

SACRED EMOTIONS AND AFFECTIVE NEUROSCIENCE: GRATITUDE, COSTLY SIGNALING, AND THE BRAIN

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Our concern in this chapter is with religious emotions and how these might link to brain mechanisms and with evolutionary approaches to understanding character strengths. Given that religion is a human universal, evolutionary and cultural perspectives on the emotions are incomplete without a comprehensive understanding of the role of religion. Religion provides context and direction for emotion, and the influence of religious systems on emotional experience and expression is considerable. For example, religions encourage certain emotions and discourage others. Religion also influences the expression of emotion—both its intensity and its quality. This chapter examines emotions and emotional processes that normally occur in the context of religion. Recent scientific research on the religious emotion of gratitude is highlighted. Specifically, we argue that as a “strength of character,” gratitude, like other virtues, can function as a hard-to-fake signal of fitness (Sosis, 2003) that signals religious commitment and enhances cooperative exchanges. “Fitness” is a technical term from evolutionary biology that means, roughly, the ability of an organism to survive to reproductive age and to get its genes transmitted to the following generations. One component of fitness is an animal’s or a person’s ability to cooperate with others of its kind. In the context of human societies, cooperation requires certain “strengths of character,” such as honesty, trustworthiness, and integrity, and we argue that all the sacred emotions/virtues serve as strengths of character, including gratitude. We use gratitude as a case in point because a lot of data have been gathered on how gratitude functions in both secular and sacred contexts.

RELIGION AND EMOTION: AN OVERVIEW

The connection between religion and emotion is a long and intimate one. For one, religion has always been a source of profound emotional experience. Commenting on this historical association, Pruyser (1968) wrote that “there is something about emotion that has always had a great appeal to the religiousist” (p. 142). More recently, philosopher Loyal Rue (2005) pithily stated that if our objective is to understand religion and human nature, then “we must begin with the emotions” (p. 79).

Religion likely influences both the generation of emotion and the regulation of emotional responses. Links between religion and emotion can also be seen in religious attitudes toward emotional experience and expression. Historically, there are two main notions about the role of emotions in religious life. The charismatic movement stresses the cultivation of intense positive emotions and their importance in religious experience and collective religious rituals (see also McCauley, 2001), whereas the contemplative tradition stresses a calming of the passions and the development of emotional quietude. Religion also provides a broad framework for considering what view to take of particular emotions. Although approaches that reduce unpleasant emotions are certainly often appropriate, a religious perspective will also want to consider when emotions are appropriate, how they can best be employed to serve a constructive purpose, and what the appropriate response to them should be (Watts, 2006).

Silberman (2003) suggests three ways in which religious and spiritual meaning systems influence emotion. First, religion encourages appropriate and inappropriate emotions and their level of intensity. For example, within Judaism, people are encouraged to love God with all their hearts (Deuteronomy 6:5) and to serve God with joy (Deuteronomy 28:47). Second, beliefs about the nature and attributes of God may give rise to specific emotions as well as influence overall emotional well-being. For example, a belief about a loving personal God may have a positive effect on emotional well-being, while a belief about a punitive vengeful God may have the opposite effect. Third, religion offers the opportunity to experience a uniquely powerful emotional experience of closeness to the sacred (Otto, 1958).

The role of emotion in religion found was central in several prominent accounts of religious experience, including Jonathan Edwards’s (1746/1959) analysis of the religious affections, such as fear, hope, love, hatred, desire, joy, sorrow, gratitude, compassion, and zeal, and Friedrich Schleiermacher’s (1799) notable treatise that placed emotion at the center of conscious religious experience. Reverence, humbleness, gratefulness, compassion, remorse, and zeal were described as essential elements of religious experience by Schleiermacher. Within emotion theory, Magda Arnold (1960) was quite possibly the first psychology of emotion theorist to write extensively about

human religious emotions in her book *Emotion and Personality*. In the chapter on positive emotions, she included a section on religious emotions in which she noted that in addition to the prototypical religious emotions of reverence and awe that Otto (1958) and others had identified, several other emotions can be experienced toward God (which was her criteria for a religious emotion). In particular, love, joy, and happiness are “reactions to overwhelming abundance, an infinity, of the good and the beautiful” (Arnold, 1960, p. 328) and contain “a hint of eternity” (p. 160).

One might rightfully ask what makes emotions sacred (or religious?) We can identify several characteristics of sacred emotions. First, sacred emotions are those emotions that are more likely to occur in religious (e.g., churches, synagogues, mosques) *settings* than in nonreligious settings. However, this does not mean that sacred emotions cannot be experienced in nonreligious settings. Second, sacred emotions are those that are more likely to be elicited through spiritual or religious activities or *practices* (e.g., worship, prayer, meditation) than by nonreligious activities. However, this does not mean they cannot be activated through nonreligious channels as well. Third, sacred emotions are more likely to be experienced by *people* who self-identify as religious or spiritual (or both) than by people who do not think of themselves as either spiritual or religious. However, sacred emotions can be felt (on occasion) by people who do not think of themselves as religious or spiritual. Fourth, sacred emotions are those emotions that religious and spiritual *systems* around the world have traditionally sought to cultivate in their adherents. Fifth and last, sacred emotions are those emotions experienced when individuals imbue seemingly secular aspects of their lives (e.g., family, career, events) with a spiritual significance (Mahoney, Pargament, Tarakeshwar, & Swank, 2001; Pargament, 2002). Spiritual emotions such as gratitude, awe and reverence, and love and hope are likely to be generated when people perceive sacredness in various aspects of their lives.

GRATITUDE AS A SACRED EMOTION

Among the emotions that might be thought of as sacred or religious, gratitude has recently emerged as a concept that has generated sustained theoretical and research attention (for an overview, see Emmons & McCullough, 2004). Emmons and his colleagues have undertaken a research program on gratitude, defined as an emotional appreciation of and thankfulness for favors received. Feelings of gratitude stem from two stages of information processing: (1) an affirmation of goodness or “good things” in one’s life and (2) the recognition that the sources of this goodness lie at least partially outside the self. Gratitude also has a dual meaning: a material one and a transcendent one. In its material sense, gratitude is simply a feeling that occurs in interpersonal exchanges when one person acknowledges receiving a valuable

benefit from another. In this sense, it, like other social emotions, functions to help regulate relationships. Its other nature is more ethereal, spiritual, and transcendent. Philosophies and theologies have viewed gratitude as central to the human–divine relationship. As long as people have believed in God, believers have sought ways to express gratitude and thanksgiving to this God, their ultimate giver. An instance of the emotion of gratitude will thus be religious if the perceived benefactor is God, conceived of as either a personal being or a “higher power” that is the source of goodness or “the first giver of all gifts.” Even in a nontheistic sense, gratitude retains its spiritual nature. This fundamental spiritual quality to gratitude that transcends religious traditions is aptly conveyed by Streng (1989): “in this attitude people recognize that they are connected to each other in a mysterious and miraculous way that is not fully determined by physical forces, but is part of a wider, or transcendent context” (p. 5).

Gratitude has been well established as a universal human attribute. Its presence is felt and expressed in different ways by virtually all peoples, of all cultures, worldwide (Emmons & McCullough, 2004). The fact that gratitude is universal across all cultures suggests that it is part of human nature. Gratitude is thus a universal religious sentiment, for it is based on gift exchange between humans and their gods, which is ubiquitous in the history of religion (Burkert, 1996). Some of the most profound reported experiences of gratitude can be religiously based or associated with reverent wonder toward an acknowledgment of the universe (Goodenough, 1998), including the perception that life itself is a gift. In the great monotheistic religions of the world, the concept of gratitude permeates texts, prayers, and teachings. Worship with gratitude to God for the many gifts and mercies are common themes, and believers are urged to develop this quality.

Gratitude from an Evolutionary Perspective

Like other emotions, gratitude can be analyzed at many levels of analysis. For example, from a biocultural or evolutionary perspective emphasizing social functional accounts of emotion (Keltner, 2003), gratitude helps individuals form and maintain relationships; relationships are essential to the survival and well-being of individuals, groups, and societies. A biocultural approach to gratitude suggests that it, like other social emotions, evolved to solve certain recurring problems in the human social landscape.

Specifically, the emotion of gratitude has been hypothesized to have developed in order to solve problems of group governance. Sociologist Georg Simmel (1950) argued that gratitude was a cognitive-emotional supplement serving to sustain one’s reciprocal obligations. Because formal social structures such as the law and social contracts are insufficient to regulate and ensure reciprocity in human interaction, people are socialized to have

gratitude, which then serves to remind them of their need to reciprocate. Thus, during exchange of benefits, gratitude prompts one person (a beneficiary) to be bound to another (a benefactor) during exchange of benefits, thereby reminding beneficiaries of their reciprocity obligations. He referred to gratitude as “the moral memory of mankind . . . if every grateful action . . . were suddenly eliminated, society (at least as we know it) would break apart” (Simmel, 1950, p. 388).

Gratitude also provides an emotional basis for reciprocal altruism. In his seminal article, Robert Trivers (1971) speculated on the evolutionary functions of gratitude. Trivers viewed gratitude as an evolutionary adaptation that regulates people’s responses to altruistic acts. Gratitude for altruistic acts is a reward for adherence to the universal norm of reciprocity and is a mediating mechanism that links the receipt of a favor to the giving of a return favor. The effect of this emotion is to create a desire to reciprocate. From this perspective, gratitude serves as a mental mechanism that calibrates the extent of debt owed—the larger the debt, the larger the sense of gratitude. Recent research indicates that gratitude may be a psychological mechanism underlying reciprocal exchange in human and nonhuman primates (Bonnie & de Waal, 2004).

Emmons and his colleagues synthesized historical perspectives and recent research on gratitude in their theory of gratitude as a moral affect. They theorized that gratitude is a moral affect—that is, one with moral precursors and consequences (McCullough, Kilpatrick, Emmons, & Larson, 2001). By experiencing gratitude, a person is motivated to carry out prosocial behavior, energized to sustain moral behaviors, and inhibited from committing destructive interpersonal behaviors. Because of its specialized functions in the moral domain, they likened gratitude to empathy, sympathy, guilt, and shame. Like empathy, sympathy, guilt, and shame, gratitude has a special place in the grammar of moral life. Whereas empathy and sympathy operate when people have the opportunity to respond to the plight of another person and guilt and shame operate when people have failed to meet moral standards or obligations, gratitude operates typically when people acknowledge that they are the recipients of prosocial behavior. Specifically, McCullough et al. posited that gratitude serves as a *moral barometer*, providing individuals with an affective readout that accompanies the perception that another person has treated them kindly or prosocially. Second, they posited that gratitude serves as a *moral motive*, stimulating people to behave prosocially after they have been the beneficiaries of other people’s prosocial behavior. Recent empirical evidence does indeed suggest that gratitude can shape costly prosocial behavior (Bartlett & DeSteno, 2006). Third, they posited that gratitude serves as a *moral reinforcer*, encouraging prosocial behavior by reinforcing people for their previous prosocial behavior.

Emmons and colleagues have argued that gratitude is a human strength in that it enhances one's personal and relational well-being and is quite possibly beneficial for society as a whole. Results on the correlates of dispositional gratitude appear to bear this out. As a disposition, gratitude is a generalized tendency to recognize and respond with positive emotions (appreciation, thankfulness) to the role of other persons' (moral agents) kindness and benevolence in the positive experiences and outcomes that one obtains. Existing research suggests that gratitude is a typically pleasant experience that is linked to contentment, happiness, and hope.

Gratitude has also been scientifically examined at the level of a personality trait, or disposition. As a trait, gratitude is the tendency to perceive benevolence on the part of others and to respond with grateful feelings and cognitions (e.g., perceptions of being "gifted") and a desire to reciprocate. Two trait measures of gratitude have been published: the GQ-6 (McCullough, Emmons, & Tsang, 2002) and the GRAT (Watkins, Woodward, Stone, & Kolts, 2003). High scorers on the GQ report more frequent positive emotions, life satisfaction, vitality, and optimism and lower levels of depression and stress (McCullough et al., 2002). Similarly, scores on the GRAT correlate positively and moderately with positive states and traits, such as internal locus of control, intrinsic religiosity, and life satisfaction; moreover, scores correlate negatively and moderately with negative states and traits such as depression, extrinsic religiosity, narcissism, and hostility. In one experiment, high scorers on the GRAT showed a positive memory bias: they recalled a greater number of positive memories when instructed to do so and even rated their memories of unpleasant experiences more positively over time relative to the initial emotional impact of these negative events (Watkins, Grimm, & Kolts, 2004). Importantly, these data showing that gratitude is correlated with beneficial outcomes are not limited to self-reports. Notably, the family, friends, partners, and others who surround them consistently report that people who practice gratitude seem measurably happier and are more pleasant to be around. Grateful people are rated by others as more helpful, more outgoing, more optimistic, and more trustworthy (McCullough et al., 2002).

Gratitude and Costly Signaling Theory

It is possible to draw a conceptual linkage between evolutionary and theological perspectives on gratitude by invoking the "costly signaling theory" (CST) of religious behavior (Bulbulia, 2004; Irons, 2001; Sosis, 2003). Recent developments in the scientific study of religion have applied this theory to explain religious belief and behavior. According to CST, both public and private religious behaviors (i.e., ritual activities such as fasting, prayer, worship, tithing) can be regarded as "costly" in that they incur significant effort

without prospect of immediate returns. In their roles as signaling devices, these religious rituals and behaviors can become reliable indicators of commitment (of the person enacting them) to the religious community (for a similar analysis, see Rappaport, 1999). By engaging in these religious practices the religious adherent is saying, in effect, "Look, I would not be devoting so much time to these irrational and useless activities unless I was truly committed to the group." No free rider would be willing to consistently engage in apparently useless ritual activities; thus, you can separate the sheep from the goats by looking at their willingness to comply with all the ritual obligations of the community. Identifying who is in and not in compliance with the rules facilitates group cohesion and cooperation, as you can have confidence that you are not being exploited by free riders (Fehr & Rockenbach, 2004; Sosis, 2003).

Theologians have recognized the effectiveness of public expression of compliance with ritual forms. A public religious expression, such as a public testimony of thanksgiving in response to answered prayer, can authenticate commitment to one's God and to one's faith community. This testimony, if it is repetitive and sincere, provides concrete evidence of one's commitment that not only reinforces and strengthens one's faith but also signals to other believers the person's level of the commitment to the group and to their shared ideology. For instance, a family ritual of saying grace before meals is a simple example of how thanksgiving practices can be inculcated within groups and lead to increased cohesiveness. Theologian Patrick Miller (1996) documented the communal character of praise and thanksgiving in biblical theology. When an individual corporately testifies to God's gracious beneficence, the faith community becomes a "circle of thanksgiving to God" (p. 195), and the resultant effect is the enhancing and strengthening of communal ties and a powerful reminder to the individual that he or she is not autonomous and self-sufficient.

But CST carries implications for other religious forms beyond public ritual displays and practices. We contend that it illuminates certain aspects of the religious emotions as described previously and in particular gratitude and trustworthiness. If we treat the religious emotions, in part, as signaling displays intended to convey a message to others, then we can bring evolutionary theory and "affective neuroscience" into the conversation on religious emotions.

As already mentioned, "costly signals" require strategic costs—costs that extend beyond the baseline costs that all behavioral actions entail—and are therefore hard to fake by individuals not truly committed to cooperative interchange. Cooperative relationships can greatly benefit participating individuals, but they are at risk of exploitation by free riders, or individuals who want to take but not give. It is important to realize just how destructive a free rider can be in attempts to cooperate (de Quervain et al., 2004). If a group of people who are engaged in a common work begin to sense that one of their members

is not putting anything into the work but is nevertheless still drawing salary or benefits from the work, then every other individual in the group begins to adjust his or her performance accordingly until eventually all trust collapses among members of the group and it disbands before accomplishing its purpose. Successful group cooperation requires reliable methods of identifying cheats and free riders. The ability to identify genuine cooperators and fakes or free riders is crucial for those wishing to pursue cooperative exchanges. Interestingly, recent studies combining neuroimaging with behavioral game experiments have shown that neostriatal and limbic prefrontal dopaminergic networks are activated when cheaters/free riders are identified and punished (Fehr & Gächter, 2002; de Quervain et al., 2004).

While multiple institutional procedures have evolved to spot and punish free riders, we are interested here in how the religious emotions might contribute to the process. It is clear how the common emotions contribute: you get angry, even enraged, when you are being exploited by a free rider, and you vow never to trust that person again. By contrast, after a successful bout of cooperation with a trustworthy individual, you increase your level of liking, comfort, and trust of that individual. But what about the religious versions of the emotions of trust, gratitude, and so forth?

We contend that religious emotions help us identify free riders and genuine cooperators because all the religious emotions contribute to the *virtues* or “strengths of character.” If a person has genuinely acquired the traditional religious virtues, then he or she is likely to be a trustworthy companion. The crucial distinction we believe is that *genuine cooperators will acquire a reputation for trustworthiness and integrity, while free riders will not be able to sustain the high costs of acting with integrity, consistency, and generosity.* The importance of trustworthiness and character is even more pronounced when social groups increase in size and number such that you can no longer rely on reputation or repeated interactions with an individual. In large groups of people, free riders find ways to escape identification in the crowd. Perceived strength of character or “trustworthiness” of an individual should, therefore, reliably indicate an individual’s willingness to engage in cooperative enterprises. Thus, considerations derived from CST predict that a premium will be placed on the neurobehavioral ability to both perceive and signal trustworthiness. The religious emotions would facilitate the ability to both perceive and display traits of trustworthiness. If I am, for example, perceived as a grateful person, then it likely means that I have received an unmerited gift at some point in the recent past. If I have received an unmerited gift, then it is likely that some important person or group trusted me enough to cooperate with me and liked me enough to confer extraordinary benefits on me in the course of that cooperation. Thus, sustaining over time the behavioral disposition of “gratitude” could bring even more *benefits* to the grateful individual because it will mark the person as trustworthy. We discuss the signaling capacities

of gratitude further later in this chapter, but first we wish to say more about the benefits of acquiring a grateful disposition, as these data support the evolutionary and neuroscience-motivated analyses presented here.

RESEARCH ON THE BENEFITS OF GRATITUDE

The significance of gratitude stems not only from its role in regulating human social relationships but also from its effects on intrapersonal functioning. An exploration into the effect of gratitude on psychological functioning has occurred within the positive psychology movement, which has sought to systematically classify human strengths and virtues into a comprehensive taxonomy (Peterson & Seligman, 2004). Basic research as well as interventions to cultivate these virtues are beginning to yield significant fruit.

As an illustration of an effective intervention, recent research has demonstrated that mood and health benefits can accrue from grateful thinking. In experimental studies, persons who were randomly assigned to keep gratitude journals on a weekly basis exercised more regularly, reported fewer physical symptoms, felt better about their lives as a whole, and were more optimistic about the upcoming week compared to those who recorded hassles or neutral life events (Emmons & McCullough, 2003, study 1). A daily gratitude journal-keeping exercise with young adults resulted in higher reported levels of the positive states of alertness, enthusiasm, determination, attentiveness, and energy compared to a focus on hassles or a downward social comparison (ways in which participants thought they were better off than others; Emmons & McCullough, 2003, study 2). Participants in the daily gratitude condition were more likely to report having helped someone with a personal problem or having offered emotional support to another, relative to the hassles or social comparison condition. This indicates that, relative to a focus on complaints, an effective strategy for producing reliably higher levels of pleasant affect is to lead people to reflect, on a daily basis, on those aspects of their lives for which they are grateful. Other benefits have extended to the physical realm including better sleep quality and more time spent exercising for those keeping gratitude journals (Emmons & McCullough, 2003).

The benefits of gratitude were further confirmed in a recent study that compared the efficacy of five different interventions that were hypothesized to increase personal happiness and decrease personal depression (Seligman, Steen, Park, & Peterson, 2005). In a random assignment, placebo-controlled Internet study, a gratitude intervention (writing and delivering a letter of thankfulness to someone who had been especially helpful but had never been properly thanked) was found to significantly increase happiness and decrease depression for up to one month following the visit. Results indicated that "participants in the gratitude visit condition showed the largest positive changes in the whole study" (Seligman et al., 2005, p. 417). Thus, the benefits

of gratitude do not appear to be limited to the self-guided journal keeping methodology utilized by Emmons and McCullough (2003).

Why Is Gratitude Good? Exploring Mechanisms

The research literature to date indicates that gratitude, either measured dispositionally or activated by specific tasks, is linked to improved well-being and general positive functioning. How does one account for the psychological, emotional, and physical benefits of gratitude? A number of mechanisms have been suggested to account for the psychological benefits of grateful thinking (Watkins, 2004); our focus here is primarily on physical effects. There appears to be growing evidence that gratitude and related states can impact physiological functioning and physical health. Activation studies are beginning to examine the physiological concomitants of gratitude and related positive emotional states. Researchers at the Institute of HeartMath and Quantum Intech in Boulder Creek, California, have developed a behavioral technique for inducing a positive emotion they call "appreciation" (McCraty & Childre, 2004). The technique consists in consciously disengaging from unpleasant emotions by shifting attention to one's physical heart, which they think most people associate with positive emotions, and focusing on feeling appreciation toward someone, appreciation being an active emotional state in which one dwells on or contemplates the goodness of someone. McCraty and Childre have found that heart rhythm patterns associated with "appreciation" differ markedly from those associated with relaxation (neutral emotion) and anger (negative emotion). Appreciation increases parasympathetic activity and also produces entrainment or coherence across various autonomic measures (e.g., heart rate variability, pulse transit time, respiration rate), a pattern that is associated with cardiovascular health.

This finding provides a criterion for the presence of "appreciation" that may be more reliable than self-report. McCraty and Childre (2004) admit that they have not been able to discriminate "between specific positive . . . emotions on the basis of heart rhythm patterns alone" (p. 250), suggesting that "appreciation" might function as a summary term for such widely different positive emotions as hope, gratitude, joy, admiration, contentment, relief, pride, and gloating. Thus, heart rhythm patterns currently discriminate emotion types only roughly, but McCraty and Childre optimistically contend that "future developments in pattern analysis technologies will enable a more refined discrimination of emotions than is currently possible" (p. 250).

Relatedly, recent studies of autonomous nervous system activity during meditation have reported a pattern of mutual activation of both the parasympathetic and the sympathetic system that is associated with the subjective experience of a sense of overwhelming calmness as well as significant alertness. We bring this up here because the conscious activation of gratitude

through the journaling exercise resulted in increased *calmness* and *alertness* (Emmons & McCullough, 2003). And, to complete the story, other studies have found that certain meditative techniques do in fact lead to an increased sense of gratitude and thankfulness (Gillani & Smith, 2001).

More broadly, sacred positive emotions such as gratitude can serve as resources that a person can draw on in times of need, including coping with stress and dealing with and recovering from physical illness. It is also plausible, for example, that the biology of emotions and related states activated during religious worship (praise, reverence, awe, gratitude, love, hope) could have neuroendocrine or immunological consequences, thus potentially accounting for the salubrious effects of religious practices on health outcomes. Any examination of the neurobiology of these states will likely have to rely on the phenomenological properties of worship or other related religious experiences, thus taking the “religio” in “religious” emotions seriously.

GRATITUDE, POSITIVE EMOTIONS, AND THE BRAIN

Given the centrality of gratitude to the religious stance, to prosocial behavior, and to moral behavior (as reviewed previously) as well as its manifestly positive effects on mood and health, it is worth attempting to construct a tentative cognitive neuroscience of gratitude (and this takes us into the realm of affective neuroscience). Affective neuroscience is far broader than the field of emotion, as it examines the behavioral, social, and neural components of emotional processes (Schmidt, 2003).

Why bother with neural processes involved in gratitude? Well, for one reason, modeling and examining the brain correlates of a complex emotion such as gratitude, though fraught with difficulties, may help us decide between competing accounts of the nature and functions of gratitude. In addition, it may provide clues as to how gratitude and other positive emotions can influence health, thus enhancing clinical attempts to elicit the emotion.

If, for example, investigation led us to assign gratitude to neural networks handling motivational states rather than to networks supporting consummatory pleasure or reward states, then it would be reasonable to conclude that the neurological data are more consistent with functional treatments of gratitude as promoting “reciprocity” for favors received and “moral behavior” for social debts incurred than with nonfunctional accounts of gratitude as simply a readout mechanism that informs us that we have received an unmerited benefit. Obviously, our neurologic investigations could lead us to believe that gratitude involves both a pleasurable emotion and a motivational state. In this case, the neurologic data help us place the psychologic accounts of gratitude into a process framework, thus allowing the investigator to place further constraints on the object of his or her investigation. Measurement

instruments would then need to address both the state-emotional aspects of gratitude as well as its motivational effects. It seems likely that a process account of gratitude would involve an initial experience of relatively intense positive affect, such as joy, appreciation, or happiness, for some significant benefit received, with the intensity of this positive emotion and its concomitant motivational effects likely decreasing over time. After the initial benefit is received from a benefactor, the recipient would experience a sense of appreciation or even joy, depending on the size of the gift. Arriving at a given level of intensity of gratitude (and presumably a related motivational state) would require the calculation of degree of benefit received along with anticipated costs of reciprocating. In addition, both the felt emotion and the accompanying motivational state would require a certain amount of memory involving the favor received and of the benefactor. In short, a process account of gratitude would involve a recipient of a benefit (1) recognizing that a gift has been received, (2) calculating benefits/costs associated with the gift, (3) experiencing an emotion that begins in appreciation and emerges into gratitude, (4) with memory of the benefit and benefactor as well as the emotion of gratitude initiating and sustaining a motivational state to reciprocate the benefit received. All four of these steps can be handled by limbic-frontal interactions (Damasio & Anderson, 2005), as such interactions have been shown to support (1) assigning significance levels to events and stimuli in the individuals' environment/experience (Rolls, 2004; Schultz et al., 1995), (2) assessing probabilities and costs of current decisions and events (Aldophs, Jansari, & Tranel, 2001; Barkley, 1997), (3) supporting positive emotionality as well as motivational and approach tendencies (Berridge, Espana, & Stalnaker, 2003; Davidson et al., 2002), and (4) supporting autobiographical memory retrieval as well as memory of recent social interactions (Craik et al., 1999; Wheeler, Stuss, & Tulving, 1997). The neurologic data therefore support the process approach to emergence of gratitude, and the process approach in turn is consistent with standard direct and indirect reciprocity accounts of the functions of gratitude. As discussed previously, in the standard reciprocity account of gratitude, its function is to support human cooperation by facilitating "giving back" to a benefactor.

But what happens when you receive a gift that you can't possibly reciprocate? Here the standard reciprocity accounts of gratitude may break down as the benefits/costs analyses of the gift cannot be computed and no conventional motivational state to reciprocate the giver can emerge. We can receive such unrepayable gifts from multiple sources, as when a comrade saves our life in war or when God confers his gifts, as in the miraculous recovery of an alcoholic in Alcoholics Anonymous when all seemed utterly lost. Certainly, the potlatch feasts in certain North American Indian tribes tended to move in the direction of conferring gifts on rivals that could not be reciprocated. Perhaps costly signaling approaches (as described previously) may be more applicable here than standard reciprocity models of gift giving

(and, by implication, gratitude). If costly signaling accounts of gratitude as a commitment device are correct, then calculation of costs/benefits is less likely to play a role, as the more costly the emotional and behavioral display associated with gratitude, the more effective the signal.

From a neurologic perspective, costly signaling models would likely involve recruitment of circuits that support positive emotions *regardless of costs*. Instead of the four-step process model described previously for standard reciprocity models of gratitude, we would need to substitute the following: (1) the cost/benefit analysis system is inhibited or shut down temporarily, as the recipient receives a gift that he or she construes as unmerited, unrepayable, or even of ultimate significance; (2) the recipient is flooded with an extreme emotion of appreciation and perhaps joy that stabilizes into gratitude; (3) depending on context, this form of gratitude issues into one of two possible motivational states/outcomes: either the recipient gives up the attempt to reciprocate in any way and rests in the memory of the gift, or the recipient dedicates his or her life to gifting others as much as possible. The second option occurs most often in a religious or spiritual context. When it does occur, it may be experienced as a kind of conversion to a new way of life.

On the face of it, the costly signaling approach to gratitude (and we must emphasize here that we are only sketching one such approach here) can more adequately account for the specifically *religious* aspects of gratitude, as religious gratitude appears to eschew finely calibrated tit-for-tat calculations of cost-benefit. Instead, religious gratitude never concludes that the debt to the benefactor has been discharged, as the gifts received are incalculable. Thus, religious expressions of gratitude may sometimes take on the most extravagant manifestations, such as the “gift of tears” or extreme altruistic self-sacrifice as we see in the life of the saints and martyrs.

Does CST allow us to examine potential benefits of adopting the strategic stance of a more or less permanent display of gratitude? Can gratitude itself (rather than gifting per se) be treated as a costly display that accomplishes some strategic social goal? If we assume that “being in a state of gratitude” can be detected by onlookers, then it is reasonable to ask whether the emotion can be usefully recruited into the strategic social goals of the individual as CST might predict. Certainly coming across a “grateful” person provides valuable strategic information to an onlooker looking for potential allies and attempting to avoid potential enemies or free riders. Detecting a hint of gratitude in a person with whom you have not previously interacted tells you that that person (1) has likely received a gift and therefore likely holds potentially valuable resources; (2) is likely to be trustworthy when cooperating, as gratitude inclines a person to reciprocate for favors received; (3) is not likely to be a freeloader, as gratitude is a costly complex emotion that is hard to fake; and (4) may likely still be in touch with another coalition that contains individuals who can confer gifts or other benefits.

From the previous analysis, it follows that the human brain likely contains neural networks that are efficient at both detecting and displaying telltale signs of gratitude. The cues are likely to include facial expressions and vocal and behavioral displays. Thus, from the point of view of CST, the neurology of gratitude would need to include (1) the fusiform face-processing areas near the temporal–occipital junctions; (2) the amygdala and limbic emotional processing systems, which support emotional states; and (3) interactions between these two subcortical centers with the prefrontal regions controlling executive and evaluative processes.

Gratitude in Persons with Neurological Deficits

Although the costly signaling approach may give us a better account of religious gratitude than does the standard reciprocity theory, it is clear that both approaches would require the neurological participation of limbic–prefrontal networks. Thus, like the other social emotions, gratitude likely relies on limbic–prefrontal networks to mediate its positive effects on the individual (Blakemore, Winston, & Frith, 2004). Admittedly, this is only a general neurologic area and therefore does not help us much in constraining evolutionary and cognitive models of gratitude. But it is a start, and until classical neuropsychologic and neuroimaging procedures are brought to bear on the issue of gratitude, we can't do much better than this.

Additional evidence comes from findings that patients with Parkinson's disease (PD) have deficits in counterfactual thinking (the ability to imagine alternatives to events that have happened). There is some reason to believe that gratitude could be considered a counterfactual emotion or response. Gratefulness or thankfulness to someone who has done you a kindness may often be accompanied by a cognition about how things could have gone differently. Teigen (1997) required his or her subjects to tell a story about two occasions when they felt grateful and then later asked them if they had thought of what might have happened instead (i.e., engaged in counterfactual thinking) and found that there was indeed a close relationship between gratitude and counterfactual thinking. A recently published study found a counterfactual deficit in patients with frontal dysfunction (McNamara, Durso, Brown, & Lynch, 2003), and thus there may be a connection between ability to adopt a grateful attitude and ability to generate counterfactuals.

To test the general conclusion that gratitude differentially relies on limbic–prefrontal networks, we conducted a pilot investigation with individuals who evidence clinically significant prefrontal dysfunction—namely, individuals with midstage PD (Starkstein & Merello, 2002). If the emotion of gratitude depends on prefrontal networks, then measures of gratitude should correlate with measures of prefrontal function. In addition, individuals with prefrontal dysfunction should not display the normal benefit in mood that

occurs when an individual conjures up a memory of an experience that induced gratitude (Emmons & McCullough, 2003). Normally, if you ask an average person to remember a time when they felt grateful for something that someone did for them or for something that happened to them, their mood slightly changes into a more positive, happy one. If, however, gratitude and its beneficial effects depends critically on prefrontal networks, then we would expect no such mood improvement in persons with prefrontal dysfunction if they are asked to recall an experience involving gratitude. That is what we indeed found when testing PD patients. We compared a group of midstage PD patients ($N = 22$) to age-matched healthy controls ($N = 18$) on the mood induction procedure (described in Emmons & McCullough, 2003). In the mood induction procedure, the subject is asked to use both an explicit self-report and an implicit unconscious report of his or her mood before and after he or she recalls either a gratitude memory or a "control" positive memory. While neither group reported a mood change when recalling a positive memory, there was a slight improvement in mood in the healthy controls after recalling a gratitude memory but no such improvement in mood for the PD patients. The postinduction mood scores for healthy controls, furthermore, were correlated with several measures of prefrontal function, while no such correlations were obtained (between postinduction mood scores and prefrontal performance) for PD patients. In addition, though the overall score on the GQ-6 questionnaire showed no difference between the PD versus control groups (mean gratitude level out of 42 total = 36.0 [4.40] for controls and 34.8 [4.2] for PD patients; $t < 1$, $p = 0.35$), it was nonetheless significantly correlated with several measures of prefrontal performance in the healthy controls but not in the PD patients. Finally, we also found significant group differences in the latency to retrieval of a gratitude memory as well as the mean length (in number of words) of gratitude memories with PD patients taking longer to retrieve memories (16.16 seconds vs. 23.45 seconds) that were also significantly more wordy or verbose than those of control subjects (100.13 words vs. 65.94 words). The latter finding was to be expected given that a classic symptom of PD is a deficit in speech monitoring (see Tables 2.1 and 2.2).

These data merely scratch the surface of what might be accomplished by examining neurologic correlates of a religious emotion like gratitude. It might also, for example, be possible to conduct brain-imaging studies during prayers of thanksgiving compared to different prayers (liturgical, petitionary), and blood flow could be detected in each prayer state. Additionally, the co-occurrence of gratitude with other positive emotional states that are activated in meditation (compassion, loving kindness, empathy) suggests that gratitude, like other positive emotions, could conceivably be associated with neuroendocrine and immunological measures (Davidson et al., 2003). One might also examine limbic prefrontal

Table 2.1 Gratitude Memory, Patient with Parkinson's Disease

Latency of response initiation: 1 minute, 15 seconds

Word Count: 229

- A: So now once again I'm going to ask you to try to remember something from the past month. Alright, I want you to tell me about a specific event that happened when you felt grateful to someone. You can take as long as you want to remember.
- P: Let me look at my calendar to see what I did this month; maybe it'll jog my mind. I can't think of anything specific in here. All I do is go to the doctor's and do my gigs.
- A: So any time that you felt grateful towards a doctor or you felt grateful towards someone, you . . .
- P: I never feel grateful towards a doctor because he's always prescribing more pills.
- A: Anytime during a gig that you felt grateful towards someone?
- P: Well it's always nice when I finish the gigs, when I finish doing the hour show, when somebody, when I get the people in the audience to stand up and applaud. And that happens quite a bit.
- A: So that happened in the past month?
- P: Yeah.
- A: And you feel grateful about that.
- P: But as I say, I think that I mentioned this earlier, my speech is deteriorating. It's slower. My voice is softer. I have to use a microphone more extensively. So that's kind of nice when I finish a program, you know in my own mind I think I was slurring my words and not saying what I wanted to say, and they still applaud. And seem to mean it. So that makes me feel good.
- A: Right. So you're grateful about that.
- P: Yeah, I would say so.
- A: OK. Now do you think that something else could easily have happened? Like do you think that maybe they wouldn't have applauded, do you ever think about that?
- P: Well that's possible. There's no reason why they should have to stand up and give me a standing ovation. But it's happened on several occasions.
- A: And that would be pretty unpleasant.
- P: They would bother me, that I had put my best out and maybe somebody didn't like it. But I haven't come across that.
- A: Good, but do you ever think that way? Do you ever think when you go into a show, "Uh oh, they might not applaud for me tonight."
- P: Oh sure, but lots of times it's only in my own mind.

dopaminergic activity in dispositionally grateful and less grateful individuals including more dopamine receptors or whether there are increases in dopamine function as a result of systematic gratefulness training (cf. Davidson et al., 2003). Certainly these are viable hypotheses for future research and would significantly advance the science of gratitude as well as religion-brain interactions more generally.

Table 2.2 Gratitude Memory, Patient in Control Condition

Latency to response initiation: 12 seconds Word Count = 199

A: So now I'm going to ask you to talk about a memory you have, OK? I want you to tell me about a time in the past month that you felt grateful to someone. And that person can be someone you know, it can be to God, to anyone, just about a time in the past month that you felt grateful to someone.

C: Well, how about this morning.

A: Ok, tell me about it.

C: Tell you about it. Well, OK. I had bought a Super Bowl video from Strawberries and if you send in the barcode and receipt they will reimburse you \$10 of the cost. Well I got a card in the mail this morning and it says you didn't send in the barcode so you can't get the \$10. So what I did, I went to Strawberries and I showed the man the card, and he gave me 10 bucks. So I was grateful.

A: So who were you grateful to?

C: The gentleman that took care of the issue.

A: OK, so you were grateful to the guy at Strawberries.

C: Yeah, manager or whoever he was.

A: Very good. OK, so I'm going to ask you some questions about that experience. So this man at Strawberries, he gave you the \$10 back. Now, do you think that something else could easily have happened?

C: He could have said "I can't do anything for you. You need to get the barcode." The barcode right now is, if I'm lucky, it would be in Texas because I sent it to my son. So I'd never get it.

A: So you think that definitely something else easily could've happened?

C: Oh sure.

A: OK, so where would you say?

C: I would say that could've happened. Oh sure, up here somewhere.

A: So you were saying that he could have said to you . . .

C: He could have said that "I can't do anything for you because you don't have the barcode."

A: Alright now if that had happened, how pleasant or unpleasant would that have been?

C: It would have been unpleasant because I'd think it was either my stupidity or something and would've resulted in the loss of 10 bucks. So, unpleasant. That would be about a 2.

CONCLUSION

In conclusion, for the psychology of religion there are lessons to be learned from the success of affective neuroscience. An interdisciplinary approach such as we have sketched here and provided a concrete example of can expand our knowledge of religion and the brain in interesting new directions. Clearly, both costly signaling evolutionary theory and social affective neuroscience (including brain imaging) are really just "works in progress,"

but we believe that, when combined, they have the potential of extending the mind and brain sciences to a much broader range of phenomena than are typically studied by neuroscientists, including those that are of most interest to psychologists of religion and spirituality. We anticipate that, in accordance with several other contributors to this volume, the combination of the evolutionary and affective neuroscience paradigms will ultimately anchor the psychology of religion as strongly in the biological sciences as in the social and clinical sciences and will yield new and scientific ways to talk about the human spirit.

REFERENCES

- Aldophs, E., Jansari, A., & Tranel, D. (2001). Hemispheric perception of emotional valence from facial expressions. *Neuropsychology*, *15*(4), 516–524.
- Arnold, M. B. (1960). *Emotion and personality*. New York: Columbia University Press.
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, *121*(1), 65–94.
- Bartlett, M. Y., & DeSteno, D. (2006). Gratitude and prosocial behavior: Helping when it costs you. *Psychological Science*, *17*(4), 319–325.
- Berridge, C. W., Espana, R. A., & Stalnaker, T. A. (2003). Stress and coping: Asymmetry of dopamine efferents within the prefrontal cortex. In K. Hugdahl & R. Davidson (Eds.), *The asymmetrical brain* (pp. 69–104). Cambridge, MA: MIT Press.
- Blakemore, S. J., Winston, J., & Erith, U. (2004). Social cognitive neuroscience: Where are we heading? *Trends in the Cognitive Sciences*, *8*(5), 216–222.
- Bonnie, K., & de Waal, F. (2004). Primate social reciprocity and the origin of gratitude. In R. Emmons & M. McCullough (Eds.), *The psychology of gratitude* (pp. 213–229). New York: Oxford University Press.
- Bulbulia, J. (2004). Religious costs as adaptations that signal altruistic intention. *Evolution and Cognition*, *10*, 19–38.
- Burkert, W. (1996). *Creation of the sacred: Tracks of biology in early religions*. Cambridge, MA: Harvard University Press.
- Craik, F. I. M., Moroz, T. M., Moscovitch, M., Stuss, D. T., Winocur, G., Tulving, E., et al. (1999). In search of the self: A PET study. *Psychological Science*, *10*(1), 26–34.
- Damasio, A., & Anderson, S. W. (2005). The frontal lobes. In K. Heilman & E. Valenstein (Eds.), *Clinical neuropsychology* (4th ed., pp. 404–446). New York: Oxford University Press.
- Davidson, R. J., Kabat-Zinn, J., Schumacher, J., Rosenkranz, M., Muller, D., Santorelli, S. F., et al. (2003). Alterations in brain and immune function produced by mindfulness meditation. *Psychosomatic Medicine*, *65*, 564–570.
- Davidson, R. J., Lewis, D. A., Alloy, L. B., Amaral, D. G., Bush, G., Cohen, J. D., et al. (2002). Neural and behavioral substrates of mood and mood regulation. *Biological Psychiatry*, *52*, 478–502.
- de Quervain, D. J., Fischbacher, U., Treyer, V., Schellhammer, M., Schnyder, U., Buck, A., et al. (2004). The neural basis of altruistic punishment. *Science*, *305*(5688), 1254–1258.

- Edwards, J. (1746/1959). Religious affections. In J. Smith (Ed.), *Religious affections: His works* (Vol. 2.) New Haven, CT: Yale University Press.
- Emmons, R. A., & McCullough, M. E. (2003). Counting blessings versus burdens: Experimental studies of gratitude and subjective well-being in daily life. *Journal of Personality and Social Psychology*, *84*, 377–389.
- Emmons, R. A., & McCullough, M. E. (Eds.). (2004). *The psychology of gratitude*. New York: Oxford University Press.
- Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature*, *415*, 137–140.
- Fehr, E., & Rockenbach, B. (2004). Human altruism: Economic, neural and evolutionary perspectives. *Current Opinion in Neurobiology*, *14*, 784–790.
- Gillani, N. B., & Smith, J. C. (2001). Zen meditation and ABC relaxation theory: An exploration of relaxation states, beliefs, dispositions, and motivations. *Journal of Clinical Psychology*, *57*, 839–846.
- Goodenough, U. (1998). *The sacred depths of nature*. New York: Oxford University Press.
- Irons, W. (2001). Religion as a hard-to-fake sign of commitment. In R. Nesse (Ed.), *Evolution and the capacity for commitment* (pp. 292–309). New York: Russell Sage Foundation.
- Keltner, D. (2003). Expression and the course of life: Studies of emotion, personality, and psychopathology from a social-functional perspective. *Annals of the New York Academy of Sciences*, *1000*, 222–243.
- Mahoney, A., Pargament, K. I., Tarakeshwar, N., & Swank, A. B. (2001). Religion in the home in the 1980s and 1990s: A meta-analytic review and conceptual analysis of links between religion, marriage, and parenting. *Journal of Family Psychology*, *15*(4), 559–596.
- McCauley, R. N. (2001). Ritual, memory, and emotion: Comparing two cognitive hypotheses. In J. Andresen (Ed.), *Religion in mind: Cognitive perspectives on religious belief, ritual, and experience* (pp. 115–140). New York: Cambridge University Press.
- McCarty, R., & Childre, D. (2004). Gratitude and the heart: The psychophysiology of appreciation. In R. Emmons & M. McCullough (Eds.), *The psychology of gratitude* (pp. 230–255). New York: Oxford University Press.
- McCullough, M. E., Emmons, R. A., & Tsang, J. (2002). The grateful disposition: A conceptual and empirical topography. *Journal of Personality and Social Psychology*, *82*, 112–127.
- McCullough, M. E., Kilpatrick, S. D., Emmons, R. A., & Larson, D. B. (2001). Is gratitude a moral affect? *Psychological Bulletin*, *127*, 249–266.
- McNamara, P., Durso, R., Brown, A., & Lynch, A. (2003). Counterfactual cognitive deficit in patients with Parkinson's disease. *Journal of Neurology, Neurosurgery, and Psychiatry*, *74*, 1065–1070.
- Miller, P. D. (1996). *They cried to the Lord: The form and theology of Biblical prayer*. Minneapolis, MN: Fortress Press.
- Otto, R. (1958/1917). *The idea of the holy* (J. W. Harvey, Trans.). London: Oxford University Press.
- Pargament, K. I. (2002). The bitter and the sweet: An evaluation of the costs and benefits of religiousness. *Psychological Inquiry*, *13*, 168–181.

- Peterson, C. P., & Seligman, M. E. P. (Eds.). (2004). *Character strengths and virtues: A handbook and classification*. New York: Oxford University Press.
- Pruyser, P. W. (1968). *A dynamic psychology of religion*. New York: Harper & Row.
- Rappaport, R. (1999). *Ritual and religion in the making of humanity*. Cambridge: Cambridge University Press.
- Rolls, E. T. (2004). The functions of the orbitofrontal cortex. *Brain and Cognition*, 55, 11–29.
- Rue, L. (2005). *Religion is not about God*. New Brunswick, NJ: Rutgers University Press.
- Schleiermacher, F. (1799). *On religion: Speeches to its cultured despisers*. (J. Oman, Trans.) New York: Frederick Ungar Publishing.
- Schmidt, L. A. (2003). Special issue on affective neuroscience: Introductory remarks. *Brain and Cognition*, 52, 3.
- Schultz, W., Romo, R., Ljungberg, T., Mirenowicz, J., Hollerman, J., & Dickinson, A. (1995). Reward-related signals carried by dopamine neurons. In J. Houk, J. Davis, & D. Beiser (Eds.), *Models of information processing in the basal ganglia* (pp. 233–248). Cambridge: MIT Press.
- Seligman, M. E. P., Steen, T. A., Park, N., & Peterson, C. (2005). Positive psychology progress: Empirical validation of interventions. *American Psychologist*, 60, 410–421.
- Silberman, I. (2003). Spiritual role modeling: The teaching of meaning systems. *International Journal for the Psychology of Religion*, 13, 175–195.
- Simmel, G. (1950). *The sociology of Georg Simmel*. Glencoe, IL: Free Press.
- Sosis, R. (2003). Why aren't we all Hutterites? Costly signaling theory and religious behavior. *Human Nature*, 14, 91–127.
- Starkstein, S. E., & Merello, M. (2002). *Psychiatric and cognitive disorders in Parkinson's disease*. Cambridge, England: Cambridge University Press.
- Streng, F. J. (1989). Introduction: Thanksgiving as a worldwide response to life. In J. Carman & F. Streng (Eds.), *Spoken and unspoken thanks: Some comparative soundings* (pp. 1–9). Dallas, TX: Center for World Thanksgiving.
- Teigen, K. H. (1997). Luck, envy, and gratitude: It could have been different. *Scandinavian Journal of Psychology*, 38, 313–323.
- Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, 46, 35–57.
- Watkins, P. C. (2004). Gratitude and subjective well-being. In R. Emmons & M. McCullough (Eds.), *The psychology of gratitude* (pp. 167–192). New York: Oxford University Press.
- Watkins, P. C., Woodward, K., Stone, T., & Kolts, R. L. (2003). Gratitude and happiness: Development of a measure of gratitude and relationships with subjective well-being. *Social Behavior and Personality*, 31, 431–452.
- Watkins, P. C., Grimm, D. L., & Kolts, R. (2004). Counting your blessings: Positive memories among grateful persons. *Current Psychology: Developmental, Learning, Personality, Social*, 23, 52–67.
- Watts, F. (2006). Emotional regulation and religion. In J. Gross (Ed.), *Handbook of emotion regulation*. New York: Guilford Press.
- Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a theory of episodic memory: The frontal lobes and autonoietic consciousness. *Psychological Bulletin*, 121(2), 331–354.