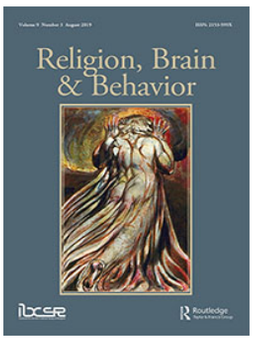

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Seeking the supernatural: the Interactive Religious Experience Model

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ABSTRACT

We develop a new model of how human agency-detection capacities and other socio-cognitive biases are involved in forming religious beliefs. Crucially, we distinguish general religious beliefs (such as *God exists*) from personal religious beliefs that directly refer to the agent holding the belief or to her peripersonal time and space (such as *God appeared to me last night*). On our model, people acquire general religious beliefs mostly from their surrounding culture; however, people use agency-intuitions and other low-level experiences to form *personal* religious beliefs. We call our model the Interactive Religious Experience Model (IREM). IREM inverts received versions of Hyperactive Agency-Detection Device Theory (HADD Theory): instead of saying that agency-intuitions are major causes of religious belief in general, IREM says that general belief in supernatural agents causes people to *seek situations* that trigger agency-intuitions and other experiences, since these enable one to form personal beliefs about those agents. In addition to developing this model, we (1) present empirical and conceptual difficulties with received versions of HADD Theory, (2) explain how IREM incorporates philosophical work on indexical belief, (3) relate IREM to existing anthropological and psychological research, and (4) propose future empirical research programs based on IREM.

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1. Introduction: a theoretical inversion

What is the relationship between low-level experiences and more abstract religious beliefs? Consider a sudden feeling of fright one might have when walking through the woods – a feeling as if someone is there. How does that experience relate to the belief, say, that demons exist? Alternately, consider the feeling of presence one might have when kneeling in front of a Mary statue in a dimly lit cathedral. How does that feeling relate to the belief that Mary listens to prayers – or the belief that Mary cares for *me*?

To answer these questions, we must first distinguish general religious beliefs from personal religious beliefs. General religious beliefs, roughly, are culturally widespread representations of supernatural agents (among other things) that do not indexically refer to the believers themselves.[1] One who believes *that God exists* has a general religious belief. But some religious beliefs are directly and indexically about the very person who has the belief; we call such beliefs personal. One who

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believes, for example, *that God visited me in the hospital* has a personal belief, because of the indexical *me*. Other general beliefs might have contents such as *that the Oracle tells the future*, *that ancestors desire sacrifice*, or *that witches cause illness*. Related personal belief contents would be *that the Oracle told my future*, *that the ancestors want a sacrifice from me*, or *that a witch caused my cousin's illness*.

We sharpen the distinction between general and personal belief below, appealing to the philosopher John Perry's work on indexicals and self-notions. But our preliminary distinction already pushes us to sharpen the question of the relation between experience and religious belief. One can ask about the relation between low-level experiences and general beliefs, or one can ask about the relation between low-level experiences and personal beliefs. The answers might be different.

In our model, the Interactive Religious Experience Model (IREM), low-level experiences, such as agency-intuitions or feelings of presence (FoP), mainly influence the formation of personal beliefs. General beliefs, on the other hand, mostly arise through cultural learning from other people; still, people use their general beliefs to interpret low-level experiences in a way that yields personal beliefs.[2] In developing this model, we focus largely on what we call agency-detection capacities as sources of low-level experiences that get folded into personal beliefs; in keeping this focus, we seek to deepen and in some ways rectify the emphasis on agency detection in the formation of religious beliefs that comes out of the Hyperactive Agency-Detection Device (HADD) tradition (e.g., Barrett, 2000). Bear in mind, however, that our model is more general than that: in addition to making it clear how people seek out situations that give them low-level agency-intuitions as a means of arriving at personal beliefs, we claim that other kinds of experiences – given by various other social or cognitive biases – might be sought in the same way in the service of personal belief.

Before continuing, we have one comment on the term "belief." One of us (Van Leeuwen, 2014, 2017) has argued that the set of mental states that receive the label "belief" in the cognitive sciences actually divides into *at least* two kinds: religious credence and factual belief, which have distinct psychological functions. Roughly, religious credences are reverential, identity-constituting attitudes that bear striking features in common with *imaginings*, whereas factual beliefs are mundane, matter-of-fact attitudes that, from the standpoint of the agent, portray straightforward facts (see Van Leeuwen, 2014 for theoretical details). We endorse this distinction, and the "beliefs" we discuss here – both general and personal – count as religious credences. The arguments of this article, however, do not *depend* on that distinction: IREM can thus be understood in a way that does not make that distinction among "beliefs."

2. HADD theories

Before presenting our model in detail, we discuss contemporary views of the relation between personal experience and religious belief. We focus specifically on a theory that has influenced our own thinking about the origins of religious beliefs: HADD Theory. ("HADD Theory" is our general term for theories that attempt to explain supernatural belief by reference to a HADD; we distinguish different versions of HADD Theory below.) Discussing HADD Theory in relation to the evidence, in turn, allows us to extract general lessons that can be incorporated into our more adequate model (IREM).

The HADD story initially seems straightforward. From an evolutionary perspective, it makes sense that humans generate false positive agency-intuitions, or low-level experiences that seem to indicate the presence of *another* agent (or another agent's effects). Other agents are sources of danger or opportunity (death or sex, most obviously), so it is adaptive to have internal psychological mechanisms that err on the side of indicating another agent is present – a hyperactive device for detecting agents. When HADD is triggered, the resulting agency-intuitions in turn often cause the uncanny feeling that an invisible agent is near; hence one comes to believe in supernatural agents. Can the story be that simple? We review different versions of HADD Theory to answer that question.

2.1. Guthrie's faces

Guthrie, in his anthropomorphization account of religion, was the first to connect agency detection to supernatural belief (Guthrie, 1993, 2001; Guthrie et al., 1980).[3] Guthrie argues that the central importance of other humans resulted in an evolved, implicit tendency to anthropomorphize our environment and over-infer the presence of other humans (see Figure 1, top). Guthrie (1993, p. 4) writes, "I claim religion consists of seeing the world as humanlike and arises because doing so is a good bet even though, like other bets, it may fail." He describes countless examples of anthropomorphic biases, such as pareidolia (perceiving illusory faces in objects) and the tendency to anthropomorphize objects (like our cars and computers). He also highlights anthropomorphic biases in religion, such as the tendency to depict supernatural agents as humanoid. According to Guthrie, humans use models to explain encountered phenomena, and the model most readily available to them is anthropomorphic. The application of this model to non-physical domains (e.g., interpreting clouds or thunderstorms as arising from human-like causes) results in animistic beliefs.

Though compelling, Guthrie's narrative logic rarely incorporates good empirical evidence, as Johnson, Blumstein, Fowler, and Haselton (2013) point out. We would add that Guthrie's account describes agency-detection biases mainly at a *perceptual level*, involving the illusory perception of other humans. But the false positives generated by this anthropomorphic perceptual bias are supposed to result in animistic *beliefs* about invisible humans, such as ghosts, spirits, angels, and dead ancestors, which can presumably outlast the initial perceptual experiences. And unfortunately, Guthrie never really explains how anthropomorphic *perceptual experiences* lead to longer-standing *supernatural beliefs*. Why don't we just discard such perceptual experiences, like we do with other illusions? Guthrie's idea seems to be that continued experiences of the felt presence of invisible beings result in belief in the existence of invisible beings with human-like properties. But the processes from perception to belief remain, in Guthrie's account, hazy.

2.2. The development of the HADD concept

Before long, scholars attempted to rectify the shortcomings of Guthrie's account. Atran and Norenzayan (2004, pp. 719–720), for example, argue:

> From an evolutionary perspective, it is better to be safe than sorry regarding the detection of agency under conditions of uncertainty. This cognitive proclivity would favor emergence of malevolent deities in all cultures, just as the countervailing Darwinian propensity to attach to protective caregivers would favor the apparition of benevolent deities. … Cultural manipulation of this modular mechanism and priming facilitate and direct the process.

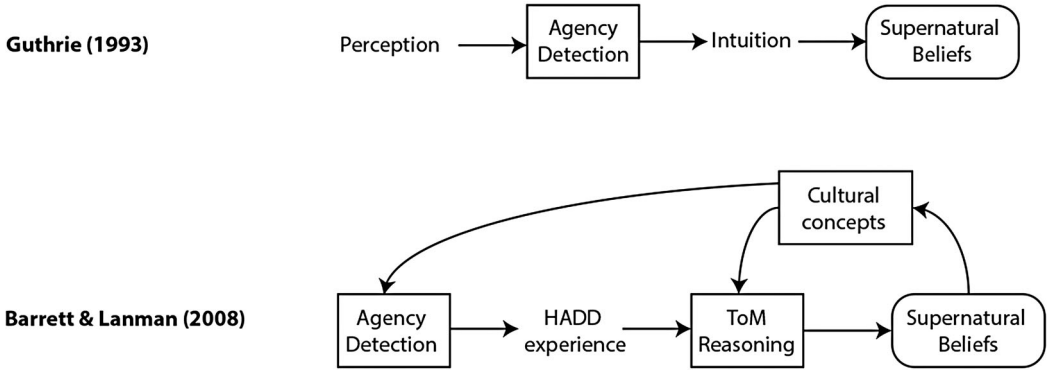

Figure 1. Overview of different theoretical models describing the relation between agency detection and supernatural/religious beliefs. The representation of Guthrie's view is based on our own interpretation of his writings. The representation of Barrett and Lanman's model is adapted from the original (2008) paper.

Thus, according to Atran and Norenzayan, the HADD produces belief in malevolent deities such as demons, evil spirits, and ghosts. These beliefs may also be produced in response to agency-detection experiences triggered by specific contexts (e.g., a dark forest will generate more agency experiences than a brightly lit street). And cultural artifacts such as churches or statues can also directly contribute to triggering agency-intuitions, which in turn produce religious beliefs. Again, however, the process whereby agency-intuitions themselves are transformed into religious beliefs remains sketchy.

Barrett (2000) extended Guthrie's theory to include hyperactive detection of other agents generally (not just detection of other humans), where agents are self-propelled, goal-directed creatures. Barrett and Lanman (2008) expand the idea of HADD even further. Barrett (2000) initially wrote of HADD as a "hyperactive agent detection device" (our underlining). Barrett and Lanman (2008) change this to "hyperactive agency detection device" (our underlining), where detecting "agency" includes detecting intentionality more broadly (including beliefs, desires, motivations, intentions, etc.) rather than just the presence of another agent.

These are welcome developments. Still, how is the gap between agency detection and supernatural belief supposed to be bridged? Presumably, one can have agency-intuitions without *believing* them (Boyer, 2001, p. 147).

Barrett and Lanman (2008) partially address this question with their more nuanced HADD Theory.[4] They propose a two-step process. In the first step, one has an agency experience; in the second, one employs one's mentalizing abilities to ascribe mental states (such as beliefs and desires) to the intuitively experienced (supernatural) agent (see Figure 1, bottom). Mentalizing and ascribing intentionality rely on theory-of-mind reasoning, which is considered a basic cognitive skill that emerges early during development and relies on specialized neural systems (i.e., the so-called theory-of-mind network; Gallagher & Frith, 2003; see also section 3.2.3). Thus, Barrett and Lanman propose that belief in supernatural agents is the joint product of a *basic perceptual system* enabling the detection of other agents and a *mentalizing system* enabling the ascription of intentionality to these agents. Thus, specific agency-intuitions (e.g., the curtain's unexpected movement makes it seem like an agent is present) provide the input to a reflective mentalizing system that in turn interprets the intuition (e.g., my deceased grandfather wishes to visit on the anniversary of his death).

According to Barrett and Lanman (where "MCI" means *minimally counter-intuitive*, which describes most supernatural agent representations):

> We are not arguing that HADD experiences are directly responsible for belief in supernatural agents. We are arguing that HADD experiences, belief in MCI agents and discourse about such agents are mutually reinforcing. HADD experiences can help encourage, reinforce, and spread belief in MCI agents. For example, having a HADD experience with no obvious natural explanation in a location that one has just been told is the site of frequent divine appearances will make belief in those appearances more plausible. Similarly, exposure to discourse about MCI agents or having a reflective belief in them can increase HADD experiences, as hearing about such ghosts or gods increases the HADD's vigilance. (2008, p. 116)

This is an improvement over Guthrie's account, because it tries to bridge the gap between intuition and belief. Specifically, their theory specifies a reciprocal interaction between religious beliefs transmitted through culture and agency-detection intuitions, with the one being reinforced by the other.

Already at this point, however, we can see several shortcomings with the more nuanced versions of HADD Theory. First, as pointed out, different versions of HADD have been specified (e.g., Atran & Norenzayan, 2004; Barrett, 2000; Barrett & Lanman, 2008; Clark & Barrett, 2010), but in all proposals there is a lack of detail regarding the definition of supernatural beliefs and their specific relation to agency-detection experiences. For instance, in the proposal by Barrett and Lanman, it remains unclear how general religious beliefs in supernatural agents (e.g., "Jesus died for my sins") can foster specific personal agency experiences (e.g., "I read this passage in the Scripture and now I believe I am truly saved"). This lack of conceptual specificity makes the theories extremely difficult to test, and as we will see below (section 3), attempts to empirically validate the theory have failed to yield impressive results. Second, existing HADD theories represent only a selective subclass of the way in which agency experiences may be related to religious beliefs. For instance, in addition to

agency-detection capacities, many other socio-cognitive biases are involved in generating experiences of agency (e.g., inferring the presence of God when viewing natural beauty), which in turn could support the emergence of some supernatural beliefs. Thus, false positive agency detection provides only a limited subclass of a broader suite of capacities and experiences that people use to develop and sustain supernatural beliefs. Finally, even though some versions of HADD Theory acknowledge a central role for culture in shaping supernatural beliefs, in popular scientific publications overly simple versions of HADD persist. For instance, in his book *The Righteous Mind*, Jonathan Haidt (2012, p. 317) writes:

> Our ability to believe in supernatural agents may well have begun as an accidental by-product of a hypersensitive agency detection device, but once early humans began believing in such agents, the groups that used them to construct moral communities were the ones that lasted and prospered.

The suggestion in the second half of this quotation may be on track – though this is a matter of active debate (Baumard & Boyer, 2015; Norenzayan et al., 2016) – but the first half represents too simple a story.

All of this is problematic, since the naive version of HADD Theory is far from an established fact; in fact, it's deeply misleading, as we demonstrate below. And the more nuanced versions are incomplete (i.e., they leave out several other important socio-cognitive factors shaping religious beliefs) and don't properly utilize the important distinction between general beliefs (e.g., *this is the site of frequent divine appearances*) and personal religious beliefs (e.g., *a ghost appeared to me at this site*). In what follows (sections 3 and 4), we raise several further empirical and conceptual concerns with HADD Theory. As indicated, however, we use these concerns as a stepping stone for developing lessons that allow us to specify our theoretical model and that deal with the shortcomings of earlier theoretical accounts.

3. Empirical concerns with HADD Theory

HADD Theory, as we see it, presently has two main empirical problems: (1) there is no good evidence for a specialized cognitive *module* for detecting agents (as the naive, popular version of HADD Theory implies), and (2) there is no good evidence that agency detection is meaningfully related to whether or not one has supernatural beliefs. The first problem might be solvable through theoretical revision – by loosening up on the idea that there is *a* hyperactive *device* – and the arrival of further evidence might alleviate the second. But having long looked for such evidence, we're doubtful. We address the first problem in section 3.1 and the second problem in section 3.2. To be fair, the extent to which each problem undermines any given version of HADD Theory varies from version to version, but our impression is that the more nuanced versions of HADD Theory manage to avoid the present problems in part by being *less* clear about what they predict; thus, we think it makes sense to consider HADD Theory in general in relation to these two issues, since doing so will point out errors (in naive versions) or lack of specificity (in more sophisticated versions). Taken together, the two problems motivate looking for a better theory.

3.1. Cognitive systems for agency detection

Many evolutionary-psychological theories posit evolved cognitive modules as domain-specific adaptations (Cosmides & Tooby, 1994). In addition to being domain specific, cognitive modules are innate, fast, and mandatory information processing systems, and they have characteristic ontogenies, neural architectures, and patterns of breakdown (Fodor, 1983, though see Carruthers, 2006 for revisions to this picture).[5] Does agency detection constitute such a module?

There is, of course, ample evidence that humans have maturationally natural tendencies, some shared with other species, to detect other agents (McCauley, 2011). Scholars in the cognitive science of religion, such as Justin Barrett, Scott Atran, and Ara Norenzayan, have pointed toward early studies indicating that when subjects watched moving self-propelled dots on a screen they often ascribed mental states to these stimuli (e.g., chasing, helping, hiding; Michotte, 1963). Indeed,

humans can perceive agency in moving geometrical figures, as demonstrated in the classic Heider and Simmel studies (Heider & Simmel, 1944) or in the Wolfpack paradigm (Gao, McCarthy, & Scholl, 2010). Agency-detection biases in adults also include a tendency to perceive face-like stimuli in noisy pictures or natural objects (e.g., seeing faces in cars or clouds), a phenomenon known as pareidolia (Liu et al., 2014). Illusory face detection rates for pure white noise stimuli can be as high as 30–40% (Gosselin & Schyns, 2003; Hansen, Thompson, Hess, & Ellemberg, 2010), though the tendency for illusory face perception differs strongly between individuals. The tendency to detect agents is also fast and automatic and needs only limited input to "fire": countless examples of pareidolia (Guthrie, 1993) and the feeling of presence experiences (Arzy, Seeck, Ortigue, Spinelli, & Blanke, 2006; Blanke et al., 2014) illustrate that, even in cases of limited or distorted sensory input, our perceptual processing systems easily generate intuitions *as if* another agent is present. So it does appear that agency detection is fast, mandatory, and innate in some sense (or at least maturationally natural, to use McCauley's phrase). Thus, if it is true that there are ontogenetically common neurocognitive mechanisms *dedicated* to producing agency-intuitions (along with corresponding patterns of breakdown), then the list of modular features for the HADD will be complete. Are there such neural mechanisms?[6]

We focus first on neural mechanisms involved in detecting face-like stimuli. (A similar argument will apply to other neural mechanisms, like those involved in biological motion detection, body perception, etc.) The so-called fusiform face area (FFA) seems to respond selectively to face-like stimuli. Neuropsychological patients with damage to the FFA show impaired face detection (as in prosopagnosia), and illusory or hallucinatory face perception arises from disturbed activity in the FFA (Ffytche et al., 1998). Furthermore, stimulation of the FFA through implanted deep-brain electrodes can result in illusory or distorted face perception, like seeing strong distortions in the face of the experimenter (Parvizi et al., 2012), which suggests a causal role for this region in face experiences.

There is, however, a recurring debate over whether the FFA is in fact domain specific for faces, with the alternative being that it serves a more general function (Bilalić, 2016). Some argue that the FFA serves detailed visual processing based on expertise *generally* (e.g., Gauthier, Skudlarski, Gore, & Anderson, 2000); car and bird experts, for example, show selective activity in the FFA in response to car and bird stimuli. In addition, *other* brain regions are crucially involved in processing face stimuli, such as the ventral anterior temporal lobes and the posterior superior temporal sulcus (Bernstein & Yovel, 2015; Collins & Olson, 2014). So it appears that the FFA is also responsive to other types of perceptual input and that multiple brain regions and networks are involved in processing different aspects of human faces (e.g., face identification, perception of dynamic facial expressions, facial emotions, etc.).

The picture becomes more complicated when we take a broader class of potential agent stimuli into account. So-called higher-level visual and auditory areas such as the extrastriate body area (EBA), the superior temporal sulcus (STS), the superior temporal gyrus (STG), and the middle temporal area (MTA) are all involved in perception of other agents more broadly (Kanwisher & Yovel, 2006; Scholl & Tremoulet, 2000). These regions may respond selectively to human bodies, biological movement, or human-like voices. Although most research focuses on illusory faces, misfiring of other brain regions may also generate agency-like experiences, as observed in auditory hallucinations in people with schizotypal personality traits or schizophrenia (Allen, Larøi, McGuire, & Aleman, 2008). Disturbed activity in multisensory brain regions, such as the temporo-parietal junction (TPJ) and specifically the angular gyrus, has been associated with feelings of presence (FoP), the often implicit and subjective feeling that another agent is looming in one's peripersonal space (the space directly surrounding the body; cf. Arzy et al., 2006).

In sum, the neuroscientific evidence indicates that humans (and, in fact, other animals; see Desimone, 1991) have *multiple* neural systems that are actively involved in detecting other agents. But these data are not compatible with a *modular* version of HADD Theory. There is no specialized neural module simply dedicated to detecting other agents; rather, different neurocognitive mechanisms respond to different but overlapping classes of agent-like stimuli. So rather than positing an

agency-detection *device*, we should speak of a suite of agency-detecting and agency-processing *capacities*. This move, in itself, is not damning to HADD Theory, as it would be possible to replace the "Device" part of the theory with a *cluster of capacities*. But it does render HADD Theory problematic in the following way: since higher-level processes that form beliefs about agents have multiple lower-level sources, beliefs in the existence of other (invisible) agents cannot arise in a simple way on the basis of input from a single processor; rather, such beliefs require at least some interpretation of several information sources and integration of them with pre-existing beliefs and expectations, contrary to what the simple modular picture suggests. If this is right, then bridging the gap between agency-intuition and actual belief becomes even more complicated than some HADD theorists seemed to realize.

These considerations give us our first lesson for the construction of a better theory of how to relate religious belief and agency detection.

Lesson 1: human psychological capacities for detecting other agents do not take the form of a simple modular device (a HADD); rather, there are different agency-detecting cognitive capacities, some of whose underlying mechanisms serve other purposes as well.

3.2. Relation between agency detection and supernatural beliefs

HADD Theory has further problems. HADD Theory (in its various forms) predicts *that people with more sensitive agency-detection capacities should be more likely to have religious beliefs* (e.g., Barnes & Gibson, 2013; Barrett, 2004).[7]

Unfortunately, the idea that agency-intuitions are a cause of religious belief has not yet produced impressive empirical results. Evidence could come from priming studies (experimentally manipulating agency detection), from individual difference studies (investigating whether more pronounced agency-detection biases are associated with supernatural beliefs), and from neuroimaging studies. We review all three kinds of study in connection with our present question.

3.2.1. Priming studies

The logic of priming studies directly follows the theoretical HADD model as presented in Figure 1, according to which belief in invisible agents is encouraged and reinforced by agency experiences. A theoretical prediction based on this model is that if individuals are primed to experience agency (e.g., by thinking about other minds), they will be more prone to believe in invisible agents, as the prime should make the supernatural agent concept more "accessible." Specifically, the implicit feeling that "there might be somebody else out there" could make participants more prone to indicate the experience of a "felt presence," or even acknowledge the existence of invisible agents looming around. Thus, in the relevant priming studies, researchers manipulate agency detection and investigate whether experiences of agency increase supernatural beliefs. Several researchers have attempted this (e.g., by presenting participants with a pair of eyes or by having them perform an intentionality detection task such as the "moving geometrical figures task" from Heider and Simmel, 1944; supernatural beliefs are then being measured as the dependent variable; cf. Jong, 2015; Rutjens, 2014; van Elk et al., 2015). To our knowledge, however, no one has obtained positive evidence for the effects of agency detection on supernatural beliefs (personal communication with Jonathan Jong; see also McKay & Whitehouse, 2015), and our guess is that the file drawer on this topic is vast.[8] To give an idea of this, Rutjens (2014) asked participants to complete a religiosity questionnaire while simultaneously presenting agency cues (e.g., a pair of eyes) or a neutral cue (e.g., a geometrical figure). In an unexpected blow to HADD Theory, a trend was found for *decreased* religiosity scores in the agency as compared to the neutral condition. Similarly, Jong (2015) conducted four studies on agency detection and religiosity. In two studies participants completed a religiosity scale while being primed with neutral cues (e.g., flowers) or agency cues (a pair of eyes): no effect of the

prime was observed on the religiosity measure. In the other two studies, participants rated pareidolia stimuli and completed an explicit or an implicit measure of religious belief (e.g., as measured with an implicit association test); by manipulating the order in which the tasks were conducted, the researchers investigated whether agency priming enhanced religiosity ratings. Again, however, no effect was observed.

One might object that it may be difficult to change long-held religious convictions (or lack thereof) by experimentally manipulating agency-detection experiences. So we can approach the question from another angle. If we follow the logic of Barrett and Lanman (2008), supernatural beliefs can reinforce agency detection (e.g., believing you're in a haunted building will make you more likely to experience the presence of another agent). In a different series of studies, one of our research groups aimed to test exactly this possible direction of causation. The hypothesis was that priming participants with supernatural agent concepts (e.g., God, angel, devil) would enhance agency detection, as measured with a biological motion detection task (representing walking human stick-figures) or with a face/house categorization task (presenting participants with noisy pictures of either faces or houses; the percentage of house stimuli that is categorized as a face is used as a proxy for an agency-detection bias; van Elk, Rutjens, van der Pligt, & Van Harreveld, 2016). However, across six different studies (including religious and nonreligious participants), we found no evidence that semantic priming with supernatural concepts resulted in more false positive responses on an agency detection task.

In sum, experimentally manipulating agency experiences through priming provides a way of testing some versions of HADD Theory. But results in favor have not materialized (and many studies yielding null-results have probably ended up in the file drawer). At the same time, however, one might be skeptical about the prospects of a priming approach because of empirical concerns about the reliability and robustness of priming procedures in general (van Elk et al., 2015). So it is worth looking for a different way of testing HADD Theory. Can individual difference studies help?

3.2.2. Individual difference studies

Several studies have investigated how individual differences in religiosity relate to agency detection and mentalizing biases. Studies show, for example, that paranormal believers compared to skeptics have a strong tendency to report seeing meaningful patterns in random noise (Blackmore & Moore, 1994), display a bias toward detecting faces in objects (Riekki, Lindeman, & Raij, 2014), and show a bias for illusory agency detection (e.g., seeing more intentionality in randomly moving figures or dots; van Elk, 2013, 2015b).[9]

These studies, however, leave it unclear whether agency detection is a *cause* or a *consequence* of religious and paranormal beliefs (or both result from some deeper underlying tendency). Importantly, some versions of HADD Theory label agency detection as a major cause, and HADD Theory in general treats it as having some causal force. But it could be that having paranormal beliefs makes people more prone to *reporting* agency-like experiences (e.g., reading auras, seeing patterns in coffee, etc.). So the studies in question are inconclusive as to whether HADD Theory posits the correct arrow of causation.

Other preliminary evidence for the role of mentalizing and intentionality attribution in religion can be found in studies showing an inverse relation between autistic traits and belief in God (Norenzayan, Gervais, & Trzesniewski, 2012): participants in North America scoring high on autistic traits tended to be less religious. This is important. But follow-up studies failed to replicate the previously observed negative association between autism and supernatural beliefs (Jack, Friedman, Boyatzis, & Taylor, 2016; Maij, van Harreveld, et al., 2017). Importantly, in a large sample collected in the US and the Netherlands, the variance of autistic traits in explaining religious belief was close to zero. By way of contrast, the effect of religious *upbringing* was impressive; that is, if one's parents are religious and show credibility-enhancing displays, one is significantly more likely to have religious beliefs (Lanman & Buhrmeister, 2017). Thus, if there is any role of mentalizing abilities in determining *whether one has supernatural beliefs at all* – following the more sophisticated reading of

HADD – its role is small compared to other effects related to one's cultural and social environment. Furthermore, we remind readers that mentalizing and intentionality attribution should be thought of as higher-level phenomena when compared to mere agency *detection*, which renders the inverse relation in question even less able to support the central idea of HADD Theory. Nevertheless, the data, such as they are (i.e., highlighting the role of cultural learning), are intriguing enough that it is worth thinking about what kind of theory they *would* support.

We can now state our second lesson, which summarizes the last two sub-sections (3.2.1 and 3.2.2).

Lesson 2: there may be weak causal links from agency-detection biases to having religious beliefs. But the cultural-social environment does much more to determine whether or not one has religious beliefs at all.

This lesson is certainly a blow to most versions of HADD Theory. But we would like to add an important qualification in interpreting it. Even though agency-detection biases (and hence agency-intuitions) do not make a great difference in whether one has religious beliefs *at all*, they may still shape *which* particular religious beliefs one has. Two people may both have religious beliefs, even of the same general religion, but they could differ significantly in which particular beliefs they have about divine agents (for example, they might differ on the belief that God makes personal visits). While advocating Lesson 2, we hold open the possibility that agency-detection biases could play a difference-making role in specific, individual, and *personal* beliefs.

3.2.3. Neuroimaging studies

Neuroimaging studies, interestingly, provide indirect evidence for the involvement of agency attribution biases and mentalizing skills in relation to religious beliefs. People reflecting on their religious beliefs, for example, show increased activation in their theory-of-mind (ToM) networks (Kapogiannis et al., 2009). One study found that paranormal believers tended to perceive more intentionality in randomly moving objects and that this bias was associated with increased activity in the medial prefrontal cortex (MPFC) – a core region of the theory-of-mind network (Riekki et al., 2014). Another fMRI study found that seeing more "meaning" in random pictures among paranormal believers was associated with reduced activation of the right inferior frontal gyrus, which means that enhanced intentionality detection could also be in part due to reduced cognitive inhibition (Lindeman, Svedholm, Riekki, Raij, & Hari, 2013). In another study, religious believers said an improvised prayer, a ritualized prayer, a nursery rhyme, or a wish list to Santa Claus while their brain activity was measured (Schjoedt, Stødkilde-Jørgensen, Geertz, & Roepstorff, 2009). Researchers found that core regions of the ToM network, such as the MPFC and the TPJ, were more strongly activated in the improvised prayer than in the control conditions.

Together these neuroimaging studies show that paranormal and religious believers readily activate their theory-of-mind network in association with the perception of agency and prayer experiences. However, this does not show that mentalizing – let alone low-level agency detection – *causes* supernatural beliefs. Instead, it seems that the conscious reflection on supernatural beliefs has the *effect* of recruiting mentalizing systems to generate vivid experiences of intentionality (we return to this point in sections 5 and 6). Thus:

Lesson 3: thinking about supernatural agents activates the ToM network, which underwrites attributions of intentional states to various perceived or believed-in entities.

Let's recapitulate section 3. How do HADD Theory's predictions hold up? Both neuroscientific and behavioral evidence support the idea that humans have neural mechanisms dedicated to processing the presence of agents in the environment; furthermore, these mechanisms are highly sensitive, easily yield false positives, and can be sensitive to the point of pathology in some people. However, rather than a specialized HADD module, the neuroscientific data indicate that humans have a suite

of brain areas involved in agency detection, responding to different types of sensory input and generating different types of false positive responses (Lesson 1). Furthermore, strong versions of HADD Theory specifying a causal relation between agency detection and religious belief are problematic. There may be a relation of some sort between agency detection and belief in the supernatural. But that relation is as-yet murky, and attempts to show that hyperactive agency detection *causes* one to be a believer have come up empty-handed. It is striking, however, that activating religious beliefs in turn activates mentalizing and intentionality attribution. Taken together, these points suggest that we should not jettison altogether the idea of a link between agency detection and religious belief. Rather, we should look for a different model of that relation, one that takes seriously the idea that initial (general) religious beliefs arise mostly from cultural influences (Lesson 2), while acknowledging that people who reflect on those beliefs are then prone to having agency-related thoughts and seeking agency-related experiences in light of them (Lesson 3).

4. Conceptual problems with HADD

HADD Theory's lack of empirical success makes us suspect that it has conceptual problems too, which lead to its underwhelming empirical performance. Three conceptual shortcomings leap out.

First, intuition is not the same thing as a belief, and this distinction is often muddled or overlooked in discussions of HADD (for a notable exception, see Boyer, 2001, pp. 147–148). An intuition is a fleeting conscious experience – often of murky significance – that is the output of "fast and frugal" (often called System 1) processors or other sub-doxastic systems (see McGahhey & Van Leeuwen, in press). Intuitions may indicate certain entities in the nearby environment (snake!) or give quick answers to certain problems (e.g., the average length of several lines; see Kahneman, 2002). But they are not mental states that contain *detailed* descriptions of how things are. An intuition would not encode detailed information such as *the virgin mother of Jesus visited me in the hospital*; such information is too specific and culturally idiosyncratic to be intuited. An intuition might yield a feeling of presence, but intuiting a mysterious presence is not tantamount to representing the virgin mother of a deity. Something *additional* is needed to get to the belief. Furthermore, even for simple informational contents, intuition is not sufficient for belief. If someone throws what you know to be a rubber snake at you, you might have a snake-indicating *intuition* (cf. LeDoux, 1996 on the "low road" to the amygdala). But knowing that it is not a real snake, you won't *believe* that a snake is headed for you. Belief (roughly) is an affirming cognitive *attitude*, and one can have low-level intuitions without having attitudes that affirm their contents. In sum, intuitions are more informationally impoverished than many beliefs, and they don't necessarily generate the affirming *attitude* of belief. But some versions of HADD Theory (at least the popularized accounts) seem to hold that an intuition of agency is enough to give a full-blooded belief that a supernatural agent is present. Obviously, this supposed explanation leaves much out (for related criticisms of early HADD Theory, see Boyer, 2001 and Lisdorf, 2007). Other versions of HADD Theory (e.g., Barrett & Lanman, 2008) are just not very clear about how the gap between intuition and belief is to be bridged.

Second, HADD Theory does not make clear the role of *culture* in fostering supernatural belief; nor is it clear how culture and the HADD are supposed to interact. Is it mere coincidence that so many people in Nahuatl culture across several centuries believed in a feathered snake god? Or is it coincidence that people in India, Sri Lanka, and Nepal worship a god with an elephant's head? If HADD Theory in its simpler forms were true, then these would be coincidences. But cultural learning accounts of religiosity have received substantial support over the past decade (Gervais & Henrich, 2010; Gervais, Willard, Norenzayan, & Henrich, 2011), showing a prominent role for socialization and credibility-enhancing displays (Lanman, 2012) in the transmission of religious beliefs. To be fair, Barrett and Lanman (2008) allow some place for cultural learning, but their account is vague about *how* background cultural information interacts with HADD-based intuitions. And it is not trivial to explain this interaction. Suppose, for example, that one of us is walking through the forest and that, due to a shadow of a certain shape, he has an agency-intuition – a sudden, fleeting feeling of

fright, as if an agent were present. What leads him to believe, on this poor evidence, that he witnessed a god? Why not think that he saw just another person or some other primate? After all, he believes in other people and non-human primates already. So HADD theorists owe us an explanation of what leads someone to leap to the conclusion that a specific *god*, not some other creature, was present. So far, no clear explanation has been given.[10]

A third conceptual shortcoming of HADD Theory as it currently stands is that it is not well-suited to accommodate the fact that *other* socio-cognitive biases interact with belief in supernatural agents. So it's not clear how HADD Theory integrates with a large chunk of contemporary thinking in cognitive science of religion. Numerous studies have identified different socio-cognitive biases that relate to supernatural beliefs. For instance, dual-process models have attributed the origins of supernatural beliefs to the magical intuitions generated by an intuitive System 1 (as opposed to the more analytical System 2; Risen, 2016). Others have shown that humans have a pervasive and developmentally early-emerging tendency for teleological thinking (Kelemen, 2004), and a stronger tendency for teleological thinking is in turn related to increased religiosity (e.g., Heywood & Bering, 2014). Another profound bias that has been associated with supernatural beliefs is the "experience of meaningful coincidence," whereby a seemingly random event is attributed special significance (e.g., reading a passage in the Bible that really stands out and that is interpreted as a personal message from God; van Elk, Friston, & Bekkering, 2016). These and other socio-cognitive biases have at least similar explanatory potential to agency-detection biases, when it comes to supernatural beliefs. A good model should accommodate this point.

How do these conceptual shortcomings relate to the empirical problems just noted? Variation in agency detection does not do much to predict differences in whether people have religious beliefs because (1) agency-intuitions are not sufficient for belief and other socio-cognitive biases play a substantial role as well, and (2) cultural learning swamps agency-intuitions when it comes to accounting for whether an individual person has religious beliefs or not. This gives us:

Lesson 4: though there are many sources of intuition and low-level experience, intuition and low-level experience are not sufficient for belief: believers learn many aspects of the contents of their religious beliefs from their surrounding cultures.

5. IREM: the Interactive Religious Experience Model

Despite our criticisms, we think HADD theorists were right to relate agency processing (broadly construed) to religious belief. Religious ontologies feature supernatural/minimally counter-intuitive *agents* (Atran & Norenzayan, 2004). And religious rituals and practices often feature either representations of, or attempts to interact with, divine agents. Given that humans have a biased tendency for detecting and inferring agency, it would be surprising if religious beliefs about such supernatural agents had *no* relation to our agency experiences and intuitions. So we should explore the idea that there is some interesting relation to be found, while letting go of the specific causal picture that some versions of HADD Theory present.

First, however, one more lesson is in order.

5.1. The problem of personal belief

To make the present lesson clear, we discuss an example that highlights the first-person perspective – the perspective of the individual experiencing subject. The problem for the believer that emerges is *the problem of personal belief*.

Francis, let's say, is a mainstream protestant Christian. As such, he has many general religious beliefs whose contents fellow Protestants also believe: *that Jesus is the son of God*, *that Jesus descended into Hell and rose again*, *that God is triune*, etc. Furthermore, he has many specific beliefs that – by inference from general beliefs – apply to him. From John 3:16 he believes that "whosoever believes in [Jesus] shall have eternal life." So Francis can infer from this, logically, that if *he* believes in Jesus *he*

will have eternal life. But none of this is yet personal in our sense. None of these general beliefs apply to Francis in a way that does not also apply to someone else. Furthermore, Francis believes that he *should* have a personal relationship with Jesus. So one day he finds himself wondering the following:

> How does Jesus relate to *me* personally? When has Jesus appeared to *me* by myself? Did Jesus ever do anything to solve a problem specific to me, in addition to what he did for humanity generally? How can I have a personal relationship with Jesus if I can't answer these questions?

Francis realizes these questions cannot be answered by reading Catechism or other doctrinal sources.

This example highlights our distinction from the Introduction. *General religious beliefs* are beliefs about supernatural agents that are not directly about the person holding the beliefs; *personal religious beliefs* have first-personal constituents and are about *one's own particular place* within the wider religious narrative. Francis, in our example so far, has general but *not* personal religious beliefs.

To give another example, one can generally believe that deceased ancestors are living spirits. But one can also have the personal belief that *my* ancestor visited *me*, where the belief in question has *indexical constituents*: in this case *my* and *me*. Personal beliefs, unlike general, are in part about the self and involve what John Perry calls *self-notions* as part of their representational structure (Perry, 1979, 1990, 2001). Thus, a belief *that God loves everyone* would count as a general belief on our schema, since it lacks an indexical constituent (like *me*) and is only about any given person indirectly, by inference from the universal quantifier *everyone* ("whosoever" in John 3:16 is also a universal quantifier). By way of contrast, the belief *that God cured my cancer* is personal, because of the indexical *my* (and because it could not be derived by logic alone from general beliefs).

So the problem of personal belief arises because background cultural information does not by itself specify contents for personal religious beliefs. And if general religious teaching (from parents, preachers, gurus, texts, etc.) is not sufficient on its own to generate personal beliefs, *how are such beliefs acquired*? Answering that question is an explanatory problem for theorists. And importantly, individual believers, like Francis, often face a practical version of this problem: *on what basis do I form beliefs about God's (the ancestors', a spirit's, etc.) relation to me?*

Why would anyone feel the need for personal religious beliefs? Answers to this are heterogeneous, and not all religions require personal belief. But various factors can be compelling. First, religious belief and commitment are heightened by situations of *existential need*: disease, death, war, life uncertainty, and life changes like birth and marriage (Atran & Norenzayan, 2004). So if I, as a believer, turn to a supernatural agent in a time of existential need in *my* life, it is better to have personal beliefs about how that agent relates to *me*, than just to have general beliefs about what God happens to do for people in need. This is not to deny that general beliefs may provide comfort; indeed, they can (Landau, Kay, & Whitson, 2015). But personal beliefs make important contributions of their own that can make the believer feel special. Second, individual relationships with supernatural agents can give *status* in a religious community. To be a religious specialist, one must be regarded as having commerce with supernatural agents, so one must have personal beliefs, which can be reported to others, about *one's own* relation to the supernatural. Even for lay practitioners, individual commerce with the supernatural can generate admiration (Luhrmann, 2012), so one might eagerly *want* personal beliefs about supernatural agents that describe that commerce. Third, *signs*, taken to be from supernatural agents, occur in one's own peripersonal space and time, and signs are desirable because they can be used in making individual life choices. Consider the Poison Oracle practice among the Azande (Evans-Pritchard, 1937). In this ritual, a practitioner wishing to have an answer about the future (or whether someone is a witch) makes a prediction and then commands the Oracle to kill a certain chicken, after which the practitioner gives the chicken some poison. Then, after making the opposite prediction, the practitioner commands the Oracle to spare the chicken. The amount of poison is enough that things could go either way. Whether or not the chicken dies is taken as a sign about which prediction is right. All of this happens in the peripersonal space of interested persons. Hence, when the chicken lives or dies, the practitioner forms a *personal* belief about an Oracular sign (that is, about what the Oracle indicated to *me*). The way this practice works is encoded in general, cultural beliefs, but many beliefs about its outcome are *personal*. For these reasons, and many more,

religious believers may be compelled to seek personal beliefs. And they will need personal *experiences* to ground such beliefs. The dry template of a general religious belief will not do all the work. (Note a further point about the Oracle. It is unlikely that *agency*-detection biases alone are responsible for the experiences that yield the personal beliefs related to the Oracle, since it is not obvious what part of the Oracular event appears like an agent. It is more likely that the bias toward finding coincidences meaningful – see section 4 and below – is the one that feeds into the personal beliefs about the Oracle.)

William James, who distinguishes *personal religion* from *theological beliefs* (which he also calls "second hand religious life"; James, 1902, p. 30), offers a comparable outlook:

> In one sense at least the personal religion will prove itself more fundamental than either theology or ecclesiasticism. Churches, when once established, live at second-hand upon tradition; but the founders of every church owed their power originally to the fact of their direct personal communion with the divine … so personal religion should still seem the primordial thing, even to those who continue to esteem it incomplete.

James here emphasizes personal religious experience, as opposed to institutionalized belief. He also thinks people learn religions as general belief systems, but ultimately they personalize their beliefs on the basis of individual experiences. The extent to which James is right (that the personal is "more fundamental") differs from religion to religion and person to person, but we agree with him entirely that a distinction should be drawn. Note, however, that our distinction between general beliefs and personal beliefs does *not* line up perfectly with James's distinction: personal beliefs, for us, always have indexical constituents, so our category of personal is more restrictive than James's; James's category of *personal religion* will include both some general and some personal beliefs in our defined senses (James's theological beliefs, by way of contrast, will consist entirely of general beliefs).

Lessons 2 and 4 may have made it seem as though cultural learning drives religious belief much more than agency-intuition does or other socio-cognitive biases do. But now we see it is not so simple. Cultural learning, for the most part, drives *general* religious belief.[11] But it *cannot* by itself produce personal beliefs. *Some* constituents of personal beliefs come from the background culture, but background culture can't give or even provide a basis for the indexical constituents. That is because, from the first-person perspective of an individual ordinary believer, *I* am not even mentioned in background cultural information: I may encounter that information personally; it may affect me deeply at an emotional level; but the stories, narratives, doctrines, ritual formats, and ontologies of the supernatural do not directly/indexically refer to *me*. Personal religious beliefs, however, refer to the supernatural entities described in general beliefs *and* indexically refer to the persons holding the beliefs. Furthermore, personal experiences *ground* personal beliefs about things that happen in an agent's peripersonal time and space; without such experiences, such personal beliefs would be *merely* made up, free from constraint. This brings us to the next lesson.

Lesson 5: while cultural learning largely accounts for general religious beliefs, it is inadequate on its own to explain the many personal beliefs that religious believers form and value.

5.2. IREM: a new theory of low-level intuition and religious belief

The theory we present here coheres with Lessons 1–5; it explains how agency detection and religious belief relate in a broad range of cases; it expands the view of that relation to include other socio-cognitive biases; and it explains one way that religious believers solve the problem of personal belief. We call our theory the *Interactive Religious Experience Model* (IREM). (Note that "HADC" now takes the place of "HADD" and refers to the (hyperactive) *agency-detection capacities* outlined in section 3.1; "agency-intuition" still refers to low-level experiences that normally function to indicate the presence of agency.)

IREM: Religious believers arrive at *general* beliefs about supernatural agents mostly by way of cultural learning from others in their society. But given their general background religious beliefs, believers may further seek *experiences* that allow them to form *personal* religious beliefs as well.

> Hence, many religious believers *seek out situations* that trigger HADC and other socio-cognitive biases, like teleological thinking and meaningful coincidence. Such situations include rituals, prayer, enactments, various forms of sensory deprivation, and even playing make-believe that a supernatural agent is present. The low-level intuitions triggered by such situations then allow religious believers to form personal religious beliefs, since those experiences are *their* experiences as if an agent is present, as if something happened for a reason, as if a sign has been sent, etc. A HADC-based agency-intuition allows a believer to transition from merely having the general belief *that God exists* to having the personal belief *that God visited me* (and so on, *mutatis mutandis*, for other triads of general belief, low-level intuition, and personal belief). Intuition and experience, interpreted in light of general belief, ground personal belief.

We expand on this model below. But to grasp it fully, it is useful to think in the following terms. Our model posits both *creative* and *constrained* aspects to the formation of personal religious beliefs. Some creativity is needed, since standard general beliefs don't uniquely specify personal beliefs about supernatural entities. But a personal belief that was just invented out of whole cloth (creativity without constraint) would be unsatisfying; its posits wouldn't "feel real." Hence, believers go into situations that might – if things go as hoped – yield internal experiential constraints that make their personal beliefs *feel as if* they describe real encounters with supernatural agents or supernatural patterns more broadly. Agency-intuitions, among other experiences, are one extremely useful kind of constraint in this regard, because one cannot (typically) cause them endogenously at will; one must be in a situation that prompts them. So when one has an agency-intuition, it *feels* like a real encounter, which can be a basis for a (*partly* invented) personal belief.

It is, we emphasize, an empirical question how far our model extends. We think it applies to many but not all religious believers. Traditional Dutch Calvinists, for example, have been known to *discount* personal experience.[12] But for many kinds of religious practices and even internal mental activities, the glove fits: religious rituals depicting ancestors, auditory mental imagery of a voice, visual mental imagery of an angel, going into nature to feel God, standing before a statue of a saint, randomly opening a religious text and imagining that God chose the text on the page for *me*, interpreting a natural event as a sign – all of these things can involve agency-intuitions or other low-level experiences, and all of them are common religious practices. Once intuitions or other low-level experiences are present in a person's mind, they can be incorporated into personal beliefs: *the ancestor came to me* (ritual), *God spoke to me* (auditory imagery), *an angel came to me in a vision* (visual imagery), *I heard God's voice in the wind* (quiet place in nature), *God chose this scripture for me* (random text opening), *the thunder was God's sign I should leave my job* (interpreting natural signs), etc. Such practices enable personal beliefs that locate, in one's own peripersonal time and space, the supernatural agents (or their effects) described in general religious beliefs. Such practices might allow Francis, our hypothetical believer described above, to solve the problem of personal belief: in the dim, quiet room, God spoke to *me*. What he is doing is interpreting low-level experiences (agency-intuition, auditory imagery) in light of general belief (God exists and loves his children) to form personal beliefs (God spoke to me); our suggestion here is that cultural practices like praying in a dark room developed over time *to* generate low-level experiences for this very purpose (see also Schjoedt et al., 2013 for a similar suggestion), though few practitioners would describe their practices in these terms.

We discuss further the kinds of practice to which IREM applies in section 6.1. Now, in service of theory construction, let's address the distinction between personal and general beliefs with more rigor and discuss how one forms personal beliefs on the basis of agency-intuitions, other intuitions, and experience.

5.3. Personal vs. general beliefs (and how to get personal beliefs)

John Perry, in his seminal work on indexical belief (extending his work on indexical language), distinguishes *self-attached information*[13] from *objective* or *detached information*. Self-attached information comes from an agent's environment or own body and relates that environment or body

to the agent *her-* or *him*self. So, to focus on one individual, a pain in my toe or a perceptual experience of a rose are signals that carry *self*-attached information, since they convey that something has happened to *my* toe or that something is in *my* environment. Mental states that carry self-attached information (such as pains, percepts, sensations, and agency-intuitions) are typical bases for indexical beliefs, which have indexical constituents, such as internal versions of *I*, *me*, *my*, *here*, and *now*. Indexical beliefs have contents like *I hurt my toe* or *I see a rose*. Objective/detached information, by way of contrast, does not relate one's self to the subject matter that that information concerns. Propositions like *Singapore is an island* or $a^2 + b^2 = c^2$ *on a right triangle* count as objective/detached information, since the truth value of those propositions does not relate reflexively to any agent who happens to believe them.[14]

Objective/detached information, on Perry's view, can become attached, or "linked" (as he puts it), to self-attached information. A person might judge, for example, that an item conveyed by self-attached information (a *visually experienced* canyon) is *identical* to an item that one's objective information is about (the canyon *learned about in school*). Never having seen the Grand Canyon, one might look out of an airplane window and form the belief that *that geological structure*$_{\{visually\ experienced\}}$ *is the Grand Canyon*$_{[learned\ about\ in\ school]}$ (subscripts here indicate the types of information source connected to the respective belief constituents). Judgment can thus link information encoded in visual percepts to information encoded in book learning; that is, it links self-attached information to objective information. So not only do certain *experiences* convey self-attached information about one's environment or body, their informational content can also be linked to objective information, thereby enriching one's file of information about the entity in question (one's Grand Canyon mental file now contains the information: the Grand Canyon was seen by *me*).[15] To give another example, if you believe the detached information *that the plane to Chicago leaves from 27A* and you then have a visual percept of **27A** (which carries self-attached information about *your* spatial relation to that sign), that previously detached information becomes attached to your self-attached information about your surrounding here and now by way of a linking judgment. Before, you knew where the Chicago gate was *in some detached sense*, but now, in virtue of the self-attached perceptual experience, you know where it is in relation to your own body.

How does all this relate to religious belief?

Let's start with the role of agency-intuition in relation to personal religious belief; we'll see that key elements of the picture that emerges can be generalized to other socio-cognitive biases. Agency-intuitions carry self-attached information. That is, they seem to indicate that another agent is nearby in one's own peripersonal time and space: *an agent is in front of me*; *an agent is behind me*; *someone is present*; *there is a particular face in front of me*; etc. And even if an agency-intuition occurs without another agent actually present (as often happens in illusory cases), the agency-intuition still carries self-attached information (in Perry's sense) insofar as it conveys that *something* is happening to *me here now* (even if one is wrong about what that something is).[16] As we have indicated, personal religious beliefs are beliefs about supernatural agents that have indexical constituents and that *could not* have been derived from general religious beliefs by rational inference. So how does one get such beliefs? One forms beliefs that *link* self-attached information conveyed by HADC-based agency-intuitions to detached information about supernatural agents described in culturally inculcated general religious beliefs. A linking belief, for example, could be: *this agent*$_{\{intuited\ in\ the\ local\ environment\}}$ *is one of the ancestor spirits*$_{[learned\ about\ from\ cultural\ teachers]}$.

Thus, a person with a HADC-based agency-intuition may come to accept it and link its content to the detached conception of a supernatural agent encoded in general religious beliefs. The resulting personal belief has the content that a certain supernatural agent was present to *me* at a certain time and place. One might hold that God visits His servants, but she might still wonder where and when God will visit *me*. An agency-intuition can put this wonder to rest; having an agency-intuition – say, a feeling of presence – allows her to interpret the source of her intuition as being the presence of God, and in this interpretation she forms a personal belief.

As indicated, other socio-cognitive biases can play a similar role. We have already suggested examples. One's low-level intuition that cautions against "tempting the fates" (Risen, 2016) can be folded into a personal belief that there are spirit agents that *I* should not provoke. One's sense of teleology (Kelemen, 2004) in a sequence of events – whether that sense is accurate or not – can ground a personal belief that supernatural forces are at work in *my* life. And it is a well-known practice among evangelical Christians to flip open a page of the Bible at random and interpret that passage as being relevant to an issue in one's own life; when the passage seems particularly pertinent, this triggers an experience of meaningful coincidence that can be construed as God speaking to *me here now* (van Elk, Friston, et al., 2016). In each case, a low-level signal that carries self-attached information of some sort is interpreted in light of general beliefs in order to arrive at a personal belief. Importantly, such intuitive signals may not occur sufficiently often in everyday life for personal *religious* belief to be sustained; hence, many people engage in religious practices *because* those practices are well structured to elicit the low-level signals that enable personal belief.

The overall picture appears in Figure 2.

So far, we have a sense of *which* low-level intuitions and experiences – along with the underlying processes that produce them – are appealed to in support of personal belief. We can now ask: once

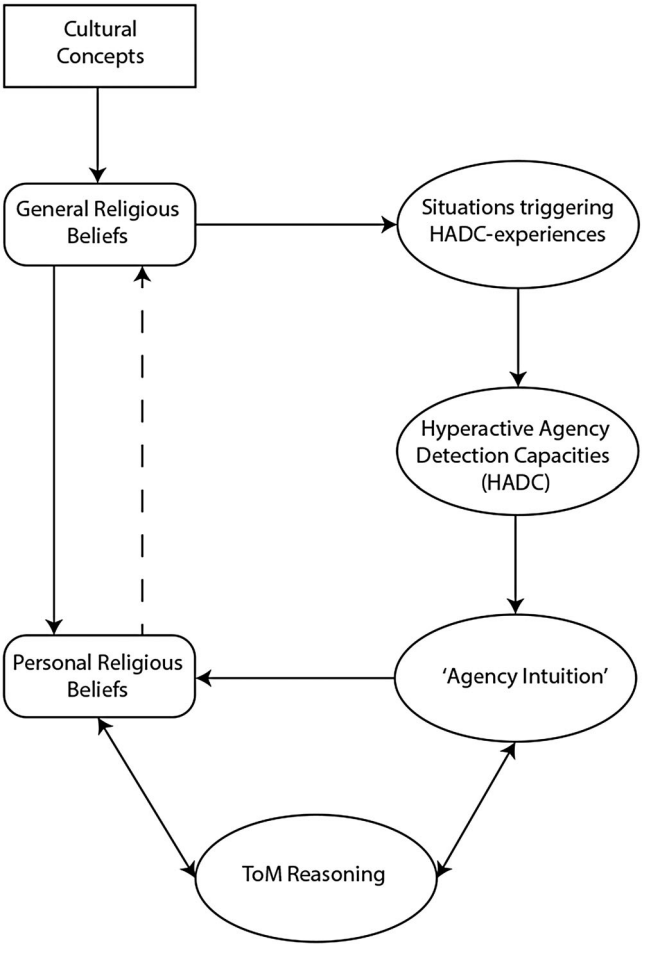

Figure 2. Graphical representation of the Interactive Religious Experience Model (IREM). General religious beliefs cause believers to seek situations that trigger their HADC. The figure illustrates the relevant connections for cases of personal belief formation in which agency-intuitions are at work; similar figures would illustrate analogous connections for other socio-cognitive biases.

the intuitive mental events occur, what specific processes connect them to personal belief? The answer is that *many* different specific processes may support transitions from low-level intuitions to personal beliefs, though the majority of them will involve using the ontology of supernatural agents described in general religious beliefs. Hence, various research programs will prove relevant to fleshing out this portion of our model. Ann Taves (2011), for example, has proposed a building-block approach to religious experience, on which basic emotional experiences can be "deemed religious" in situations in which the person's context and personal background make this labeling seem appropriate. On this view, the "feeling of a presence" represents a basic phenomenon that has been reported across different times and cultures (Geiger, 2009); however, in a haunted house it may be experienced as terrifying, whereas in the practical setting of a prayer session the feeling of presence may be comforting and interpreted as a sign *that God has visited me*. Alternatively, Clark's (2013) predictive processing model could characterize some instances of personal belief formation: one's general religious beliefs constitute a prior "model" of the world (there will, of course, be other models as well). One's prior expectations derived from this model yield top-down predictive signals, which in turn can dominate sensory perception and experiences – especially when the sensory input is reduced or ambiguous. Thus, when one has an expectation that a ghost will appear, ambiguous visual information (e.g., a dark shadow or a moving curtain) will likely be interpreted as coming from a ghost-like entity posited by the model and will eventuate in the personal belief that a ghost visited *me*.

Much more research is needed to flesh out the links between agency-intuition, other intuitions and low-level experiences, and personal belief, but the connections drawn here indicate directions that such research could take. In addition, other theoretical frameworks might also account for some processes whereby intuitive experiences are transformed into personal beliefs, e.g., dual-process accounts of human reasoning (e.g., Risen, 2016), emotion attribution theory (Weiner, 1985), or cognitive-experiential self-theory (Kirkpatrick & Epstein, 1992). *Whatever* the exact underlying mechanisms, for IREM it suffices to note that intuitions and experiences (and situations that produce them) may be actively pursued in order to personalize the supernatural agents described in one's pre-existing general religious beliefs.[17]

Once one has a personal belief that a supernatural agent is or was present, the next step is to try to figure out that supernatural agent's mental states. *What does the agent want? Is he mad at me? Does she want to help me? Does he intend to see me again?* On our view, a person with personal beliefs will seek to answer such questions partly by consulting general beliefs and partly by activating her ToM network, as discussed in section 3.2.3. Importantly, the attribution of intentionality is far *less constrained* than having an agency-intuition: an agency-intuition is a sudden, involuntary rush that concerns the presence of an agent (supernatural or otherwise) in the here and now, prompted typically by external stimuli, but ToM reasoning can happen long after any such experience, as the religious person continues to pray and meditate on what happened. We have focused on the role of agency-intuitions here, since on our view, that's what stood most in need of clarification; be that as it may, however, there is a rich and interesting story to be told about the role of ToM reasoning in the formation of personal beliefs as well.

We have thus far focused on the causation of personal religious beliefs, which involves interpreting low-level intuitions and experiences in light of general beliefs. We now add one complication[18] to this overall picture (this complication is symbolized by the dotted line in Figure 2). It is possible that instead of having background general religious *beliefs*, a particular person might have background general religious *ideas*, which are not yet endorsed as beliefs (the person is agnostic as of yet). That person might then, on having an intuition (agency-intuition or otherwise) in a particular situation, interpret it in light of their background religious ideas and thereby form a personal belief (say, *that God visited me*) *and* general belief (say, *that God exists*) at the same time. This may ultimately be one route from intuition to general belief and may partly explain why intuitive cognitive styles are consistently associated with religiosity (Pennycook, 2014). We give a possible example of this route below (section 6.1). We emphasize, however, that the overall structure of the process remains largely

the same, with general ideas and/or beliefs being initially learned culturally, even if they are in some cases taken to be confirmed by experience and intuition.

This completes the statement of our theory, the Interactive Religious Experience Model. Once the background pieces of the puzzle are in place, IREM is remarkably simple. Instead of saying agency-intuitions cause religious beliefs in general (as some forms of HADD Theory do), we say *some* general religious beliefs cause people to *seek* situations that trigger agency-intuitions and other low-level intuitions and experiences caused by socio-cognitive biases. Such experiences help solve the problem of personal belief. Culturally derived general beliefs lead believers to *interact* with their surroundings in ways that are likely to give them the experiences they want, including agency-intuitions. Then, on the basis of these experiences, people form personal beliefs about a supernatural agent who was or is (believed to be) present; once that has happened, one's mentalizing systems can go on to attribute to that agent various intentional states that would explain why it chose to be present; this mentalizing then yields further personal beliefs about the minds of the supernatural agents themselves.

5.4. Coherence with the lessons

Below we highlight the advantages and potential of this view (section 6). In this sub-section, we explain how our view coheres with the lessons so far enumerated.

First, IREM appeals not to HADD, but to an expanded notion of HADC, which consists of multiple, well-evidenced low-level agency-detecting capacities. This comports with Lesson 1, which emphasizes that the modular ("device") view of agency detection was wrong. On our view, religious believers seek to encounter the supernatural beings in which they believe by *various* methods, which makes exact sense, if one has a *cluster* of agency-processing capacities, as opposed to just one module. One seeks to trigger HADC by entering various sorts of situations: different religious situations (e.g., statues and dim lighting vs. actors and bright lighting) trigger *different* HADC capacities. Furthermore, we integrate other socio-cognitive biases, like magical thinking, into IREM, as sources of personal belief-forming intuitions. This theoretical move allows us to unify many religious practices into a single framework.

Second, Lesson 2 emphasizes that variation in agency-detection bias – so far as the data currently go – does not do much to explain *whether or not* one is a religious believer. Our view is consistent with this. We hold that one's cultural upbringing does more than anything to determine whether one has general religious beliefs at all. HADC and agency-intuitions, however, come into the process of forming personal beliefs (and if they influence general beliefs, it is *by way of* personal beliefs). If one believes *that my ancestor visited me the day after my mother died*, there is a good chance that an agency-intuition occurred the day after the person's mother died and was involved in the formation of this personal belief; the intuition served as a constraint on belief formation. So our view gives credit to the insight of HADD Theory, without over-emphasizing the role of agency-intuition in forming general beliefs, which are mostly derived from one's cultural background in any case. Furthermore, insofar as the link HADD Theory posits from agency-intuition to religious belief does exist, our model brings clarity to how that link might work and how it relates to background cultural information: the "believer" treats background ideas about the supernatural as confirmed by intuitions and supported by resulting personal beliefs (see Dennett, 2006, p. 120, for a similar suggestion, put in the framework of memetics). If HADD theorists develop their views in a way that accepts these suggestions, then the resulting HADD Theory will describe a special case of processes that IREM models.

Third, Lesson 3 emphasizes that thinking about supernatural agents activates the ToM network, which means that believers attribute *mental states* to such agents. In IREM, such activation can come into play *either* as a result of reflection on already-existing general religious beliefs *or* from reflection on personal beliefs (possibly in conjunction with general beliefs). Yet we carefully distinguish between a believer's *thoughts* about mental states of supernatural agents and her *intuitions* as of an agent's being present (agency-intuitions). Both have unique roles to play in the formation of

personal belief. But the difference is important. One can *voluntarily* engage ToM, but one cannot voluntarily have an agency-intuition (or other low-level experience); for that, one must be *impinged upon* in the right way by something from the environment (though, as we argue, there is often an *active* component to *seeking out* an environmental situation that will impinge in the "right" way). This is why priming supernatural agent concepts is not sufficient to activate agency-intuitions: just thinking about an agent does not suffice to activate the intuitions that are meant to function as *constraints* on cognition.

Fourth, it was a problem for HADD Theory that, as Lesson 4 puts it, intuition is not sufficient for belief, since HADD Theory never really explained how the gap between intuition and religious belief was crossed. It was also awkward for HADD Theory that surrounding culture does so much work in bringing religious beliefs about. But both points can be well understood in the IREM framework: one typically acquires general religious beliefs from one's surrounding culture; one then forms personal beliefs by interpreting agency-intuitions *in light of general beliefs*. We allowed that there are multiple psychological pathways by which this might happen, and further research is needed, for which IREM can be the overarching framework. But the gap between intuition and belief no longer leaves the contribution of agency-intuitions to religious beliefs mysterious: beliefs about oneself (indexical beliefs) are *in general* formed through interpreting incoming, low-level experiences in light of background beliefs. On IREM, the formation of personal religious beliefs in light of agency-intuitions is an instance of this more general kind of process, in which low-level experiences and intuitions produced by various socio-cognitive biases are interpreted in light of general beliefs to produce personal ones.

Fifth, recall that Lesson 5 states: "while cultural learning largely accounts for general religious beliefs, it is inadequate on its own to explain the many personal beliefs that religious believers form." IREM takes up the explanatory question posed by this lesson (how are personal beliefs formed?) and uses HADC, agency-intuitions, intuitions and experiences produced by socio-cognitive biases generally, and core conceptual components from the philosophy of John Perry to answer it.

6. Advantages of IREM

So far, we have clear reason to prefer IREM to HADD Theory in its simpler forms. IREM comports with Lessons 1–5, while simpler versions of HADD Theory do not (see sections 3 and 4). Furthermore, even if more sophisticated versions of HADD Theory do not contradict IREM, they are underdeveloped: crucially, they omit the distinction between general and personal religious beliefs, which is needed to make sense of how background cultural information and intuitive processing interact in the formation of personal religious beliefs. We grant that the more sophisticated versions of HADD Theory, like Barrett's and Lanman's, *could* be developed and further specified in a way that coheres with Lessons 1–5; if this were to happen, however, the resulting picture would just be a special case of IREM, since all the causal connections that such a theory would specify are already modeled by IREM. Thus, IREM is a more general theoretical model of the relation between belief and intuition/experience that can be used in future research in cognitive science of religion – construed broadly to include those parts of anthropology, cultural studies, evolutionary theory, philosophy, and psychology that pertain to religious cognition.

In this section, we point out two further reasons to pursue IREM as a research paradigm: it coheres with extant, already fruitful research programs (6.1), and it generates predictions that are both plausible and interesting (6.2).

6.1. Coherence with existing research

Space prohibits us from discussing all existing research that coheres with IREM, so what follows are highlights.

Tanya Luhrmann (2012) writes about the Vineyard Christian Fellowship, an American Evangelical Church with congregations in several major cities, including Chicago, where she did her field

research. The Vineyard emphasizes that its members should have a personal relationship with God and in fact trains its members to engage in activities that will, if all goes well, give them a *feeling* of God's presence. Moreover, its members seek to have auditory experiences during prayer that they can construe as God's voice; hence Luhrmann's title: *When God Talks Back*. In describing how Vineyard members "make-believe" God is present by setting up various props, like pouring a cup of coffee for Him, Luhrmann writes:

> I only knew one person in the Chicago Vineyard who really poured that second cup of coffee. But I knew people who talked about setting an extra dinner plate for God or pulling out a chair for him to sit on while they poured out their troubles. (p. 75)

Such imaginative games could make God feel "more real" (p. 94). But how?

> They learn to infuse the absent, invisible being with presence by cherry-picking mental events out of their own familiar experience and identifying them as God; they integrate those events into the awareness of a personlike being by using "let's pretend" play; and then as they shape their own interior world … they learn to react emotionally to that being, as if that being were alive in an ordinary way right now. (p. 131)

IREM coheres with Luhrmann's observations. On our view, seeing a chair pulled out with a dinner plate set in front of it is a visual input that can trigger HADC and thus agency-intuitions, surge-like feelings that seem to indicate the presence of another agent. Thus, Vineyard members, who *antecedently* generally believe that God exists, deliberately create situations that cause their HADC to fire. The resulting agency-intuitions allow them to link their abstract, general representation of God to a time and place that is experienced from their own ego-centric point of view. One then forms the personal belief that he or she was with God at *that* time and place.

Recall that HADC-based intuitions carry self-attached information, as Perry puts it, in the following way: even if I'm not sure at first what an intuition means, I can be sure that whatever caused it happened in relation to *me* in my nearby, peripersonal space. Accordingly, if a Vineyard member puts herself in a situation in which she has such an intuition, she can conclude that whatever caused the intuition was near to her personally. And if she then concludes that the God she had heard about in sermons and read about in the Bible was the source of the agency-intuition, she has effectively *linked* detached/objective general religious beliefs to her own personal experience, thereby generating personal beliefs.

Luhrmann's focus, of course, is on auditory mental imagery, but it is also clear that her phrase "cherry-picking mental events" casts a broader net than just auditory experiences; it includes what we would call agency-intuitions. In any case, the auditory imagery that Vineyard members interpret as God's voice and the HADC-based agency-intuitions that they have through pretending are mutually supportive: both kinds of experience (1) support generation of personal beliefs from general beliefs and (2) facilitate greater emotional engagement in their religious practices. We further note that our IREM-based explanation of Vineyard members' personal religious beliefs coheres well with Luhrmann's own explanation of individual differences in the extent to which people can "hear" the voice of God: Luhrmann explains such individual differences in "hearing" God's voice by appeal to differences in *absorption*, where people who can become more absorbed in internal or external experiences are more prone to "hearing" God's voice; we would add to this that greater absorption makes it more likely that perceptual imagery (e.g., auditory) can trigger low-level socio-cognitive biases in the way that actual perception typically does, thus giving the individual believer intuitions and low-level experiences on which to base personal beliefs.

The practices of Vineyard members are just a few of hosts of rituals around the world that can be understood on the IREM framework. We already discussed the Azande Poison Oracle above (Evans-Pritchard, 1937). Let's consider a few other examples. One kind of traditional healer among the Zulu in South Africa is a *sangoma* (Martin, 2014). One thing a sangoma does is summon ancestors through drumming and falling into a trance or convulsive fits, which gives the impression that the sangoma is *channeling* an ancestor. The "ancestor" then responds to the people present through

call-and-response singing. Such a ritual will activate HADC in numerous ways, thereby enabling personal beliefs based on agency-intuitions: the ancestor said *this* (whatever the sangoma sings) to *us* (the people having the agency-intuitions) at this *time* (the time at which the experience was had). Many Catholics, to give another example, pray before statues of Jesus, Mary, or one of their chosen saints (see, for example, DeBona, 2007, p. 251). Though the statues are rarely confused with supernatural agents themselves, part of the appeal of the statues is that their visual form triggers agency-intuitions; people often pray before a statue in dim lighting when all else is quiet, which heightens feelings of presence or other HADC-based experiences (other sensory inputs are kept low, so what agency-intuitions one does have seem all the more pronounced). These HADC-based experiences can then be interpreted in a way that fosters personal belief: for example, Mary was present with *me*. Importantly, the phenomenon of prayer before a statue is not unique to Catholics. Prayer statues representing agents are also found in Hinduism and Buddhism, and god statues in general are widespread cultural artifacts around the world (Bowker, 2006). Furthermore, the fact that people bother to *make* statues of their preferred supernatural agents coheres much better with IREM than it does with simple versions of HADD Theory (though nuanced versions of HADD Theory can accommodate this). On simple HADD Theory, coming to have a religious belief seems largely passive: one is struck in a certain way and forms a belief in a supernatural agent as a consequence. But IREM portrays religious believers as actively *trying* to create situations that will give them agency-intuitions. *Making* a statue is a form of active trying. But still, it is important that the statue be external; that way it can impinge on one's sensory organs and ultimately HADC in ways that provide constraints on personal beliefs – in ways that make their subject matters feel real.

Other ethnographic examples may be added.

Studies on witchcraft illustrate that believers often resort to different socio-cognitive biases in seeking out supernatural experiences, which in turn give rise to personal religious beliefs. In her book *Persuasions of the Witch's Craft* (1991), Luhrmann describes how practicing witches in contemporary England learn to look for experiences of "meaningful coincidence" in order to support their belief in the efficacy of the rituals that they perform. She describes, for example, a case of a magician who performed a ritual to heal a woman who suffered from epilepsy. Initially, the woman felt slightly better but was still not able to function normally. She then got involved in a traffic incident, and (seemingly miraculously) the blow to her head immediately cured her of her epileptic seizures. As a result, the magician formed the personal belief that *his* healing ritual actually caused the traffic incident and brought about the desired effect. In this case, a cognitive bias for detecting meaningful coincidences was used to transition from general beliefs (i.e., magic can be used to heal) to personal beliefs (i.e., *my* performance of the ritual generated real-world effects).

Another ethnographic example that comports with IREM is Rödlach's (2006) detailed study of sorcery beliefs and their relations to the AIDS epidemic in Zimbabwe. In this context, people commonly suspect that cases of AIDS were caused by the work of a sorcerer, even though it is also widely known that HIV and AIDS are sexually transmitted. Suspected sorcerers can be anyone, though people with financial success are particularly suspicious; accusations of sorcery are widespread, though explanations of how the sorcery works are always sketchy and the accusations are often only rumors. Rödlach's portrait is as fascinating as it is depressing: blaming AIDS on sorcery is often a way of avoiding personal responsibility for becoming infected; it is also a way of avoiding shame; accusations of sorcery are often the result of interpersonal tensions, such as jealousy; accusing people of sorcery often serves strategic social purposes, like getting them to share more of their money; fear of being suspected of sorcery leads people to dissemble about what they actually think; and accusing someone of sorcery is also often a way of feeling one has some control over a disease that is in fact an inevitable killer. For our purposes, the following fact is most significant: people appear to be more likely to accept sorcery beliefs about the causes of the disease when they are *personally* affected by AIDS. That is, experiencing the disease first-hand – either in oneself or in a close friend or relative – makes it more likely that one will attribute the illness to sorcery than before one had such experiences (conversely, skepticism about sorcery is more common among

those who do not have personal experiences with the disease). There are many reasons why this would be so, and one that Rödlach emphasizes is that attributions of agency are a way of feeling like one has control over the illness; one might actively *want* it to be the case that one's illness is a case of sorcery rather than simple AIDS, since then one could do something by undoing the sorcery. But another reason is salient in light of IREM: individual *experience* of the symptoms of the illness is more likely to trigger one's meaningful coincidence bias, in comparison with third-person, detached awareness of such symptoms. For example, experiencing symptoms of AIDS shortly after a fight with one's mother-in-law may strike one as a meaningful coincidence. When meaningful coincidence intuitions occur, they are apt to be interpreted in light of general sorcery beliefs or suspicions to yield personal beliefs of the following form: a sorcerer inflicted this illness on *me*. Crucially, this may provide an illustration of the dotted line from Figure 2. That is, the formation of personal beliefs (about sorcery, in this case) can strengthen or generate new general beliefs (about how sorcery can cause AIDS); alternately, it raises general "suspicions" (a word Rödlach uses frequently) to the level of general *beliefs*.[19] Though we think this route to general religious beliefs is less common than cultural learning – see Lesson 4 and the preceding discussion – it is still a possibility we recognize and can explain.

The considerations of the previous paragraphs give us confidence that much ethnographic research will cohere with IREM, and it will be useful for ethnographers to keep IREM as a theoretical tool that may illuminate findings. But ethnography is not our only ally. To finish this sub-section, we review two kinds of lab-based research that fit with IREM.

In a recent line of studies, we investigated to what extent specific contexts can facilitate agency-intuitions. In some studies, we used Virtual Reality (VR) and presented participants with threatening scenarios that were low in illumination and visibility (e.g., a haunted house, a dark forest with scary trees and moving objects, etc.; Maij, Amodio, van Schie, & van Elk, 2017). We contrasted these scenarios with a control condition in which participants were walking through a bright and non-threatening forest. Participants were instructed to press a button whenever they had the feeling that another agent – be it an animal or another human – was present. Participants pressed the button more often in the threat condition than in the neutral control condition in which they had to navigate through a brightly lit forest. This indicates that agency-related experiences arise more easily in situations of dim lighting. When we included sound effects and visual effects potentially indicating the presence of another agent (e.g., the sound of a breaking branch or a moving tumbleweed), this effect was even stronger. It should be no surprise, then, that people seeking to have experiences of God go to places with dim lighting and unusual soundscapes, such as cathedrals or forests at night. On the IREM perspective, what people are doing in such cases is seeking a context in which agency-intuitions are more likely to arise; the research mentioned in this paragraph supports the idea that the "right" situations can indeed work this way. We think many ritual physical settings and practices exist and are structured *so that* they can help facilitate the sorts of experiences and intuitions that can be folded into personal religious beliefs, and many people seek them out for this very purpose; the VR experiments simply confirm that certain kinds of setting can indeed work this way.

In other studies, we used a placebo brain stimulation device, which we claimed was capable of inducing mystical experiences (Maij, van Elk, & Schjoedt, 2017; van Elk, 2015a). Specifically, we presented participants with a so-called God-helmet and had them watch a short video in which people reported intense mystical experiences after stimulation with it, ranging from the feeling of a presence to seeing supernatural agents (ghosts, spirits, etc.). We then manipulated expectations regarding the God-helmet, by informing participants in one session that the helmet was switched on, while in the other session we told them that the helmet would remain switched off. In fact, the helmet remained off in both conditions. Thus, the expectations were set high, and we used conditions of sensory deprivation (i.e., participants were blindfolded and white noise was presented on headphones). Crucially, in the placebo "stimulation" condition many people reported very

intense emotional experiences – often involving the experience of other agents. One woman reported the following experience:

> I had to close down from the environment. I began to see spots moving in front of me. Everything was black and white. I saw a kind of dunes, as if I was in a desert. Then a spot started circling around. The spot was in the far distance and did not bother about me. First I was afraid of the spot and it circled back and forth. At a certain moment the spot came toward me and it started speaking to me. I told the spot I was not afraid of it. I started weeping intensely. I started a conversation and we talked about my life – we laughed and wept together. I knew the voice so well. It was my own voice, but still from someone else. The voice gave me a message that I knew already unconsciously. The voice told me that finally I was ready to give birth to a child, even though the circumstances may not be optimal. The voice also consoled me when the helmet was taken off and it stayed with me for a while. It was very nice to have someone present. It felt as if I still carry the voice with me, like my own thoughts.

People also frequently reported the feeling of presence or the hearing of voices talking or hearing a choir while undergoing presumed stimulation by the God-helmet. For instance, another person reported a felt presence:

> I felt a presence – a dim white light looming at the side of my thoughts. At some point, I felt a presence behind me – a large being who rose above me and bent over me. I also saw two figures, who moved in a circle from behind to in front of me. They were like shadows without a clear shape. At some point the environment started moving and trembling, like a bird, while I was doing nothing.

How do these examples illustrate IREM? They show how external props (the situation) combined with different background beliefs (believing that the helmet causes mystical experiences) can dramatically affect both one's personal beliefs about the meanings of experiences and possibly even the experiences themselves (our view does not entail that possibility, but it is consistent with it). Note that in both quotations above, the participants report experiences in indexical language: "the spot came toward *me*," "*we* talked about *my* life," "the voice gave *me* a message," "*I* felt a presence," and so on. The personal beliefs that these phrases report were based on experiences that came involuntarily from the unusual situation, combined with expectations about it. One does not just choose to have such experiences, as the absence of them in the control condition suggests. But given the right background beliefs, even minimal cues, such as tingling bodily sensations, minimal visual or auditory patterns, or movements in the surroundings are readily interpreted as indicating the presence of another agent. Our view is that many religious environments – unusual spaces, eyes closed, different soundscapes – are crafted to get religious believers to experience similar effects to the effect that our placebo God-helmet had: religious environments support agency-intuitions and other low-level experiences that form the basis for personal beliefs.

6.2. Hypotheses and predictions: the IREM research program

Importantly, IREM supports novel and testable hypotheses that can form the starting point of a research program. Below we canvass some of IREM's suggested hypotheses and empirical recommendations.

First, IREM explains why some but not all religious believers have agency-like experiences. As indicated in section 3, mixed findings appear in the literature about the relation between agency detection and supernatural beliefs, with some studies showing a positive relation (e.g., Norenzayan et al., 2012; Willard & Norenzayan, 2013) and other studies showing the absence of a relation (Maij, van Harreveld, et al., 2017). IREM predicts, however, that a relation between religious belief and agency detection is mainly to be expected in religious communities that actively encourage the seeking of agency experiences (e.g., such as Charismatic Pentecostal churches or paranormal/New Age communities), and even then, the relation will not be between agency detection and having religious beliefs in general, but mainly between agency detection and personal belief. Thus, analogous to the role of religiosity in fostering teleological reasoning and reasoning about fate (Banerjee & Bloom, 2014, 2015; Heywood & Bering, 2010), we hypothesize that a relation between religiosity and agency

detection will be found to occur primarily in religious communities that value personal religious beliefs.

We also argue that the training and learning experiences that believers have been offered to seek agency-intuitions should result in stronger and/or more elaborate personal religious beliefs. For instance, a Christian who has been active in the Vineyard Fellowship for years will likely have had frequent agency-related experiences and quite elaborate personal religious beliefs (e.g., *God personally spoke to me through the pop song on the radio*). In contrast, a new convert in the Vineyard Fellowship may be a devout general believer (e.g., subscribing to the Church's creed), but lack personal religious beliefs and vivid experiences of God's presence. One's religious upbringing will also strongly impact the frequency and intensity of agency-related experiences. When you are raised in a Pentecostal family you probably have a stronger capability to hear God's voice compared to those who are raised in a Catholic family. Thus, a concrete recommendation following IREM is to take into account one's religious upbringing when studying religious experiences and how they inform personal beliefs. Also, the psychological and cognitive study of religion should be combined with an anthropological research approach, doing justice to the peculiar beliefs and practices of seeking agency-intuitions and other experiences that are encouraged within specific religious communities. As illustrated above, an important step in this direction can be found in Luhrmann's work among Pentecostal believers.

Second, IREM suggests the empirical utility of a systematic investigation of the different circumstances that are well suited to generate agency-intuitions. Existing research lines on material religion and the use of sacred objects in religious practice should be integrated with the study of religious experience (Meyer, Morgan, Paine, & Plate, 2010). Also, contextual aspects of religious experience have mostly been studied from an anthropological perspective, which suggests that specific spaces may be optimally designed to foster religious experience and agency-intuitions (e.g., Holloway, 2006; Klaver, 2011). Thus, on the one hand, specific spaces and sacred objects may afford the generation of agency-intuitions in a *bottom-up fashion*, through specific images, sounds, smells, etc. On the other hand, as discussed above, several research lines suggest that sensory deprivation – when combined with strong prior expectations yielding *a top-down modulation of sensory input* – may also elicit agency experiences, such as the feeling of a presence or the elicitation of visual or auditory hallucinations. Accordingly, a distinction could be made between bottom-up (i.e., triggered by props) vs. top-down (i.e., endogenously generated) agency-intuitions. An intriguing possibility for future research would be to assess these different intuitions in terms of vividness and impact on personal religious beliefs. In any case, two points are likely to hold true, according to IREM, for both kinds of agency-intuition. First, a structured external environment is crucial in either case (one with props on the one hand and one with sensory deprivation on the other). Second, in both cases the intuitions will largely be involuntary (the agency-intuitions that arrive in contexts of sensory deprivation may be top-down, but that does not mean that believers get to *choose* to have them). Importantly, many religious environments *combine* sensory deprivation with props; sites of oracles in the ancient world, for example, were often caves, and similarly, Catholic cathedrals often have dim light and shadow shrouding the effigies. The effect in sense-depriving environments is to lower the levels of *other* sensory experience so that the agency-intuitions feel more pronounced.

A third recommendation of IREM is to map out the different psychological mechanisms whereby agency-intuitions form the basis for personal religious beliefs. As we pointed out, different theoretical models might account for such processes, including the predictive processing framework (Clark, 2013), the building-block approach to religious experience (Taves, 2011), dual-process accounts of human cognition (Risen, 2016), and theories positing a central role for theory-of-mind reasoning (e.g., Schjoedt et al., 2009). It is unlikely that a single mechanism underlies the transition from intuitions to personal beliefs, and throughout this article we have advocated a multifaceted approach, whereby we propose to integrate and extend promising existing research lines that are broadly compatible with our framework. For instance, following dual-process accounts of religion, a stronger reliance on intuitive thinking should make people more likely to accept agency-intuitions (for related work in this direction, see, for example, research on teleological thinking; Kelemen & Rosset, 2009).

Similarly, reduced error monitoring (e.g., through a process of *cognitive resource depletion* induced through intense religious rituals) may also make people more willing to accept agency-intuitions (Schjoedt et al., 2013). Thus, IREM proposes that different contexts may trigger different psychological mechanisms, fostering the incorporation of agency-intuitions or other low-level experiences into personal beliefs.

A fourth implication of the IREM framework is that differences in mentalizing abilities (e.g., as observed in autism) should affect the endorsement of *personal* religious beliefs, even if those differences don't much affect *general* beliefs. Hyperactive mentalizing abilities (e.g., as observed in schizotypy) may result in an exaggerated reliance on personal (rather than general) religious beliefs (see, for instance, Fyfe, Williams, Mason, & Pickup, 2008, who show an association between apophenia and delusional beliefs). Thus, a central prediction of IREM is that measures of personal religious beliefs should be strongly related to the agency experiences and intuitions that people encountered. This calls for the introduction of novel measures and for clearly distinguishing between general religious beliefs, personal religious beliefs, and personal experiences.[20]

Fifth, IREM predicts that specific types of agency experience will differ as a function of the practices encouraged within one's community. Given an emphasis on seeing patterns (e.g., auras, reading coffee, reading chakras), paranormal believers may be specifically inclined toward having perceptual agency-intuitions. Indeed, our field studies among paranormal believers indicate that they frequently have agency experiences that they tend to interpret in a paranormal way (van Elk, 2013, 2017). For instance, one middle-aged man reported that following his move into a new apartment, "There were objects moving without an apparent explanation; things would drop from the shelf. My TV turned itself on and off, and went back to normal when I called the name of the previous deceased inhabitant." In contrast, Pentecostal believers frequently engage in auditory imagery to seek experiences of supernatural agency (e.g., imagining hearing the voice of God or interpreting spontaneous visual imagery). As noted above, Catholics may more readily use statues of religious persons as props for generating agency-related experiences. Thus, again, rather than hypothesizing a general association between agency detection and supernatural beliefs, researchers need to differentiate between different types of agency detection (e.g., biological motion detection; auditory agency detection; the feeling of a presence), and specific groups of believers should be probed with more appropriate tasks that fit well with their background general religious beliefs and practices.

7. Conclusion: creativity and constraint in the formation of personal belief

The basic outlook of IREM is by now clear. Religious believers go into the specific structured environments they do (props and all) in order to have powerful experiences – sometimes thrilling, sometimes reassuring, and sometimes frightening. In this article, we have mostly focused on the low-level experiences we call *agency-intuitions*, but it is clear that our model extends to include intuitions and experiences resulting from teleological thinking, magical thinking, meaningful coincidence, and various other System 1 biases.

Intuitions come in various forms, corresponding to the different agency-detecting or neural systems that underlie them, but they all involve a rush of feeling as if *someone, something, or some event* is or has been there. But unlike the proponents of HADD Theory, we do not say that agency-intuitions in any contemporary individual are likely to be a major cause of their general religious beliefs; evidence for that view is hardly compelling. Rather, individuals typically *interpret* such intuitions in light of general religious beliefs they already have in order to form personal beliefs.

Furthermore, religious believers often deliberately structure their environments, or go into previously existing peculiar environments, *in order to* induce intuitions and other experiences, since such experiences cannot simply be had at will. According to IREM, agency-intuitions, for example, provide one form of constraint on personal beliefs and thereby make their subject matters seem more real. If one simply forms a personal belief *that God visited me on Sunday*, this would feel simply invented – fake almost. But if one, by one means or another, has a frightful, exhilarating *feeling of presence* one Sunday morning, *then* one's personal belief to the same effect will feel much more

"real." Accordingly, one might eagerly go to ritual environments that *induce* such feelings of presence. Hence, the constraints provided by agency-intuitions powerfully aid in forming indexical, personal beliefs. On such a view, we notice a striking parallel: the impulse to go into a sacred room with magic objects and figures that represent divinities and saints in many ways parallels the impulse to go into a dark, somber house with figures that represent supernatural agents of another sort; one is a cathedral and the other a haunted house, but both trigger low-level rushes of personal experience that can be interpreted in light of background cultural narratives about the supernatural.

But importantly, in addition to constraint, there is a creativity at work here too, and this fact highlights the *active* nature of personal belief formation that is present in IREM but not in traditional HADD Theory: it is no small task to work out what kinds of situations can give one the thrill one seeks. So one must be creative, building shrines, carving statues, painting images, going into caves, turning down the lights, or setting a place at the dinner table for God. People want to *feel* something. And in feeling something they can tell themselves a personal story. From this perspective, the cultural evolution of religious environments and practices is in many ways a history of the development of creative ways to engender belief-constraining experiences, so that when one enters such environments or performs such practices, one in fact can be said, from an experiential standpoint, to be seeking the supernatural.

Notes

1. General religious beliefs, on our taxonomy, may also be less widespread (though *typically* they *are* culturally widespread); for example, one might come to an idiosyncratic theory of a supernatural agent, and this theory would still be encoded in general beliefs. The key point is that general beliefs do *not* have indexical constituents derived from personal experience, as personal beliefs do.
2. We also discuss the influence cognitive biases might have in forming general beliefs *by way of* personal beliefs. We choose, however, to focus more on the first step: how cognitive biases influence the formation of personal beliefs, since (1) the empirical studies that have looked specifically for an influence of agency-detection on forming (general) beliefs have not yielded impressive results (see section 3) and (2) the formation of personal beliefs has not yet been properly addressed in the literature.
3. The general idea that much religious belief is anthropomorphic is of course very old; it can even be found in the fragments of the pre-Socratic philosopher Xenophanes. But Guthrie was the first to propose the more specific idea that we have special *evolved detectors* for agency and that *these* engender anthropomorphic religious belief.
4. We note that Justin Barrett has developed different versions of HADD Theory (e.g., Barrett, 2000; Barrett & Lanman, 2008; Clark & Barrett, 2010) that differ in nuanced ways. For the sake of clarity and brevity here, we focus on the model developed by Barrett and Lanman (2008), which in our view provides the most complete and compelling account of the role of agency detection in religious beliefs.
5. We set aside the interesting (and tortured) issue of informational encapsulation, since addressing it would involve a long digression that would not advance the aims of this article.
6. Lisdorf (2007) also discusses the potential neural correlates of the HADD and proposes the superior temporal sulcus (STS) and the mirror neuron system (MNS) as candidate mechanisms. In addition, he discusses the role of what is now known as the mentalizing system (theory-of-mind network) in ascribing intentionality. Although we are favorable to his approach, the potential function of the MNS in social cognition is more contentious these days (e.g., Hickok, 2009). In addition, we do not necessarily agree with Lisdorf's proposal that a modular account of the HADD entails the requirement that such a system should be unique to humans.
7. Though the assumption is often left implicit, a general axiom of the by-product view of religiosity is that stronger agency detection/mentalizing should result in stronger supernatural beliefs. We note that the most prominent examples of by-products stem from biology (e.g., the belly button is a by-product of the umbilical cord). It is more difficult to find good examples of by-products of cognitive faculties – which is surprising given the prevalence of by-product explanations in evolutionary psychology. It has been proposed that language is a by-product of our general intelligence and increased dexterity (Hauser, Chomsky, & Fitch, 2002), that music is a by-product of more general mechanisms supporting language and coordination (Honing & Ploeger, 2012), and that religion is a by-product of our agency-detection capacities (Barrett, 2000). Interestingly, anorexia nervosa as characterized by rigorous self-constraint and episodic impulsivity has been proposed to be a by-product of a cognitive mechanism to cope with times of scarcity (e.g., Fessler, 2002). These examples indeed have in common that a stronger underlying cognitive propensity (e.g., for fasting) should result in an even more striking by-product (e.g., developing anorexia).
8. We note that Ryan McKay and Robert Ross are currently conducting a meta-analysis on (unpublished) studies that have attempted to manipulate religious beliefs (see: http://pc.rhul.ac.uk/sites/mab-lab/meta-analysis/) and we are looking forward to seeing the first results from this important endeavor.

9. Interestingly, several studies have found that religious believers are more likely to provide teleological explanations for natural phenomena (e.g., this thunderstorm happened for a reason; cf., Banerjee & Bloom, 2014; Heywood & Bering, 2014) and to make fate attributions (e.g., believing that seemingly random events such as finding a diamond ring on the street were destined to be; Norenzayan & Lee, 2010), which were in turn related to belief in God. We note, however, that teleological thinking and fate attributions cannot be considered agency-detection capacities in the narrow sense implied by HADD Theory, but are part of a broader class of socio-cognitive biases that have been associated with supernatural beliefs – a point to which we will return when presenting our theoretical model in section 4.
10. Upon close reading, Guthrie's account does do some work here. He seems to hold that humans jump from the inference that another *human* was present to the conclusion that an invisible deity was present. He attempts to explain this by arguing that humans are also often invisible and ambiguous and therefore share many attributes with invisible deities. At the same time, his theory places a strong value on the motivational needs that religion fulfills; people have a motivated tendency to seek relief from threat, uncertainty, and unpredictability, and anthropomorphic models provide a way to satisfy these motivational needs. This has some plausibility, but on our view, it is still not clear enough on how background cultural beliefs and agency-intuitions are supposed to interact.
11. There is a complication here. It is possible that there is a causal route from agency-intuitions to general beliefs *via* personal beliefs. We explore that possibility below.
12. However, even among this group a trend toward a more experience-based approach to religion can be observed, as many Calvinist believers frequently visit musical events and religious festivals for instance (de Hart, 2014).
13. Perry, to be precise, distinguishes *self-attached knowledge* from what he calls *agent-relative information*, where the former is a species of the latter; but for our purposes, the intricacies of this distinction don't make a difference, so we write in terms of "self-attached information," since it results in a less confusing terminology for the purposes of our exposition. The concept invoked is still Perry's (see Van Leeuwen, 2012).
14. An analogous distinction can be found in cognitive psychology, in which semantic memory for general world knowledge is often contrasted with episodic memory, referring to the first-person subjective experiences that one has encountered across one's life.
15. There is another possible connection here between self-attached information and objective information. One might antecedently *know about* some subject matter in an objective/detached way, without actually *believing* propositions about it (even though one knows others believe them). But then, on having experiences with certain self-attached information (such as seeing the Grand Canyon), one goes on to form the attitude of *belief* toward the objective information, even though one's previous attitude was only hypothetical. Prompted by one anonymous referee, whom we thank, we explore this kind of connection in relation to general and personal religious belief below.
16. Philosophers call this feature of experiential mental states immunity to error through misidentification; see Perry (1990, 1998) for discussion.
17. Thus, one main theoretical advantage that IREM has over traditional HADD Theory is that IREM posits general beliefs as pre-existing due to culture, so they are available for us to use in explaining how agency-intuitions come to be interpreted in a way that yields personal beliefs; HADD Theory, by way of contrast, is silent on the differences between general and personal beliefs and so *can't* give explanations of this form.
18. Suggested by one anonymous referee.
19. We thank one anonymous referee for suggesting this approach to analyzing Rödlach's work.
20. Recent studies on paranormal beliefs provide an important first step in this direction, by asking specifically about agency-related experiences (e.g., *I have had the impression of a figure nearby, yet nobody could possibly have been there*) and about the interpretation of those experiences (i.e., a paranormal interpretation, *Yes, and it was probably an apparition or ghost.* vs. a mundane explanation, *Yes, but it was probably just an illusion or a misperception*; cf. Ross, Hartig, & McKay, 2017).

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COMMENTARIES

Predicting the supernatural

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Recent years have seen a resurgence in research on agency detection (Andersen, 2017a, b; Andersen, Pfeiffer, Müller, & Schjoedt, 2017; Andersen, Schjoedt, Nielbo, & Sørensen, 2014; Maij & van Elk, under review; Maij, van Schie, & van Elk, 2017; Riekki, Lindeman, & Raij, 2014; Riekki, Lindeman, Aleneff, Halme, & Nuortimo, 2013; van Elk, 2013; van Elk & Allen, 2015; van Elk, Rutjens, van der Pligt, & van Harreveld, 2016). Van Leeuwen and van Elk follow suit, providing us with a timely theoretical article that is a valuable and welcome contribution to the cognitive science of religion. In their target article, Van Leeuwen and van Elk make a commendable effort to formalize the relationship between agency detection, socio-cognitive biases, and religious belief. The result is the IREM, a plausible model that represents a vast improvement compared to former accounts of the role of agency detection in the forming of religious belief. However, I am haunted by one or two minor reservations. In the following, I therefore highlight a few issues with the IREM that I hope Van Leeuwen and van Elk will address and elaborate upon in their future work.

First, a central idea of the IREM is that agency-detection capacities and other socio-cognitive biases are hypothesized to be involved mainly in the forming of personal beliefs. While Van Leeuwen and van Elk make a strong argument for agency detection being mostly relevant to the forming of personal belief, previous research suggests that a range of socio-cognitive biases do in fact seem to have profound effects on *general* beliefs as well. For instance, in their classic study, Barrett and Keil (1996) used a story-recall test to show that participants often intuitively fell back on an anthropomorphic God concept replete with human limitations when asked to re-tell a story in which God was described

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