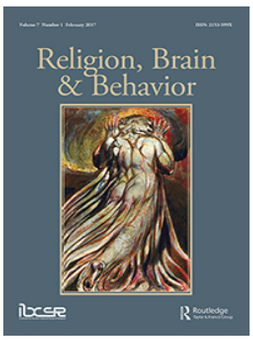

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COMMENTARY

Can predictive coding explain past experiences?

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In their target article, Taves and Asprem suggest disassembling religious experiences into events, and studying the formation and interpretation of religious experiences using the approach of cognitive science. We support such an approach and especially embrace using experimental methods to better understand how religious experiences can be generated. However, we are concerned with the feasibility of using first-person narratives to reconstruct "originatory events." The study of unusual experiences has not been prominent in the cognitive science of religion (CSR), as the authors note, because of "the difficulties inherent in the use of first-person narratives." Although Taves and Asprem try to address some of these difficulties (e.g., bias in recollecting past events), there is a host of remaining issues that might significantly impede the attempt to rehabilitate the first-person accounts as a prime data source for CSR. We identify and outline three crucial problems and suggest that clarifying these issues might advance the approach proposed by Taves and Asprem.

First, assuming that a patterned practice shapes one's top-down generative models and helps to make sense of prediction errors (Clark, 2013; Roepstorff, Niewöhner, & Beck, 2010), we would need to be able to quantify the strength of an individual's predictive models (priors) and their influence on particular experiences. However, such data are difficult to acquire from a first-person narrative. A person might be affiliated with a specific religious tradition, but we cannot really know how much his or her religious belief is internalized (Berger & Luckmann, 1991). Self-declared religiosity might give us a hint, but these declarations might be biased for various reasons (e.g., prestige; see Gervais & Norenzayan, 2012). In the words of hierarchical predictive coding (HPC), we cannot be sure of the predictive strength that such generative models would have in an individual mind. One's patterned practice might predict the existence of ghosts in haunted houses, but such a hypothesis might have a very low posterior probability. Although the ghost explanation might indeed be selected by the individual, such an explanation might be just the best out of bad hypotheses. Prediction error caused by "the presence of a ghost" would probably lack both weight and precision and would not impact the top levels of cortical hierarchy. This uncertainty would make retrospective inferences difficult, because we would lack confidence in the main predictive models influencing real-time appraisals.

Second, given that one strongly believes in ghosts, it is reasonable to expect that a ghost's presence will be inferred when triggered by specific cues. However, an inference process is not fully conscious, and tracing original cues back from a narrative to a real-time model will be constrained by a narrator's focus of attention. Attention might be highly selective in isolating only some features in perception (Barsalou, 1999), and a person will report different factors in a haunted house when looking for a ghost (top-down sensory expectation) than, for instance, when looking for a treasure with no expectance of ghosts (see a discussion of inattentional blindness in Hohwy, 2012). Such a situation might be narrated in very different ways, highlighting different environmental cues. Moreover, research on the role of automaticity in behavior suggests that humans often make decisions based

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on unconsciously perceived cues (Bargh, Schwader, Hailey, Dyer, & Boothby, 2012). For example, a picture of an old man hanging on a wall might trigger the experience of ghost presence, but we will rarely know, because such a factor would most likely be left out from the narrative.

Third, it is unclear from the target article what experiences are to be studied. For instance, experiences deemed religious might span from participating in the *Hajj* to feeling a sense of unity during meditation or to talking with one's ancestors. From the perspective of HPC, such experiences will have different causal mechanisms that might impact the construction of working models. When talking about religious experiences, Taves and Asprem usually refer to "dreams, visions, voices, and appearances," suggesting that they are interested mostly in unusual perceptual experiences. However, the more unusual an experience is, the less confident we can be in reconstructing events promoting it, because we lose clear distinction between self-generated percepts and external inputs. The authors acknowledge that sometimes it will not be possible to distinguish between original cues and appraisals. But we are concerned that when studying "originatory events," this scenario will be a regularity rather than an exception.

Consider again seeing a ghost in a haunted house. Such an experience might be a product of a very strong top-down generative models (hyper-priors) that fill in the sensory gaps caused, for example, by sensory deprivation in dark environments or by extremely noisy input comprising a number of predictive errors (Corlett, Frith, & Fletcher, 2009; Whitson & Galinsky, 2008). Or it could be a defect in self-monitoring that tags a self-generated visual stream as external (Fletcher & Frith, 2009). Any of these scenarios can make past reconstructions equivocal, because we would not be able to distinguish between self-generated perceptions and actual environments. A possible solution to this problem would be to assess proneness to such experiences as suggested by the models of positive symptoms in schizophrenia (Corlett, Krystal, Taylor, & Fletcher, 2009). For instance, we might be able to quantify the rigidity of a corollary-discharge inhibition that normally helps to suppress the self-generated sensory signals, assuming that people with more variable inhibitions will be more likely to experience the self-generated thoughts and actions as external (Fletcher & Frith, 2009). However, assessing the rigidity of corollary discharge retrospectively would just affirm the consequent, as Taves and Asprem note elsewhere in the target article.

In sum, we do not claim that the approach proposed in the target article is infeasible. But we conjecture that models of past religious experiences will have different confidence levels, and some will be very uncertain. It would be helpful to see a real application to historical data in order to estimate the utility of this approach. Such an analysis should show how to (1) ascertain that narratives were not purposefully constructed (i.e., made up) to reach specific goals; (2) identify and filter out effects of unconscious biases in a narrative construction; (3) reconstruct a past event's environment; (4) assess the strength of predictive models that might have caused a religious appraisal; and (5) distinguish between self-generated percepts and external cues.

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