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The Socio-religious Brain: A Developmental Model

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> Therefore, a prince must have great care that . . . to see him and hear him, he appear all piety, all faith, all integrity, all humaneness, all religion. And there is nothing more necessary to seem to have than this last quality. And men in general judge more by the eyes than by the hands; because to see is for everyone, to feel for a few. (Machiavelli, *The Prince* 1997 [1532], 67)

THE SOCIAL BRAIN HYPOTHESIS has made significant progress toward explaining why humans have such large brains for their body size (Byrne & Whiten 1988; Dunbar 1998, 2003; Whiten & Byrne 1997). Our large brains have enhanced our social capacities—particularly the ability to track multiple interconnecting relationships—and introduced selective pressures to maintain and heighten these abilities in order to keep pace in the competitive landscape (Byrne 1998). Here we examine the role of religion in this evolutionary dynamic. Any of the core elements of human society—political structure, economics, kinship, resource acquisition, art, religion, etc.—could have independently played an important role in the development of the social brain. Why distinguish religion among these core elements? Is religion an important part of the repertoire of social manoeuvres that are linked to brain size? Or even, as Machiavelli advises, the most important?

Religion stands out from other aspects of society because it is the medium through which enculturation and social bonding took place during the bulk of our evolutionary past. Components of the religious system, such as ritual participation, supernatural belief, myth recitation and sacred/taboo distinctions are the language in which human sociality is transmitted. The specifics of each system vary from culture to culture, but there are important cross-cultural similarities, including a consistent pattern of developmental timing that is linked to neural development and universal life history phases.

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Following brief introductions to the social brain hypothesis and relevant concepts in the evolutionary study of religion, we discuss religion as a medium for enculturation. We argue that human sociality is inextricably linked to religion and offer a developmental account of the socio-religious brain through four phases of the life course—childhood, adolescence, adulthood and post-reproductive adulthood. The developmental account highlights the vital role that religion has played in transmitting and sustaining the cultural information that guides our social lives.

THE SOCIAL BRAIN HYPOTHESIS

There are fitness costs and benefits for individuals living in groups. The most significant costs include increases in pathogen exposure and direct competition for mates and resources (Byrne & Bates 2007). The proposed benefits of group living, which presumably outweigh these costs, include increased access to environmental information, safety from predation and cooperative resource acquisition that yields increased per capita returns. In order for individuals to reap these rewards effectively they must possess a suite of cognitive abilities that allow them to successfully negotiate living among a relatively large number of intricately intertwined relationships. The social brain hypothesis posits that selection favoured increased investment in hominin brain growth, especially the neocortex, to navigate a complex social world (Dunbar & Shultz 2007).

If human brain size is a consequence of selective pressures for increased social cognition, there should be differences between humans and other primates in the number, types, duration and complexity of social relationships. Dunbar (1998) has shown that group size, a measure of social complexity, is significantly correlated with neocortex size for the anthropoid primates. This relationship is robust to changes in metrics for the relevant variables (Dunbar 1995). While total number of individuals is only a proxy for interactions that take place within social groups, other measures of social complexity are also related to brain size, including social clique size (Kudo & Dunbar 2001), frequency of deception (Byrne & Corp 2004) and social play (Lewis 2000). Dunbar and colleagues have shown that the human mind could realistically maintain personal, not solely official, relationships with about 150 individuals (Hill & Dunbar 2003). Beyond this number, the cognitive demands imposed are expected to be too great, and groups of greater size are predicted to either fission or collapse.

A more recent version of the social brain hypothesis emphasizes the role of pair bonding. In a groundbreaking study, Shultz and Dunbar (2007) found a positive correlation between brain size and long-term pair bonds among carnivores, artiodactyls, birds and bats, but not anthropoid primates. The authors suggest that perhaps primate sociality is different from sociality in other taxa because primates have extended the qualities of their pair-bonded relationships to other social partners (Dunbar & Shultz 2007).

The benefits of group living are typically achieved through collective action, which creates a tension between individual and group interests. If some individuals are able to put forth less effort in a collective task (e.g. foraging and defence) than others, while still reaping the same benefit (e.g. food and safety), defection should spread. But if too many defect in this manner then eventually cooperation will fail. Presumably, both the ability and the tendency to defect should increase with group size since detecting free-riders is more difficult in larger groups (Olson 1965). However, this is not what we find in human groups. Humans are able to cooperate well in large numbers (Richerson & Boyd 2005) and economic studies in various cultures have shown that we tend to cooperate even when defection is not particularly costly (Fehr & Fischbacher 2003; Roth et al. 1991), though these studies do often find a small minority of participants playing a free-rider strategy. Given the potential benefits of free-riding, why does it seem that cooperation is in fact the dominant strategy?

RELIGION AND COOPERATION

Religion is one possible solution to the free-rider problem posed by evolutionary theorists attempting to understand group cohesion and cooperation, with three primary mechanisms offered as potential explanations. First, as anthropologists have long noted, ritual activity creates an emotional bond among participants which has been variously (and mysteriously) described as collective effervescence (Durkheim 1995 [1912]) and communitas (Turner 1967). Remarkably, this solidarity is achieved through both positive (e.g. dance, chanting) and negative (e.g. scarification, genital mutilation) affect rituals. The underlying physiological mechanisms that create this sense of cohesiveness during ritual activity remain obscure, but several authors have offered possible causal pathways that require further exploration (see Alcorta & Sosis 2005). The second explanation, referred to as the supernatural punishment

hypothesis, focuses on cognitive function and posits that pro-social behaviour can be motivated by fear of supernatural sanctions (Johnson 2005; Johnson & Bering 2006). Norenzayan and Shariff (2008) suggest that when people believe in supernatural beings with access to morally relevant information, this can help reduce defection by invoking evolved reputational concerns.

A third explanation of how religion impacts social cohesion involves costly signalling, in which participation in religious activity serves as a costly and therefore hard-to-fake signal of commitment to the group (Bulbulia 2004; Irons 2004; Sosis 2003; Sosis & Alcorta 2003). Religious systems maintain expectations concerning communal activities, often referred to as the four B's: bans (taboos), badges (markers), behaviours (rituals) and beliefs (Sosis 2006). Willingness to fulfil these obligations signals one's commitment to the values of the community, which typically include in-group cooperation. If fulfilling these obligations is more costly for non-believers than believers, then cooperation can emerge and stabilize.

Religion not only increases in-group cooperation (e.g. Sosis & Ruffle 2003), but it also enables individuals to extend their cooperative alliances beyond their immediate community. Religious signals may have less signalling value within small-scale groups where everyone knows each other well, since reputational concerns can often sustain pro-social behaviour. Rather, signals in small-scale groups may be used to build alliances with individuals who share a common religious identity but live in other communities, and thus whose reputations are less accessible (Sosis 2005). Indeed, in a recent computer simulation Dow (2008) has shown that costly religious signals can emerge when those outside of the group increase their trust of in-group members. Hayden (1987) has argued that inter-band cooperation was essential in our evolutionary history to overcome the challenges of resource stress, and that ecstatic ritual was the key mechanism that enabled inter-band alliances to form. The successful cooperative trade networks among Muslim and Jewish co-religionists of distant communities provide a more recent example of religion's ability to extend across community boundaries (Greif 1989; Landa 2008; Sosis 2005). While we think it is unlikely that religion could extend the cognitive limits of community size, religion does seem to increase *functional* group size by extending cooperation across community boundaries.

RELIGION AS MEDIUM FOR SOCIAL PROCESSES

Has religion's ability to promote cooperation and extend collaborative relationships across time and space played a role in the evolution of the social brain? There are two conceptual problems with this question. The first concerns a definition of religion. Countless scholarly definitions of religion have been offered, but religion is an inherently fuzzy category and there is no definition which has been universally accepted. Therefore, rather than define religion, many scholars have concluded that it can best be studied by considering its constituent parts (Alcorta & Sosis 2005; Atran & Norenzayan 2004; Bering 2005; Bulbulia 2005; Sosis n.d.; Whitehouse 2008), and here we continue this trend. Religion consists of recurrent core features including ritual, myth, supernatural agent concepts, symbolic representation and sacred/profane distinctions, which receive varied emphasis across cultures, but they all play important roles in enculturation.

A related second conceptual problem concerns generalizing this category of religion, however it is defined, across time and space. Anthropologists have long warned about the pitfalls of employing contemporary categories, especially religious ones (Bloch 2008; Evans-Pritchard 1965; Klass 1995), to interpret the behaviours and beliefs of traditional populations. Whereas in contemporary Western societies religion is conceived as a distinct and often separate aspect of social life, in most non-stratified societies traditional religions are not separated conceptually from other aspects of life. Belief systems and ritual practices permeate all other aspects of culture, rather than lying near the centre or periphery of individual identities, as they do in Western societies (Rappaport 1999). Given that the vast majority of our evolutionary history was spent in small hunter-gatherer groups, we must look to these societies if we wish to understand the relationship between religion and the social brain.

In small bands, religious rituals and beliefs *are* the language and method of many forms of cultural transmission. The transmission of these beliefs mediates the enculturation of younger members into the identities, roles and commitments necessary for functioning in the group. If selective pressures favouring sociality drove the evolution of larger brains, then the role played by supernatural belief, ritual and the sacred in this process cannot be overestimated.

Supernatural beliefs, rituals, the sacred and other core elements of religion all combine to form a complex of mechanisms that creates dis-

tinct group identities. Social cognitive processes contribute to the polarization that mediates bond (in-group relationships) and prejudice (out-group relationships). Just as children acquire language and theory of mind (ToM) according to distinct but typical developmental patterns, they also acquire the significant features of their own cultures (beliefs, behaviours, rituals, etc.) in a predictable progression of maturation (Morgan & Kegl 2006). The process of enculturation could potentially have innate features—perhaps we also have a 'universal grammar' for religion as we do for language (Alcorta 2006; Bloom 2007; Bulbulia 2005). We may be born expecting to receive and internalize a set of beliefs regarding the world that fit within certain cognitive constraints. The primary function of these beliefs would be to provide social rules and direct social interaction.

In band-level societies, abstract symbols and supernatural beliefs are invested with emotional significance through communal ritual participation, which also serves to promote bonding between the participants who are demonstrating their commitment to one another. While this process still occurs in religious communities today, what is novel in the modern setting is that it is now possible to identify millions of people as members of the same religious group, albeit in a more limited sense than if they actually knew each other. This makes it possible for markers of group membership to tap into evolved associations between religious signals and the trustworthiness of those bearing them (or at least their potential as a cooperative partner; see Sosis 2005). For example, consider the Jewish and Muslim merchants mentioned above—two particular individuals in a business relationship might not have participated in any group rituals with each other during childhood, so they likely are not deeply bonded to each other. They are, however, bound with the distinctive symbols, beliefs, and behaviours of their shared religion. Cooperation can then flourish even when reputations are largely unknown because religious identity provides a proxy for treating co-religionists as extended members of an in-group. The great advantage of this system is that it can achieve successful collective action among large numbers of people without imposing the impossible cognitive load required to actually keep track of them.

A DEVELOPMENTAL ACCOUNT OF THE SOCIO-RELIGIOUS BRAIN

As mentioned above, religious social bonding makes use of communal rituals, supernatural belief, and sacred symbols. We suggest that these features are used to organize enculturation and in-group bonding, and that ritual participation and the acquisition of supernatural beliefs vary in their expression and impact over the course of human lifetimes in predictable ways. What follows is a description of how religion mediates social bonding and identity formation during four developmental stages: childhood, adolescence, adulthood and post-reproductive adulthood. We focus especially on the stages in which the influence of religion is least understood—childhood and adolescence.

We propose that our susceptibility to the acquisition of new religious beliefs will be higher during childhood and adolescence in order to take advantage of the cognitive and neural flexibility characteristic of these stages. Sense of self, social cognition and linguistic ability develop during these early stages. Culturally acquired knowledge, self-concept and group bonding are all cemented during adolescence via emotionally salient initiations into adulthood. After adolescence the acquisition of new supernatural beliefs, while certainly still possible (as seen in modern societies in religious conversion) is less likely. Concerns in adulthood shift toward demonstrations of commitment to the group with increased ritual engagement in order to maximize the benefits of group living during reproductive years. Ritual engagement persists in post-reproductive adulthood, as older adults become the primary transmitters of beliefs, roles and rituals for younger generations.

CHILDHOOD

Although developmental psychologists have produced a wealth of literature on moral development (Killen & Smetana 2006), the field has a history of conspicuously ignoring religious cognition in children (Harris 2000). Recently, however, developmental psychologists have turned their attention to experimental examinations of religion with results that point to typical developmental stages in the areas of mind-body dualism and supernatural agent concepts (Bering & Parker 2006; Bloom 2007). A growing body of evidence also suggests an innate tendency in young children to include supernatural beliefs in their view of the world. Studies

have demonstrated that children are likely to apply teleological reasoning to explain a wide range of phenomena. This tendency occurs regardless of religious upbringing and in spite of parental tendency to use causal rather than teleological explanations (Kelemen et al. 2005), and only begins to decline in Western societies around the age of 9 or 10 (Kelemen 1999).

Religion and childhood are also intimately linked in the forms of early social interaction known as pretence and play. Dunbar (2003) suggests that the ability to infer intentions and beliefs in other agents, which we expect to have been strengthened throughout the evolution of the social brain, may have relevance for understanding religion. The scaffolding of levels of intentionality achieved by humans is underwritten by a theory of mind (ToM). Reasoning about supernatural agents and their concern with societal norms is expected to carry a significant cognitive load, not least because their behaviour is not directly observable. It is clear that ToM must be involved in the process of thinking about the beliefs and desires of supernatural beings, including the possibility that they may be false or different from one's own. Research on how pretend play and fantasy affect the developmental progression of ToM in children demonstrates that these phenomena are tightly bound to one another. We now explore the idea that religion has assumed some of the functions of play and pretence found in other species, similar to the way that language may have taken over the function of social grooming in humans (Dunbar 1996). Religion engages ToM to simulate interaction with supernatural and unfamiliar agents, assisting people in exploring the boundaries of their social relationships, even as they form and maintain these bonds.

Play and the social brain

Social play is among the behavioural indices of social complexity that are hypothesized to have spurred the evolution of large brain sizes in primates (Dunbar & Shultz 2007). Lewis (2000) found a positive relationship between neocortex ratio and social play behaviour in seven primate species. Similarly, Byers (1999) reports a positive correlation between relative brain mass and frequency of social play in Australian marsupials. Iwaniuk et al. (2001), however, found a play–brain size relationship between orders of mammals, but not within lower taxonomic groups, including primates and marsupials. Other research has shown that amygdala size predicts sexual adult–adult play in primates (Pellis & Iwaniuk 2002), and that amygdala and hypothalamus size are both positively

related to all kinds of social play in non-human primates (Lewis & Barton 2006). Another compelling finding is that primate species that have more brain growth occurring postnatally play more as adults (Pellis & Iwaniuk 2000). Humans were not included in this analysis, but human rates of postnatal brain growth are significantly higher than for other primates (Kaplan et al. 2000) and we suspect that humans also maintain among the highest levels of adult play, although this has yet to be assessed in comparative studies. This cumulative evidence points to a relationship between cognitive-emotional processing ability and play behaviour, although the direction of causality remains unclear.

Play appears to offer many benefits. In general, it may be seen as a rehearsal of behaviour in which the animal loses partial control of its body, thereby gaining experience in recovering from abnormal and unexpected situations (Spinka et al. 2001). Social play in particular may aid in learning the boundaries of social relationships in a safe environment where there are relatively few penalties for transgressions (Bekoff 2001). In chimpanzees, play rates become elevated in captive populations just before feeding time (Palagi et al. 2004), and therefore may also function in reducing tension and preventing conflict escalation.

On the other hand, play is also energetically expensive and carries opportunity costs. Social play in particular is cognitively demanding in that it requires the player to understand that its partner is acting 'non-seriously', sometimes communicated through play markers (e.g. Bekoff 1995; Waller & Dunbar 2005). In humans, pretence adds another level of cognitive complexity.

Play and theory of mind

Pretend play in children is often richly imaginative and involves substantial departure from real situations and actual identities. There is an apparent contradiction between children's ability to participate in pretend play before the age of 4 years and their inability to pass false-belief tasks during this period (Lillard 2001, 175). How can a child pretend to be (or be with) different people or animals without a developed understanding that others have distinct knowledge and perceptual states? The answer to this question remains controversial. Pretend play emerges by the second year at the latest, and possibly by 15 months (Lillard 2002, 190). Although children younger than 4 years old tend to fail the standard false-belief task, there is some evidence that they can succeed if demands on speech and memory in the task are limited (see Wellman et al. 2001). Despite

uncertainty about the timing of onset for ToM capacity, its correlation with pretence is still strongly supported. First, several studies have uncovered a relationship between ToM, as measured by false-belief tasks, and pretend play or certain constituent play behaviours. Four-year olds' scores on a fantasy/pretence factor were shown to predict their performance on ToM tasks (Taylor & Carlson 1997). Children observed performing more social pretence fared better on false-belief tasks seven months later (Youngblade & Dunn 1995). Theory of mind is positively correlated with joint action proposals and explicit role assignments (Astington & Jenkins 1995) or object substitution and role assignment behaviours (Nielsen & Dissanayake 2000). Second, autistic children, who have long been described as having a theory of mind deficit (Baron-Cohen et al. 1985), have difficulty producing spontaneous, creative pretend play (Jarrold 2003). Third, some evidence from neuroimaging suggests that brain areas associated with making mental state judgements are activated when adults watch others engaging in pretend situations (German et al. 2004).

Supernatural agents are no ordinary 'others', but they are assumed to have minds, which raises the question of whether the developmental progression of ToM applies to their cognition as well. Barrett et al. (2001) presented children aged 2–6 years with a false-belief task in which the researchers showed the children a box with a picture of crackers on it, revealed that it had rocks inside instead of crackers, and then showed them a paper bag that actually had crackers inside. When asked where Mom, God and a few other agents would look for crackers, there was a significant correlation with age in assuming that Mom would have the false belief and look in the cracker box, but age was not correlated with responses about God. Children typically assumed that God did not have false beliefs. Similar results have been found for Yukatek Maya (Knight et al. 2004) and Greek Orthodox children (Makris & Pnevmatikos 2007, but see authors' discussion). If these children conceived of God as just another kind of agent, they might attribute false beliefs to God when they understand that their fellow humans have them. Instead, they seem to retain the (culturally specific) 'theologically correct' (Barrett et al. 2001) belief that God is omniscient past the age at which they pass the false-belief task. Either they have a somewhat intuitive understanding that God's mind is different from humans', or they are flexibly reversing their ToM prediction when thinking about God. In either case, children appear well-equipped to reason about supernatural minds.

Play and religion

Similar to the study of religion, the study of play focuses on seemingly 'purposeless' composites of multiple interacting systems, with little consensus about its adaptive value. This is true for both play in animals and for pretend play in children. However, recent attempts to compare possible evolutionary functions across taxa have had success (Burghardt 2005; Mitchell 2002; Power 2000). Here we consider social play in animals as a mechanism for establishing and strengthening social bonds, and pretending in humans as an extension of this function. Imaginative play allows individuals to explore several dimensions of various social situations without actually experiencing them, contributing to a greater understanding of the mental and emotional states of others through simulation.

Religious stories are distinguished from fiction by certain truth values attached to them by those who follow their teachings. But there is no denying that the mythological and literary aspects of religion are spectacularly imaginative and fantastical. Supernatural characters are right at home in the epics and sagas of world literature, such as the Hindu Mahabharata or the Norse Eddas. Creation myths, eschatological scenarios and everything in between get imaginative treatment from religion. For instance, Black Muslims followed this Final Judgment story in the mid 20th century: a half mile long spaceship will descend on North America, releasing 'baby planes' that lay waste to civilization with incendiary bombs, while dropping leaflets in Arabic and English to believers in black Islam that direct them away from the flames (Walker 1990, 345–346). Sometimes the most bizarre and cryptic aspects of religious stories are effective at generating commitment, as with David Koresh's obsession with opening the 'seven seals' of Revelation 5.

Individuals engaging in religious cognition past the age of 4 years old are clearly not practising their ToM skills in order to develop the ability to make inferences about mental states, but they are exercising this capacity. If the links between pretend play and ToM are preserved over the life course, religion, in its deployment of both, may conserve some of the functionality of play found phylogenetically and ontogenetically. Psychological approaches have traditionally considered pretence only in the juvenile period, tending to ignore it altogether afterward (Göncü & Perone 2005). This is unfortunate because failing to study pretence among adults has obscured links between juvenile pretence behaviour and its adult manifestations, including art, literature, cinema, sports, comedy

Table 14.1. How pretence can encourage social understanding, and instances of its use in children's play and in Christianity. Pretence behaviors are from Lillard (1998, 15–16); examples are the authors' except where noted.

Pretence behaviour	Children's example	Religious example
Confronting others' beliefs through script negotiation	I'll be Batman and you be the Joker. Oh, alright, you can be Batman and I'll be the Joker	Dialectical engagement of pre-existing religious concepts in new belief introduction (Rappaport 1999)
One entity as two things at once	I'm a kid, but I'm also a dinosaur	Jesus as man and deity at once (John 1: 14)
One entity as representing another	This banana is a telephone (Leslie 1987)	This cracker is the body of Christ —often understood in practice as a representation (Burnham & Giaccherini 2005)
Role-playing, perspective-taking	I'm a fireman, I need to save the kittens from the pet store fire	What would Jesus do? (Fiala 2007)
Acting out conflicts with emotional resonance	I'm the mommy, and I don't like it when you hit my baby!	Story of the binding of Isaac (Genesis 22: 1–19)

and, most notably for our purposes, religion. Lillard (1998, 15–16) suggests five ways by which pretending could encourage social understanding: (1) negotiating topic and script of pretence, thereby confronting the beliefs of others, (2) seeing one entity as two things at once, (3) seeing one entity as representing another, (4) role-playing and assuming the mental representations of others, and (5) acting out conflicts that may have emotionally vivid connotations. Table 1 shows how religion carries over all of the socially salient pretend play behaviours described by Lillard into adulthood for familiar Christian examples. Religious cognition possesses some of the structure and content of pretend play, and is manifest in religious narratives. The allegorical and pedagogical features of religious stories make them a safe arena for exploring social norms and power relationships. This is expected to be especially important in early human groups and contemporary small-scale societies, whose norms are not codified into a system of secular contracts like those found in large-scale societies.

Furthermore, the influence of religious imagination on an individual's ability to signal his or her commitment to the community must be explored (Sosis & Alcorta 2003). Knowledge of religious texts, history and the supernatural realm in general commonly carries a certain amount of prestige in groups across the world. Participation in religious rituals,

which entail shared imaginative acceptance of a pretence situation accompanied by physical arousal, can be a potent signal of individual commitment. Religious narratives drive the mental exploration of socially relevant situations, as well as provide relatable characters. As such, they can be powerful aids to the internalization of beliefs, which can alter cost-benefit equations and make costly commitment attractive (Sosis 2003). In this way, signals of religious commitment are lent force by receivers' understanding that the signaller must be exploring the same social landscape and internalizing the norms that they share. This additional dimension for signalling theory will benefit from the input of research on play markers in animals, because they both communicate intent to enter into a specific kind of relationship and to follow the rules implicit in it (Palagi 2008).

ADOLESCENCE

The adolescent stage carries several distinct goals as the bridge between childhood and reproductive adulthood. Adolescents must form and perpetuate friendships and alliances of increasing complexity, conform to societal gender roles, and understand and control their developing sexuality. The stakes in this developmental stage are higher—one's actions and the perceptions of one's character are directly relevant to one's status within the community and affect future reproduction. Consequently, deviations from social expectations become more costly because individuals are assumed to have achieved a grasp of basic social interaction in childhood. They must also learn to forego short-term benefits for long-term benefits, although the tension between these priorities is characteristic of this stage. Of course, these cost-benefit ratios will be different for boys and girls, and there may be conflicting behavioural and morphological strategies for children and parents at this time (Surbey 1998).

We now know that brain development continues through adolescence in humans. Recent neuroimaging studies show that areas involved in processing social information continue to develop during adolescence, including the medial prefrontal cortex (mPFC), and the superior temporal sulcus (STS) (Blakemore 2007). These areas show increases in grey matter, an indication of synaptogenesis, through childhood up to its peak during adolescence, followed by a decrease in grey matter in adulthood, a sign of neural pruning and the formation of stable connections. Other evidence shows that neural correlates of 'socially integrated self-concept'

undergo important development during adolescence (Blakemore 2008). This neural reorganization suggests that adolescence is indeed an important time during the development of social cognition. Adolescence has been characterized as 'experience expectant' (Alcorta 2006), which highlights the idea that this phase is ontogenetically designed to receive environmental information regarding both individual personality differences and socio-cultural features. We examine two major tasks for the developing adolescent brain and how they are aided by religious behaviour: (1) how out-group distinctions are formed while generating strong in-group relationships, and (2) how social structure is utilized to become socially integrated and position oneself for reproduction.

In-group/out-group belonging

During adolescence we are primed to commit ourselves to belonging to certain groups and not belonging to others. Again we can see radical differences in the way this process unfolds in small bands and large societies. In small societies, adolescence is marked by the ceremonial transition to adulthood, usually mediated by an initiation ritual. The extreme costliness of these rituals may contribute to increased group cohesion by signalling commitment and demonstrating that those who participate are not likely to shrink from pain and danger when it counts (Sosis et al. 2007). Whitehouse (1996) has further argued that such emotionally intense rites may be stored as 'flashbulb' memories, making it more likely for them to be retained in long-term memory. Whether these memories are recalled more accurately than others or not (Talarico & Rubin 2007), the events and the ways they transform relationships are highly salient, even for more benign rituals.

In large-scale societies, the content of in-group relationships has been heavily altered by changed ecological demands. For individuals in these societies, religious rituals continue to mark major transitions between life stages (e.g. circumcision—bar mitzvah—marriage—funeral), cementing sense of identity within a particular religion. However, in demographically mobile societies fewer individuals spend their lives within the same religious community. Moreover, secular groups engaged in sustained cooperation like sports teams, fraternities and sororities, and military units (Richerson & Boyd 1999) have co-opted features of religious initiation rites in order to manipulate identity. These organizations follow a standard progression of steps used in initiation rites: separation, liminality and reintegration (Turner 1969). Initiates are removed and given phys-

ically, mentally or emotionally challenging tasks to complete according to ritual formulae. They live in a liminal phase for a certain amount of time (sports training camps, fraternity houses during 'hell week', military housing), but once they demonstrate their commitment satisfactorily, they are reintegrated into the group with a new sense of identity. To a lesser extent, we find the same features in summer camps, youth groups, and sometimes even in schools. These institutions aim to educate as well as instil a sense of belonging to a certain group. Concurrently, religion not only supplies rituals that unite cooperative units, but it also instils beliefs that can help categorize others as members of out-groups. For example, even when tempered by liberal attitudes toward religious pluralism, a significant proportion of American adolescents express exclusivist religious beliefs, claiming that only one religion can be true (Trinitapoli 2007).

Social integration

Before their attention turns to reproduction and sustaining families, interpersonal interaction with peers becomes more prevalent for adolescents (Steinberg & Morris 2001). Religion may act to direct them toward resources for social support in order to encourage healthy development. Results from Western societies indicate that religion has a modest positive influence on the outcomes of several dimensions of adolescent lives, including physical and emotional health, education, volunteerism and political involvement, and family well-being (reviewed in Regnerus 2003). These effects are likely to be stronger in small-scale societies where each dimension is even less readily extricable from each other one.

There is evidence that a solid cultural-religious framework of belief is important for good mental health and positive adjustment (Alcorta 2006). Doubts about the truth or value of one's religious beliefs have been linked to greater susceptibility to depressive symptoms (Krause & Wulff 2004). Religious doubt seems to exert the greatest effect on psychopathology at younger ages, and this influence erodes as individuals age (Galek et al. 2007). We interpret this as support for the idea that religion has played and continues to play an organizing role in the construction of socially informed world-views. When the behavioural guidelines that inform individual decisions and bind together virtually all of one's peers and superiors are called into question, the result is cognitive dissonance and social anxiety.

In the US, as adolescence progresses religiosity tends to decline (Smith

et al. 2002). Yet religiosity may prepare adolescents for the challenges of adulthood. Barry and Nelson (2005) found that the most religious 18–20–year-olds in their sample (Mormons) consistently perceived themselves as having achieved the necessary criteria for adulthood to a greater extent than any other group. The underlying cause of this effect is likely the church's mobilization of large social networks, prohibitions on diet and conduct, and extensive ritual engagement.

If religion is an important medium of enculturation and social bonding, then adolescence clearly plays an enormously transformative role in this process. It is during this time that the practice and play of childhood culminate in more serious and costly rituals, which both create and demonstrate commitments among participants. Though rituals and beliefs continue into adulthood, the cessation of neural plasticity in brain areas involved in social cognition at this time suggests that bonds and beliefs acquired in this stage may be fundamentally different than those acquired later in life.

ADULTHOOD

Though ritual and belief play a major role during adolescence in the formation of self-concept, social cognition and in-group identity, ritual and belief certainly continue to be important features of life during young adulthood. This stage of life is characterized (or defined) by reproduction. The first offspring are typically born during the early or mid twenties, with the number of living offspring peaking during the thirties and forties. This stage of life is rarely included in developmental accounts since physical development is complete by its onset. In our account, however, the role of religion in mediating social bonding continues unabated, and the introduction of children makes the cultural education afforded by religion more attractive.

Religion and sociality in young adulthood

In the US, adolescents primarily attend religious services with their parents, and parents are more likely to attend than non-parent adults (Sherkat 2001). Parents expose their children to the beliefs and rituals of their group in order for them to build identity and bond with their cohort. The trend noted above, that religious affiliation and attendance diminish later in adolescence, continues into young adulthood (Uecker et al. 2007).

Religious affiliation and attendance increase with marriage, and increase again with reproduction.

Interestingly, the costs of such attendance are likely higher for parents with young children or adolescents since there can be associated membership fees, time and energy costs are greater, and children may be resistant. However, the benefits of belonging to such a community, such as receiving aid during times of difficulty, may be crucial in order for parents to raise their children successfully, and such attendance is also likely the only way for them to inculcate a sense of religious affiliation or identity.

Religious trends in adulthood

McCullough et al. (2005), in their study on adult religious development, found three independent trends in religiousness throughout the adult life course. One trend showed an initial high level of affiliation that grew slightly during the life course. Another trend showed a low level religiosity that decreased very slightly (but significantly). The third showed a parabolic trend, beginning in between the other trends (medium religiosity), increasing during peak reproductive years (thirties to fifties), and then decreasing to original medium levels in the seventies. These trends are likely based on the interaction of personality characteristics and situational exigencies, and reflect the ability of individuals in large societies to avoid religion in their daily lives. The major factor associated with the low religiosity trend was remaining unmarried for the duration of one's life. The main factors associated with the high religiousness trend were 'religious upbringing' and 'agreeableness'. Those in the parabolic trend were more likely to be married than either other trend, and also were more likely to be women. We interpret the parabolic trend to depict those who rely on religious communal life to support reproductive costs as described above. Peacock and Poloma (1999) also examined religiosity through the adult life course. They suggest that during the first half of adulthood (18–50) spirituality is associated with 'development of identity . . . mutual relationships with others, and a sense of spiritual transcendence' (Peacock & Poloma 1999, 336) which again supports the developmental perspective proposed above.

POST-REPRODUCTIVE ADULTHOOD

Human life history is characterized by an extended period of juvenile dependence, high rates of male provisioning, a long lifespan and support

of reproduction by older, post-reproductive individuals (Hill & Kaplan 1999). With their reproduction finished, their cultural milieu mastered, and their personality characteristics set, older individuals will not benefit directly from the interaction between religion and social cognition we have detailed for earlier developmental stages. Yet religion remains a significant feature past the reproductive years. Now these individuals are on the transmitting end of the flow of enculturation and are able to influence their descendants via religion. In most small-scale societies, those knowledgeable about religion and those who hold important spiritual 'offices' can be respected well beyond their functional abilities. Elderly individuals may be remembered shortly after their deaths as supernatural beings still concerned with the state of affairs in the living world. Maintaining religious involvement ensures that one will remain a compelling paragon of pro-social behaviour from beyond the grave.

In large-scale modern societies, there has been a conceptual shift from viewing older people as venerable to treating them as vulnerable (Davie & Vincent 1998). The function of religion for older individuals in these societies may have followed suit, now treated as a way to restore health and maintain competence or independence. An enormous literature has emerged documenting positive relationships between religion and physical (Koenig et al. 2001), as well as mental (Koenig 1998), health. Especially well-supported is the inverse relationship between frequency of church attendance and mortality rates (Gillum et al. 2008). In terms of mental health, religious individuals tend to rate their well-being and their global satisfaction with life higher than those who are not religious (McFadden 1999). As mentioned above, religious doubt is less troublesome and challenges to belief structures are more easily accommodated. The underlying causal mechanisms are unclear, but one candidate is social integration and support, including social network size (Musick et al. 2000). Religion seems to sustain older individuals as they attempt to sustain their descendants. Some individuals report a shift in the content of their prayers as they age, from self-interest in early adulthood to increased social consciousness and compassion in later years (Ingersoll-Dayton et al. 2002). By participating in the institution that will transmit desirable cultural information to relatives, post-reproductive individuals communicate their continuing endorsement of those beliefs, influence future behaviour, and derive socially mediated health benefits.

CONCLUSION

We begin childhood ready to soak up the particular beliefs of our own group in much the same way we are prepared to learn our own language. We practise these beliefs and begin our experiences with ritual during the childhood processes of pretence and play, which continues into adulthood via religion. We cement our beliefs and relationships with our age cohorts (and the rest of our in-groups) during the initiation rites of adolescence, though modern society has a wide range of options available to fill this role if religion is not present or salient. We continue our ritual engagement into adulthood, further strengthening communal ties based on signals of solidarity and commitment. In post-reproductive adulthood we engage with the younger generation as models, teachers, and guides.

Machiavelli noted that religion's influence rests in its ability to represent the underlying qualities of those who participate in it. That is, in fact, the thesis of this chapter. Religion is a way of *packaging information*. The process of development takes an individual through the early stages of first unwrapping this package to the later stages when he or she ties a bow on it and gives it to others. The information contained therein reciprocally informs and is enabled by social cognition. In large-scale modern societies, many of the contents of the religion package have been scattered into a variety of more or less discrete sources. But for nearly all of human evolutionary history, religion united vast amounts of cultural knowledge into frameworks of belief and behaviour that guided the kinds of social manoeuvres described by the social brain hypothesis.

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