Neuroscience and Biobehavioral Reviews 128 (2021) 406–414

Contents lists available at ScienceDirect

Neuroscience and Biobehavioral Reviews

journal homepage: www.elsevier.com/locate/neubiorev

Super-natural fears

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ARTICLE INFO

Keywords:
Specific phobias
Beliefs
Fear acquisition
Preparedness
Supernatural
Unknown

ABSTRACT

Supernatural fears, although common, are not as well-understood as natural fears and phobias (e.g., social, blood, and animal phobias) which are prepared by evolution, such that they are easily acquired through direct experience and relatively immune to cognitive mediation. In contrast, supernatural fears do not involve direct experience but seem to be related to sensory or cognitive biases in the interpretation of stimuli as well as culturally driven cognitions and beliefs. In this multidisciplinary synthesis and collaborative review, we claim that supernatural beliefs are "super natural." That is, they occur spontaneously and are easy to acquire, possibly because such beliefs rest on intuitive concepts such as mind-body dualism and animism, and may inspire fear in believers as well as non-believers. As suggested by psychological and neuroscientific evidence, they tap into an evolutionarily prepared fear of potential impending dangers or unknown objects and have their roots in "prepared fears" as well as "cognitively prepared beliefs," making fear of supernatural agents a fruitful research avenue for social, anthropological, and psychological inquires.

1. Introduction

Several recent polls show that supernatural beliefs are ubiquitous, presenting very high overall percentages, from the Far East to the West. For example, 79 % of Americans seem to believe in miracles (Lugo et al., 2008) and 73 % believe in the existence of at least one supernatural or paranormal phenomenon, such as extrasensory perception (41 %), haunted houses (37 %), or ghosts (32 %) (Dagnall et al., 2015; Moore, 2005). Similar results were found in 2009 by the Pew Forum on Religion & Public Life (Pew Research Center, 2009), with 65 % of participants expressing a belief in or reporting previous experience with diverse supernatural phenomena. Among these, 18 % of American respondents said that they have seen a ghost (see also Lipka, 2015). Belief in ghosts seems to be increasingly prevalent (Lindeman et al., 2011; Newport and Strausberg, 2001), possibly due to increased exposure to pseudoscientific television programs and fiction shows that vividly depict instances of what may appear to be supernatural activity (Sparks et al., 1995, 1997; Tsai et al., 2012).

Fears related to the supernatural (i.e., evaluating an apparently supernatural or paranormal phenomenon as fearful) have received scientific attention as an aspect of normal fear development among children. These fears tend to decrease with age; for instance, Muris and colleagues (2001) found that 74 % of 4- to 6-year-olds, 53 % of 6- to 8-year-olds, and 5% of 10- to 12-year-olds reported fears of ghosts and monsters. They also pointed out that the majority of interviewed children attributed their fear to negative information as opposed to conditioning or modeling. Another study (Gordon et al., 2007) found that 79.4 % of children (8–12 years) and a surprising 48.8 % of adolescents (13–16 years) reported nighttime fears (e.g., fears related to bad dreams, nightmares, noises, shadows, monsters, intruders, burglars, kidnappers, and of being left alone at night). Interestingly, the prevalence of fear of imaginary creatures was 5.3 %. So, zombies, ghosts, and monsters are in the scientific literature mainly discussed as part of children's developmental trajectory (Field et al., 2001; Malhotra et al., 2012; Shepherd and Kuczynski, 2009), probably because adults are not supposed to fear nonexistent entities (even if they believe in them), and these fears are seen as temporary child tribulations expected to be overcome by adolescence.

Few adults will admit to fearing ghosts when home alone at night (de Oliveira-Souza, 2018). However, while many adults may find

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https://doi.org/10.1016/j.neubiorev.2021.06.036
Received 22 May 2020; Received in revised form 4 June 2021; Accepted 23 June 2021
Available online 27 June 2021

supernatural agents – such as zombies, ghosts, or monsters – scary, their ability to control such fears appears superior to that of children. Such supernatural agents certainly play a prominent role in entertainment designed to frighten the audience, such as horror movies (Clasen, 2017). In some ways, these fears seem to have a similar developmental trajectory to other common fears such as blood, fire, strangers, separation, heights, social scrutiny, storms, thunder/lightning, or darkness, which are also especially common in childhood, and which we generally learn to overcome by adulthood (Coelho and Purkis, 2009; McNally, 1987; Zsido et al., 2019). They are considered to be biologically prepared or "hardwired" by evolution, in such a way that they only require a small extent of direct or indirect (vicarious/information-based) experience to be learned, cf. the theory of *prepared learning* (New and German, 2015; Seligman, 1971; Zsido et al., 2018a, b). Neuroscience suggests that common fears and phobias trigger threat detection survival circuits. Results from human brain imaging studies primarily highlight the role of the amygdala and medial prefrontal cortex in relation to these circuits (LeDoux and Daw, 2018). Crucially, a recent preprint finds that horror movies with supernatural elements tend to trigger the same networks as real-life stimuli (Nummenmaa, 2021), suggesting that supernatural fears recruit the same evolved brain mechanisms as natural fears.

While there is scientific consensus that fears and phobias evolved to protect us from actual, concrete danger, it is not fully known why fear of nonexistent objects should be so widespread. Fear of supernatural agents differs from common phobic objects most obviously as they have no referents in the empirical world, and there has been no historical selection pressure from zombies, ghosts, or other supernatural monsters. Thus, fear of the supernatural, while an ancient phenomenon, remains scientifically neglected (e.g., Dagnall, 2020; Lange and Houran, 1999). A recent case report (de Oliveira-Souza, 2018) noted that phobia of the supernatural may be more common than usually thought, seems to appear comorbidly with other phobias, and often prevents individuals from seeking professional help due to shame, with deleterious effects such as general feelings of ill health, poor sleep quality, and widespread socio-occupational impairments (see also Finucane, 2001). In other words, fear of the supernatural is worth taking seriously despite the cultural stigma associated with it in some parts of the world.

If common fears are biologically prepared, how can the fear of *supernatural* entities be so common? This article explores the hypothesis that fear of the supernatural and other nonexistent things can be easily learned, remembered, and fear-conditioned, even though such fear does not appear to have a direct survival advantage. That is, fear of supernatural entities, such as zombies, should not be evolutionarily advantageous since they do not exist. Still, supernatural agents are apt to be fear targets because they exhibit a combination of prepared, attention-grabbing, and memorable characteristics, such as cues to contagion and predation. The study of supernatural fears is relevant to psychological science for a number of reasons:

1) The relation between belief in supernatural agents and events (e.g., ghosts) and fear of these imagined objects or situations is largely unknown.
2) Supernatural beliefs likely have serious consequences for both physical and mental health (de Oliveira-Souza, 2018). For example, people with supernatural beliefs may, as a consequence of such beliefs, suffer certain disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), such as panic, obsessive-compulsive disorder (OCD), or agoraphobia (Carlisle, 2015; Hinton et al., 2005; Nie and Olson, 2016). Supernatural beliefs may also affect mental health literacy (Jorm, 2000) and cause problems of communication with health practitioners (Lim et al., 2015), which can ultimately affect the prevalence of DSM disorders. In addition, people with deeply held spiritual beliefs often see psychiatrists as unhelpful or downright threatening, leading to a conflict between the secular (scientific) and the sacred religious views; a conflict that may discourage persons with mental illness from seeking psychiatric care and that may hamper healing practices (Koenig, 2007).
3) Fear of supernatural agents and events such as ghosts might be a suitable "stimulus" to compare with real and evolutionarily relevant fears such as heights or blood.
4) Fear of ghosts and the supernatural, in general, is related to social influences and social representation (Finucane, 2001; Rajadhon, 1954), more so than other fears (given the lack of real-world referents for supernatural beliefs), and so its study can contribute significantly to the understanding of how social factors shape fears.
5) The unique characteristics of supernatural fears allow researchers to differentiate prepared from learned fears in new ways, as we will next discuss.

2. Proneness to supernatural belief

2.1. Demography, analytical thinking, and intuitive processes

Beliefs in supernatural agents and events are held by people of various demographic groups, occupations, and economic levels (Sparks et al., 1997), leading researchers to wonder "why well-educated Western people still believe in things that seem so irrational" (Lindeman and Aarnio, 2007, p. 732). Believing in supernatural agents comprises complex multi-determined emotional, experiential, developmental, and cultural variables. However, research suggests that such belief is rooted in intuitive "default" cognitive processes. Conversely, disbelief requires a subsequent analytic-cognitive intentional effort of problem-solving and decision-making to critically examine and/or counteract these intuitions; so much so that Pennycook and colleagues (2012) reason that "two people who share the same cognitive ability, education, political ideology, sex, age and level of religious engagement can acquire very different sets of beliefs about the world if they differ in their propensity to think analytically" (Pennycook et al., 2012, p. 335).

People with a greater capacity for or interest in analytic thinking seem to be more skeptical about religious and supernatural concepts (Pennycook et al., 2015), even after controlling for cognitive ability (Pennycook et al., 2012). For example, Bouvet and Bonnefon (2015) misled participants to believe they were being profiled by astrological means or had their mind read in a rigged experiment causing them to consider that a telepathic occurrence could be taking place. The researchers' results corroborate the hypothesis that analytic individuals are less likely to attribute a supernatural cause to this kind of eerie experience. According to a previous study (Aarnio and Lindeman, 2005), higher education and intelligence seem to favor analytic thinking and reduce paranormal beliefs, although skepticism toward paranormal beliefs may be acquired socially before higher education. Other research has found that people believing in the supernatural gave more incorrect answers in the Cognitive Reflection Test than did non-believers (Gervais and Norenzayan, 2012; Pennycook et al., 2012; Razmyar and Reeve, 2013; Shenhav et al., 2012). The Cognitive Reflection Test (Frederick, 2005) comprises three questions. As the intuitive responses to each of the test questions are incorrect, non-reflective, intuitive thinkers more often give incorrect responses than do reflective thinkers, who are more prone to use analytic reasoning to question their initial intuition (Bouvet and Bonnefon, 2015). Indirectly supporting these results, atheists have been found to mainly provide rational and scientific reasons for their religious apostasy (Abelson et al., 1958).

Following this analytic/intuitive dichotomy, Pennycook and colleagues (2012) propose *an asymmetric model of belief and disbelief* to explain belief in the supernatural. This model, which is quite old (Bain, 1887), posits that to explore an idea, people first accept it as being true so that they can subsequently critically evaluate it. The model is supported by the proposal of separate cognitive systems underlying analytic vs. intuitive thinking with distinct evolutionary histories (Evans, 2003; Stanovich and West, 2000). It seems plausible that an initial acceptance of a new idea is required to allow the individual to further inquire about

that given idea and examine it against their background knowledge. This initial acceptance allows for mentally testing and analyzing its implications. The process of analytically reviewing early intuitions or new ideas requires effort and deliberation that might not always be available (Gilbert et al., 1993). Sometimes ideas are unexamined or examined lightly and not questioned, reconfirmed, modified, deepened, or rejected. The intuitive or less analytical person does this more often and becomes more vulnerable to this initial acceptance bias. The analytical thinker, in general, is open to initially accepting all presented ideas and then examining them critically. The *dual-process theory* assumes that these intuitive and analytic cognitive processes are independent processes with different neural and evolutionary foundations (Evans and Over, 2013; Kahneman, 2011). This argument, together with the *naturalness of religion thesis* (Barrett, 2000; Boyer and Bergstrom, 2008; Guthrie, 1993; Liénard and Boyer, 2006), seems to well describe both the universal proneness to believing in the supernatural, as well as the individual differences.

Believers in the supernatural generally attribute the origins of their belief to a *personal experience* (Clarke, 1995). Given our premise that the supernatural does not exist, it seems reasonable to assume that such believers have misinterpreted certain stimuli and that their interpretation of the event is crucial in shaping their belief. Indeed, a tendency to see causal relationships where there are none is common (Blanco et al., 2015; Griffiths et al., 2019; Matute et al., 2011). However, believers appear to be more biased to interpret random patterns as signals of supernatural causes, presenting more misidentifications or false alarms (events mislabeled as supernatural) than non-believers, and being more confident in their interpretations, responding faster in the face of unclear information, whereas disbelievers are more careful, less confident and slower, giving fewer errors (Simmonds-Moore, 2014; Van Elk, 2015).

Intuitive processing correlates with a tendency to perceive a stimulus when none is presented (i.e., Type I errors or false positives) or to perceive meaningful patterns in ambiguous stimuli. Believers, in general, seem to be more attuned than non-believers to internal rather than external reality (and score higher on measures of imagination, apophenia, and creativity) (Brugger et al., 1993; Gianotti et al., 2001; Simmonds-Moore, 2014). Believers in religious creeds may also find that their beliefs reinforce false positives, as when they see sacred signs in random patterns. It has been found that believers are often afraid to question God's nature and challenge sacred aspects of life and ultimate immutable truths (Hill and Pargament, 2008). In contrast, non-believers, when faced with ambiguous stimuli, go over multiple interpretations, many of which are then discarded. Intuitive thinkers might be more likely to believe in, memorize, and fear supernatural causes, as such people are more prone to relying on their first impression and evaluation of a problem. Fear itself can favor intuitive thinking and a more superficial but "safer" approach to the problem (we return to the thesis that fast, intuitive thinking can be adaptive in conditions of uncertainty below). This is also consonant with the *two-system model* proposed by LeDoux and Pine (2016), where one circuit is responsible for controlling automatic defensive reactions to threats (LeDoux, 2012, 2014) and the other circuit generates conscious feelings. The first circuit, favoring immediate action, is often triggered by interpreting random patterns and ambiguous stimuli as fearful (e.g., in the shape of supernatural agents), generating defensive reactions. The resultant association between a fearful bodily state and concepts of the supernatural might reinforce fear of the supernatural and result in conscious experience and memory, that is, cognitions such as "I was scared because I saw a ghost" (the output of the second circuit). In this two-system model, besides the amygdala (lateral, central nucleus, and the basal nucleus), the extended amygdala (the bed nucleus of the stria terminalis) and the nucleus accumbens have the key roles in the defensive reactions (e.g. flight, freezing) and defensive actions (e.g. escape, avoidance).

Lindeman and Aarnio (2007) convincingly argue that the concepts of superstition, magical thinking, and supernatural beliefs have substantial overlap, and that all have their cognitive roots in an erroneous transposition of core properties of one ontological category (mental, physical, and biological) to an entity in another such category. One salient example is the common notion that old houses or objects can have memories, i.e., the transposition of a trait from one ontological category (mental) to another (physical). These findings help explain the many similarities between supernatural beliefs in different cultures. A previous study (Lindeman and Aarnio, 2007) found that ontological confusions were the best predictor for distinguishing between superstitious individuals and skeptics, followed by thinking style (intuitive/analytical). Such confusions are common in children, maybe because they are more prone to intuitive and non-skeptical thinking, but since intuitive and analytical thinking operate in a dual process (Evans, 2003; Pacini and Epstein, 1999; Sloman, 1996) throughout life (rather than one process gradually replacing the other as an individual matures), it seems plausible that ontological confusions might be due to an extreme reliance on intuitive thinking to the detriment of the analytical mode of thought, which such an individual still possesses but which is suppressed.

The intuitive tendency to find meaningful patterns in noise or ambiguous cues also has a specific expression in *anthropomorphism*, which manifests either by the projection of human-like mental states to supernatural agents (Guthrie et al., 1980) or the projection of human-like characteristics to non-human things such as clouds (Barrett, 2008; Barrett and Keil, 2016; Willard and Norenzayan, 2013). This cognitive bias can lead to *animistic beliefs* that the world is infused with gods, spirits, and ghosts (Barrett, 2000; Guthrie, 1996; Willard and Norenzayan, 2013). In line with these findings and the dual-processing theories discussed above, Bering (2006) suggests that belief in the supernatural is hardwired and intuitive, requiring a small amount of cognitive processing.

It is important to mention that reflective thinking is not necessarily better than non-reflective thinking, and the existence of unusual behaviors does not necessarily reflect mental health issues and should be considered in conjunction with other variables (Bouvet and Bonnefon, 2015). Belief in supernatural agents and events can also have beneficial effects. For example, beliefs in forest spirits have been found to have measurable positive consequences for biodiversity and forest sustainability (Atran and Norenzayan, 2004). Moreover, in certain contexts the use of intuition is desired, e.g., among creative artists such as musicians and writers, although non-reflective thinkers can be more vulnerable and receptive to pseudo-profound misinformation (e.g., Pennycook and Rand, 2020).

Moreover, health professionals can benefit from knowing a patient's religious background (Koenig, 2012), which may help shed light on the origins of certain (supernatural) fears and phobias which, as we have seen, can occur in all cultures, and not just those in which supernatural belief is pervasive.

The findings discussed above illuminate cognitive factors (also see Fig. 1) that may influence supernatural and religious beliefs. While many supernatural concepts tap into concrete and specific prepared fears, as we will discuss shortly, they may also exploit a deep-seated and evolved fear of the unknown.

2.2. Other cognitive factors

While there is some individual variation in the tendency to anthropomorphize (Waytz et al., 2010), just as there is individual variation in fearfulness (Charney, 2004), the anthropomorphic bias – the tendency to detect human-like features anywhere – may be adaptive. The bias might in ancestral times have helped individuals avoid being surprised by a hidden agent. The bias (also termed hyperactive agency detection) may facilitate caution toward unknown possible dangers, particularly those emanating from other humans and other predatory agents, by projecting human-like mental states to non-human things or supernatural agents. Threatening stimuli have been shown to have prioritized access to visual

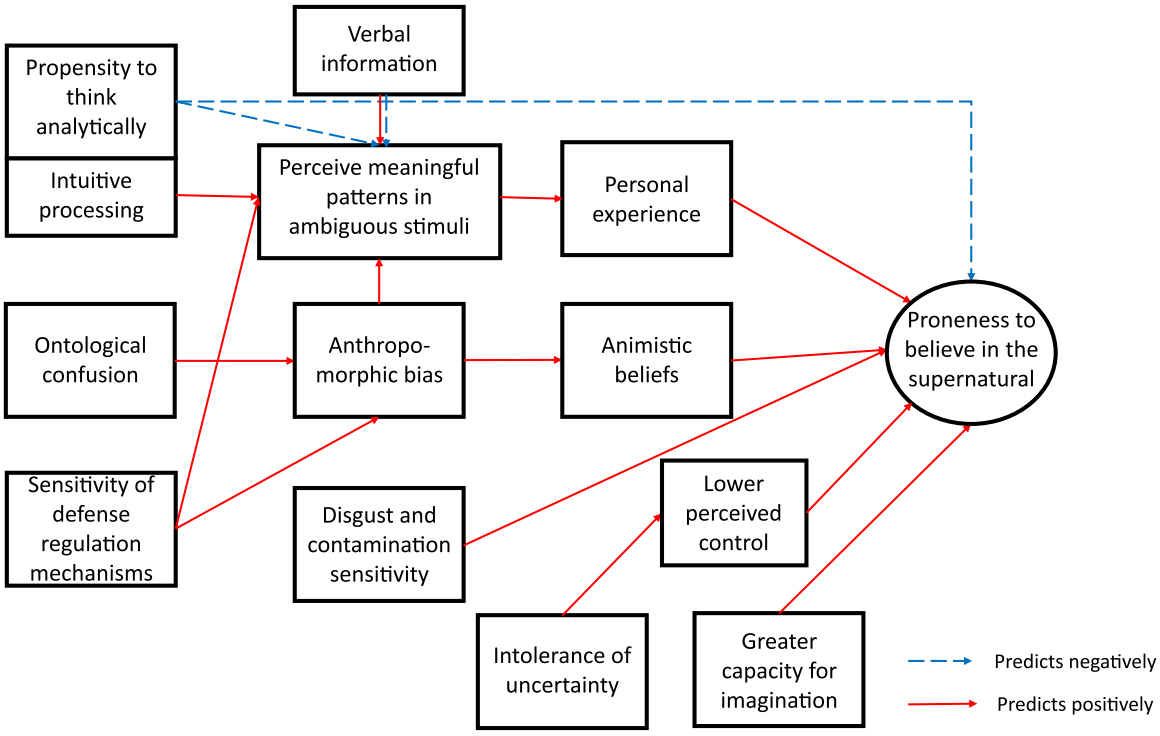

Fig. 1. A visualization of the cognitive factors covered in the present paper which may influence supernatural and religious beliefs and could contribute to the acquisition of supernatural fears.

processing through the brainstem–amygdala–cortex alarm system that incorporates the magnocellular pathway (Van Strien et al., 2016) and the superior colliculus-pulvinar-amygdala pathway (Almeida et al., 2015; Wang et al., 2018). Natural selection may thus have favored this bias since the cost of seeing agents where there are none is small, compared to the cost of not seeing an agent that could potentially harm or kill us (Atran and Norenzayan, 2004; Barrett, 2000; Geary and Huffman, 2002; Guthrie, 1996; Nesse, 2005).

The tendency to detect (and over-detect) human-like features is underpinned by the same adaptive logic as the evolution of fear: Both are psychological dispositions that evolved to protect humans from danger (Barrett, 2000; Campbell et al., 1997; Guthrie, 1996; Nesse, 2005). When the expression of a defense mechanism has a low cost (e.g., running away from danger) compared to the possible harm (e.g., a serious injury or even death), the optimal system will tend to be shaped by natural selection to express many false alarms following a probabilistic optimization (Nesse, 2005). In sum: the price of not escaping danger brings injury or death, thus selecting for systems that err on the side of excessive defensive expression (Marks and Nesse, 1994).

Horror fiction capitalizes exactly on this tendency to err on the side of caution by immersing audiences in fictional universes filled with cues of dangers and predators to produce strong emotional engagement in spectators and readers (Clasen, 2012). Supernatural agents such as the ones familiar from horror movies – ghost and werewolves, for instance – thus tap into evolved defense mechanisms. Many such agents have features humans are evolutionarily prepared to fear or avoid, such as cues of contamination and other disgust-evoking qualities; traits that facilitate predation, such as fangs or claws; and a tendency to appear suddenly, often at nighttime, just like real-world ambush predators.

Disgust and contamination-related associations as emotional factors seem to play a crucial role in the development and maintenance of specific phobias (Huijding and de Jong, 2007; Polák et al., 2020; Tolin et al., 1997). The *disease-avoidance model* of animal phobias (Matchett and Davey, 1991) claims that disgust and contamination sensitivity is mostly related to animals that are not perceived to attack and harm people, thus phobic fear for such animals is best explained through disease-avoidance rather than predator-avoidance processes. The predator-avoidance processes could be described in terms of the *general feature theory* (Coelho and Purkis, 2009; Davey, 1995) arguing that prioritization of predatory-related features is more cost-efficient from an evolutionary point of view than developing a distinct module for possible predators. That is, nonexistent beings highly associated with such features (e.g. monsters or ghosts) can become feared as they use the same evolved defense mechanisms, and thus, result in similar bodily sensations as existing predatory threats (e.g., a snarling dog).

Such features have high survival value and are frequently combined with bizarre or implausible qualities (such as disembodiment or the state of being alive and dead at the same time) that enhance attention and cognitive processing. Nairne and colleagues (2007, 2008; Nairne and Pandeirada, 2010) proposed that survival processing enhances retention and may be an efficient mnemonic strategy. That is, we tend to attend to and retain information that is relevant for survival, more so than survival-irrelevant information. Likewise, Kazanas and Altarriba (2017) found that a supernatural predator (a demon) motivated the highest amount of recall, suggesting that the concept of a demon might tap into an ancestral fear of predators in combination with a more abstract fear of the unknown. Similarly, a previous study (Soderstrom and McCabe, 2011) compared threats encountered by human ancestors (e.g., predators) with threats from fictitious creatures (i.e., zombies) in modern and "primitive" scenarios (i.e., grasslands–predators, grasslands–zombies, city–attackers, city–zombies) and found recall to be more significant when zombies were the threat, independently of the used scenarios. While this study may seem to challenge the specificity of ancestral priorities in survival-processing advantages in memory, that is in fact not the case because zombies – fictitious though they are – are a combination of several prepared features (predation and contagion) that have added unexpected, unpredictable, and attention-grabbing characteristics (e.g., undeath). Albeit unreal, supernatural entities are attention-grabbing and more compelling than other actually dangerous agents that lack these characteristics (e.g., bears) (Clasen, 2017) due to a combination of commonsensical and counterintuitive features that give added salience (Atran and Norenzayan, 2004).

Fear of the unknown appears to be a fundamental fear and is a core component of anxiety (Carleton, 2016). One culturally prominent (and probably universal) supernatural agent that exploits the fear of the unknown is the ghost. According to most cultural representations, ghosts can arise unexpectedly, cause harm, and outsmart scientists to hide evidence about their existence. The idea of a ghost – an entity of ambiguous ontological status, able to bypass or subvert the laws of nature – can evoke a deep, epistemological fear of the unknown. In addition, as we have discussed above, from an evolutionary perspective, it is better to be cautious than sorry regarding the detection and reaction to uncertain stimuli that might or might not be threats. Supernatural fears exploit not just fear of the unknown, but also the anxiety that accompanies situations that are unpredictable and/or uncontrollable. In fact, it has been proposed that *intolerance of uncertainty* is a key maintaining factor in several anxiety disorders (Gallagher et al., 2014; Nelson and Shankman, 2011). Moreover, an element of uncertainty about the threat reinforces fear learning throughout an activity in the bed nucleus of the stria terminalis (LeDoux and Daw, 2018). Further, it has also been shown (Nelson and Shankman, 2011) that intolerance of uncertainty lowered *perceived control* over anxiety-provoking situations which in turn lead to smaller startle response indicating that these individuals were more prepared and also emphasizing the evolutionary adaptiveness of such traits (Carleton, 2012, 2016). It appears that evolution selected a psychological system to counteract these potentially dangerous situations. A mental faculty that allows for speculation about potential unpredictable dangers, one that is supported by specific neural systems (Walker et al., 2003), has given rise both to the human ability to predict and prepare for future events as well as to the felt anxiety that comes with imagining a future unsuccessful situation (Grillon et al., 2008; Nesse, 2005; Öhman and Mineka, 2001). This speculative mental faculty is conceivably the same that conveys a conjectural ability allowing for the imagination of ghosts. So, imagination, fear of the unknown, and *intolerance of uncertainty* (Carleton, 2012, 2016; Carleton et al., 2007a,b), seem to be related and have an ecological background related with helping humans to become more prepared and aware of potential unexpected and low-frequency fitness-relevant events. Fear of a hitherto unknown or unforeseen threat may be easily learned and thus avoided, irrespective of the probability of its occurrence.

The imagination is involved when we try to deduce the purpose of something that we encounter, when we imagine alternative trajectories or courses of action, and when we interpret aspects of the environment as signs of other agents' presence, looking for cues of potential danger (Boyer, 2007). This production of imagined scenarios, while consciously experienced, happens largely outside conscious deliberation. In this way, too, the evolved human *capacity for imagination* also brings worry and anxiety and may give rise to anxiety disorders if poorly calibrated (Nesse, 2005). Similarly, poor calibration of the fear system can produce disorders of deficient anxiety (hypophobia) as well as disorders of excessive anxiety. So, it is possible that some people might feel their present environment to be "too safe" and use horror movies to "spice up" their emotional life a bit. But when it comes to fear and being voluntarily scared, it seems that people seek out horror media with threatening stimuli that they perceive to be plausible. Recently, Clasen and colleagues (2020) found that people with stronger beliefs in the paranormal prefer horror media with supernatural content, whereas those with weaker beliefs in the paranormal prefer horror media with natural content. It is possible that this exposure to fictional danger acts as a form of preparation or training for unexpected and dangerous events, particularly at younger ages. This exposure gives viewers adaptive mastery by letting them cope with virtual dangers, and might theoretically prepare people for dangerous situations in reality (Scrivner et al., 2021). This adaptive mastery may be achieved through the practice of keeping a clear state of mind and avoiding a panic reaction (as when the audience for a horror movie repress flight behaviors) that would in a real situation likely enhance danger (e.g., when a diver emerges from a deep dive too fast, or when a person freezes when seeing a car approaching quickly).

3. Fear acquisition, verbal information, and fear of the unknown

Rachman (1974, 1977) postulated three possible routes for fear acquisition: conditioning (e.g., a traumatic event such as falling from a tree), vicarious experience (e.g., seeing another person falling and getting hurt), and information (e.g., listening to ghost stories). It has been shown that the most important brain regions in fear acquisition (amygdala, insula, anterior cingulate cortex, and hippocampus) are the same for direct and indirect fear learning (Greco and Liberzon, 2016). It is now well-known that information and instruction from peers, parents, and other role models can have a strong influence on the acquisition of fear. Nowadays, the DSM acknowledges traumatic events, unexpected panic attacks, vicarious learning, and – significantly – information transmission as processes that may facilitate the development of phobias (American Psychiatric Association, 2013).

Several studies support the influence of information in the exacerbation of fear-related beliefs in normative children's fears (see King et al., 1998; LoBue and Rakison, 2013 for a review). Lawson and colleagues (2007), for instance, found that verbal information was efficient in changing children's fear-related beliefs about social situations particularly when the information given was negative, influencing both explicit and implicit fear beliefs. Field and colleagues (2001) found a similar result when they exposed children between 7 and 9 years old to novel stimuli (monster toys). Before the exposure, the researchers gave positive or negative information verbally or vicariously exposed the children to a video that exhibited a woman interacting (positively or negatively) with the monsters. According to the results, verbal information was more effective than the video in influencing the children's fear and beliefs regarding these stimuli. The relationship between information and fear may be a complex interaction between the type of information, the source of information (e.g., from parents), and the present relevant fear concerns of the children (Field et al., 2003). However, verbal information can be a primary source leading to a cognitive bias that influences the interpretation of a subsequent encounter with an ambiguous stimulus, which may then be interpreted as a ghost or other supernatural phenomenon, depending on the previously learned information. It is scientifically well-established that verbal threat information has a highly significant effect on fear beliefs and avoidance of never-seen-before animals (Askew and Field, 2007; Field and Lawson, 2003).

Thus, supernatural fears can be caused by cognitive biases learned through verbal information transmission. Moreover, the excessive attribution of meaning to coincidences (apophenia) is often elicited in perceptually ambiguous or stressful situations (Beitman, 2009). Since the intuitive cognitive style is enhanced when the opportunity to think rationally is diminished (Simmonds-Moore, 2014), the fear of ghosts can create a self-perpetuating cycle where analytic thinking becomes too difficult to be used, as the ghost elicits a natural fear, and fear itself reduces analytic thinking. In addition, in more strict cultures and low context societies (societies that rely primarily on explicit verbal content, rather than e.g. extraverbal nuance, for communication) with high levels of supernatural belief, there is an additional fear of asking details about the how and why of (apparently supernatural) events, which can be seen as a sign of lack of faith in authority. In such cultures and societies, belief in ghosts may be more difficult to extinguish.

In sum, it appears that verbal information that triggers "the unknown" can be prepared. Prepotency, i.e. paying greater attention to certain stimuli, and preparedness, i.e. a genetic predisposition to learn more easily certain reactions to certain stimuli, combine to produce a nonrandom distribution of fears (Marks, 1987). Verbal information can facilitate fears (and belief in the supernatural) and the later acquisition of phobias at a young age. Prepotency and preparedness have survival value, and while supernatural phenomena such as ghosts did not exert direct selection pressure on human ancestors (because they do not and

have never existed), they still manage to inspire fear as representations of the uncontrollable and unpredictable while exhibiting traits that do match stimuli that are prepotent and/or prepared (zombies, for example, have predatory and contagious traits, and ghosts do share many traits with ordinary humans, such as having emotions and motives and, in some iterations, the ability to harm). The fear response triggered by supernatural agents and events may thus be the output of a survival mechanism that evolved to let us deal with novel environments where new creatures and other threats could suddenly appear. Moreover, supernatural concepts become especially salient as they break certain default assumptions about the ontological category to which they belong, which makes them attention-grabbing and easy to memorize (Boyer and Bergstrom, 2008).

4. Conclusions

At first glance, the fear of supernatural agents such as ghosts seems to be caused by an imagined stimulus (an illusion). The tendency to "see" ghosts, that is, misinterpret ambiguous cues as evidence of spectral activity, seems to be fueled by information (e.g., television programs, horror films, and urban legends about ghosts). It is possible to believe in, but not fear, supernatural agents, but such agents are often fearsome, e.g. because they are believed to have privileged epistemic access (the ability to know our self's psychological states) (Bering and Johnson, 2005). Supernatural fears seem to be mainly vicariously acquired from stories, peers, the media, or via other sources of information (Broeren et al., 2011; Forde, 1958; LoBue et al., 2019; Muris et al., 2001, 2003a).

Thus, the fear of ghosts and other supernatural agents is more dependent on cognition than are other specific phobias, the latter of which are more obviously derived from environmental dangers. At the same time, demons, ghosts, zombies, etc. are human-like predators and tend to be variations on real-world threats. These agents are unreal, but still built on actual, and possibly prepared, templates. In fact, these agents seem to be made of a combination of elements with several prepared characteristics (they often have prominent teeth and are bloody, contagious, and disgusting). Moreover, they are often depicted as manifesting themselves loomingly in dark environments. They exhibit bizarre and unexpected features that call for attentional resources and are highly memorable. This cocktail of prepared features is part of the stimulus. All this would explain why even non-believers can be frightened by supernatural creatures since such creatures tap into universal cognitive dispositions.

More than exhibiting traits (and combinations of traits) that tap into evolved defensive cognition, supernatural agents and events also depend on beliefs that are socially transmitted. Such beliefs seem to be based on a more general fear of the unknown, as supernatural agents and events are unexpected, unpredictable, and call for general anxiety and constant surveillance. Believers in the supernatural often use the fact that absence of proof is not proof of absence to perpetuate uncertainty toward and fear of the supernatural. The relation between the characteristics of the supernatural stimulus, the individual's educational background, and their cognitive style might play an interactive role in how much fear a person might have of supernatural events. Believers might have higher levels of supernatural fear or they might participate in rituals or prayers that mitigate that fear. Conversely, people with low belief but who are highly intuitive and/or have high levels of fear of the unknown might fear supernatural events, particularly in situations characterized by ambiguity of threat (McAndrew, 2019).

In sum, we have seen that it is possible for people to fear things that do not exist. While this may seem counterintuitive, it does make adaptive sense in that salient features presented by supernatural entities have prepared characteristics, which easily trigger threat detection survival circuits and automatic defensive reactions (LeDoux, 2012, 2014), as well as bizarre (memorable) and unpredictable (anxiogenic) properties. Further, the characteristics of supernatural entities trigger the same pathways in the brain as existing stimuli (e.g. amygdala and the nucleus accumbens). This, combined with the fact that fear acquisition through direct experience and based on verbally transmitted information involves the same brain regions (amygdala, insula, anterior cingulate cortex, and hippocampus), suggests that fear of the supernatural is rather natural and may be highly dependent on the interpretation of the cues that trigger the threat-detection survival circuits.

The two-system perspective (LeDoux and Pine, 2016) is appropriate to clinically frame the problem presented here, as it makes a clear distinction between the neural circuitry supporting subjective feeling states as opposed to nonconscious automatic defensive responding. As research targeting supernatural fears is scarce to date, options for treatment remain to be explored. In children, the "anti-monster letter" proved to be a reliable therapeutic tool for reducing night-time fears (Muris et al., 2003b). This intervention is based on children's imagination to overcome fears, in which the child draws the scary monster and writes it a letter explaining that s/he is not afraid of it anymore. Regarding specific phobias, exposure-based treatments seem to be superior to other approaches (Wolitzky-Taylor et al., 2008). When the object of the phobia is nonexistent, this might not be feasible, although modern technology such as virtual reality might be useful in making the nonexistent tangible. Yet, first decomposing the fear and understanding which of the underlying factors (e.g., the ones highlighted in this paper) constitute the fear and then targeting these factors would appear to be more effective. Nonetheless, more research is needed to explore the relationship between supernatural beliefs and supernatural fears, including whether such beliefs facilitate the development of fears, and how easily supernatural fears are acquired and maintained.

Declaration of Competing Interest

The authors declare no conflict of interest.

Acknowledgement

Carlos M. Coelho's research is is supported by Rachadapisek Sompote Fund for Postdoctoral Fellowship, Chulalongkorn University, and by the Center for Psychology at the University of Porto, Foundation for Science and Technology Portugal (FCT UIDB/00050/2020).

Andras N. Zsido's research is supported by the European Union, co-financed by the European Social Fund "Comprehensive Development for Implementing Smart Specialization Strategies at the University of Pécs", grant number: EFOP-3.6.1.-16-2016-00004, and the ÚNKP-20-4 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund.

Mathias Clasen's research is supported by the Independent Research Fund Denmark, grant number 0132-00204B.

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