
EXECUTIVE FUNCTIONS IN MORALITY, RELIGION, AND PARANORMAL BELIEFS

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Moral, religious, and paranormal beliefs share some degree of overlap and play important roles in guiding peoples' behavior. Although partly cultural phenomena, they also have neurobiological components based on functional neuroimaging studies and research in clinical populations. Because all three show relationships to prefrontal system functioning, the current study examined whether they related to executive functions as measured by the Executive Function Inventory in a community sample. As in previous research, religious beliefs related positively to both moral attitudes and paranormal beliefs. Moral attitudes, however, did not relate to paranormal beliefs. Paranormal beliefs related inversely to impulse control and organization, whereas small positive correlations occurred between traditional religious beliefs, impulse control, and empathy. Moral attitudes, on the other hand, showed consistent positive correlations with all executive functions measured, independent of demographic influences. These findings concordantly support that prefrontal systems play a role in morality, religion, and paranormal beliefs.

Keywords executive functions, morality, paranormal, prefrontal, religion, superstition

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Morality, religion, and paranormal (or superstitious) beliefs share some degree of overlap and play important roles in guiding peoples' behavior. They are largely affected by culture but not all individuals in a given culture subscribe to the same beliefs. There is evidence that they, like all psychological and behavioral phenomena, have neurobiological components.

Religion can be defined as beliefs in manlike supernatural, mystical, uncanny, or bizarre beings. The axial age of religion is considered to be the time period from 600 BCE to 600 CE, during which the world's major philosophies and religions flourished, including Judaism, Christianity, Islam, Buddhism, Hinduism, Taoism, and religious Confucianism (Barnes, 1997). Although religious practices are ubiquitous throughout human history, their biological basis is little understood, particularly at the neural level. Their ubiquitous nature raises the question as to whether there are factors in human evolution and neurobiology that predispose humans toward religious and/or philosophical thought. Recent advances in neuroscience have made possible the study of neural correlates of highly complex mental and cognitive processes, including the arts and religion. Religious activities involve many human cognitive functions including language, memory, judgment, reasoning, and emotions such as awe, joy, and fear. The nature of these cognitive and emotional functions implicate particular brain regions in religious activity (Muramoto, 2004). Indeed, alterations of brain function can change religious behavior and attitudes. For example, people with epilepsy, schizophrenia, mania, and brain tumors may show increased interest in religion (Saver & Rabin, 1997). Excessive activity in the limbic system is associated with hyper-religiosity. Hyper-religiosity may result from the hyper-function of the medial prefrontal cortex, including rigid legalism (indicating excessive error detection), excessive concern over one's existence (indicating excessive self-reflection), and delusional interpretations of God's mind, perhaps indicating excess of theory of mind activity (Muramoto, 2004). Conversely, degeneration of the limbic system results in decreased interest in religion as displayed by people with Alzheimer's disease. Healthy religious individuals also show brain activation during religious activity such as reading of the Bible or reciting the Qu'ran. Specifically, activation is seen in dorsolateral/medial prefrontal cortex and medial parietal cortex (Azari et al. 2001). Religiosity or religious behaviors have also been associated positively with characteristics of obsessive-compulsive disorder (OCD), which is associated with prefrontal system dysfunction involving prefrontal cortex and basal ganglia (Tek & Ulug, 2001; Whiteside et al., 2004).

Morality involves systems of ideas of right and wrong conduct and it can be measured as the quality of being in accordance with these conducts. It

is related to religious and cultural beliefs and neurobiological correlates are also being discovered. For example, neuroimaging of individuals engaging in moral reasoning tasks shows activation of dorsolateral and medial prefrontal cortex (Greene et al., 2004). Activation of these areas suggest both emotional and cognitive aspects of moral reasoning, including abstract reasoning and cognitive control. Further evidence of a neural basis for morality comes from individuals with prefrontal dysfunction. Heekeren and colleagues (2003) found semantic aspects of ethical reasoning to activate left temporal language areas and ventromedial prefrontal cortex. Individuals with normal social and moral development can precipitate dramatic changes in social and moral behavior after a neurological insult despite the preservation of other cognitive abilities (Anderson et al., 1999). This condition has been termed acquired sociopathy, and many such afflicted retain knowledge of moral norms (Moll et al., 2001). Neuroimaging and neuropsychological studies indicate prefrontal system dysfunction in congenitally antisocial individuals or psychopaths (Vollm et al., 2004; Dolan & Park, 2002).

Superstitious beliefs are common, and may be defined as belief in paranormal or anomalous phenomena that are incompatible with scientific explanation. The neurobiological basis of paranormal beliefs has yet to be thoroughly investigated. Empirical research findings suggests that some paranormal experiences and beliefs are partly dissociative in nature (e.g., Irwin, 1994). In many cases, they are associated with childhood trauma such as physical or sexual abuse (Ross & Joshi, 1992). Superstitious beliefs tend to be irrational in nature and have no apparent basis in logical understandings of causality. They are not founded on empirical evidence and may exist regardless of evidence to the contrary (Zebb & Moore, 2003). It has been suggested that superstitious beliefs and behaviors may represent attempts to control circumstances and situations that are perceived to be beyond one's control (Jahoda, 1969). Superstitious thinking is increased in individuals with OCD. Superstitious thinking correlates with OCD symptoms in clinical and nonclinical samples, suggesting that mild prefrontal dysfunction is associated with superstitious thinking in the general population (Einstein & Menzies, 2004a,b). Furthermore, neuroimaging studies of logical reasoning in normal individuals show involvement of prefrontal systems (Noveck et al., 2004; Bunge et al., 2004; Goel & Dolan, 2003). Luo and colleagues (2003) showed that verbal analogical reasoning activates prefrontal systems including bilateral prefrontal cortex, anterior cingulate, and the basal ganglia. Goel and Dolan (2003) specifically showed that emotionally neutral reasoning activated dorsolateral prefrontal cortex, whereas emotionally-laden reasoning activated ventromedial

prefrontal cortex. Thus, the pattern of reasoning over emotional topics is neuroanatomically distinct from other forms of reasoning.

Executive functions are a collection of cognitive functions that are mediated by prefrontal circuits in the brain (Tekin & Cummings, 2002). They include functions such as planning, organizing, impulse control, initiation, abstract reasoning, and mental flexibility. Given the interrelationships among religion, morality, and superstitious thinking, and the evidence for their prefrontal substrates, this study sought to examine whether they relate to executive functioning.

METHODS

Participants

The sample ($n = 213$, 72 male and 141 female) was a non-clinical convenience sample recruited by word of mouth. Surveys were passed out on the college campus and in the local community. There was no financial compensation for participants to take part in the study. Participants were asked to read the implied consent and to fill out the questionnaire in private. They were given an envelope in which to seal the questionnaire before returning it in order to maintain anonymity and to encourage more honest responding. The age of participants ranged from 18 to 83 years ($M = 28.0$, $SD = 11.9$) and formal education ranged from 9 to 20 years ($M = 14.8$, $SD = 1.6$). There were 151 who indicated Christian affiliation (70.9%), 19 atheist or agnostic (8.9%), 5 Jewish (2.3%), 2 Wicca (0.9%), 2 Hindu (0.9%), and 2 Muslim (0.9%). Twenty-four of the participants reported "other" as their religious affiliation (11.3%) and 5 did not respond to that question (2.3%). None reported Buddhist affiliation. Formal religious education was reported by 97 participants and 51 reported currently attending religious services on regular basis.

Measures

Executive Function Index. The Executive Function Index (EFI) is a self-rating measure of executive functions developed in a nonclinical community sample (Spinella, 2005). It has 27 items and a 5 factor structure derived by principal components analysis: Empathy (EM), Strategic Planning (SP), Organization (ORG), Impulse Control (IC), and Motivational Drive (MD). It is a reliable scale that has been validated against other executive function measures such as the Barratt Impulsiveness Scale and Frontal Systems Behavior Scale.

Paranormal Beliefs Scale. The Paranormal Beliefs Scale (PBS) is a 26-item scale that assesses one's beliefs about five areas of paranormal beliefs: Psychic Beliefs, Superstitions, Traditional Religious Belief, Witchcraft, and Anomalous Natural Phenomena (e.g., the Loch Ness monster) (Lange et al., 2000).

Belief in Divine Intervention Scale. The Belief in Divine Intervention Scale (BDIS) is a 6-item, unidimensional scale that assesses beliefs in divine intervention, including God's physical healing of humans, direct communication with humans, and intervention in conditions of nature (Degelman & Lynn, 1995). Its unidimensional structure is supported by principal components analysis. Validity of the scale was indicated by correlations with ratings of the importance of religion, and by the fact that students attending a Christian college scored higher than those attending a community college.

Sociomoral Reflection Measure. The Sociomoral Reflection Measure is an 11 item measure of moral attitudes developed from the Moral Judgment Interview of Kohlberg (Gibbs & Widaman, 1982). Items involve keeping promises, telling the truth, altruism, and obeying the law. The scale has excellent psychometric properties including reliability (interrater, test-retest, internal consistency) and validity (criterion-related and construct) (Gibbs et al., 2003). Good concurrent validity was demonstrated with Kohlberg's Moral Judgement Interview ($r = .69$). It correlates with social perspective taking, prosocial behavior, but not social desirability. Discriminant validity indicated by correct identification of juvenile delinquents.

RESULTS

Correlations

Bivariate correlations were performed between measures of executive functions, paranormal, religious, and moral beliefs (Table 1). Bivariate correlations of executive functions with anomalous natural phenomena and psychic beliefs show significant inverse relationships with impulse control and organization. Correlation of the superstitions beliefs produced significant inverse relationship to all the executive functions except strategic planning. People with beliefs in witchcraft showed significant negative correlation to impulse control. Traditional religious beliefs significantly positively correlated to motivational drive and empathy. Motivational drive, empathy, and strategic planning also positively correlated with belief in divine intervention. The Sociomoral

Table 1. Correlations between measures of executive functions, paranormal, religious, and moral beliefs

	EFmd	EFic	EFem	EForg	EFsp	EFtotal
Bivariate correlations						
Anomalous natural phenomena	.03	-.35 [‡]	-.08	-.28 [‡]	.02	-.23 [‡]
Psychic beliefs	.06	-.23 [‡]	.04	-.13*	.04	-.08
Superstitions	-.15*	-.16*	-.23 [‡]	-.35 [‡]	-.08	-.31 [‡]
Witchcraft	-.03	-.21 [†]	.00	-.13	.05	-.10
Paranormal total	.00	-.30 [‡]	-.05	-.25 [‡]	.02	-.19 [†]
Traditional religious beliefs	.15*	.03	.22 [‡]	-.05	.10	.13*
Belief in divine intervention	.14*	.08	.14*	-.08	.23 [‡]	.16*
Sociomoral reflection measure	.25 [‡]	.29 [‡]	.54 [‡]	.21 [†]	.32 [‡]	.52 [‡]
Partial correlations						
Anomalous Natural Phenomena	.03	-.32 [‡]	-.04	-.26 [‡]	.03	-.19 [†]
Psychic beliefs	.05	-.25 [‡]	.02	-.13*	.04	-.10
Superstitions	-.17*	-.12	-.23 [‡]	-.33 [‡]	-.08	-.30 [‡]
Witchcraft	-.04	-.22 [†]	-.01	-.12	.05	-.11
Paranormal total	-.01	-.29 [‡]	-.05	-.23 [‡]	.03	-.19 [†]
Traditional religious belief	.14*	.03	.21 [†]	-.05	.11	.13
Belief in divine intervention	.13*	.08	.14*	-.08	.23 [‡]	.16*
Sociomoral reflection measure	.24 [‡]	.24 [‡]	.51 [‡]	.18 [†]	.32 [‡]	.49 [‡]

$n = 213$; * $p < .05$, [†] $p < .01$, [‡] $p < .001$. Partial correlations control for age, sex, and education ($df = 208$). Abbreviations: EFmd = motivational drive, EFic = impulse control, EFem = empathy, EFor = organization, EFsp = strategic planning.

reflection measure positively correlated with all of the executive functions. Partial correlations controlling for age, sex, and education ($df = 208$) showed essentially the same results, indicating little affect of the demographic variables on the results.

Correlations among the measures used showed that combined paranormal beliefs correlated positively with traditional religious beliefs and belief in divine intervention (BDIS), but not moral attitudes (SRM) (Table 2). Partial correlations were performed controlling for age, sex, education, attendance of religious services, and formal religious education. Bivariate correlations (not shown) yielded essentially the same results. Moral attitudes (SRM) correlated positively with the Traditional Religious Belief & Belief in Divine Intervention,

Table 2. Partial correlations among measures of executive functions, paranormal, religious, and moral beliefs, controlling for age, sex, education, attendance of religious services, and formal religious education

		1	2	3
Total paranormal beliefs	1	—		
Traditional religious beliefs	2	.31 [‡]	—	
Belief in divine intervention	3	.31 [‡]	.46 [‡]	—
Sociomoral reflection measure	4	-.07	.33 [‡]	.30 [‡]

n = 213, *df* = 206; * *p* < .05, † *p* < .01, ‡ *p* < .001.

and there was a strong correlation between Traditional Religious Belief & Belief in Divine Intervention.

Analyses of Variance

Results from the comparison of those who do and do not attend religious services on measures of executive functions, paranormal, religious, and moral beliefs are shown in Table 3. In this analysis, 51 of the participants reported currently attending religious services on regular basis and 102 reported not

Table 3. Analyses of variance comparing who attend (*n* = 51) and do not attend (*n* = 162) religious services on measures of executive functions, paranormal, religious, and moral beliefs

	Attend		Do not attend		<i>p</i>	<i>d</i>
	M	SD	M	SD		
Anomalous natural phenomena	11.1	3.8	12.3	3.6	.038	0.3
Psychic beliefs	25.8	6.9	27.7	6.7	n.s.	
Superstitions	5.5	2.9	5.7	2.7	n.s.	
Witchcraft	9.8	4.1	10.8	3.9	n.s.	
Traditional religious belief	17.3	3.3	14.8	4.1	.000	0.7
Belief in divine intervention	19.4	3.7	17.2	3.9	.001	0.6
Sociomoral reflection measure	60.8	7.5	57.9	7.4	.016	0.4
Motivational drive	15.2	2.8	14.7	2.7	n.s.	
Impulse control	16.8	3.8	15.2	3.8	.011	0.4
Empathy	25.0	3.5	24.6	3.5	n.s.	
Organization	17.2	3.5	17.0	3.9	n.s.	
Strategic planning	24.4	3.9	24.2	4.0	n.s.	
Total executive functioning	98.7	12.1	95.7	10.7	n.s.	

Effect sizes are expressed as Cohen’s *d*.

Table 4. Comparison of people who received ($n = 97$) versus those who did not receive ($n = 116$) formal religious education on measures of executive functions, paranormal, religious, and moral beliefs

	Formal religious ed.		No formal religious ed.		<i>p</i>	<i>d</i>
	M	SD	M	SD		
Anomalous natural phenomena	11.9	3.7	12.1	3.6	n.s.	
Psychic beliefs	26.6	6.9	27.8	6.7	n.s.	
Superstitions	5.7	2.7	5.6	2.8	n.s.	
Witchcraft	10.9	4.0	10.3	3.9	n.s.	
Traditional religious belief	16.4	3.2	14.6	4.5	.001	.5
Belief in divine intervention	18.2	3.7	17.3	4.2	n.s.	
Sociomoral reflection measure	58.8	7.2	58.5	7.8	n.s.	
Motivational drive	14.9	2.7	14.7	2.8	n.s.	
Impulse control	15.6	4.2	15.6	3.6	n.s.	
Empathy	24.6	3.6	24.8	3.4	n.s.	
Organization	16.8	4.1	17.3	3.4	n.s.	
Strategic planning	24.1	3.9	24.3	4.1	n.s.	
Total executive functioning	95.9	12.2	96.8	10.2	n.s.	

Effect sizes are expressed as Cohen's *d*.

currently attending religious services. There was a significant difference between people who attended formal religious services and who don't in the aspect of anomalous natural phenomena [$F(1, 212) = 4.34, p = .038$, Cohen's $d = 0.3$], traditional religious belief [$F(1, 212) = 15.43, p < .001$, Cohen's $d = 0.7$], belief in divine intervention [$F(1, 212) = 12.32, p = 0.001$, Cohen's $d = 0.6$], and Sociomoral Reflection Measure [$F(1, 212) = 5.89, p = 0.016$, Cohen's $d = 0.4$]. In the executive function there were significance differences only for impulse control [$F(1, 212) = 6.62, p = 0.011$, Cohen's $d = 0.4$].

Finally, the results from comparison of people with and without formal religious education on measures of executive functions, paranormal, religious, and moral beliefs are reported in Table 4. In this analysis 97 of the participants reported having formal religious education and 116 reported no formal religious education. There was a strong significant difference between people who attended formal religious education and who did not on the measure of traditional religious belief [$F(1, 212) = 10.68, p = 0.001$, Cohen's $d = 0.5$].

DISCUSSION

This study showed that an increase in traditional religious beliefs corresponded with increased belief in divine intervention, as would be anticipated because

this concept is taught by many religions. However, it also showed that both traditional religious beliefs and belief in divine intervention correlated positively with paranormal beliefs. Despite the fact that many paranormal beliefs are seen as less legitimate than the beliefs of organized religions, they both involve phenomena that are beyond the scope of everyday experience for the majority of people. They also may involve beliefs in phenomena that do not fit with current scientific understanding of the physical universe (e.g., psychic phenomena, miracles, non-corporeal beings). Because religions teach morality, it would be anticipated that traditional religious beliefs and belief in divine intervention correlated positively with moral attitudes, as they did in this study. However, moral attitudes had no relationship whatsoever with paranormal beliefs. Thus, belief in supernatural phenomena and morality are distinct and separate phenomena, whereas religious beliefs show partial overlap with both. These findings support logical relationships between superstition, religion, and morality and agree with previous findings. For example, Rudski (2003) found that those with higher levels of religious belief also tended to be superstitious and believed in the paranormal.

This study showed that executive functioning correlates inversely to superstitious paranormal beliefs. Particularly, inverse relationships emerged with impulse control and organization. Thus, people who are more superstitious tend to be more impulsive and less organized cognitively. Controlling for age, sex, and education did little to change this pattern of results. Belief in traditional religion and divine intervention had little to do, however, with executive functions. Small, positive correlations were found with motivational drive and empathy. These make logical sense since religious beliefs may hypothetically provide an individual with motivation and greater caring for others. However, the relationships are very small. In contrast, moral attitudes showed consistent positive relationships with all areas of executive function: motivational drive, impulse control, organization, strategic planning, and empathy. This is consistent with the large literature showing prefrontal and executive dysfunction in people who lack moral beliefs (e.g., antisocial personality disorder, psychopathy, conduct disorder).

Group comparisons found differences between people who do and do not attend formal religious services. Those who do attend had mildly lower beliefs in anomalous natural phenomena, but no differences in other paranormal phenomena. As anticipated, they reported greater belief in traditional religious belief and belief in divine intervention. They also reported higher levels of moral attitudes and impulse control. In contrast, those with formal religious education only scored higher on traditional religious belief, but none of the

other scales. These indicate that active participation in religious services is more pertinent to the present measures than simply having been taught the principles of the religion.

One limitation of this study is that it was composed predominantly of people of Christian denominations. This does not significantly represent different religious affiliations and does not allow for comparisons between the groups. Future studies could address by targeting samples of different religious affiliations.

In summary, this study supported anticipated relationships between executive functions, paranormal beliefs, morality, and religious beliefs. Relationships between executive functions and religious beliefs were slight positive correlations, whereas those with paranormal beliefs were negative in magnitude. Although both of these involve belief in supernatural phenomena, belief in traditional religion is more normative and socially accepted in this culture and thus less likely to be associated with pathology. Belief in paranormal phenomena, however, tends to involve culturally fringe beliefs that are not supported by religious institutions that are perceived by many as legitimate or authoritative (e.g., the Roman Catholic Church). Nonetheless, belief in religion did moderately relate to superstitious beliefs. In contrast, a greater degree of moral attitudes was consistently associated with better executive function in this sample. Moral attitudes relate to pro-social behavior and better social functioning. This would allow a person to have better social relationships and networks and function more adaptively.

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