

and ethnographers have noted (Mair 1969), this may not be necessary for accusations to take place or for belief in mystical harm to be widespread within certain societies.

It seems that “cultural selection” here means something almost the same as cognitive bias. We would place greater emphasis on the second and third processes of selection: plausible explanations of misfortune and demonizing narratives. While Singh is not commenting that those performing harmful magic are necessarily the same as those who are accused of it, documented accusations seem to be less preoccupied with the mechanism of witchcraft and more with the identification and motivation of the witch (e.g., Thomas 1971), for example, following conflict between the accused and the accuser. In numerous cases, it seems unlikely that “witches” have attempted to bring misfortune on others, such as with accusations documented against children, which frequently occur in specific contexts. There are instances when children are brought up by stepparents or distant relatives, and a witchcraft accusation may remove the need to provide for a burdensome individual (Cimpric 2010; Secker 2013). The same can be inferred from accounts in which the elderly are accused of witchcraft (Foxcroft 2017; Miguel 2005a). Accusations may provide (through their demonizing narrative) a convenient way of severing ties while protecting the reputation of an accuser: it may be better to be seen as expelling a heinous witch than a harmless but unproductive relative who is a drain on resources.

Witchcraft can also be conceived of as an unconscious, innate trait (e.g., McCulloch 1952), which illustrates, as demonstrated by Singh’s PCA, the tendency of supernatural beliefs to overlap with one another. Many of those accused of witchcraft unrelated to the evil eye are young, particularly in more recent years (e.g., Adinkrah 2011; Foxcroft 2017; Secker 2013). Similarly, evidence from a number of societies suggests that individuals with the evil eye are not thought to be particularly young (Chaudhuri 2012; Reminick 1974; Spooner 1970), but further research is required in this area. As mentioned above, often the plausibility of an individual’s ability to undertake harmful magic seems less important than the circumstances leading to accusations or suspicions (Sarah Peacey, unpublished PhD thesis).

It is also worth noting that when the distinction between sorcerers and witches, as originally observed by Evans-Pritchard in the Azande (1937), was investigated by subsequent anthropologists in a number of societies (Douglas 1967), it became apparent that the Azande’s precise distinction between the types of practitioner did not generalize to all cultures (e.g., Douglas 1967; Hutton 2017; Mair 1969; Thomas 1971).

We support Singh’s concluding observation that witchcraft beliefs are not a group-level adaptation. Mace et al. (2018) found no evidence to suggest that those accused of witchcraft were uncooperative. In some instances, individuals accused of witchcraft are described as antisocial in ethnographic accounts; this does not seem to apply to all cases (Sarah Peacey, unpublished PhD thesis). Witchcraft beliefs and accusations do not seem to us to operate as a mechanism for intragroup cooper-

ation. Instead, it appears that they are largely explained by their adaptive functions as a causal explanation for misfortune and as a means of removing competitors and burdensome individuals.

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### What Ultimately Predicts Witchcraft and Its Variation around the World?

Witchcraft and related beliefs, such as evil eye, are a normal feature of life for many across the world. Our scientific separation of these “supernatural” forces from the natural is arguably weird (Henrich, Heine, and Norenzayan 2010; Saler 1977), but since the proposed mechanisms that turn malicious intent into maleficent outcomes contradict our best understanding of how the world works, their persistence and ubiquity require explanation. Singh offers a compelling explanation building on known psychology, but because this explanation relies on universal psychology, it falls short of explaining why these beliefs have varied across societies and over time. Figure 4 (Winkler 2017) illustrates both how widespread these beliefs are and how much they vary. And as a range of studies (e.g., Gershman 2016; Mace et al. 2018; Schnoebelen 2009) illustrate, while witchcraft still affects everyday life in many places in Asia, Africa, South and Central America, Oceania, and even parts of south, central, and eastern Europe, many western Europeans, Americans, and Australians may have never even heard of evil eye. How do we explain this variation?

Here, we propose a cultural evolutionary theory to explain this cross-cultural and cross-temporal variation that forms part of our ongoing work on competition between scales of cooperation (Muthukrishna 2017; Muthukrishna et al. 2017). Evil eye in particular is a puzzling belief because it incentivizes people to reduce conspicuous consumption and other forms of status signaling (Dundes 1981) that would otherwise lead to influence, mating opportunities, and other social benefits. We argue that these beliefs can be rationalized as culturally evolved adaptations to different levels of resource availability that change the disparity in relative returns on competition (the ratio of payoffs between winners and losers; “disparity in relative returns”) and the different degrees to which wealth can be accumulated and protected (what we might call “property rights” as a shorthand). This explanation also helps explain why hunter-gatherers have relatively lower levels of witchcraft and evil eye beliefs and relatively higher levels of egalitarian norms (Boehm 2001; Cashdan 1980; Guenther 1992; von Rueden 2019).

The explanation is as follows: In all societies, people compete, and the returns on this competition lead to social benefits such as influence, mating opportunities, and offspring outcomes,

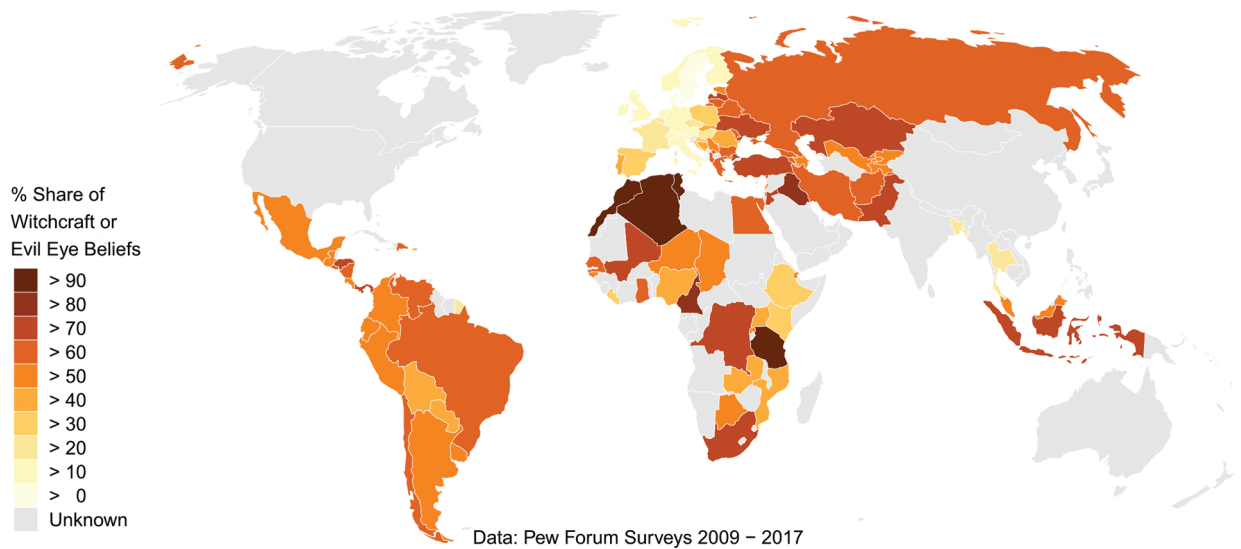


Figure 4. Shown are witchcraft and evil eye beliefs around the world (Winkler 2017) based on the Pew survey question “Do you believe in the ‘evil eye’ or that certain people can cast curses or spells that cause bad things to happen to someone?”

but the nature of that competition differs among societies. In some societies, the relative returns to winners compared with losers are much higher. For example, if resources are scarce and the world is more zero-sum, then one person’s success predicts another’s failure. The winner has taken a piece of a small pie that the losers can never get back. In contrast, if resources are plentiful, the world may be more positive sum, and one person’s success may be predictive of another’s success. For example, in a growing economy, if the coffee business is booming, you would do well to open a café yourself. The relative returns on this competition lead to differences in relative status and the pathways to relative status, in turn leading to different optimal behaviors. In the zero-sum world, harming others, even at a cost to oneself, may raise one’s relative status. In a positive-sum world, working harder to secure yet-untapped resources may be a more fruitful strategy. That is, the former incentivizes destructive competition and the latter productive competition. We see some evidence of this behavior in cross-cultural work on the Joy of Destruction game, in which players can destroy another’s endowment at a cost but with no direct benefit to themselves. The tendency to do this is much higher in Namibia than in Ukraine or the Netherlands (Abbink and Herrmann 2011; Abbink and Sadrieh 2009; Prediger, Vollan, and Herrmann 2014), and even within the Namibian sample, Prediger et al. (2014) show that pastoralists from more resource-scarce areas engaged in significantly more destructive behavior compared with pastoralists from high-yield areas. Connecting this to witchcraft beliefs, Miguel (2005) finds similar patterns in a positive relationship between extreme rainfalls (flood and drought) and witch killings.

The second dimension in our explanation is the level of property rights, the degree to which property can be accumulated and protected. A society with high property rights dis-

incentivizes destructive behavior. Many of these dynamics are captured by Gershman (2015, 2016), who also shows that witchcraft beliefs correlate with levels of competitiveness, property rights, and inequality and affect productivity and economic growth, human development, and social well-being. Gershman argues for evil eye beliefs as a culturally evolved mechanism for reducing conspicuous consumption and status signaling under conditions that incentivize destructive competition. Building on this reasoning, we argue that relative returns and property rights, which are a joint function of the environment and institutions, shape destructive versus productive competitive behaviors and furthermore behaviors associated with witchcraft and evil eye beliefs. We can derive the following predictions, which are stylized in figure 5.

To summarize our argument, evil eye is a culturally evolved mechanism reducing the temptation to advertise status in a world in which that higher relative status would incentivize destructive behavior. Witchcraft is an intuitive mechanism, as Singh argues, for representing the tendency of others wanting to harm the successful in unobservable ways to avoid retaliation. We predict that those with high or increasing status are more likely to suppress signaling their success under conditions of weak to moderate property rights and moderate to high disparity in relative returns. We further predict that harm will be directed at those with higher or increasing status and with whom we are in direct competition. Elon Musk sending his Tesla Roadster into orbit is cool, but my neighbor buying a Tesla is annoying. We have no specific prediction as to who will be perceived as a witch; however, we expect that within these same societies, witch hunts are triggered by factors that create unexpected inequality, such as heterogeneity in misfortune (or fortune). The destruction of everyone’s houses in a hurricane may increase destructive competitive behavior by

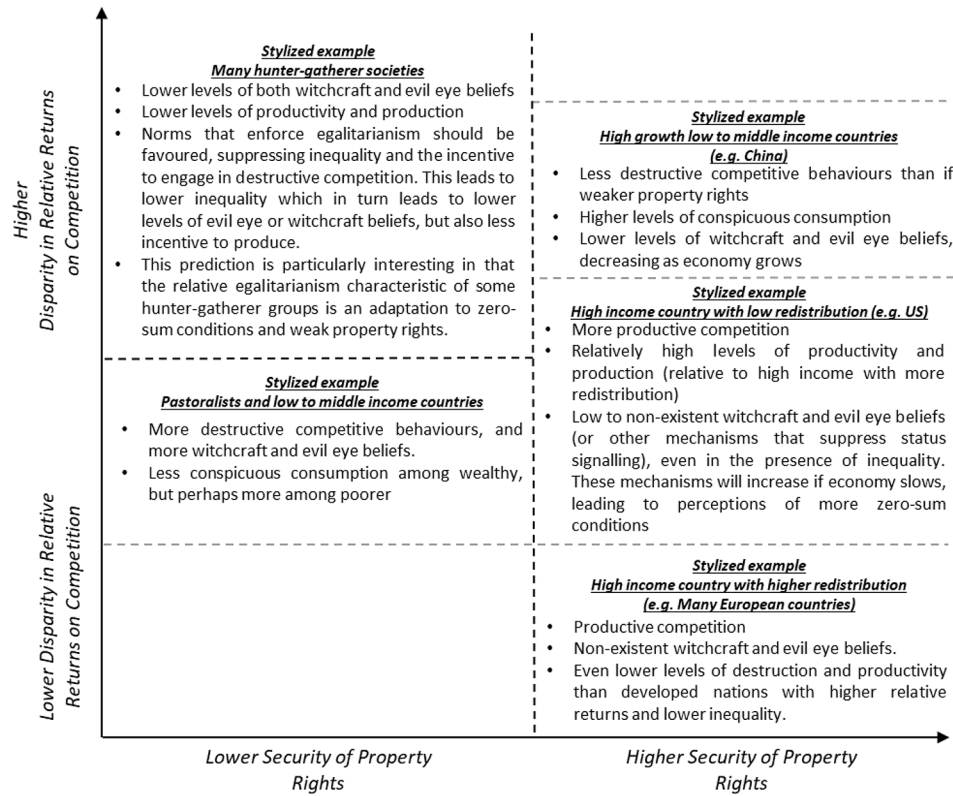


Figure 5. Shown are predictions for different disparities in relative returns and property rights mapped to stylized versions of different societies. Our identifications of different types of societies are only examples; the world is more complicated than the model. For example, there are hunter-gatherer societies with more accumulation of wealth and property rights and corresponding higher witchcraft and evil eye beliefs; within any nation there are differences in resource availability, disparity in relative returns, redistribution, security of property rights, and so on. Nonetheless, we do expect that this model can explain broad patterns.

creating a more zero-sum situation but is less likely to trigger a witch hunt than is the destruction of only a subset of houses. Rather than recognizing their place in a probability distribution, people target those who escaped misfortune or increased their fortune. Extending this argument, decreases in economic growth leading to increased inequality and increased resource scarcity (Piketty 2017) might lead to an increased perception of zero-sumness triggering relatively more destructive competition (tempered by the strength of property rights). We hope that this perspective offers an ultimate theory to complement Singh's fascinating argument and together explains both the existence of these beliefs and their variation.

## Reply

### Science, Delusion, Explosive Cockroaches, and Other Issues Surrounding Witchcraft and Sorcery

The commentators find value in the systematic comparison, beg for clarification, challenge empirical claims, propose alternative explanations, and, in one case, express skepticism about whether psychology can tell us much about the origins of be-

liefs. All agree that mystical harm beliefs are puzzling and important. All are enthusiastic and thoughtful. Thank you.

The commentators' many points can be organized into five broad questions.

### What Do the Principal Components Mean?

Boyer understands the two components of the principal components analysis (PCA) to be "relevant dimensions of the ways harm doers are construed." I agree. He writes that PC1, which tracks features like cannibalism, flight, and nighttime conspiracies, captures the extent to which representations of perpetrators are attention-grabbing. That differs from my interpretation, which is that PC1 represents how demonized a representation is, that is, the extent to which it inspires outrage and violence toward the accused. It is true that outrage-inducing descriptions are also attention-grabbing, but Boyer's interpretation raises a simple question: Why *these* attention-grabbing features? Lots of things, including torn scrotums, rats living in a person's anus, and cockroaches exploding out of a person's arm, grab attention (Heath, Bell, and Steinberg 2001), yet PC1 includes a particular set of features: heinous acts, supernatural powers, and threatening behaviors. Given that these also inspire punitive collective action ("Witches Are Well