit category contained 375 (out of a possible 1,540) "Yes" ratings, while the hazard category contained 1,198 (out of a possible 1,540) "Yes" ratings, indicating that hazard information appears approximately three times as frequently as benefit information. To statistically assess this ratio without inflating the degrees of freedom above the number of ULs, we first tallied the number of "Yes" benefit ratings and "Yes" hazard ratings for each UL, producing 220 tallies for each category ranging from 0 to 7 (0 = no judges gave the UL a "Yes" rating, 7 = all judges gave it a "Yes" rating). We then calculated the tally means within each content category and compared the two. A two-group mean comparison test revealed a significantly higher "Yes" count for hazards (M = 5.40, S.D. = 1.89) compared to that found for benefits (M = 1.70, S.D. = 2.27), $t_{219} = 14.62$. $p < 1 \times 10^{-33}$. These findings are consistent with the

notion that, when scaled up over multiple actors, generalized negativity bias and negatively-biased credulity produce an imbalance in socially transmitted cultural content.

## 5.0 STUDY 4

If generalized negativity bias and negatively-biased credulity are panhuman features of mind, then the imbalance in cultural content found in our sample of urban legends in the English-speaking West should also occur in beliefs sampled across diverse cultures. By virtue of their frequency around the world, supernatural beliefs afford testing this prediction; additionally, only 4.3% of the urban legends examined in Study 3 concerned supernatural forces, enhancing the independence of such a test. We therefore examined the frequency of hazard information in a representative sample of the world's supernatural beliefs.

### 5.1 Methods

Assistants, naïve to the hypothesis, collected supernatural beliefs from the 60 cultures described in the Probability Sample Files of the Human Relations Area Files (HRAF), a representative sample of the world's cultures [67]. Supernatural beliefs were identified using HRAF search codes for "Spirits and Gods," "Religious Beliefs," "Eschatology," and "Avoidance and Taboos". To preclude overweighting cultures having elaborate belief systems, only the first five beliefs encountered in each Sample File were collected (although as few as two per culture were found in some cases). The aforementioned HRAF search codes, which vary, in descending order, from broad to narrow, are listed in the order in which they were applied for each culture: to maximize the breadth of beliefs captured, assistants only moved down the list of codes if, for a given culture, the preceding code(s) had not yet yielded five beliefs. The vast majority of the

463 beliefs collected thus derived from the categories “Spirits and Gods” and “Religious Beliefs”.
464 Six of the coders employed in Study 3 were then recruited to evaluate the resulting sample of
465 219 supernatural beliefs using the same criteria applied in Study 3. These coders were again
466 naïve to both the specific hypothesis at issue and the larger question of factors that might
467 determine the frequency of different types of information in supernatural beliefs. Inter-rater
468 reliability was validated as in Study 3, with an ICC mean of .86 for hazard ratings and .82 for
469 benefit ratings.
470
471 **5.2 Results**
472 The benefit category contained 556 (out of a possible 1,314) “Yes” ratings, while the
473 hazard category contained 817 (out of a possible 1,314), indicating that hazard information
474 appears approximately 1.5 times as frequently as benefit information. We assessed the
475 significance of this difference using the method employed in Study 3, returning 219 tallies for
476 each category ranging from 0 to 6 (0 = no judges gave a “Yes” rating, 6 = all judges gave a
477 “Yes” rating), and then averaging them within category. A two-group mean comparison test
478 revealed a significantly higher “Yes” count for hazards ($M = 3.73$, $S.D. = 2.24$) compared to that
479 found for benefits ($M = 2.54$, $S.D. = 2.14$), $t_{218} = 4.75$, $p < 0.0001$. Hence, as predicted,
480 information concerning hazards is substantially more common than information concerning
481 benefits in supernatural beliefs.
482
483 **6.0 GENERAL DISCUSSION**
484 Replicating and extending Hilbig’s [37-39] findings from German participants, in two
485 samples of U.S. adults, we demonstrated that people are more credulous of information regarding

hazards than of information concerning benefits. Expanding existing functionalist perspectives on negativity bias into the realm of the acquisition and use of socially transmitted information, we view this negatively-biased credulity as reflecting a pattern wherein, in the environments in which humans evolved, the costs of erroneous incredulity toward information regarding hazards would, on average, have exceeded the costs of erroneous credulity. No equivalent asymmetry would have characterized the treatment of information regarding benefits, hence natural selection can be expected to have favored negatively-biased credulity. Our thesis is agnostic as to whether such asymmetry reflects, on the one hand, a novel manifestation in humans of the same processes responsible for negativity bias in other species, or, on the other hand, a serially homologous derived trait [68,69] operating in parallel with such processes: for the present purposes, what matters is simply that people evince greater credulity toward information concerning hazards.

Our framework introduces the possibility that negatively-biased credulity may be facultatively adjusted, as its utility depends in part on the actual risks posed by hazards in the individual's environment. Subjective perceptions of the extent to which the world is dangerous capture a combination of one's past encounters with hazards and an assessment of one's ability to effectively address hazards. Consonant with the above, we demonstrated that credulity toward hazard information, but not toward benefit information, is correlated with perceptions that the world is dangerous. Although we interpret this relationship in terms of the effects of self-perceived vulnerability to hazards on credulity, because the data are correlational, we cannot rule out reverse causality, i.e., some people may perceive the world as more dangerous because, due to some additional factor, they are more credulous toward information about hazards.

Moving from the level of individual psychology to the level of information shared by members of a society, the combined effects of general negativity bias and negatively-biased credulity in the minds of learners should constitute an attractor [6] that shapes the contours of cultural evolution: culture can be expected to exhibit an imbalance wherein information regarding hazards is more prevalent than information regarding benefits. This imbalance should be particularly pronounced in domains in which the information at issue lacks, or is distant from, an objective basis, as this reduces the influence of selection pressures in cultural evolution that favor functional utility – and thus, frequently, accuracy – in cultural information. We found the predicted imbalance in two widely disparate samples, one a set of urban legends circulating on the Internet in the contemporary English-speaking West, the other a collection of supernatural beliefs extracted from ethnographic descriptions of a representative sample of the world's cultures.

Being the product of innumerable instances of information acquisition, retention, and transmission, urban legends and supernatural beliefs are sufficiently removed from the individual minds that shaped them that we cannot say for certain what the relative contributions of general negativity bias and negatively-biased credulity are to the resulting cultural content. Nevertheless, our findings provide the basis for further investigations aimed at illuminating the manner in which features of learners' minds influence the shape of culture. Notably, social dynamics operate at an intermediate level in this process. Regardless of the direction of causality underlying the correlation, our observation that people who view the world as dangerous exhibit enhanced negatively-biased credulity suggests that such individuals may be critical nodes in the transmission chains that mold culture: being more likely to acquire, retain, and transmit beliefs concerning hazards than are others in their population, those who see the world as dangerous

may exercise an outsized influence on the eventual imbalance in the contents of culture between information concerning hazards and information concerning benefits. Future investigations aimed at capturing the processes of social information transmission and the structure of networks involved therein may therefore be strengthened by examining individual variation along this dimension.

Our thesis that general negativity bias and negatively-biased credulity are universal features of the human mind predicts that the resulting imbalance in beliefs should be common across cultures. Beyond this overarching pattern, cultures may differ substantially in the extent of this imbalance. In part this is because, for any given society, the asymmetry in the costs of errors with regard to credulity concerning hazard information will be a function of the base rate of actual hazards in the given environment. The costs of failing to believe true statements about hazards hinge on the likelihood that the given hazard will be encountered. This probability will be higher in societies located in relatively dangerous environments (e.g., many natural hazards; high rates of violence; etc.) than in societies located in relatively safe environments. As a consequence, in dangerous environments, the cost/benefit ratio is shifted even further toward greater credulity regarding hazard information. If, as we have suggested, such credulity is shaped in part by subjective perceptions of vulnerability, then it is plausible that negatively-biased credulity will partially track the base rate of actual hazards in the environment. In turn, greater credulity in objectively more dangerous environments will enhance the opportunity for spurious beliefs about hazards to proliferate in the given culture, leading to the prediction that both negatively-biased credulity and the prevalence of beliefs about hazards will be greater in dangerous environments than in safe environments, and, moreover, that the latter difference will persist even after controlling for differences in objective danger. Furthermore, if subjective

554 vulnerability is itself shaped in part by cultural information (i.e., individuals feel more vulnerable
555 when the cultural context depicts many hazards than when it depicts few), then, by virtue of the
556 impact of subjective vulnerability on the success or failure of beliefs in the marketplace of ideas,
557 feedback loops may occur wherein both prevailing levels of subjective vulnerability and the
558 prevalence of beliefs about hazards change over time without corresponding alterations in the
559 objective base rate of hazards in the environment. Due to the core asymmetry in costs
560 underlying negatively-biased credulity, we can expect such runaway processes to be similarly
561 biased: it should be easier to increase than to decrease subjective vulnerability, and,
562 correspondingly, positive feedback processes that successively increase the frequency of hazard
563 beliefs relative to the objective prevalence of hazards should be more common than negative
564 feedback processes that generate the reverse pattern. Indeed, observing the extreme degree to
565 which Melanesian cultures – which occupy objectively dangerous environments – populate
566 cosmologies with dangerous forces and entities, Schwartz [70] posited the existence of self-
567 reinforcing 'paranoid ethoses'.

568 As noted in the Introduction, credulity is a prerequisite for the acquisition and
569 exploitation of valuable knowledge produced by cumulative cultural evolution in large part
570 because the functional utility of such information is often opaque to the learner, and, moreover,
571 frequently to its expert adherents as well. Such opacity has been cited as the adaptive
572 consideration driving overimitation, the pattern, largely unique to humans, wherein, once they
573 have grasped the apparent goal of a given model's actions (which need not be isomorphic with
574 its true utility), learners imitate even seemingly extraneous features of the model's behavior [71].
575 As such, overimitation can plausibly be construed as a form of credulity operating in contexts in
576 which information transmission is mediated primarily by behavior rather than language. If so,

577 then we should expect negatively-biased credulity to be evident here as well, generating the
578 prediction that overimitation will be more pronounced when the actions of the model address
579 hazards than when said actions address benefits. In turn, at the level of cultural evolution, this
580 pattern may contribute to the development of rituals, as rituals both frequently address hazards
581 and are characterized by stereotyped behaviors that are transmitted with a high degree of fidelity
582 [72,73].

583 The cultural evolution of supernatural beliefs is likely shaped in part by the positive
584 effects on cooperation of beliefs in moralistic supernatural entities [74,75]. Although we did not
585 differentiate between punitive moralistic entities and other types of hazards in our ethnographic
586 sample, such an effect cannot explain our overall results, as only a small fraction of the urban
587 legends that we examined concerned supernatural forces. The success of modern Christianity
588 might lead observers to presume that supernatural beliefs are generally a source of comfort to
589 their holders. Granted, the predominance of hazard information in our cross-cultural corpus of
590 beliefs may not translate into anxiety in believers since, for example, beliefs might offer sense-
591 making accounts of why hazards exist. However, given the demonstrated role of anxiety in
592 enhancing cultural transmission, the success of hazard information in the marketplace of ideas
593 likely reflects its capacity to create, not alleviate, aversive subjective experiences. Rather than
594 reflecting the impact of psychological attractors, the success of proselytizing religions that depict
595 beneficent but moralistic deities may therefore primarily reveal larger-scale dynamics wherein
596 supernatural beliefs that further within-group cooperation and altruism are favored by cultural
597 group selection [76-79], thus illustrating the complex, multi-level nature of cultural evolution.
598

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## REFERENCES

1. Boyd R, Richerson PJ (1985) Culture and the evolutionary process. Chicago: University of Chicago Press. viii, 331 p.
2. Boyd R, Richerson PJ (2005) The origin and evolution of cultures. New York: Oxford University Press.
3. Boyer P (2000) Evolutionary psychology and cultural transmission. American Behavioral Scientist 43: 987-1000.
4. Conway LG III, Schaller M (2007) How communication shapes culture. In: Fiedler K, editor. Social Communication. New York: Psychology Press. pp. 107-127.
5. Norenzayan A, Atran S (2004) Cognitive and emotional processes in the cultural transmission of natural and nonnatural beliefs. In: Schaller M, Crandall CS, editors. The psychological foundations of culture. Hillsdale, NJ: Lawrence Erlbaum Associates. pp. 149-169.
6. Sperber D (1996) Explaining culture: A naturalistic approach. Cambridge, MA: Blackwell. vii, 175 p.
7. Sperber D (2006) Why a deep understanding of cultural evolution is incompatible with shallow psychology. In: Enfield NJ, Levinson SC, editors. Roots of human sociality: Culture, cognition, and interaction. London: Berg. pp. 431-449.

8. Mesoudi A, Whiten A (2004) The hierarchical transformation of event knowledge in human cultural transmission. Journal of Cognition and Culture 4: 1-24.
9. Mesoudi A, Whiten A, Dunbar R (2006) A bias for social information in human cultural transmission. British Journal of Psychology 97: 405-423.
10. Boyer P (1994) Cognitive constraints on cultural representations: Natural ontologies and religious ideas. In: Hirschfeld LA, Gelman SA, editors. Cambridge: Cambridge Univ Press. pp. 391-411.
11. Fessler DMT, Navarrete CD (2003) Meat is good to taboo: Dietary proscriptions as a product of the interaction of psychological mechanisms and social processes. Journal of Cognition & Culture 3: 1-40.
12. Norenzayan A, Atran S, Faulkner J, Schaller M (2006) Memory and mystery: The cultural selection of minimally counterintuitive narratives. Cognitive Science 30: 531-553.
13. Nesse RM (1990) Evolutionary explanations of emotions. Human Nature 1: 261-289.
14. Baumeister RF, Bratslavsky E, Finkenauer C, Vohs KD (2001) Bad is stronger than good. Review of General Psychology 5: 323-370.
15. Rozin P, Royzman EB (2001) Negativity bias, negativity dominance, and contagion. Personality & Social Psychology Review 5: 296-320.
16. Young JR (2003) The role of fear in agenda setting by television news. American Behavioral Scientist 46: 1673-1695.
17. Soroka SN (2006) Good news and bad news: Asymmetric responses to economic information. Journal of Politics 68: 372-385.
18. Nguyen VH, Claus E (2013) Good news, bad news, consumer sentiment and consumption behavior. Journal of Economic Psychology 39: 426-438.

19. Garz M (2012) Unemployment expectations, excessive pessimism, and news coverage. Journal of Economic Psychology 34: 156-168.
20. Akhtar S, Faff R, Oliver B, Subrahmanyam A (2011) The power of bad: The negativity bias in Australian consumer sentiment announcements on stock returns. Journal of Banking & Finance 35: 1239-1249.
21. Akhtar S, Faff R, Oliver B, Subrahmanyam A (2012) Stock salience and the asymmetric market effect of consumer sentiment news. Journal of Banking & Finance 36: 3289-3301.
22. Eriksson K, Coultas JC (n.d.) Corpses, maggots, poodles and rats: Emotional selection operating in three phases of cultural transmission of urban legends. Manuscript submitted for publication
23. Heath C, Bell C, Sternberg E (2001) Emotional selection in memes: The case of urban legends. Journal of Personality & Social Psychology 81: 1028-1041.
24. Peters K, Kashima Y, Clark A (2009) Talking about others: Emotionality and the dissemination of social information. European Journal of Social Psychology 39: 207-222.
25. Nichols S (2002) On the genealogy of norms: A case for the role of emotion in cultural evolution. Philosophy of Science 69: 234-255.
26. Walker CJ, Blaine B (1991) The virulence of dread rumors: A field experiment. Language & Communication 11: 291-297.
27. Berger J (2011) Arousal increases social transmission of information. Psychological Science 22: 891-893.
28. Berger J, Milkman KL. (2012) What makes online content viral? Journal of Marketing Research 49: 192-205.

29. Anthony S (1992) The influence of personal characteristics on rumor knowledge and transmission among the deaf. American Annals of the Deaf 137: 44-47.

30. Bangerter A, Heath C (2004) The Mozart effect: Tracking the evolution of a scientific legend. British Journal of Social Psychology 43: 605-623.

31. Pezzo MV, Beckstead JW (2006) A multilevel analysis of rumor transmission: Effects of anxiety and belief in two field experiments. Basic and Applied Social Psychology 28: 91-100.

32. Rosnow RL (1980) Psychology of rumor reconsidered. Psychological Bulletin 87: 579-591.

33. Rosnow RL, Esposito JL, Gibney L (1988) Factors influencing rumor spreading: Replication and extension. Language & Communication 8: 29-42.

34. Walker CJ, Beckerle CA (1987) The effect of state anxiety on rumor transmission. Journal of Social Behavior & Personality 2: 353-360.

35. Anthony S, Gibbins S (1995) Believability and importance as determinants of rumor among deaf college students. American Annals of the Deaf 140: 271-278.

36. Rosnow RL (1991) Inside rumor: A personal journey. American Psychologist 46: 484.

37. Hilbig BE (2009) Sad, thus true: Negativity bias in judgments of truth. Journal of Experimental Social Psychology 45: 983-986.

38. Hilbig BE (2012) Good things don't come easy (to mind): Explaining framing effects in judgments of truth. Experimental Psychology 59: 38-46.

39. Hilbig BE (2012) How framing statistical statements affects subjective veracity: Validation and application of a multinomial model for judgments of truth. Cognition 125: 37-48.

40. Siegrist M, Cousin ME, Frei M (2008) Biased confidence in risk assessment studies. Human and Ecological Risk Assessment 14: 1226-1234.

41. Siegrist M, Cvetkovich G (2001) Better negative than positive? Evidence of a bias for negative information about possible health dangers. Risk Analysis 21: 199-206.
42. Slovic P (1993) Perceived risk, trust, and democracy. Risk Analysis 13: 675-682.
43. White MP, Pahl S, Buehner M, Haye A (2003) Trust in risky messages: The role of prior attitudes. Risk Analysis 23: 717-726.
44. Boyd R, Richerson PJ (2006) Culture and the evolution of the human social instincts. In: Levinson S, Enfield N, editors. Roots of human sociality. Oxford: Berg. pp. 453-477.
45. McElreath R (2004) Social learning and the maintenance of cultural variation: An evolutionary model and data from East Africa. American Anthropologist 106: 308-321.
46. Kurzban R (2007) Representational epidemiology: Skepticism and gullibility. In: Gangestad SW, Simpson JA, editors. The evolution of mind: fundamental questions and controversies. The Guilford Press. pp. 357-362.
47. Nesse RM (2001) The smoke detector principle. Annals of the New York Academy of Sciences 935: 75-85.
48. Nesse RM (2005) Natural selection and the regulation of defenses: a signal detection analysis of the smoke detector principle. Evolution and Human Behavior 26: 88-105.
49. Beck J, Forstmeier W (2007) Superstition and belief as inevitable by-products of an adaptive learning strategy. Human Nature 18: 35-46.
50. Foster KR, Kokko H (2009) The evolution of superstitious and superstition-like behaviour. Proceedings of the Royal Society B: Biological Sciences 276: 31-37.
51. Haselton MG, Buss DM (2000) Error Management Theory: A new perspective on biases in cross-sex mind reading. Journal of Personality and Social Psychology 78: 81-91.

52. Haselton MG, Nettle D (2006) The paranoid optimist: An integrative evolutionary model of cognitive biases. Personality and Social Psychology Review 10: 47-66.

53. Johnson DDP, Blumstein DT, Fowler JH, Haselton MG (2013) The evolution of error: Error management, cognitive constraints, and adaptive decision-making biases. Trends in Ecology & Evolution 28: 474-481.

54. Shermer M (2002) Why people believe weird things: Pseudoscience, superstition, and other confusions of our time. New York: Holt.

55. Wiley RH (1994) Errors, exaggeration, and deception in animal communication. In: Real L, editor. Behavioral mechanisms in evolutionary ecology. Chicago: University of Chicago Press. pp. 157-189.

56. Boyd R, Richerson PJ (1988) An evolutionary model of social learning: the effects of spatial and temporal variation. In: Zentall TR, Galef BGJ, editors. Social learning: psychological and biological perspectives. Hillsdale, NJ: Lawrence Erlbaum Associates. pp. 29-48.

57. Kahneman D, Tversky A (1984) Choices, values, and frames. American Psychologist 39: 341.

58. Tversky A, Kahneman D (1981) The framing of decisions and the psychology of choice. Science 211: 453-458.

59. Hilton DJ (1995) The social context of reasoning: Conversational inference and rational judgment. Psychological Bulletin 118: 248-271.

60. Sperber D, Wilson D (1995) Relevance: Cognition and communication. Oxford: Blackwell.

61. Christley RM, Pinchbeck GL, Bowers RG, Clancy D, French NP et al. (2005) Infection in social networks: Using network analysis to identify high-risk individuals. American Journal of Epidemiology 162: 1024-1031.
62. Snyder JK, Fessler DMT, Tiokhin L, Frederick DA, Lee SW et al. (2011) Trade-offs in a dangerous world: Women's fear of crime predicts preferences for aggressive and formidable mates. Evolution & Human Behavior 32: 127-137.
63. Navarrete CD (2005) Death concerns and other adaptive challenges: The effects of coalition-relevant challenges on worldview defense in the US and Costa Rica. Group Processes & Intergroup Relations 8: 411-427.
64. Hume D (1757) The natural history of religion. Boston: MobileReference.
65. Tangherlini TR (1990) " It happened not too far from here.": A survey of legend theory and characterization. Western Folklore 49: 371-390.
66. Brunvand JH (2001) The truth never stands in the way of a good story. University of Illinois Press.
67. Lagacé RO (1977) Sixty cultures: A guide to the HRAF probability sample files. New Haven, CN: Human Relations Area Files.
68. Clark JA (2010) Hubristic and authentic pride as serial homologues: The same but different. Emotion Review 2: 397-398.
69. Clark JA, Fessler DMT (n.d.) Serial homologies of psychological traits. Manuscript in preparation
70. Schwartz T (1973) Cult and context: The paranoid ethos in Melanesia. Ethos 1: 153-174.

71. Gergely G, Csibra G (2006) Sylvia's recipe: The role of imitation and pedagogy in the transmission of cultural knowledge. In: Enfield NJ, Levenson SC, editors. Roots of human sociality: Culture, cognition, and human interaction. Oxford: Berg Publishers. pp. 229-255.
72. Boyer P, Liénard P (2006) Why ritualized behavior? Precaution Systems and action parsing in developmental, pathological and cultural rituals. Behavioral and Brain Sciences 29: 595-613.
73. Lienard P, Boyer P (2006) Whence collective rituals? A cultural selection model of ritualized behavior. American Anthropologist 108: 814-827.
74. Atkinson QD, Bourrat P (2011) Beliefs about God, the afterlife and morality support the role of supernatural policing in human cooperation. Evolution and Human Behavior 32: 41-49.
75. Shariff AF, Norenzayan A (2011) Mean gods make good people: Different views of God predict cheating behavior. The International Journal for the Psychology of Religion 21: 85-96.
76. Henrich J, Ensminger J, McElreath R, Barr A, Barrett C et al. (2010) Markets, religion, community size, and the evolution of fairness and punishment. Science 327: 1480-1484.
77. Norenzayan A, Shariff AF (2008) The origin and evolution of religious prosociality. Science 322: 58-62.
78. Roes FL, Raymond M (2003) Belief in moralizing gods. Evolution and Human Behavior 24: 126-135.
79. Wilson DS (2003) Darwin's cathedral: Evolution, religion, and the nature of society. Chicago: University of Chicago Press.

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## Appendix

### Materials Used in Studies 1 and 2 to Evaluate Hazard Credulity Bias

*Highlighted items are dependent variables; items without highlights are similarly structured distractors.*

### SET 1

For each of the statements that follow, please indicate, by checking the appropriate box, how confident you are that the statement is **TRUE** or **FALSE**.

**1.** Although proponents consider German shepherds loyal and intelligent pets, a recent study in the U.S. notes that this breed is responsible for 11% of dog attacks.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

---

**2.** On average, four years after opening, 44% of small businesses are turning a profit and still in business.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**3.** Many people find rare ground beef patties delicious. However, 13% of ground beef patties contain bacteria that could cause illness if eaten rare.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**4.** Homes that border a wilderness preserve are typically 11% more valuable than homes in the same neighborhood that do not border the wilderness.

☐ ☐ ☐ ☐ ☐ ☐ ☐

1 2 3 4 5 6 7

I'm absolutely certain this statement is **FALSE**

I'm absolutely certain this statement is **TRUE**

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**5.** In the case of suspected cardiac arrest, an automatic external defibrillator (AED) can recognize heart arrhythmias and apply an electric shock if needed, thus saving lives. If treated early with an AED, over 50% of people undergoing cardiac arrest will survive.

☐ ☐ ☐ ☐ ☐ ☐ ☐

1 2 3 4 5 6 7

I'm absolutely certain this statement is **FALSE**

I'm absolutely certain this statement is **TRUE**

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**6.** When civil litigation cases go to trial, 60% of plaintiffs lose, winning no money, and often having to pay attorney fees.

☐ ☐ ☐ ☐ ☐ ☐ ☐

1 2 3 4 5 6 7

I'm absolutely certain this statement is **FALSE**

I'm absolutely certain this statement is **TRUE**

---

**7.** In heavy city traffic, bicyclists typically arrive at their destination twice as fast as motorists traveling the same distance by car.

☐ ☐ ☐ ☐ ☐ ☐ ☐

1 2 3 4 5 6 7

I'm absolutely certain this statement is **FALSE**

I'm absolutely certain this statement is **TRUE**

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**8.** LASIK eye surgery leads to lasting complications -- including double vision -- in 5% of patients who undergo the procedure.

☐ ☐ ☐ ☐ ☐ ☐ ☐

1 2 3 4 5 6 7

I'm absolutely certain this statement is **FALSE**

I'm absolutely certain this statement is **TRUE**

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**9.** Owning a dog has many benefits: People who own dogs are 55% more likely to get the amount of exercise recommended for good health than people who don't own dogs.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**10.** Becoming a professor is a less desirable career path than you might think, as few tenure-track positions are available: only 34% of the faculty positions offered at US colleges and universities are tenure-track.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**11.** Chemotherapy is known to slow or stop tumor growth in many cancer patients. However, at least 30% of young people and at least 60% of people over 40 who undergo chemotherapy are subsequently infertile.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**12.** Many people enjoy jogging. Adults who run regularly have a significantly lower risk of heart disease than those who do not run regularly.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**13.** Gardasil has been shown to protect women from types of human papilloma virus that cause the majority of cervical cancers. 93% of women who receive the vaccine experience no serious side effects.

| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 | ☐ 6 | ☐ 7 |
|---|---|---|---|---|---|---|
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**14.** Short-term momentum investors, who buy when high performance stocks are on sale and sell when the market price of their stocks increases, overestimate the strength of their strategy: critics argue that, due to changes in the market, the momentum strategy can be used effectively only 15 to 20% of the time.

| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 | ☐ 6 | ☐ 7 |
|---|---|---|---|---|---|---|
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**15.** 99% of people are not allergic to peanuts and can benefit from their high fiber content.

| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 | ☐ 6 | ☐ 7 |
|---|---|---|---|---|---|---|
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**16.** Many people find crab fishing alluring as a quick job that pays well; however, fishing is a dangerous job, taking over 100 lives annually per 100,000 fishermen.

| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 | ☐ 6 | ☐ 7 |
|---|---|---|---|---|---|---|
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**SET 2**

For each of the statements that follow, please indicate, by checking the appropriate box, how confident you are that the statement is **TRUE** or **FALSE**.

**1.** Despite their fierce appearance, German shepherds are considered loyal and intelligent pets. A recent study in the U.S. notes that other breeds of dog are responsible for 89% of dog attacks.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

I'm absolutely certain this statement is **FALSE** — I'm absolutely certain this statement is **TRUE**

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**2.** On average, four years after opening, 66% of small businesses have failed and gone out of business.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

I'm absolutely certain this statement is **FALSE** — I'm absolutely certain this statement is **TRUE**

---

**3.** Many people find rare ground beef patties delicious. 87% of ground beef patties are free of bacteria that could cause illness if eaten rare.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

I'm absolutely certain this statement is **FALSE** — I'm absolutely certain this statement is **TRUE**

---

**4.** Homes that border a wilderness preserve become 10% less valuable during the five years following a local wildfire than homes in the same neighborhood that do not border the wilderness.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

I'm absolutely certain this statement is **FALSE** — I'm absolutely certain this statement is **TRUE**

---

**5.** In the case of suspected cardiac arrest, an automatic external defibrillator (AED) can recognize heart arrhythmias and apply an electric shock if needed, thus saving lives. If used improperly, however, a layperson operating an AED can also receive a shock, injuring them.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**6.** When civil litigation cases go to trial, 40% of plaintiffs succeed and win money.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**7.** In heavy city traffic, bicyclists are typically twice as likely to be injured in a crash as motorists traveling the same distance by car.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**8.** LASIK eye surgery improves vision to 20/20 in 90% of patients who undergo the procedure.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**9.** Owning a dog has many costs: The average lawsuit over a dog attack costs the dog owner approximately $24,000.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**10.** Becoming a professor is a more desirable career path than you might think, as tenure-track positions pay well: on average, tenure-track professors earn $81,000 a year.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**11.** Chemotherapy is known to slow or stop tumor growth in many cancer patients. Up to 70% of people who undergo chemotherapy experience slowing or stopping of tumor growth.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**12.** Although many people enjoy jogging, adults who run regularly are four times more likely to have a knee injury than the general population.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**13.** Gardasil has been shown to protect women from types of human papilloma virus that cause the majority of cervical cancers. However, 7% of women who receive the vaccine experience serious side effects.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**14.** Short-term momentum investors, who buy when high performance stocks are on sale and sell when the market price of their stocks increases, praise the strength of their strategy: proponents claim that the momentum strategy allows investors to profit from 70% of their stock purchases.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**15.** 1% of people are allergic to peanuts and must not eat them despite their beneficial fiber content.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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**16.** Many people find crab fishing alluring as a quick job that pays well: fishermen often make $60,000 for three months work.

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I'm absolutely certain this statement is **FALSE** | | | | | | I'm absolutely certain this statement is **TRUE** |

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## STUDY 2 ONLY

### Beliefs in the Dangerousness of the World scale (Navarrete, 2005)

1.) I often fear for my safety

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

2.) I often fear for the safety of my family and/or friends.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

3.) The world is a dangerous place.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

## Generalized Credulity scale (created by the authors)

1.) I am a skeptical person – unless I have seen it with my own eyes, I often do not believe what people tell me.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

2.) Newspapers report objective facts – the things you read in the newspaper are true.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

3.) I tend to believe what other people tell me – compared to most people I know, I am a very trusting person.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

4.) I don't believe anything I hear on television news programs – those guys just spread rumors.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Very Strongly Disagree** | | | | **Neutral** | | | | **Very Strongly Agree** |

Study 3: Sources of urban legends; material collected between July 15 and August 22, 2008.
www.snopes.com
www.truthorfiction.com
www.geocities.com/rayman_7575/urbanlegendcentral.html
www.netscrap.com/netscrap.cfm?cat_show=Urban%20Folklore
http://urbanlegendsonline.com/classics.html
http://urbanlegends.about.com/od/reference/a/top_25_uls.htm