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## Comments

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Weingarten and Chisholm make an excellent, and often overlooked, case for the importance of the attachment system in the evolution of religious belief and behavior, particularly in relation to the individual's perceived relationship with authoritarian and moralistic supernatural agents. They give considerable mention to the role of "theory-of-mind" capacities (which are invoked when reasoning about the unobservable psychological states motivating events and behaviors) as providing vital cognitive scaffolding for their proposed evolutionary mechanisms. I certainly agree that theory of mind is crucial to the attachment system as outlined here, and, like the authors, I suspect that such relationships originate through processes similar to the more mundane parent-child attachment profile.

Bovet (1928), a contemporary of Piaget's, argued that children's representation of God as an omniscient agent was an extension of their original ascription of these "all-knowing" properties to their mothers. Once they escaped their egocentric biases and realized that their mothers could be deceived, argued Bovet, they transferred this omniscience to God, who was conveniently introduced to them via culture around this same time. In fact, recent, unpublished data in the field of cognitive development reveal a clear trajectory in the way young children are able to reason about the extraordinary mental abilities of supernatural agents. Although there is some debate, current work in this area shows that children are unable to truly grasp the construct of omniscience until they are about 5–6 years of age and have been explicitly told that, say, God is an extraordinary agent with special mental abilities. Before this, children who have a theory of mind appear to regard God as being just as psychologically fallible as a run-of-the-mill person, that is to say, as an agent who can hold false beliefs and be confused.

On the surface at least, such data appear to support Wein-

garten and Chisholm's arguments concerning the shared countenance of parental and supernatural-agent attachment mechanisms, with the latter just being special types of relational partners that, like parents, are expected to react punitively to bad behavior. However, although the attachment system is clearly an important piece of the evolutionary puzzle of religion, it is less obvious to me why this necessarily implicates group-selection processes. As the authors note, there is an empirically established positive correlation between such things as moralistic gods and group size (Roes and Raymond 2003). Although such data can be used to favor group-selection (or multilevel-selection) models, it can do just the same for more standard individual-level arguments of natural selection, and more parsimoniously, for that matter. In terms of the adaptive value of attachment to supernatural agents, what is "good" for the group is typically "good" for the individual group member as well. Even in those cases where this would not obviously apply, such as in examples of costly religious rituals or even suicide, group-level selection arguments are often obviated by the basic principles of inclusive fitness (Bering and Shackelford 2004).

Finally, attachment to supernatural agents is buttressed by perceived ostensive-referential communication signals "emitted" by supernatural agents. In principle, believers should see a natural event, such as a family member's illness, as a form of punishment, but in fact this is a cognitively complex issue, since "punishment" is highly subjective. For the individual who stands to inherit resources in the event that this beloved family member dies, the episode may be privately perceived as a benevolent gesture on the part of the supernatural agent. This is where theory of mind, and in particular being able to attribute privileged epistemic states to relationally attached supernatural agents (e.g., knowing what the self wants, in spite of this desire being hidden from other people), must be accommodated by the authors' attachment model, because such phenomenological nuances seem vastly important.

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*Gods of Love?* If Darwinian evolution favors self-interest, how is large society possible? One popular idea is that god-commitment polices cooperation through negative punishment incentives (Johnson and Kruger 2004, 173; Bering and Johnson 2005). Attachment theory observes that love also swamps selfish desire. Weingarten and Chisholm argue that religious love is an especially powerful community-building emotion, visible to selection's grain.

Cognitive neuroscience helps to evaluate hypotheses about

how religion works by enabling researchers to identify specific proximate circuits and their relative contributions (Lisdorf 2007). In an intriguing supplement (supplement B), the authors find evidence for their attachment model in the neuroscience of love, focusing especially on the cognitive and behavioral effects of oxytocin and vasopressin. Though promising, such studies bear only indirectly on hypotheses about religion. Here, we review recent religion-specific functional magnetic resonance imaging (fMRI) studies that give qualified support for an attachment model, cast doubt on strong versions of the punishment hypothesis, and signal exciting new interdisciplinary horizons in the naturalistic study of religion.

*Neuroscience and Social Cognition.* If religion evolved to generate fearful social restraint, then we might expect the presentation of religious stimuli to evoke a fear response in the amygdala or an anxiety response in the anterior cingulate cortex (ACC). A recent NIH (National Institutes of Health) study used fMRI to evaluate Blood-Oxygen-Level-Dependent signal (BOLD) responses to religious expressions reflecting varying degrees of God's emotion and God's involvement (Kapogiannis et al. 2009). Examples included "Religion is moral guiding" and "God is punishing." In the intention and emotion conditions, religious expressions activated prefrontal circuits associated with self-referential thought, language, and the evaluation of intention and emotion. However, only where expressions denied God's existence did the team find elevated emotion (in believers). Further, the regions of activity were located in the anterior insula, suggesting moral disapproval or disgust. No specific amygdala or ACC activity was found and therefore no evidence of increased fear or anxiety. While social-strategic contrasts are needed to specifically evaluate the role of divine punishment in cooperative settings, a strong version of the punishment model implying general fear appears unwarranted. Supporting a broader attachment theory, the activity of social mind circuitry was observed and varied with the presentation of God's involvement and emotion.

The NIH study considered responses to religious statements. Yet how do religious persons *experience* their gods? A series of experiments conducted at Århus University sought to answer this question. Schjødt et al. (2009) compared neural responses for personal petitionary prayer with those for repetitive prayer in a group of devout Danish Christians. The team was interested in how different practices within the same tradition affect non-elite Christians who pray. The two prayer conditions—personal/improvisational and repetitive (the Lord's Prayer)—were further contrasted with comparable secular conditions: making wishes to Santa Claus (improvised) and a nursery rhyme (repetitive). In Christians who pray often, improvisational prayer elicited robust recruitment from social mind networks in the anterior medial prefrontal cortex (mentalizing), the temporoparietal junction (assessing intentional causation), the left temporopolar region (personal autobiography and social narrative processing), and the precuneus (self-referential activity/kinesthetic movement). However, no such effects were found for wishes to Santa. Regarding

divine punishment, no specific amygdala or ACC activations were found, casting further doubt on strong versions of the divine-punishment model. As with the NIH study, however, social mind areas were active, giving further support to dynamic attachment. Schjødt et al. (2009) conclude,

Our results show that young Danish Christian Protestants of IM [Inner Mission] recruit areas of social cognition during personal prayer, which suggests that praying to God is an intersubjective experience comparable to "normal" interpersonal interaction. . . . [I]n terms of brain function, our results suggest that the IM participants mainly think of God as a person, rather than as an abstract entity. (P. 205)

Music to an attachment theorist's ears? There is a twist. The Danish team found no specific BOLD response in social mind networks for repetitive prayer. It appears that when Christians repeat the Lord's Prayer, they do not engage with a representation of their Lord's mind. Instead, the researchers found activation in the dorsal striatum, an area at the head of the caudate nucleus important to reinforcement learning and anticipated reward (Schjødt et al. 2008). Furthermore, goal-oriented neural signatures were observed; there was no evidence of fear or anxiety. Pull—as opposed to push—motivations appear more compatible with dynamic attachment than with punishment. Importantly, only Christians who prayed regularly enlisted reward-related circuitry in repetitive prayer. Rewarding prayer, then, appears to arise through training; it does not arise merely from group membership or belief (on the cognitive importance of training, see Luhrmann 1991). Taken collectively, then, the Danish findings reveal that adoption-specific cultural practices and training matter to religious cognition, even within the context of a small, unified religious community.

These results are consistent with those of older studies showing neural phenotypic variation for distinctive religious practices: suppression of self-referential capacities during meditation (Newberg and Newberg 2008) and altered states of consciousness (Cahn and Polich 2006) and nonaffective abstract cognitive representation during prayer (Azari et al. 2001). Although neural variation is observed, at present we can hardly assess its scope and so cannot properly address the question of how variation relates to attachment models of religion.

*Summary.* Any honest assessment of the present state of understanding reveals that little is known about how religion operates in the mind. The next few decades may require us to reconsider almost everything we think we know. Better models will arrive through intelligent interdisciplinary collaboration, drawing cultural anthropologists, historians, and scholars of religion into the fold, with no holds barred. Attachment theory carries us one more step toward that intriguing future.

light on eusociality (Wilson and Hölldobler 2005). Perhaps it could throw light on human cooperation.

—Carol Popp Weingarten and James S. Chisholm

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