

**ACCEPTANCE:
THE ESSENCE OF PEACE**

**SELECTED PAPERS
FROM
THE FIRST
INTERNATIONAL CONGRESS
ON
INTERPERSONAL
ACCEPTANCE AND REJECTION**

FATOŞ ERKMAN, EDITOR

Neural Processes in Rejection Sensitivity: Differences in Emotional Appraisal or Control?

Ethan Kross

Peter Clasen

University of Michigan, Ann Arbor, USA

Abstract

Rejection Sensitivity (RS) is the tendency to anxiously expect, readily perceive, and intensely react to rejection. This chapter summarizes recent work exploring the cognitive and neural processes underlying the more intense responses to rejection characterizing individuals who are high in this disposition (high RS). We begin by briefly reviewing prior research and theory on RS. We then discuss the role that emotional appraisal and cognitive control processes may play in distinguishing high and low RS individuals' responses to rejection, and describe the results of a recent fMRI study that was conducted to examine this issue. The chapter concludes with a discussion of important directions for future research.

A hard-working employee is passed over for a promotion. An adolescent's bid to secure a date with his first real love is ruthlessly turned down. A recent college graduate is told that she is not qualified for her dream job. For better or worse, most people receive rejection feedback at some point in their lives. Although these experiences are common and typically unpleasant, dramatic differences exist in the way people respond to them. Some people respond in ways that are harmful to themselves and their relationships. For example, they become angry, hostile, and depressed (e.g., Downey, Feldman & Ayduk, 2000; Ayduk, Downey, & Kim, 2001). Others respond more adaptively – they recover quickly and move on with their lives.

To help explain this variability in people's responses to rejection, Downey and Feldman (1996) proposed that early experiences of rejection lead some people to develop anxious expectations of rejection, a social-cognitive processing disposition called Rejection Sensitivity (RS). There is now ample evidence indicating that people who are high in this disposition (high RS) readily perceive and intensely react to rejection cues in ways that are maladaptive for themselves and their relationships (e.g., Downey & Feldman, 1996; Romero-Canyas & Downey, 2005).

This chapter summarizes recent work exploring the cognitive and neural processes underlying the more intense responses to rejection that characterize high RS individuals. In this vein, we begin by briefly reviewing prior research and theory on RS. We then discuss the role that emotional appraisal and cognitive control processes may play in distinguishing high and low RS individuals' responses to rejection, and describe the results of a recent fMRI study that was conducted to examine this issue. We conclude by discussing important directions for future research.

The Rejection Sensitivity Model

The rejection sensitivity (RS) model was introduced to account for individual differences in the way people respond to rejection experiences (Downey & Feldman, 1996). According to this theory, individuals become increasingly sensitive to rejection as a result of early, prolonged or acute rejection experiences with caregivers and significant others. These early experiences may manifest themselves in the form of cruelty, hostility, neglect or abuse, and lead individuals to expect to be rejected by significant people in their lives. As a result, they develop anxious expectations of rejection. These anxious expectations, in turn, lead them to display a heightened attentiveness to perceiving negativity in rejection-relevant cues and situations, and to display intense affective reactions to them (e.g., Downey Freitas, Michaelis, & Khouri, 1998; Levy, Ayduk, & Downey, 2001).

A critical feature of the RS model is the manner in which it is activated. Consistent with person X situation interactionist models of personality (Mischel & Shoda, 1995, 1998), dispositional responses to rejection become activated in an if... then... manner (i.e., if a high RS individual encounters a rejection related stimulus, then anxious expectations become activated). Prior research indicates, for example, that exposing high RS individuals to images that convey rejection themes (i.e., paintings depicting people who appear socially disconnected or lonely) or words associated with the concept of rejection (e.g., abandon, betray, exclude) leads to the activation of the RS dynamic and the negative thoughts, feelings, and physiological responses associated with it. In contrast, exposing individuals to non-rejection related negative stimuli does not lead to similar outcomes (Ayduk, Downey, Testa, Yen, & Shoda, 1999; Downey, Mougios, Ayduk, London, & Shoda, 2004; Romero-Canyas & Downey, 2005).

A great deal of research indicates that being high in RS has severe negative implications, both for the individual and their relationships (for review see Romero-Canyas & Downey, 2005). For example, high RS individuals show greater vulnerability to loneliness, social anxiety, and

depression (London, Downey, Bonica, & Paltin, 2007; Downey et al., 2000; Ayduk et al., 2001). In addition, they show more hostility and aggression, and experience more difficulty and dissatisfaction in their relationships (Downey et al., 1998; Ayduk et al., 1999; Downey et al., 2000). Given these significant negative outcomes, a key need is to understand the processes that give rise to differences in the way high and low RS individuals respond to rejection.

Processes Underlying Rejection Sensitivity: Differences in Emotional Appraisal or Control?

Prior research on RS suggests that differences in the way high and low RS individuals respond to rejection may be explained in three ways. One hypothesis is that high RS individuals respond more intensely to rejection because they appraise rejection cues as more threatening than low RS individuals. Initial evidence supporting this prediction comes from a study that examined differences between high and low RS individuals startle reflex response to rejection stimuli (Downey et al., 2004). The startle response measures the magnitude of an individual's eyeblink response to a sudden, unexpected stimulus. Prior research indicates that when individuals are in a highly aroused negative state, as high RS individuals are thought to be when exposed to rejection situations and cues, the magnitude of their startle response increases (Lang et al., 1990, 2000). For example, most people show a greater startle response when viewing negatively valenced pictures (e.g., a picture of a pointed gun) than positively valenced pictures. In this study, Downey and colleagues recorded acoustic startle eye blink magnitudes while high and low RS participants viewed rejection and acceptance themed paintings (works of art by Edward Hopper and August Renoir), as well as positively and negatively themed paintings that served as controls for stimulus valence (paintings by Jean Miro and Mark Rothko). They found that high RS participants showed increased startle eye-blink magnitude and greater levels of distress relative to low RS participants only when viewing the rejection paintings. No other significant differences were found between the two groups on any of the other study stimuli.

At the neural level, such heightened threat responses may be reflected by increased activity in a network of brain regions involved in appraising the affective relevance of aversive stimuli, including the amygdala, insula, and cingulate cortex (Ochsner & Gross, 2004, 2005; Vogt, 2005; Eisenberger & Lieberman, 2004; Wager & Barrett, 2004; Ochsner & Barrett, 2001; Davidson & Irwin, 1999). Recent work indicates that activity in these regions correlates with differences in the way individual's process emotions and appraise stimuli as threatening (Hamann & Canli, 2004; Phillips, Drevets, Rauch, &

Lane, 2003). For example, increased levels of amygdala activity are found when people perceive threat in neutral faces (Lieberman, Hariri, Jarcho, Eisenberger & Bookheimer, 2005; Donegan et al., 2003; Hart et al., 2000; Phelps et al., 2000; Birbaumer et al., 1998) and the insula responds when participants become aware of their own anxious feelings and specific emotions like sadness (Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004; Eugene et al., 2003). Similarly, activity in the cingulate cortex has been shown to co-vary with awareness and experience of distress (e.g., Coghill, McHaffie, & Yen, 2003; Eisenberger, Lieberman, & Williams, 2003; Goldin et al., 2005; Ochsner et al., 2006; Ray et al., 2005) and specific sub-regions of the cingulate appear to be sensitive to rejection feedback (Somerville, Heatherton, & Kelley, 2006).

A second possibility is that differences between the two groups may result from high RS individuals' failure to adaptively regulate rejection responses using "top-down" cognitive control strategies. In this vein, behavioral research indicates that high RS individuals show maladaptive responses to rejection only if they also have low self-regulatory abilities (Ayduk et al., 2000). For example, Ayduk and colleagues (2000) found in two longitudinal studies that high RS individual only displayed maladaptive outcomes (e.g., low levels of self-worth, self-esteem, coping ability, education, and interpersonal functioning, and higher drug use) if they also scored low on an index of self-control ability. In contrast, individuals who were both high in RS and high in self-control ability were buffered against such negative outcomes. Moreover, experimental evidence shows that when individuals who have been instructed to relive a rejection experience are instructed to appraise it in a cool, abstract manner, rather than in terms of its "hot", arousing features, they show less intense negative emotional responses, even if they are high in RS (Ayduk, Mischel, & Downey, 2002).

Additional evidence suggesting that control processes may play a role in distinguishing the responses of high and low RS individuals comes from recent studies indicating that instructing people to cognitively reconstrue aversive emotional experiences and stimuli in ways that improve the way they feel lead to decreases in autonomic responses, subjective distress, startle reflex responses, and activity in affective appraisal systems such as the insula and amygdala (e.g., Ayduk & Kross, in press; Harenski & Hamann, 2006; Kross, Ayduk, & Mischel, 2005; Jackson, Malmstadt, Larson, & Davidson, 2000; Kalisch et al., 2005; Levesque et al., 2003; Ochsner, et al., 2004; Ochsner, Bunge, Gross, & Gabrieli, 2002; Phan, Fitzgerald, Nathan, & Tancer, 2005). At the neural level, these strategies correspond to increased levels of activity in left and right lateral prefrontal cortex areas that are

thought to support the selection and application of reappraisal strategies, and of dorsal anterior cingulate cortex (dACC) regions that may monitor conflict between bottom-up appraisals of stimuli as aversive and top-down reappraisals of them as innocuous (Jackson et al., 2003; Ochsner et al., 2002, 2004; Ochsner & Gross, 2005).

A third possibility, of course, is that both emotional appraisal and control processes underlie differences in high and low RS individuals' responses to rejection. In the next section, we describe the results from a recent fMRI study that was conducted to examine the role that appraisal and control processes play in RS.

Neural Dynamics of Rejection Sensitivity

To examine whether individual differences in RS are mediated by differential recruitment of brain regions involved in emotional appraisal and/or cognitive control, Kross and colleagues instructed high and low RS participants to passively view emotional stimuli while monitoring their brain activity using fMRI¹. The stimuli used in this study consisted of four types of artwork – rejection-and acceptance-themed works of art (respectively, selected paintings by Edward Hopper and August Renoir), as well as positively and negatively themed works of art that served as controls for stimulus valence (respectively, selected paintings by Jean Miro and Mark Rothko). Downey and colleagues (2004) used these stimuli in prior research to probe the startle responses of high and low RS individuals. In the present study they were used in conjunction with fMRI to address two main questions. First, what regions of neural activity become increasingly active across both high and low RS individuals when they are exposed to rejection stimuli? Second, how do the two groups differ – i.e., what regions of neural activity become differentially active among low vs. high RS individuals (or vice versa) when they are exposed to rejection?

To address these questions the subtraction method was used to examine rejection specific brain activity. In this method, two stimuli are matched so that they differ by only one process. Activity associated with one stimulus is then subtracted from activity associated with the second stimulus in order to reveal regions of activity associated with the target process. Use of such contrasts in fMRI research is critical because any task, whether it be viewing an image or resting quietly, produces huge activations across the brain. Therefore, in order to associate brain activity with a particular process of interest (i.e., rejection specific activity) it is necessary to isolate changes related to that process. In the current study, rejection specific activity was identified by subtracting brain activity in response to viewing rejection

images from brain activity associated with viewing acceptance images. These stimuli were matched on a number of dimensions but differed critically on the type of emotion they elicited (for details see Kross et al., 2007).

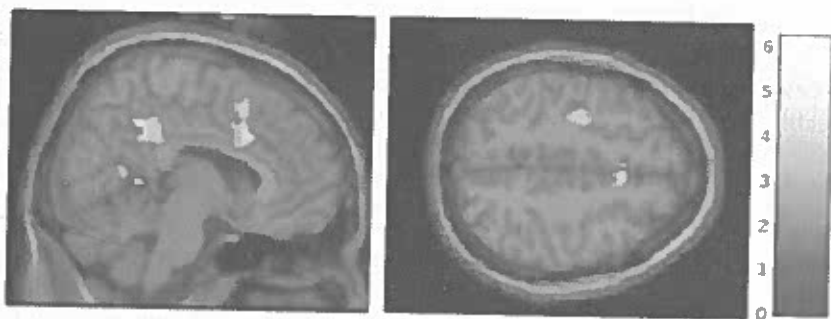


Figure 1. Increased activation across all subjects for rejection > acceptance contrast included foci in the dorsal anterior cingulate and posterior cingulate gyrus, as well as in left precentral gyrus (Kross et al., 2007, p. 950).

The results from this study indicated that across all participants rejection vs. acceptance images (i.e., a rejection > acceptance contrast) activated regions of the brain involved in processing affective stimuli (posterior cingulate; parahippocampal gyrus) and emotion regulation (dorsal anterior cingulate cortex; inferior frontal gyrus; medial frontal gyrus; middle frontal gyrus; precentral gyrus). Low and high RS individuals' responses to rejection vs. acceptance images were not, however, identical. Specifically, low RS individuals displayed significantly more activity in left inferior and right dorsal frontal regions, and activity in these areas correlated negatively with the levels of self-report distress participants experienced while viewing rejection images during the study. Importantly, control analyses comparing brain activity in the high and low RS groups in response to viewing positive vs. negatively valenced images revealed no significant differences. Thus consistent with prior research (e.g., Downey et al., 2004), differences between high and low RS individuals were specific to rejection.

These findings suggest that responses in regions traditionally implicated in emotional processing and cognitive control are sensitive to rejection stimuli irrespective of RS, but that low RS individuals may additionally activate lateral prefrontal structures to regulate distress associated with viewing such images. This interpretation is consistent with prior research indicating that lateral prefrontal cortex plays a critical role in the cognitive

control of behavior (e.g., Eegner & Hirsch, 2005a, 2005b; MacDonald, et al., 2000; Miller & Cohen, 2001; Smith & Jonides, 1999) and regulation of emotion (Beauregard et al., 2001; Davidson, 2002; Levesque et al., 2003; Ochsner et al., 2002, 2004; Ochsner & Gross, 2004, 2005; Phan et al., 2005). In this vein, it is noteworthy that the activations observed in this study - when participants were free to appraise the stimuli presented to them in whatever way they chose - were similar to those observed in studies when participants are instructed to down-regulate negative responses to aversive images by reappraising their meaning in "cool" unemotional ways (Ochsner et al., 2002, 2004).

Future Research Directions

The findings raised by Kross and colleagues (2007) fMRI study of RS raise a number of questions for future research. Paramount among them is the importance of determining what processes are mediated by the increased levels of lateral prefrontal cortex activity displayed by low RS individuals when exposed to rejection cues. A number of recent studies suggest that activation in these regions increases when people are involved in reappraising the meaning of aversive stimuli in order to reduce their affective impact (Ochsner et al., 2004). However, because participants in the present study were not explicitly directed to reappraise their responses to the rejection stimuli, it is not possible to determine whether activity in this area reflects the operation of reappraisal processes or some other process(es).

A second issue raised by these findings concerns the role that the amygdala, and emotional appraisal processes more generally, play in distinguishing the responses of high and low RS individuals to rejection. In the Kross et al. study, no differences were observed in amygdala activity between high and low RS individuals in response to rejection stimuli. Failure to observe such heightened levels of amygdala activity is surprising given prior work indicating that high RS individuals display greater startle responses to rejection stimuli and the well-known finding that the amygdala plays a critical role in mediating the startle reflex circuit in both humans and animals (Davis, 1992). One explanation for why such group differences in amygdala activity were not observed is that the amygdala may have habituated to the stimuli used in the present experiment through repeated exposure. This interpretation is consistent with neuroimaging studies of animal phobia, which reveal amygdala activity in response to phobic stimuli only when designs that are relatively resistant to habituation effects (e.g., event-related designs) are used (Dilger et al., 2003; Straube, Mentzel, &

Miltner, 2006). Future research is thus needed to address the discrepancy between Kross et al.'s findings and the findings suggested by startle research.

Finally, the Kross et al. study found that the regions of neural activity observed across groups in response to rejection could not be attributed to the negative valence of rejection stimuli alone. This is consistent with findings from the behavioral domain indicating that rejection is a unique kind of negative experience (Baumeister, DeWall, Ciarocco, & Twenge, 2005; Downey et al., 2004). However, it remains unclear exactly how the neural dynamics underlying rejection are different from those underlying the experience of other kinds of negative emotions (e.g., anxiety, sadness). Does the experience of rejection always differ from the experience of other kinds of highly arousing, negatively valenced emotions? If so, what neural processes are unique to the experience of rejection? Addressing these questions in the future may help shed light on the basic mechanisms underlying the way people process different types of emotions, and also help inform clinical practices oriented towards treating patients who suffer from emotional disturbances that are centered around rejection.

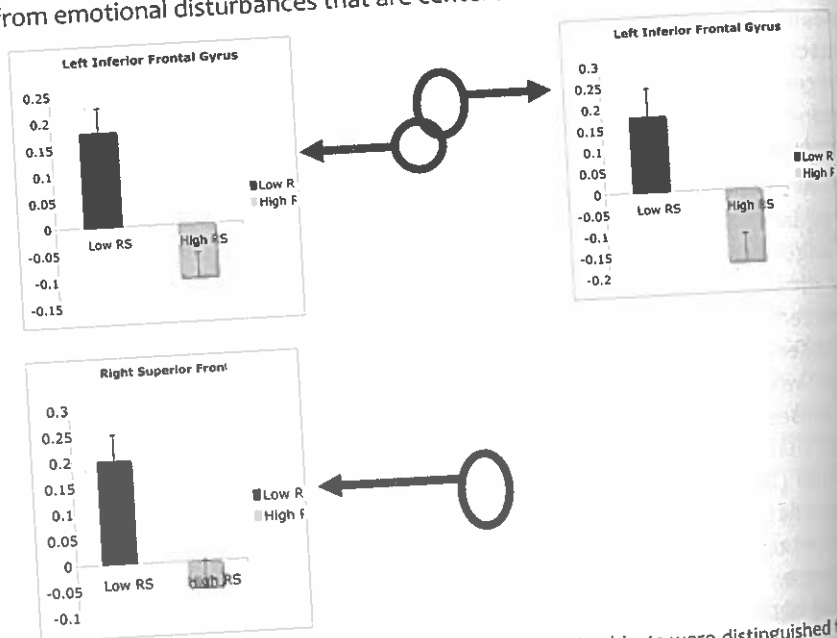


Figure 2. A between-group comparison shows that low RS subjects were distinguished from high RS subjects by increased activation primarily in the left LPFC, specifically along the inferior, as well as in right dorsal superior frontal gyrus (Kross et al. 2007, p. 951).

Conclusions

The findings reviewed in this chapter suggest that a critical difference distinguishing between low and high RS individuals is the former group's ability, and later group's apparent failure, to activate cognitive control processes involved in regulating emotional responses when confronted with rejection cues. Given prior work indicating that high RS individuals can regulate negative emotional responses to rejection when they are instructed to do so (Ayduk, Mischel, & Downey, 2002), it seems unlikely that these individuals simply lack the ability to reconstrue negative experiences. Instead, a more likely alternative is that they lack the ability to adaptively implement the appropriate emotion regulatory strategies when they are most needed – when the possibility of rejection exists or when they are confronted with a stimulus that elicits rejection concerns. A key question for future research is to understand how such difficulties arise and whether they can be reduced through self-regulatory training interventions. In this vein, fMRI and related brain imaging techniques promise to play a valuable role. As this chapter indicates, a great deal of research is already linking activity in specific brain networks to cognitive and emotional processes involved in self-control (for reviews see: Lieberman, 2007; Ochsner & Gross, 2007). These techniques could provide researchers with tools for assessing specific deficits in self-control ability and monitoring the effectiveness of training interventions designed to improve these skills.

Clearly, many important questions regarding the cognitive and neural processes underlying rejection-sensitivity remain unanswered. The research reviewed in this paper, we hope, provides an initial step towards enhancing our understanding of some of these processes, and the role they play in mediating adaptive and maladaptive responses to rejection experiences.

References

- Ayduk, O., & Kross, E. (in press). Enhancing the pace of recover: Differential effects of analyzing negative experiences from a self-distanced vs. self-immersed perspective on blood pressure reactivity. *Psychological Science*.
- Ayduk, O., Downey, G., & Kim, M. (2001). Rejection sensitivity and depressive symptoms in women. *Personality & Social Psychology Bulletin*, 27, 868-877.
- Ayduk, O., Downey, G., Testa, A., Yen, Y., & Shoda, Y. (1999). Does rejection

- elicit hostility in rejection sensitive women? *Social Cognition*, 17, 245-271.
- Ayduk, O., Mendoza-Denton, R., Mischel, W., Downey, G., Peake, P. K., & Rodriguez, M. (2000). Regulating interpersonal self: Strategic self-regulation for coping with rejection sensitivity. *Journal of Personality and Social Psychology*, 79, 776-792.
- Ayduk, O., Mischel, W., & Downey, G. (2002). Attentional mechanisms linking rejection to hostile reactivity: The role of "hot" versus "cool" focus. *Psychological Science*, 13, 443-448.
- Baumeister, R. F., Dwall, C. N., Ciarocco, N. J., & Twenge, J. M. (2005). Social exclusion impairs self-regulation. *Journal of Personality and Social Psychology*, 88, 589-604.
- Beauregard, M., Levesque, J., & Bourgouin, P. (2001). Neural Correlates of conscious self-regulation of emotion. *Journal of Neuroscience*, 21, RC165.
- Birbaumer, N., Grodd, W., Diedrich, O., Klose, U., Erb, M., Lotze, M., et al. (1998). fMRI reveals amygdala activation to human faces in social phobics. *NeuroReport*, 9, 1223-1226.
- Coghill, R. C., McHaffie, J. G., & Yen, Y. F. (2003). Neural correlates of interindividual differences in the subjective experience of pain. *Proceedings of the National Academy of Sciences, U.S.A.*, 100, 8538-8542.
- Critchley, H. D., Wiens, S., Rotshtein, P., Ohman, A., & Dolan, R. J. (2004). Neural systems supporting interoceptive awareness. *Nature Neuroscience*, 7, 189-195.
- Davidson, R.J. (2002). Anxiety and affective style: Role of prefrontal cortex and amygdala. *Biological Psychiatry*, 51, 68-80.
- Davidson, R.J., & Irwin, W. (1999). The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Sciences*, 3, 11-21.
- Davis, M. (1992). The role of amygdala in fear and anxiety. *Annual Review of Neuroscience*, 15, 353-375.
- Dilger, S., Straube, T., Mentzel, H. J., Fitzek, C., Reichenbach, J. R., Hecht, H., et al. (2003). Brain activation to phobia-related pictures in spider phobic humans: An event-related functional magnetic resonance imaging study. *Neuroscience Letters*, 348, 29-32.
- Donegan, N. H., Sanislow, C. A., Blumberg, H. P., Fulbright, R. K., Lacadie, C., Skudlarski, P., et al. (2003). Amygdala hyperactivity in borderline personality disorder: Implications for emotional dysregulation. *Biological Psychiatry*, 54, 1284-1293.

- Downey, G. & Feldman, S. (1996). Implications of rejection sensitivity for intimate relationships. *Journal of Personality and Social Psychology*, 70, 1327-1343.
- Downey, G., Feldman, S., & Ayduk, O. (2000). Rejection sensitivity and male violence in romantic relationships. *Personal Relationships*, 7, 45-61.
- Downey, G., Freitas, A.L., Michaelis, B., & Khouri, H. (1998). The self-fulfilling prophecy in close relationships: Rejection sensitivity and rejection by romantic partners. *Journal of Personality and Social Psychology*, 75, 545-560.
- Downey, G., Mougios, V., Ayduk, O., London, B., & Shoda, Y. (2004). Rejection sensitivity and the defensive motivational system: Insights from the startle response to rejection cues. *Psychological Science*, 15, 668-673.
- Egner, T., & Hirsch, J. (2005a). The neural correlates and functional integration of cognitive control in a Stroop task. *Neuroimage*, 24, 539-547.
- Egner, T., & Hirsch, J. (2005b). Cognitive control mechanisms resolve conflict through cortical amplification of task-relevant information. *Nature Neuroscience*, 8, 1784-1790.
- Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: A common neural alarm system for physical and social pain. *Trends in Cognitive Sciences*, 8, 294-300.
- Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. *Science*, 302, 290-292.
- Eugene, F., Levesque, J., Mensour, B., Leroux, J. M., Beaudoin, G., Bourgouin, P., et al. (2003). The impact of individual differences on the neural circuitry underlying sadness. *Neuroimage*, 19, 354-364.
- Goldin, P. R., Hutcherson, C. A., Ochsner, K. N., Glover, G. H., Gabrieli, J. D., & Gross, J. J. (2005). The neural bases of amusement and sadness: A comparison of block contrast and subject-specific emotion intensity regression approaches. *Neuroimage*, 27, 26-36.
- Hamann, S., & Canli, T. (2004). Individual differences in emotion processing. *Current Opinion in Neurobiology*, 14, 233-238.
- Harenski, C. L., & Hamann, S. (2006). Neural correlates of regulating negative emotions related to moral violations. *Neuroimage*, 30, 313-324.
- Hart, A. J., Whalen, P. J., Shin, L. M., McInerney, S. C., Fischer, H., & Rauch, S. L. (2000). Differential response in the human amygdala to racial outgroup vs ingroup face stimuli. *NeuroReport*, 11, 2351-2355.

- Jackson, D. C., Malmstadt, J. R., Larson, C. L., & Davidson, R. J. (2000). Suppression and enhancement of emotional responses to unpleasant pictures. *Psychophysiology*, *37*, 515-522.
- Jackson, D. C., Muller, C. J., Dolski, I., Dalton, K. M., Nitschke, J. B., Urry, H. L., et al. (2003). Now you feel it, now you don't: Frontal brain electrical asymmetry and individual differences in emotion regulation. *Psychological Science*, *14*, 612-617.
- Kalisch, R., Wiech, K., Critchley, H. D., Seymour, B., O'Doherty, J. P., Oakley, D. A., et al. (2005). Anxiety reduction through detachment: Subjective, physiological, and neural effects. *Journal of Cognitive Neuroscience*, *17*, 874-883.
- Kross, E., Ayduk, O., & Mischel, W. (2005). When asking "why" does not hurt: Distinguishing rumination from reflective processing of negative emotions. *Psychological Science*, *16*, 709-715.
- Kross, E., Egner, T., Ochsner, K. N., Hirsch, J., & Downey, G. (2007). Neural Dynamics of Rejection Sensitivity. *Journal of Cognitive Neuroscience*, *19*, 945-956.
- Lang, P., Bradley, M., & Cuthbert, B. (1990). Emotion, attention, and the startle reflex. *Psychological Review*, *97*, 377-395.
- Lang, P., Davis, M., & Ohman, A. (2000). Fear and anxiety: Animal models and human cognitive psychophysiology. *Journal of Affective Disorders*, *61*, 137-159.
- Levesque, J., Eugene, F., Joannette, Y., Paquette, V., Mensour, B., Beaudoin, G., et al. (2003). Neural circuitry underlying voluntary suppression of sadness. *Biological Psychiatry*, *53*, 502-510.
- Levy, S., Ayduk, O., & Downey, G. (2001). The role of rejection sensitivity in people's relationships with significant others and valued social groups. In M. Leary (Ed.), *Interpersonal Rejection* (pp. 251-289). Oxford, England: Oxford University Press.
- Lieberman, M. D. (2007). Social cognitive neuroscience. In R. F. Baumeister & K. D. Vohs (Eds.), *Encyclopedia of Social Psychology*. Thousand Oaks, CA: Sage Press.
- Lieberman, M. D., Hariri, A., Jarcho, J. M., Eisenberger, N. I., & Bookheimer, S. Y. (2005). An fMRI investigation of race-related amygdala activity in African American and Caucasian-American individuals. *Nature Neuroscience*, *8*, 720-722.
- London, B., Downey, G., Bonica, C., & Paltin, I. (2007). Social causes and

- consequences of rejection sensitivity. *Journal of Research on Adolescence*, 17, 481-506.
- MacDonald, A. W., Cohen, J. D., Stenger, V. A., & Carter, C. S. (2000). Dissociating the role of the dorsolateral prefrontal and anterior cingulate cortex in cognitive control. *Science*, 288, 1835-1838.
- Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience*, 24, 167-202.
- Mischel, W., & Shoda, Y. (1995). A cognitive-affective system theory of personality: Reconceptualizing situations, dispositions, dynamics, and invariance in personality structure. *Psychological Review*, 102, 246-268.
- Mischel, W., & Shoda, Y. (1998). Reconciling processing dynamics and personality dispositions. *Annual Review of Psychology*, 49, 229-258.
- Ochsner, K. N., & Barrett, L. F. (2001). A multiprocess perspective on the neuroscience of emotion. In T. J. Mayne & G. A. Bonanno (Eds.), *Emotions: Current issues and future directions* (pp. 38-81). New York: Guilford Press.
- Ochsner, K. N., Bunge, S. A., Gross, J. J., & Gabrieli, J. D. (2002). Rethinking feelings: An FMRI study of the cognitive regulation of emotion. *Journal of Cognitive Neuroscience*, 14, 1215-1229.
- Ochsner, K.N. & Gross, J.J. (2004) Thinking makes it so: A social cognitive neuroscience approach to emotion regulation. In R.F. Baumeister & K.D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 221-255). New York: Guilford Press.
- Ochsner, K.N. & Gross, J.J. (2005). The cognitive control of emotion. *Trends in Cognitive Sciences*, 9, 242-249.
- Ochsner, K. N., Ludlow, D., Knierim, K., Hanelin, J., Ramachandran, T., Glover, G., et al. (2006). Neural correlates of individual differences in pain-related fear and anxiety. *Pain*, 120, 69-77.
- Ochsner, K. N., Ray, R. D., Cooper, J. C., Robertson, E. R., Chopra, S., Gabrieli, J. D., et al. (2004). For better or for worse: Neural systems supporting the cognitive down- and up-regulation of negative emotion. *Neuroimage*, 23, 483-499.
- Phan, K. L., Fitzgerald, D. A., Nathan, P. J., & Trancer, M. E. (2005). Association between amygdala hyperactivity to harsh faces and severity of social anxiety in generalized social phobia. *Biological Psychiatry*, 59, 424-429.
- Phelps, E. A., O'Connor, K. J., Cunningham, W. A., Funayama, E. S., Gatenby,

- J. C., Gore, J. C., et al. (2000). Performance on indirect measures of race evaluation predicts amygdala activation. *Journal of Cognitive Neuroscience*, 12, 729-738.
- Philips, M. L., Drevets, W. C., Rauch, S. L., & Lane, R. (2003). Neurobiology of emotion perception: II. Implications for major psychiatric disorders. *Biological Psychiatry*, 54, 515-528.
- Ray, R. D., Ochsner, K. N., Cooper, J. C., Robertson, E. R., Gabrieli, J. D., & Gross, J. J. (2005). Individual differences in trait rumination modulate neural systems supporting the cognitive regulation of emotion. *Cognitive, Affective & Behavioral Neuroscience*, 5, 156-168.
- Romero-Canyas, R., & Downey, G. (2005). Rejection sensitivity as a predictor of affective and behavioral responses to interpersonal stress: A defensive motivational system. In K. D. Williams, J. P. Forgas, & W. Von Hippel (Eds.), *The social outcast: Ostracism, social exclusion, and bullying* (pp. 131-154). New York: Psychology Press.
- Smith, E. E., & Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science*, 283, 1657-1661.
- Somerville, L., Heatherton, T., & Kelley, W. (2006). Anterior cingulate cortex responds differentially to expectancy violation and social rejection. *Nature Neuroscience*, 9, 1007-1008.
- Straube, T., Mentzel, H. J., & Miltner, W. H. (2006). Neural mechanisms of automatic and direct processing of phobogenic stimuli in specific phobia. *Biological Psychiatry*, 59, 162-170.
- Vogt, B. A. (2005). Pain and emotion interactions in subregions of the cingulate gyrus. *Nature Reviews Neuroscience*, 6, 533-544.
- Wager, T. D., & Barrett, L. F. (2004). From affect to control: Functional specialization of the insula in motivation and regulation. *PsychExtra*. Retrieved from www.columbia.edu/cu/psychology/tor on 3 June 2005.

Footnote

- ¹ In this study, functional MRI using the Blood Oxygen Level Dependent method (BOLD) was used to measure the ratio of oxygenated to deoxygenated hemoglobin in the blood across different regions of the brain. The BOLD effect is a complex interplay between oxygen consumption, blood volume and blood flow. (for overview see Wager, Hernandez, Jonides, & Lindquist, 200X).