Research on the neuroscience of choice has primarily focused on how probability and reward value influence decision making. Yet economic models have long established that human behavior deviates from rational choice predictions. Seemingly irrational behavior can often be explained by emotional and social information, which generate a subjective sense of “affective value” that strongly influences choice. I seek to understand how different forms of affective information such as rewards, emotions, and social context are processed in the brain and how this information influences subsequent decisions. I have explored this topic through two lines of research, one on the neural mechanisms of emotion and value processing, and the other on disruptions in affective value processing in individuals with eating disorders.

**Neural Mechanisms of Emotion and Value**

Emotional experiences lie at the heart of what it means to be human. They influence what we pay attention to, what we remember, and how we decide. My work has explored how interactions between emotion and reward drive choice through two studies, one examining changes in emotion regulation in later life (Winecoff, LaBar, Madden, Cabeza & Huettel, 2011), and the other investigating the neural overlap between emotion and reward processing (Winecoff et al., 2013).

Despite declines in cognitive functioning, older adults demonstrate stable socioemotional functioning (Mather & Carstensen, 2005). The maintenance of emotional and social processing in older adults is thought to result from increased motivation to regulate emotions in later life. Using functional magnetic resonance imaging (fMRI), I investigated how older adults maintain emotion regulation abilities despite declines in cognitive and emotional control regions of the brain. Our results indicated that though older adults showed reduced activation in some executive control regions (e.g., in the inferior frontal gyrus), they largely maintained brain activation during emotion regulation. Additionally, after controlling for chronological age across both age groups, greater decreases in amygdala activation during emotion regulation were associated with better cognitive functioning. Thus, cognitive capacity, rather than age per se, may be a better determinate of effective emotion regulation. Changes in emotional regulation in later life could have an impact on how older adults make important financial and medical choices. Thus, this study provides insight into the mechanism of affective biases that could potentially predispose older adults to poorer decision making.

Behavioral economists have long documented the impact of emotions on decision making (e.g., framing effects, loss aversion, etc.). Even so, few neuroscience investigations have focused on how emotion interacts with reward processing in the brain. Research on the regulation of negative emotion suggests that the ventromedial prefrontal cortex (vmPFC) is important for down-regulating affective responses (Diekhof, Geier, Falkai, & Gruber, 2011); however, studies of reward processing have suggested instead that this brain region translates value signals originating from different reward modalities (e.g., juice versus monetary rewards) into a common scale (Levy & Glimcher, 2012). To distinguish between these two theories, I ran a neuroimaging experiment in which participants underwent fMRI scanning while either regulating or naturally experiencing both negative and positive emotions.

Results indicated that positive emotions engaged the vmPFC in a manner consistent with vmPFC response in studies of canonical rewards (e.g., food and money). Moreover, as participants subjectively experienced images as more positive, vmPFC
response increased. Participants’ attempts to regulate positive emotions resulted in decreased activation in the vmPFC as well as less positive valence ratings. Therefore, our results suggest that in previous studies of negative emotion regulation, vmPFC activation likely reflects a change in the “emotional value” of stimuli. That is, regulated negative stimuli become relatively more positive than unregulated negative stimuli, and vmPFC activation tracks this change. Based on our results, we concluded that emotions are computed in a similar fashion to monetary or food rewards (i.e., they contain value) and likely enter into the decision process in the same way.

Changes in Social and Affective Valuation in Eating Disorders

Anorexia nervosa (AN) has one of the highest mortality rates of all psychiatric disorders (Harris & Barraclough, 1998), yet treatments focused mainly on weight restoration have limited effectiveness (Kaplan, 2002). In addition to extreme weight loss, patients with AN also have difficulties with emotional and interpersonal functioning (Zucker et al., 2007). Thus, research on dysfunctional social and affective value responses in AN could inform the development of more effective treatments. In my second line of research, I have examined how disruptions in responses to primary rewards (i.e., food) in AN relate to disturbances in responses to other forms of affective value such as in emotional and social stimuli.

To examine differences in social value processing in anorexia, I ran an experiment in which a group of women recovered from AN and a group of healthy women underwent fMRI scanning while viewing scrambled images, images of bodies, and images of faces. Preliminary results indicate that when viewing faces, women with a history of AN show an association between the severity of current eating disorder symptoms and activation in the insula. Because the insula is involved in emotional, visceral, and value processing, this result suggests that heightened neural response to social stimuli could relate to maintained psychological disturbances in AN even after weight restoration.

In addition to my research on social value processing, I am importing techniques from behavioral economics to study the relationship between disordered eating and social and economic behavior. Most studies of social and emotional functioning in anorexia rely primarily on self-report data. Yet self-report measures may not accurately capture social and affective functioning in patients with AN because these patients also demonstrate poor self- and emotional-awareness. (Nowakowski, McFarlane, & Cassin, 2013). Studies of emotional functioning suggest individuals with AN have heightened disgust and anger responses (Aharoni & Hertz, 2012; Miotto, Pollini, Restaneo, Favaretto, & Preti, 2008). Anger and disgust are thought impact responses to unfair treatment in economic games. Thus, individuals exposed to unfair behavior in these contexts may be more reactive if they also display more severe eating disorder symptoms. To test this prediction, I am currently collecting data in which participants take part in the dictator and ultimatum games, classical behavioral economic paradigms for studying the effect of emotion on economic decision making. Participants also are asked to report current eating disorder symptoms. I hypothesize that those with more severe disturbances in eating and body experience will be more emotionally reactive to perceived social slights, and will therefore reject more offers in the ultimatum game compared to those with healthy eating habits. This research could lead to a better
understanding of how affective reactions influence social behavior in eating disorders and therefore inform treatments focused on interpersonal interventions.

**Future Research**

Moving forward, I hope to extend my basic and clinical research on how emotion and social context influence valuation and decision making. For example, many studies focus on how emotion regulation alters affective responses in the moment, but not on how emotion regulation impacts subsequent decision making. In a study of emotion regulation and decision making, participants could be shown cues paired with rewards and asked to either naturally experience or regulate their emotional responses to these cues. If later asked to choose between cues with equal expected value, would participants choose cues they previously regulated less often than cues they experienced naturally? Emotion regulation would likely reduce the value associated with a regulated cue and cause that cue to be chosen less often than an unregulated cue. Moreover, such a change in reward valuation would likely be predicted by either neural (e.g., reduced activation in the striatum or vmPFC) or behavioral (e.g., reaction time, pupil dilation) metrics during emotion regulation.

I am also interested in expanding my research on emotional, social, and reward processing in people with eating disorders. Data suggests that patients with anorexia show abnormal expression of emotion (Davies et al., 2011). However, research has not fully characterized how difficulties with emotional expression in eating disorders influence social functioning. Flattened emotional expression in AN may be associated with poorer social outcomes. If so, training more appropriate emotional responses through implicit or explicit conditioning could potentially improve social functioning in these patients. I also hope to expand my study of emotional and social behavior in eating disorders using economic games. For example, in games in which higher payouts depend on inferring whether to trust a partner, individuals with AN may perform worse due to impaired theory of mind.

Throughout my scientific pursuits, I have actively involved undergraduate researchers at all levels including research design, data collection, analysis, and manuscript preparation. I have mentored undergraduates simply seeking to peer into the scientific process through casual involvement in research as well as through intensive summer-long programs in which undergraduates develop, execute, and present independent work. I have also mentored new graduate students just beginning their first independent research endeavors. I hope to extend my work applying concepts from decision neuroscience to the study of affective value in healthy and clinical populations and to build a program of research that fosters intellectual growth and scientific discovery amongst students. I have discovered that students find social and emotional processing to be intrinsically engaging. Of particular interest to many students is the study of affective function in eating disorders. One of the demographics most affected by eating disorders is college-aged women. As a result, many students either have personal experience with eating disorders or know a friend or family member who does. Thus, research programs focused on eating disorders offer students a unique opportunity to bring both personal as well as intellectual interests to their scientific inquiries.
References


