Examining the Relationship Between Ostracism and ADHD

By Myla Bastien

Abstract

Attention Deficit-Hyperactivity Disorder (ADHD) is a behavioral disorder characterized by inattention, hyperactivity, and impulsivity (Cincinnati Children's, 2013). Much of ADHD research focuses on the potential social consequences of ADHD such as ostracism. More detailed research goes on to examine the impact of ostracism on affect, such as increased depression and anxiety among ostracized individuals. However, recent ostracism research indicates that feelingsof social exclusion may cause a decline in performance on cognitive and behavioral measures. I propose that if ostracism can cause cognitive and behavioral patterns that resemble those of ADHD, then it is possible that prolonged ostracism (especially early in life) can exacerbate risk for developing ADHD. Furthermore, it is plausible that individuals who are ostracized, as a consequence of ADHD may not only experience negative emotions, but may also experience compromised cognitive function. Thus while the present view of the relationship between ADHD and ostracism is one directional: ADHD leads to ostracism (ADHD ostracism), I propose that the relationship between ADHD and ostracism might be reciprocal: ostracism causes ADHD, thus causing further ostracism, further increasing ADHD-related cognitive and behavioral deficits (ADHD ostracism). This review surveys the literature and links cognitive and behavioral characteristics that ADHD and the consequences of social exclusion share.

Introduction

Attention deficit-hyperactivity disorder (ADHD) is a neurobehavioral disorder that has three main characteristics: inattention (the tendency to frequently shift attention), hyperactivity, and impulsivity. Although many scientists believe that several factors can contribute to the onset of ADHD, research in various fields of psychology indicates that social isolation could be a possible contributor to the severity of expressed ADHD. For example, social isolation can cause people who do not have a history of ADHD to act impulsively (Baumeister et al, 2005). Attentional patterns can also be altered as a result of social exclusion (Baumeister et al, 2005). Furthermore, animal studies of social isolation have demonstrated that social isolation can cause hyperactivity (Heidbreder et al, 2000).

It should be noted that, studies of social isolation have ignored the lasting effects of social exclusion on impulsivity and attentional functioning in humans. Existing studies have instead focused on the lasting effects of depression and anxiety in children who have been ostracized (Leary, 1990). Children who feel they have been neglected by their parents are more likely than children who were raised in nurturing homes to be diagnosed with ADHD (Asherson, Kuntsi, & Taylor, 2005). Thus, both ADHD and social isolation research may benefit from further examination of the relationship between social isolation and impulsivity, inattention, and hyperactivity. More specifically, this research can be useful for understanding the impact of social ostracism on the short-term behavioral characteristics that resemble ADHD, and the long-term contribution of persisting social ostracism on the risk of ADHD onset and its severity. This survey of the literature seeks to demonstrate that social isolation is a possible contributing factor to ADHD.

The purpose of this review is to analyze various factors that are relevant to both ADHD and social exclusion. More specifically, to analyze behaviors, traits and characteristics that emerge as the result of social isolation that are also characteristic of individuals with ADHD. I will begin by providing background information on the two major constructs of this paper- ADHD and ostracism. Next attention, impulsivity, and hyperactivity will be explained as they relate to ADHD and how they may emerge as a response to ostracism. Then, evidence based on evolutionary psychology and evolutionary biology will be presented to demonstrate that over time, humans have evolved systems to detect and respond to ostracism, and that ADHD characteristics may be is a possible consequence that may have been beneficial in certain social and environmental contexts.

I. Background

Ostracism is the state of being ignored, excluded, or rejected by another individual or group (Gruter & Masters, 1986; Williams, 2007). Ostracism research has largely focused on the affective consequences of social exclusion such as depression and social anxiety (Leary, 1990; Sebastian, 2010). However, more recent research has turned its attention to the cognitive and behavioral implications of social isolation.

On the neural level, ostracism resembles physical pain such that both physical pain and ostracism (whether perceived or real) activates the same region of the brain- the dorsal anterior cingulate cortex (dACC; Williams, 2007). Long-term periods of ostracism may lead individuals to engage in health-damaging behaviors (Siegrist, 2000). Even brief periods of ostracism can result in aggressive behavior and lack of motivation as well as cause changes in attention, inhibition, and self-regulation (Baumeister, DeWall, Ciarocco & Twenge, 2005; Williams, 2007).

Children with ADHD are often ostracized by their peers (Ohan & Johnston, 2007). This may be because the key characteristics of ADHD result in behaviors that may repel their peers (Hoza, 2007). Specifically, the inattentive symptom prevents children from being able to attend to social cues through observation long enough to learn social norms and interactions (Hoza, 2007); further, the hyperactive symptom of ADHD may result in aggressive, overwhelming behaviors that are undesirable to their peers (Hoza, 2007). Without positive peer relationships, children are subject to negative outcomes (Hoza, 2007). ADHD children risk spiraling down a path of social exclusion, which may exasperate their behavioral problems, causing them to be further ostracized by their peers (Hoza, 2007). However, few studies address the possibility that ostracism alone could prompt behavioral issues that resemble the symptoms of ADHD.

Executive Functioning: Research on ADHD & Ostracism

Executive function can be defined as a collection of "neurocognitive processes that maintain an appropriate problem solving set, to attain a late goal" (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). This section will describe characteristics of ADHD, and the potential cognitive/ behavioral responses to ostracism, in the terms of the three executive domains; maintaining attention, and impulse control, and inhibition of motor hyperactivity / aggression.

I. Maintaining Attention

Individuals with ADHD demonstrate difficulties with attention in several ways including focused attention, sustained attention, selective attention, alternating attention, and dividing attention. Individuals who have experienced social exclusion subsequently display impaired attentional abilities. Baumeister et al. (2005) found that participants who were told they would likely be alone in the future (compared to participants who were told they would likely be

surrounded by loved ones in the future) performed worse on a dichotic listening task. It is important to note that, social exclusion and not negative mood accounted for the poor performance (Baumeister et al., 2005). Thus, if brief implicit social exclusion can directly cause a change in attentional style, it is plausible that prolonged feelings of ostracism, especially early in life may influence attention deficit disorder that follows an individual into adulthood.

Ostracism may cause difficulties with maintaining attention (Baumeister, DeWall, Ciarocco, & Twenge, 2005). Feelings of social exclusion cause a deficit in attention and decrease an individual's ability to self-regulate attention to relevant stimuli (Baumeister, DeWall, Ciarocco, & Twenge, 2005). Therefore, while a key characteristic of ADHD is inattention, the ostracism often faced by individuals with ADHD could exasperate problems with attention regulation.

II. Impulse Control

Impulsiveness is characterized by the tendency to act without previous planning or little to no forethought (Dickman, 1990). Although many people may find that they act on an impulse from time to time (Dickman, 1990), individuals with ADHD act impulsively more frequently, and this characteristic may also be detrimental to their interpersonal relationships, daily functioning, and overall well-being. Impulsivity (or an inability to inhibit undesired behaviors) is common between individuals with ADHD (Barkley, 1997), and socially isolated individuals (Otten & Jonas, 2012). For example, as it relates to ADHD, impulsivity is often discussed as difficulty inhibiting motor activity. However, some ADHD studies have extended impulsive behaviors to include eating behaviors and substance use (Arias et al., 2008; Campbell & Eisenberg, 2007). Studies on social exclusion have demonstrated a similar deficit in being able to inhibit these behaviors as well.

Impulsivity may be exhibited in a variety of ways; however, many of the decisions to act

impulsively and to ignore the need to inhibit undesirable or damaging behaviors are related to the dopamine reward system.

Role of the dopamine reward system: The nature of rewards systems in the brain is fundamental to classical conditioning (Pan et al., 2005). When an individual learns that a particular behavior will decrease negative stimuli and/or increase positive stimuli, he will be more likely to repeat that behavior to achieve the same goal. The release of dopamine in the ventral striatum increases positive feelings and decreases negative emotion (Drevets, 2001).

Because individuals with ADHD may have lower dopamine activity in their prefrontal cortex, they are more likely to seek rewards (including sex, drugs, and food) that will increase their dopamine levels (Misener et al., 2004). Additionally, the tendency for novelty seeking behavior (discussed later) may increase these impulsive behaviors in an attempt to seek rewards.

Individuals who have been socially isolated also tend to seek to increase their dopamine levels. Feelings of social isolation thwarts the basic need for belonging and thus, may cause negative feelings as a consequence of lack of need satisfaction. The significance of the role of dopamine as it relates to ostracism and ADHD will be discussed in terms of two stimuli that activate the dopamine reward system: substance use, and food.

Substance Use: Social isolation can cause increased substance use and abuse (Baumeister et al., 2005), which is also a behavior associated with ADHD (Arias, 2008; Lambert & Hartsough, 1998). Individuals with ADHD often show increased risk of substance use. Lambert and Hartsough (1998) concluded that "ADHD is a contributory factor in adolescent and adult tobacco use." Because ADHD individuals have a desensitized dopamine rewards system, they may be more likely to begin substance use, and need more of the substance to achieve a significant desired effect (Lambert & Hartsough, 1998). Additionally, substance use may indicate the lack of the ability to inhibit undesired behaviors (Lambert & Hartsough, 1998).

Research on ostracism also indicates that people who feel ostracized are more likely to increase substance use (Siergrist, 2000). This is caused by several factors. First, ostracism thwarts fundamental needs of belonging and substances are used to self-medicate. Second, the negative feelings which result from ostracism can decrease dopamine levels in the brain and many substances act to increase those dopamine levels (Lambert & Hartsough, 1998). Thus in this case, substance use serves two reinforcing purposes: 1) it decreases negative affect 2) it increases positive affect. Third, substance use can simply serve to distract one from his problems. Finally, substance use can be a consequence of the lack of inhibition.

Eating behaviors/Obesity: If increased substance use reduces upset and increases positive feelings, Campbell and Eisenberg (2007) suggests that people with ADHD and isolated individuals may increase food consumption as a form of self-medication as well. Obesity prevalence is significantly higher among adults and children with ADHD, when compared to the general population (Campbell & Eisenberg, 2007). Because individuals with ADD or ADHD have a reduced sensitivity to this rewards system, they are more likely than people without ADHD to over-indulge in food consumption (Campbell & Eisenberg, 2007). In other words, individuals with ADHD may be more likely to use food as a reinforcer, to increase dopamine activity in the brain (Eisenberg et al. 2008), and are less likely to stop eating once satisfied (Campbell & Eisenberg, 2007).

Increased eating behavior is also characteristic of ostracized individuals. In an experiment conducted by Baumeister et al. (2005), participants who felt socially excluded ate more cookies than participants who were socially accepted. While both groups (socially excluded and socially accepted) completed the task in which they were asked to eat cookies, only the participants who were told that no one wanted to work with them ate more cookies even though all participants completed this task alone (Baumeister et al., 2005). Thus, it was not the physical isolation that

led to the self-defeating behavior of consuming an unhealthy snack, but the perception of social isolation that caused the effect.

III. Inhibition of Hyperactivity and Aggression

Many of the topics covered so far relate to an individual's ability to self-regulate one's behavior. We have discussed self-regulation as it relates to eating behavior, substance use, and attention, and have found that these types of self-regulation difficulties have been related to both individuals with ADHD and people who have been socially isolated but do not have ADHD. When difficulties with self-regulation combine with motor hyperactivity, aggression often results.

Gruter and Masters (1986) note that individuals who have been socially excluded often aggress towards the individuals who have ostracized them. Several studies have found that ostracized individuals aggress both socially and overtly and are more likely to act in gender-typical aggressive styles. For example, girls who have been socially ostracized may engage in rumor spreading and gossiping (Ohan & Johnston, 2007). Other studies have demonstrated various types of overt aggression due to ostracism such as increasing electric shocks to the individual who had caused feelings of ostracism, or putting more hot sauce on a plate of food that belongs to someone who has expressed an extreme dislike for hot sauce. Furthermore, peer aggression may not be caused by ADHD, but may be a response to ostracism as an attempt to regain control (Warburton et al., 2006).

Based on the observation that prefrontal lesions may result hyperactivity, distractibility, and impulsivity, one neuropsychological theory on ADHD posits that the symptoms of ADHD are due to a deficit in executive function (Willcutt et al., 2005). Willcutt et al. (2005), state that four criteria must be met for executive dysfunction to be considered a main deficit of ADHD:

1. Groups with ADHD must consistently exhibit weaknesses on [executive function] measures. In addition, many argue that these weaknesses must remain significant after controlling for potential confounding variables such as age, language, general intelligence, reading ability, and symptoms of other psychopathology, but the importance of this specificity criterion for multifactorial disorders is in considerable dispute in the field.
2. [Executive function] weaknesses must account for a substantial proportion of the variance in ADHD symptoms in the population.
3. [Executive function] weaknesses must be present in most individuals with ADHD.
4. [Executive function] weaknesses and ADHD symptoms must be attributable to common etiologic influences. Because ADHD is highly heritable, this suggests that [executive function] weaknesses must be coheritable with ADHD (Garber and Hollon 1991; Sergeant et al 2003; Willcutt et al 2005a, 2005b).

IV. Summary

Ostracism research found that social exclusion also results in executive dysfunction (Baumeister et al., 2002). Several laboratory studies found that inducing feelings of social isolation causes a decline in cognitive function. People who feel ostracized are less able to use working memory, less likely to persist in the face of adversity, and less able to make appropriate decisions to achieve a particular goal (Baumeister et al., 2002).

Taken together, two main points regarding executive function point to the notion that there may be a link between ostracism and ADHD: 1) the notion that ostracism can cause a decline in the executive function abilities of normal individuals, and 2) the fact that executive dysfunction is commonly primarily associated with ADHD. Thus if ostracized individuals exhibit executive dysfunction, and executive dysfunction is primarily associated with ADHD, then it is plausible that normal individuals who are ostracized may exhibit ADHD characteristics, and that prolonged feelings of ostracism can induce chronic ADHD cognitive and behavioral patterns.

Evolutionary Science

We have discussed the characteristics of ADHD, attention, impulsivity, and hyperactivity, and how these behaviors may remerge as a result of being ostracized. Evolutionary science may explain these relationships between ostracism and ADHD cognitive behavioral patterns. Because social inclusion is vital for survival, evolutionary psychologists argue that, humans evolved internal systems to be able to detect social cues of potential ostracism (Wesselmann, Nairne, & Williams, 2012). Further, because ostracism resembles physical pain (Lieberman & Eisenberger, 2006; Wesselmann, Nairne, & Williams, 2012), this may increase the need to develop detection systems in order to respond to or avoid ostracism (Wesselmann, Nairne, & Williams, 2012). Once social exclusion is detected, people will respond in such a way to attempt to be included in the group (Wesselmann, Nairne, & Williams, 2012). Thus, certain responses to ostracism may be an adaptive response.

I. Evolutionary Perspective of ADHD

There are several arguments that propose that ADHD is an adaption to particular environments and societal structures. One argument states that ADHD increases the reproductive fitness of an individual and/or the social group to which he belongs (Williams & Taylor, 2006). More specifically, when a small minority of group members has ADHD traits, causing them to engage in unpredictable risk-taking behaviors, they are able to explore new resources and gain new knowledge that they are then able to disseminate to the group (Williams & Taylor, 2006).

Another line of evolutionary psychology indicates the key traits of ADHD may have evolved as a functional adaptation to nomadic lifestyles (Eisenberg et. al, 2008). Living in a social situation that involves less stability of basic necessities such as food, shelter, and resources would call for people to need to be able to shift attention to watch for potential dangers, to be

impulsive to explore new resources, and to be hyperactive to act quickly when necessary (Eisenberg et. al, 2008).

II. Adaptive Responses to Ostracism

Additionally, Heidbreder et al. (2000) indicated an adaptive response to social isolation by demonstrating that rearing rats in social isolation resulted in a change in attentional style and loco-motor reactivity. Though these responses may seem maladaptive, the may be beneficial in two ways: 1) the attention deficit response may emerge as a tendency to shift attention frequently to scan for new resources or potential predators, 2) reduced inhibition of motor control may serve the purpose of preparing an isolated individual to respond to a threat. Therefore it is plausible that social exclusion may elicit an adaptive response in humans as well' particularly in high-risk environments that have limited resources.

However, in modern society, these responses to social exclusion could lead to adverse psychological, and health effects (Siegrist, 2000). People who experience social isolation such as the loss of a social role experience a decline in self-regulation abilities and consequently, a 'social reward deficiency,' which may cause various subsequent behaviors (Siegrist, 2000). Ideally, these behaviors would be likely to help the individual to be reintegrated into society; however, studies have also demonstrated the opposite effect- that people are likely to engage in behaviors that would cause them to be *further* ostracized (Baumeister et al., 2005).

III. Novelty Seeking

Novelty seeking is a pattern of behavior that is characterized by exploratory activity that is motivated by novel stimulation (or arousal), the tendency to make impulsive decisions, actively seeking rewards (such as food and sex) even when there is high risk associated with the pursuit of the reward, and a tendency toward anger or aggression in mildly frustrating situations.

Although certain novelty seeking behaviors are associated with ADHD individuals, and may have served as an evolutionary, ostracized individuals may have developed novelty seeking behaviors to cope with their lack of social support for survival. This is especially true for behaviors that would contribute to one's survival and reproductive fitness such as being hyperaware of new resources (i.e. new food sources) and mating opportunities (taking advantage of an opportunity for sex).

Evolutionary theorists suggest that males with an ADHD-like behavioral profile may have improved reproductive fitness. This may be because females prefer men who display sensation and novelty seeking behaviors (Williams & Taylor, 2006). Additionally, sex drive (Campbell &Eisenberg, 2007), and the likelihood to engage in unprotected sex are increased among individuals with ADHD (Williams & Taylor, 2006). Thus males with ADHD are also likely to contribute their genes to the gene pool. Furthermore, researchers argue that novelty-seeking behavior may be a heritable trait (Williams & Taylor, 2006), and may have a genetic link to a particular dopamine receptor (Williams & Taylor, 2006). This may explain the predominance of ADHD in males.

Ostracized individuals also display novelty-seeking behaviors. Socially isolated individuals are more likely to engage in aggressive behaviors, more likely to make impulsive decisions (due to a decline in the cognitive ability to plan and make appropriate decisions), and are more likely to engage in reward seeking in an attempt to increase dopamine activity (Otten & Jonas, 2012).

Thus ostracism can lead to increased novelty seeking behavior in individuals without ADHD. Because ADHD is associated with novelty seeking behavior, the tendency toward novelty seeking behavior in individuals with ADHD might also emerge a result of prolonged ostracism. This notion raises a curious question: If ostracism and ADHD both increase novelty

seeking behaviors, then what makes ostracism bad? What is the trade-off of between being ostracized and being more likely to search for new resources? Perhaps it is that novelty-seeking behavior only emerges out of necessity because an ostracized individual can no longer rely on group members to help locate resources.

Responses to ostracism such as aggression and novelty seeking can be considered to be abnormally over-active, and thus resemble behaviors that are typical of ADHD individuals.

III. Adaptive Benefits of ADHD & Ostracism

To build the connection between ostracism and ADHD, we hypothesize that ADHD-like behaviors that may cause an individual to be further ostracized. We have discussed that ADHD is seen as a potentially beneficial cognitive-behavioral pattern as it may lead to the acquisition of new resources, and may increase reproductive fitness, and that an adaptive response to ostracism may also lead to the acquisition of new resources. This may mean that potential strategies to adapt to ostracism may be to adjust to the lack of social support by being hyper aware of new resources and ready to defend one's self in the event of an attack, or to increase behaviors that will attract mates as an attempt to rebuild social networks.

Thus behaviors that emerge as a response to ostracism including unique attentional patterns, loco-motor responsivity, and hyperactivity that resemble the characteristics of ADHD-inattention, impulsiveness, and hyperactivity may have first evolved as a style of novelty seeking in order for ostracism individuals to survive in social isolation.

Conclusion

In conclusion, ostracism can cause cognitive and behavioral patterns that resemble those of ADHD. Thus it is possible that prolonged ostracism (especially early in life) can increase Risk for expression of behaviors related to ADHD. Furthermore, it is plausible that individuals who

are ostracized, as a consequence of ADHD may not only experience negative emotions, but may experience further cognitive dysfunction as a result of ostracism. Thus while the present view of the relationship between ADHD and ostracism is one directional, with ADHD causing social exclusion (ADHD ostracism), I propose that the relationship can be reciprocal, and that ostracism can initially lead to ADHD, which causes further ostracism and thus exasperates ADHD cognitive and behavioral characteristics (ADHD ostracism).

I. Future directions for research

Currently, there is no research on humans that explicitly discusses the notion that social exclusion can cause ADHD, although there are a few studies that allude to this theory. Future research should attempt to directly investigate the relationship between ostracism and ADHD. More specifically, several lines of research should be conducted to gain a more comprehensive view of the relationship between social isolation and ADHD. For example, experimental research in which an isolation variable is manipulated in normal people, and ADHD traits are subsequently measured. Correlational research should also be conducted to compare the naturally existing relationship between early isolation and ADHD status.

ADHD may be attributed to a variety of factors. Thus not every case of ADHD is related to social exclusion. Future research should seek to distinguish individuals who's ADHD has been caused by social exclusion from individuals with ADHD who's diagnosis may have been caused by other factors so that these individuals can receive treatment that is tailored for their specific needs.

II. Shifting Ideologies

ADHD individuals are often stigmatized. One study found that children would ostracize an individual if they believed that individual had ADHD whether or not the child's ADHD status

was accurate (Hoza, 2007). Although this may be due to the anticipated behavioral patterns from previous interactions with other ADHD peers, it may instead cause behavioral patterns that are repulsive to peers. Thus, the expectation of individuals with ADHD to act in socially undesirable ways causes children with ADHD to be ostracized by their peers, and the perception of ostracism may cause the ADHD child to actually exhibit stereotypical socially undesirable behaviors associated with ADHD that may then further ostracize the individual. Thus, we need to first begin by shifting our view of people with ADHD and changing our expectations.

III. Solutions

The current view of ADHD as maladaptive leads people to not only stigmatize individuals with ADHD, but it causes us to attempt to "fix" the problem merely by drugging ADHD individuals, even at a young age. This view of ADHD as relatively one-dimensional leads us to conceptualize ADHD treatment as one-dimensional as well. On the other hand, viewing ADHD as multidimensional, and understanding that ADHD may have adaptive components rather than entirely maladaptive will help professionals to view treatment as a multidimensional process as well.

Treatment for individuals should not just prescribe heavy medication to children and young adults that merely treat the symptoms of ADHD. Rather, treatment should seek to address the root of the condition by investigating the cause. In understanding the notion that social isolation could be an antecedent to ADHD, treatment should involve therapy sessions that help the individual to address issues that may have played a role in the onset of his ADHD. Furthermore, because parents often manage much of their children's social lives, parents of adolescents and especially young children should also participate in specialized sessions geared toward helping the parent to understand the factors that play a role in contributing to ADHD, and to learn how to help their child combat these problems.

References

Arias, A. J., Gelernter, J., Chan, G., Weiss, R. D., Brady, K. T., Farrer, L., & Kranzler, H.R. (2008). Correlates of co-occurring ADHD in drug-dependent subjects: prevalence and features of substance dependence and psychiatric disorders. *Addictive behaviors*, *33*(9),1199.

Asherson, P., Kuntsi, J., & Taylor, E. (2005). Unravelling the complexity of attention-deficit hyperactivity disorder: a behavioural genomic approach. *The British Journal of Psychiatry*, *187*(2), 103-105.

Attention Deficit Hyperactivity Disorder (ADHD). CincinnatiChildrens.org. Retrieved October 29, 2013 from http://www.cincinnatichildrens.org/health/a/adhd/

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychological bulletin*, *121*(1), 65.

Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Twenge, J. M. (2005). Socialexclusion impairs self-regulation. *Journal of personality and social psychology*, *88*(4), 589-604.

Baumeister, R. F., Twenge, J. M., & Nuss, C. K. (2002). Effects of social exclusion on cognitive processes: Anticipated aloneness reduces intelligent thought. *Journal of personality and social psychology*, *83*(4), 817-827.

Campbell, B. C., & Eisenberg, D. (2007). Obesity, attention deficit-hyperactivity disorder and the dopaminergic reward system. *Collegium antropologicum*, *31*(1),33-38.

Dickman, S. J. (1990). Functional and dysfunctional impulsivity: personality and cognitive correlates. *Journal of personality and social psychology*, *58*(1), 95.

Drevets, W. C. (2001). Neuroimaging and neuropathological studies of depression: implications for the cognitive-emotional features of mood disorders. *Current opinion inneurobiology*, *11*(2), 240-249.

Eisenberg, D. T., Campbell, B., Gray, P. B., & Sorenson, M. D. (2008). Dopamine receptor genetic polymorphisms and body composition in undernourished pastoralists: An exploration of nutrition indices among nomadic and recently settled Ariaal men of northern Kenya. *BMC Evolutionary Biology*, *8*(1), 173.

Gruter, M., & Masters, R. D. (1986). Ostracism as a social and biological phenomenon: An introduction. *Ethology and Sociobiology*, *7*(3), 149-158.

Heidbreder, C. A., Weiss, I. C., Domeney, A. M., Pryce, C., Homberg, J., Hedou, G., & Nelson, P. (2000). Behavioral, neurochemical and endocrinological characterization of the early social isolation syndrome. *Neuroscience*, *100*(4), 749-768.

Hoza, B. (2007). Peer functioning in children with ADHD. *Journal of Pediatric Psychology*, *32*(6), 655-663.

Lambert, N. M., & Hartsough, C. S. (1998). Prospective study of tobacco smoking and substance dependencies among samples of ADHD and non-ADHD participants. *Journal of Learning Disabilities*, *31*(6), 533-544.

Leary, M. R. (1990). Responses to social exclusion: Social anxiety, jealousy, loneliness, depression, and low self-esteem. *Journal of Social and Clinical Psychology, 9,* 221–229.

Lieberman, M. D., & Eisenberger, N. I. (2006). A pain by any other name (rejection, exclusion, ostracism) still hurts the same: The role of dorsal anterior cingulated cortex in social and physical pain. *Social neuroscience. People thinking about thinking people., JT Cacioppo, PS Visser, & CL Pickett, eds., The MIT Press, Cambridge, Mass*.

Ohan, J. L., & Johnston, C. (2007). What is the social impact of ADHD in girls? A multi-method assessment. *Journal of abnormal child psychology*, *35*(2), 239 250.

Otten, M., & Jonas, K. J. (2012). Out of the group, out of control? The brain responds to social exclusion with changes in cognitive control. *Social Cognitive and Affective Neuroscience*.

Pan, W. X., Schmidt, R., Wickens, J. R., & Hyland, B. I. (2005). Dopamine cells respond to predicted events during classical conditioning: evidence for eligibility traces in the reward-learning network. *The Journal of neuroscience*,*25*(26), 6235-6242.

Sebastian, C., Viding, E., Williams, K. D., & Blakemore, S. J. (2010). Social brain development and the affective consequences of ostracism in adolescence. *Brain and cognition*, *72*(1), 134-145.

Siegrist, J. (2000). Place, social exchange and health: proposed sociological framework. *Social science & medicine*, *51*(9), 1283-1293.

Warburton, W. A., Williams, K. D., & Cairns, D. R. (2006). When ostracism leads to aggression: The moderating effects of control deprivation. *Journal of Experimental Social Psychology*, *42*(2), 213-220.

Wesselmann, E. D., Nairne, J. S., & Williams, K. D. (2012). An Evolutionary Social Psychological Approach to Studying the Effects of Ostracism. *Journal of Social, Evolutionary, and Cultural Psychology*, *6*(3), 309-328.

Williams, K. D. (2007). Ostracism. *Psychology*, *58*(1), 425.

Wiliams, J., & Taylor, E. (2006). The evolution of hyperactivity, impulsivity and cognitive diversity. *Journal of the Royal Society Interface*, *3*(8), 399-413.

Myla Octavia Bastien majored in psychology with a minor in cognitive science. She was the first UC Merced student to Study abroad in Accra, Ghana where she attended the University of Ghana, Legon and taught at a primary school. Myla has interned as a research assistant in several labs both on and off campus in the fields of cognitive science, applied psychology, health psychology, evolutionary psychology and developmental psychology. Her aspiration is to become a pediatric neuropsychologist.