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Limbic Emotions, Moral Emotions and the Social Brain Network

William J. Shoemaker

Faith founded on knowledge and sustained by free inquiry
must be the spiritual religion of the future.
Octavius Brooks Frothington (1822-1895)
Humanist, Unitarian minister

Abstract

Emotion is a term used loosely to cover many different phenomena. Emotions can be thought of as body changes that prompt us to act. They have evolved to get us to do what we have to in order to survive and pass our genes on to the next generation. This definition refers to *Limbic emotions* that are governed by brain structures that are analogous from reptiles to birds to mammals, including humans. The limbic emotions energize the organism to search for food, seek shelter, fear predators and seek a mate. The emotions referred to in relation to theology and religious experience are *Moral (or Social) emotions*. Humans are exceptionally social creatures. We need each other for mutual support and protection, and to this end we have evolved brains that are exquisitely sensitive to others of our kind. The *Social Brain Network* consists of some cortical regions, some limbic regions and some sub-cortical regions all acting together in ways not yet understood, to produce appropriate social behavior. This network links a set of specialized regions that work together to ensure that we can operate in a tightly knit community. These brain regions allow us to recognize faces, to express empathy, provide nurture and, importantly, allow us to envision the outcome of our possible actions. How do we know that this is true? Because there are some people who cannot recognize that they may be hurting someone by looking at their face, who cannot express empathy or nurture, and who never worry or are concerned about what their actions may do to others. These individuals have a lesion in their social brain network, specifically the prefrontal cortex, and they are known as psychopaths. Knowledge of the Social Brain Network can help us to understand people's mind-set and their social behavior. It can also suggest ways to communicate better in relation to religious congregations. In the past, much of the religion and science dialog has been presented to people in a top-down approach that posits a Supreme Being or some ancient texts as the starting point. If you accept that initial premise, the rest of the beliefs follow in a manner that is basically a cerebral exercise. This approach has been more and more rejected by those who accept rational thought and scientific research as the final word. Seeking God, finding faith and participating in a religious community are all products of our social brain network. It is suggested that religious organizations increase their inclusion of the social emotions in practices of nurture, community building and feelings of togetherness [but not the practice of exclusivity], and not demand that people believe in pre-Enlightenment concepts that are no longer credible.

Keywords
Emotions, limbic system, social brain network, moral emotion, fMRI.

1. Limbic Emotions

Emotions may seem to be conscious feelings, but they are actually "inner motions", physiological responses to stimuli (Damasio & Carvalho 2013). Early man recognized that many animals acted with similar goals in mind; procurement of food, fear of larger or more fierce animals, shelter seeking in inclement weather, procreation and at least some care for the newborn and young. They often termed these behaviors as instincts, but these behaviors are products of the animal's *limbic system* that are governed by brain structures that are analogous from reptiles to birds to mammals, including humans. They have evolved to ensure the survival of the individual and the survival of the succeeding generations.

2. Moral Emotions

Humans have a similar limbic system that generates similar emotions, but in advanced nations, people don't worry where their next meal is coming from, have a secure place to sleep every night, encounter fierce animals only rarely and carry umbrellas. So much of the time we are unaware of our limbic system. The emotions referred to in relation to theology and religious experience are *Moral (or Social) emotions*. Humans are exceptionally social creatures. We need each other for mutual support and protection, and to this end we have evolved brains that are exquisitely sensitive to others of our kind. The *Social Brain Network* consists of some cortical regions, some limbic regions and some sub-cortical regions all acting together in ways not yet understood, to produce appropriate social behavior. This network links a set of specialized regions that work together to ensure that we can operate in a tightly knit community. These brain regions allow us to recognize faces, to express empathy, provide nurture, activate altruism, and, importantly, allow us to envision the outcome of our possible actions. The moral emotions, the product of the social brain network, have arisen later in development and evolution (Adolphs 2003). There is, of course, a negative side to these emotions since they also play a role in feelings of guilt, shame, embarrassment, jealousy and pride. Overall they function to regulate social behaviors, often in the long-term interest of a social group rather than the short-term interest of the individual person (Adolphs 2003). However these brain systems should not be thought of as separate and distinct. The architecture of the social brain network maps onto the neural circuitry of the limbic system (Decety 2011), especially the amygdala and the insular cortex (see figure 1). When studied intensely and for a long period (usually in the field), one can view complex social systems in lower animals. There is a phylogenetic progression from lower vertebrates to monkeys to apes on conflict resolution (DeWaal 2000), cooperation and response to inequity (Brosnan 2011), rejection of unequal pay (in a laboratory setting) (Brosnan and DeWaal 2003), compassion (Goetz *et al.* 2010), and ethics, aggression and violence (DeWaal 2004). Thus the social brain network, so active and necessary for humans and human culture, has been evolving for millennia.

3. The Social Brain Network

The social brain network has only recently been described as a coherent brain system (Grossman and Johnson 2007; Johnson *et al.* 2005) (see Figure 1). Early reports from studies of individuals with either frontal on prefrontal lobe damage demonstrated deficits in social behavior, yet they displayed normal functioning language, memory and other cognitive skills (Anderson *et al.* 1999; Blair and Cipolatti 2000). Brain damage or lesions could be the result of cerebral stroke, brain tumors, or head trauma that damages brain tissue. The resulting damage from such lesions could affect any of the many brain functions. Only a small percentage of brain lesions would result in deficits in social behavior and not other functions.

What do we mean when we say "deficits in social behavior"? If the lesion is extensive, the individual's resulting behavior may bring harm to another person, even a loved one, a situation that was unthinkable prior to the lesion. Often the lesions are small and result in behaviors such as inappropriate comments in social gatherings like church services, family dinners, club meetings, and so on. Frequently there is impulsiveness to the behavior that the individual cannot control. Often the aberrant behavior has an overt

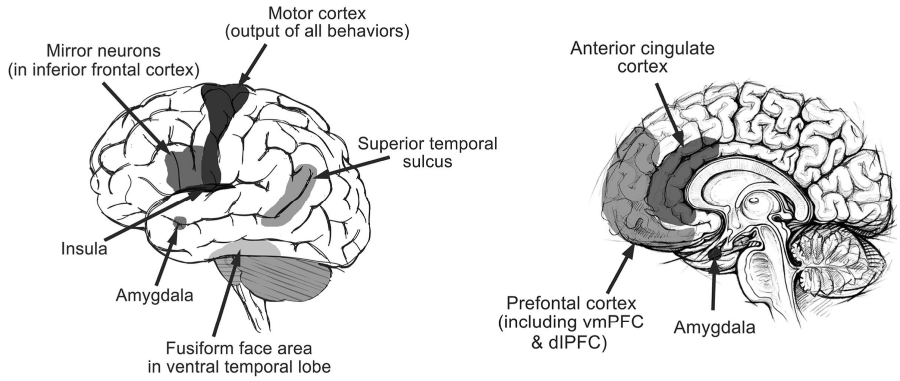

Fig 1: The Human Brain, indicating the structures of the Social Brain Network: Lateral View (left) and Saggital View (inner surface exposed, right). The amygdala cannot be seen with these views and its relative position is indicated within the depth of the tissue. The motor cortex is not part of the social brain network but is included for reference and because all behavior, social, and otherwise, must past through this region.

sexual nature and produces embarrassment to the individual, friends, and family; or, worse, results in criminal arrest (Shoemaker 2012).

Nevertheless, I believe that religious organizations should try to connect with their congregations through the social brain network. If you are trying to engage with people at the level of love and benevolence, rather than fear and obedience, the social brain network is your vehicle. Let me give you some examples from the many studies of the social brain network.

4. Studies of the Social Brain Network using fMRI

In the decade since their first description, studies of the social brain network have increased our knowledge of brain-behavior function with a large number of experimental paradigms, mostly using functional magnetic resonance imaging (fMRI). MRI is a noninvasive brain scanning technique using very sensitive magnetic fields to measure blood flow changes in the brain. The assumption is that areas of the brain that are active will be detected because of their increased metabolism and, thus, increased blood flow.

In an interesting series of studies, Klimecki *et al.* (2013) have demonstrated that aspects of the social brain network can be altered with compassion and empathy training. They conclude that "… training compassion may reflect a new coping strategy to overcome empathic distress and strengthen resilience".

Another study tested whether empathic responses to joy were as strong as responses to distress. Since almost all studies using fMRI on empathy examine the response to others' distress, this study was groundbreaking in some ways. The results show that the same brain structures that respond to other's distress respond to other's joy. However the strength of the response to distress is much stronger (Perry *et al.* 2012).

It is well known that there are subtle sex differences between the brains of men and women. Further, much evidence suggests that women have greater emotional reactivity than men. Iordan *et al.* (2013) examined sex differences in response to emotional distraction using fMRI testing for both male and female subjects. To briefly summarize their findings: they found increased impact of emotional distraction among women, and, although both men and women process emotional distractions using similar brain structures, there are small differences. These results have implications for understanding sex differences in the susceptibility of affective disorders in which basic emotional responses, emotional distractibility and coping abilities are altered (Iordan *et al.* 2013).

Some divinity schools include courses in music as part of the curriculum. And most congregations program music and singing as part of the religious service. However, what might not be realized is that music is produced and enjoyed using the social brain network. In his review, Stefan Koelsch (2010) sites scores of studies that have scanned the brain using fMRI during the playing of a wide variety of music types (see Figure 2). Koelsch points to music's effects in communication, notably for infants and young children. Musical communication during parent-child singing of lullabies and play-songs is important for social and emotional regulation (Fitch 2006; Trehub 2003). Music-making involves coordination of movement, as does dance. The coordination of movement in a group of individuals appears to be associated with pleasure (Overy and Molnar-Szakacs 2009; Patel *et al.* 2009). As a result of all this activation from music at brain sites in the social brain network, music leads to increased social cohesion of the group (Cross and Morley 2008), fulfilling the "need to belong" (Burmeister and Leary 1995), and the motivation to form and maintain interpersonal attachments (House *et al.* 1988; Hillecke *et al.* 2005). The sum of all the studies indicates that music's effects on the brain are not just aesthetic but play a vital role in social and community cohesion.

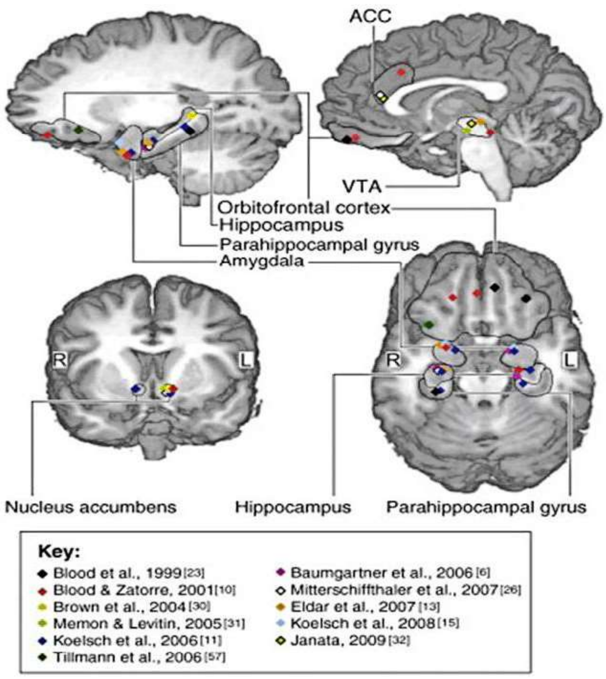

Fig 2: Illustration of some structures belonging to the social brain network that respond to played music. The diamonds represent music-evoked activity changes in these structures (the key lists the author and paper for each study). Note the repeatedly reported activation of amygdala, nucleus accumbens and hippocampus, reflecting that music is capable of modulating activity in core structures of emotion. Top left: view of the right hemisphere; top right: saggital view; bottom left: anterior view; bottom right, view of ventral (bottom) surface.

5. The Social Brain Network and Enlightened Faith

How does the social brain network play into our understanding of religion today? It does so through enlightened faith. This is an unusual statement for a scientist to make; let me explain what I mean. Many religious people today, and in the past, view faith as the willingness to believe the teachings of religious authorities, often grounded in sacred Scriptures — e.g., the Bible or the Koran — that stem from supernatural revelations from God. Since the Enlightenment, more and more people are moving in the opposite direction; not from belief to understanding, but from understanding to belief. We take everything we know into account as we decide what to believe. Enlightened faith never asks us to set aside what we know (Guengerich 2013).

The believer will open his mind to the truth on the condition that it fits in with his preconceived ideas and wishes. Faith, on the other hand, is an unreserved opening of the mind to the truth, whatever it may turn out to be. "Faith has no preconceptions; it is a plunge into the unknown. Belief clings, but faith lets go" (Watts 1951). " Faith is a commitment to live with the understanding that life is a wondrous mystery, that love is divine, that we are responsible for the well-being of those around us" (Guengerich 2013). Commitments to others, love and the caring and well-being of those around us, are all products of our social brain network.

A recent quotation from Prof. Lluis Oviedo (Pontifical University Antonianum) sums this up succinctly. "Science does not work against religion, not does it conspire to make the theologian's job harder: it just helps us to better know reality in order to better enunciate the meaning of faith" (Oviedo 2013).

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Javier Leach studied Philosophy at the Facultad San Francisco de Borja (Barcelona) from 1961-65. From 1965-1970 he studied Mathematics at Universidad de Zaragoza. From 1970-1973 he studied Theology at the Philosophisch-theologische Hochschule Sankt Georgen in Frankfurt am Main (Germany). He took a Doctorate in Mathematics in 1977. From 1987 he was Professor at the Universidad Complutense in the area of Computer Languages and Systems. Since 2012 he has been retired Professor and Honorary Collaborator in the area of Computer Languages and Systems. His research interests include: Automatic demonstration of Theorems through the Use of the Computer, Automatic Deduction Systems based on Tableaux, Declarative Programming with Constraints, Hereditary Harrop Formulas, and Science and Theology.

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