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Explaining agency detection within a domain-specific, culturally attuned model

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Agents, or objects that appear to act with intentions, are readily perceived (Heider & Simmel, 1944), even when no agent is actually there, and may be characterized as "supernatural" (Barrett, 2000). In his target article, Andersen argues that a Bayesian statistical framework of predictive coding may better account for existing data and make novel predictions relevant to agency detection. We discuss a few key points in response: (1) domain specificity and agency detection; (2) sources of variability in agency detection; and (3) sources of hypotheses explaining agency detection.

Domain specificity and agency detection

Despite important similarities to the Bayesian statistical framework, domain-specific accounts are mischaracterized in the target article as uninformed by "prior expectations," thus allowing for less flexibility. In fact,

> the more that the input supports the related conceptual structure, the greater is the probability that the attribution will be consistent with the input. However, when data are ambiguous or when there are gaps in the data, we can count on our conceptual structure to assist us. (Gelman, Durgin, & Kaufman, 1995, p. 181)

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As these words describe a domain-specific account of animacy, something similar should be true for agency detection; perceptual input, integrated with domain-relevant conceptual representations, drives inferences about the presence of an agent. Domain-specific mechanisms rely heavily on extra-perceptual information, whether it be content within the mechanisms of interest or "top-down" content delivered from other mechanisms. In fact, domain-specific accounts should precisely state what extra-perceptual information is accessible to a mechanism that enables it to operate flexibly, generating a wider array of representations or behaviors given different contexts (Barrett & Kurzban, 2006). Examples from cognitive science abound: prior events update time representations (Balsam & Gallistel, 2009), and specific contextual factors moderate social exchange computation (Cosmides, Barrett, & Tooby, 2010).

Counter to Andersen's argument, the case of culture demonstrates how prior expectations may actually rely on domain specificity. Andersen argues that predictive coding would better account for cultural variability in supernatural agency detection because it incorporates prior expectations that a person would have learned from their cultural or social surroundings, including "religious upbringing, ritual attendance, religious schooling, societal levels of religiosity, and so forth." Yet the problem is that cultural variability does not necessitate domain generality.

Take, for example, social attention. Humans show interest in what other people are attending to. Because social attention is early and reliably developing, some may assume that the social attention system is impenetrable to top-down expectations, including cultural knowledge. However, our research demonstrates that the social attention system may be *culturally penetrable*, or sensitive to cultural inputs, given that European Americans and East Asians execute different patterns of attention to social cues automatically (Cohen, Sasaki, German, and Kim, 2017). Crucially, the social attention system has domain-specific features that seem to be attuned to particular social or cultural cues in the environment. Indeed, culture often calibrates domain-specific mechanisms in order to exert its influence.

Sources of variability in agency detection

Another important consideration is that the sources of individual differences in agency detection sensitivity are due not only to cultural, situational, or otherwise "environmental" differences, but also to genetic differences. Because the Bayesian statistical framework focuses on prior experience as one of the most important sources of variability in supernatural agency detection ("pre-existing beliefs can now additionally, and perhaps more importantly, be viewed as independent drivers" of perceived experiences with supernatural agents), it may ignore the possibility that there are biologically based sources of variation and, furthermore, that these biological susceptibilities often interact with inputs from the environment, as in gene–environment interactions (G × E) (Sasaki et al., 2013; Sasaki, Mojaverian, & Kim, 2015).

For instance, exposing people to supernatural thoughts (e.g., God, divine) increases prosocial behavior, but only for those with certain genotypes of the dopamine receptor gene DRD4, who are genetically susceptible to reward sensitivity (Sasaki et al., 2013). According to this G × E research, the source of variation cannot be predicted from cultural factors alone but must instead be understood in complex interaction with biological factors.

Sources of hypotheses explaining agency detection

One final concern with the Bayesian statistical framework centers on an induction problem: for any stimulus, there is an infinite set of potential hypotheses or interpretations that are consistent with the stimulus (Chomsky, 1980; Quine, 1960). There are, in principle, an unlimited number of inferences that flow from object detection besides those about agency: the object is kin; the object is solid; the object is worth less than $10; the object weighs more than me. Why, then, does it occur to some part of the cognitive architecture that the object might be an agent? The reason may be that domain-specific mechanisms for agency detection privilege certain hypotheses when encountering particular perceptual inputs. A problem with predictive coding as described in the target article is that it

offloads the problem of where hypotheses entering into the Bayesian inference come from in the first place. We strongly agree with the claim that the mind is "a pro-active, hypothesis-generating machine that is constantly testing its hypotheses against the incoming signal," but without domain-specific mechanisms generating a set of hypotheses relevant to agency detection, a domain-general process would have to entertain a large if not infinite set of hypotheses. Mechanisms without domain-specific content to actively structure the inference cannot solve these types of problems, let alone arrive at a solution rapidly, as agency detectors regularly do.

Concluding remarks

Prior experiences or cultural factors must be incorporated in accounts of agency detection, but a revised model still needs to explain why social knowledge would be prioritized over individual learning when it comes to supernatural agency detection. A truly Bayesian model should plateau at an accurate explanation of agency detection – that is, that there are no supernatural agents given that the system should learn from having never seen a supernatural being. That the system is resistant to data from individual learning suggests some amount of domain-specific knowledge – a prior – that facilitates agency attribution, with bounded updating from socio-cultural experiences.

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Agency detection is unnecessary in the explanation of religious belief

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