The Impact of Psychopathic Traits and Anxiety on Responses to Social Exclusion in Adolescents and Young Adults

H. Nur Eken

Advised by: Arielle Baskin-Sommers, Ph.D.

Submitted to the faculty of the Department of Cognitive Science in partial fulfillment of the requirements for the degree of Bachelors of Science

Yale University
April 21, 2017

Abstract

Psychopathy is a personality disorder characterized by superficial charm, lack of guilt, reduced affect, failure to form lasting relationships, impulsivity, and chronic antisocial behavior. There is a long tradition of distinguishing psychopathic subtypes in the psychology literature, such as primary and secondary psychopathy. Primary psychopathy is associated with a lack of anxiety and is presumed to be a consequence of some intrinsic deficit that hampers self-regulation and normal adjustment, whereas secondary psychopathy is associated with comparable levels of antisocial behavior, but is thought to stem from social disadvantage and excessive neurotic anxiety. Psychopathy is an important predictor of criminal behavior, and is linked to various types of aggression. Social exclusion is a context that has also been found to induce feelings of anger and relates to aggressive behavior. However, studies so far have not investigated the responses to social exclusion in various subtypes of psychopathy. In this study, we examined how subtypes of psychopathic individuals relate to the experience of social exclusion. While we did not find a main effect of psychopathy on angry or vengeful feelings, our results indicated that affective traits of psychopathy were directly related to sustained feelings of revenge, while antisocial traits were related to sustained feelings of anger. Furthermore, we found that anxiety, but not subtypes of psychopathy, is directly linked to both angry and vengeful feelings in all situations. These findings support the previous research on the distinction between proactive and reactive aggression and how they map onto callous/unemotional and impulsive traits, respectively.

Keywords: social exclusion; cyberball; psychopathy; anxiety

Psychopathy is a personality disorder characterized by superficial (insincere) charm, lack of guilt, reduced affect, failure to form lasting relationships, impulsivity, and chronic antisocial behavior (Cooke, Forth & Hare, 2012). It has also been described with the tendency to engage in thrill-seeking behavior, a disregard for social norms, inability to control impulses or to delay gratification, rejection of authority, failure to alter punished behavior, pathological lying, and persistent antisocial behavior (Buss, 1996; Hare & McPherson, 1984). This disorder is an important predictor of criminal behavior, specifically violence (Hart & Hare, 1997; Salekin, Rogers, & Sewell, 1996), and is linked to failure on conditional release, violent recidivism, and poor treatment response (Serin, 1996; Cooke & Michie, 2001). The rate of community and institutional violence is significantly higher among psychopathic offenders than among other offenders (Douglas, Ogloff, & Nicholls, 1997; Hart & Hare, 1997; Hare, 1999), and the violence exhibited by psychopathic individuals is generally more instrumental and predatory than that of other offenders (Cornell et al., 1996; Hart & Dempster, 1997; Hare, 1999). A 1992 study showed that almost half of the law enforcement officers who died during duty were killed by individuals who match the personal profile of psychopaths (Federal Bureau of Investigation, 1992). Psychopaths are more likely than other inmates to have behaved aggressively, to have used weapons, threats and instrumental aggression, and to have committed more serious past offenses. When presented with hypothetical situations with frustrating outcomes, psychopaths predicted that they would feel angrier compared to the normal population, and they attribute greater hostile intent towards others (Serin, 1991). Psychopathic sex offenders are found to engage in more violent offenses compared to other sex offenders (Brown & Forth, 1997; Miller et al., 1994; Hare, 1999).

While the exact mechanism behind psychopathic behavior is still being investigated, it has historically been associated with the "low-fear hypothesis," which suggests that psychopaths have an innate deficit in fearfulness. This deficit can lead to dangerous behavior when the individual also has aggressive tendencies (Lykken, 1995). This hypothesis has since been supported by various studies; for instance, psychopathic offenders were shown to display poor fear conditioning (Lykken, 1955; Newman et al., 2010), give weak electrodermal responses when anticipating aversive events (Hare, 1978; Newman et al., 2010), have difficulty in passive avoidance tasks (in which participants are required to act contrary to their innate tendencies as to whether they would avoid or prefer a given condition; Lykken 1955; Kosson & Newman, 1986; Newman et al., 2010) and show less amygdala activation than controls during aversive conditioning tasks (Birbaumer et al., 2005; Newman et al., 2010). An alternative hypothesis is the "response-modulation theory," which proposes that once engaged in goal-directed behavior, psychopaths fail to allocate attentional resources to information that is peripheral to their goal (Newman & Lorenz, 2003; Newman et al., 2010). In other words, it predicts that the deficits are moderated by attention and are context-dependent. In support of this theory, previous research has shown that psychopathic offenders display weak electrodermal responses to punishment cues when they are focused on earning rewards, while they function normally when avoidance learning is their main goal (Kosson & Newman, 1986; Amett, Smith & Newman, 1997; Newman et al., 2010). Furthermore, they display normal fear-potentiated startle responses when the focus was on processing threat cues, but deficits in fear responses when the focus was directed elsewhere (Newman et al., 2010).

One aspect of the issues psychopaths experience during social interactions is the feeling of anger, and the aggressive behavior that the psychopath might engage in in response to

provocations. Psychopaths self-report experiencing high levels of anger to provocation in hypothetical scenarios presented to them (Serin, 1991, Steuerwald & Kosson, 2000); however, they do not exhibit greater or lesser physiological responsiveness to direct provocations of anger (Steuerwald & Kosson, 2000). This might point to a disjunction between the psychopath's experience and expression of anger.

While psychopathy is considered to be a well-established concept with predictive utility in adults, it has not yet been extended to youth in the same way (Lee, Salekin & Iselin, 2010). One main reason for this stems from the idea that callous unemotional (CU) traits (Hare, 1993), which are concerned with the affective factor of psychopathy delineating deficient affective experience (Cooke, Michie & Hart, 2006; Hare, 1993; Frick & White, 2008), remain instable throughout adolescence. CU traits have indeed been shown to change over time, and this change was related to the level of conduct problems children exhibit, socioeconomic status of parents and the quality of parenting (Frick & White, 2008).

Nevertheless, studies exploring psychopathic traits in adolescent populations found developmental correlates that are related to antisocial behavior and violence in a way similar to the adult population. One cluster analysis in the youth population demonstrated that adolescents in the high psychopathic traits group exhibited the highest number of antisocial behaviors and had a higher base rate for violent recidivism (Vincent et al., 2003). Another study conducted by Andershed et al. found that the psychopathic group emerging in their cluster analysis exhibited greater conduct disorder symptoms and substance use problems (2008). These findings suggest that a psychopathic subtype can be identified and used as a proxy to predict antisocial and violent behavior in adolescent populations, much like in the adult populations, albeit with less certainty due to the changes in personality traits that occur during development.

Subtypes of Psychopathy and Aggression

Although psychopathy is often discussed as a unitary syndrome, there is a long tradition of distinguishing psychopathic subtypes, such as primary and secondary psychopathy, in the psychology literature (Brinkley, Newman, Widiger, & Lynam, 2004; Lykken, 1995; Skeem et al., 2007; Baskin-Sommers et al., 2010). Primary psychopathy is associated with a lack of anxiety and is presumed to be a consequence of some intrinsic deficit that hampers self-regulation and normal adjustment (Karpman, 1941; Newman & Brinkley, 1997; Zeier, Maxwell, & Newman, 2009; Baskin-Sommers et al., 2010). Secondary psychopathy is associated with comparable levels of antisocial behavior, but is thought to stem from social disadvantage, excessive neurotic anxiety, and/or other forms of psychopathology (Cleckley, 1941; Lykken, 1995; Baskin-Sommers et al., 2010). Past studies have shown that compared to the primary cluster, secondary psychopaths have greater trait anxiety, fewer psychopathic traits, comparable levels of antisocial behavior, poorer interpersonal functioning and more symptoms of major mental disorders than primary psychopaths (Skeem et al., 2007). Furthermore, primary psychopaths were found to have lower levels of psychological distress, and scored lower on measures of antisocial behavior (e.g. drug use, violent offending) and were less likely to have a trauma history and a history of ADHD compared to individuals of the secondary subtype (Vaughn et al., 2009).

The above findings confirm the theory that secondary psychopathology is more associated with externalizing behaviors, while primary psychopathology might be more related to callous and unemotional traits. While both primary and secondary psychopaths exhibit similar behavioral patterns, including cheating and inability to form long-lasting relationships with others, the etiology of these behaviors seems to be quite different for these subtypes. Secondary

psychopaths are often more impulsive, emotionally reactive and antagonistic, traits that contradict the conventional "callous" stereotype of psychopaths.

Research on primary and secondary psychopathy also points to anxiety as one of the main differentiating factors between the two subtypes. There are mixed results on the relationship between anxiety and psychopathy. While psychopathy has historically been thought to be associated with low fear and anxiety (Dolan & Rennie, 2007), several studies also suggested that there is a negative relationship between anxiety and fear and the interpersonal/affective dimensions of psychopathy, and a positive relationship for the antisocial dimensions (Patrick, 1994; Frick et al., 1999), but that finding was not replicated by other studies (Schmitt & Newman, 1999; Dolan & Rennie, 2007). On the other hand, a past study by Hale and his colleagues showed that neither overall psychopathy score in PCL-R nor the affective and interpersonal dimensions was significantly associated with low anxiety sensitivity or trait anxiety, while antisocial dimension was indeed positively associated with trait anxiety (2004). Finally, social anxiety and psychopathic traits have found to be negatively associated, which is in line with the idea that while psychopaths demonstrate a lack of concern for others' feelings, socially anxious people focus too much on others' approvals and following social norms (Hofmann, Korte & Suvak, 2009). One reason behind the conflicting findings could be the use of different measures that are not consistent. Furthermore, past studies have often failed to distinguish between fear and anxiety as distinct emotions (Dolan & Rennie, 2007), which might have impacted how the associations between variables were interpreted. Nevertheless, conflicting findings indicate the need to investigate anxiety as a distinct factor that might moderate the effects of psychopathic traits on individuals' feelings and decisions.

Violent and aggressive behavior can also be manifested differently in the two subtypes. A frequently-used model of aggression involves the distinction between reactive and proactive aggression (Vitaro et al., 2006). These two types are proposed to have different underlying motivations and to relate to the subtypes of psychopathy in a complex way. Specifically, reactive (or affective) aggression occurs in response to the real or perceived provocation or threat, and is based on the frustration-anger theory of aggression (Berkowitz, 1993). On the other hand, proactive aggression, which has its roots in the social learning model of aggression (Bandura, 1976), is provoked by anticipation of rewards and is under the control of positive reinforcement (Vitaro et al., 2006). Reactive aggression is an impulsive response to interpersonal provocation, and is thought to be associated with high affective-physiological arousal and minimal cognitive processing (Chase, O'Leary & Heyman, 2001) whereas proactive aggression is associated with forethought and goal-directed behaviors, and involves little autonomic arousal (Blair, 2003; Cima & Raine, 2009). Certain emotions such as anger and frustration have been related to reactive aggression, while a lack of emotions might point to proactive aggression (Berkowitz, 1993). While there are significant overlaps in the phenotypes of those exhibiting proactive and reactive aggression (Dodge et al., 1997), it is still possible to distinguish between the two types using these characteristics described above.

A body of research has shown that psychopathy is predominantly related to proactive aggression, which supports the idea that psychopathic offenders tend to engage in more instrumental crimes with goal-oriented purposes, such as theft (Cima & Raine, 2009). Furthermore, researchers hypothesized that psychopathy is more related to proactive rather than reactive aggression, and the callous-unemotional traits in children, which are thought to be precursors to adult psychopathy (Blair, Leibenluft, & Pine, 2014), are correlated with higher

proactive aggression scores (Patrick, 2001; Frick et al., 2003; Raine et al., 2006). Proactive but not reactive aggression has been found to be associated with a predisposition to criminality, delinquency and disruptive behavior (Pulkkinen, 1996; Atkins & Stoff, 1993; Vitaro et al., 1998; Raine et al., 2006), and thus has been predicted to be related to the perpetration of violent criminal acts and initiation of fights in childhood (Raine et al., 2006). Criminals identified as perpetrating predominantly instrumental (proactive) violent offenses have higher scores on the Psychopathy Checklist than those with a history of reactive violence (Cornell et al., 1996; Dempster et al., 1996; Raine et al., 2006). Finally, both psychopaths and proactively aggressive individuals are found to abuse substances in adulthood (Koivisto &Haapasalo, 1996; Pulkkinen, 1996; Vitiello et al., 1990), which supports the idea that there are commonalities between the psychopathic and proactive aggressive phenotypes.

On the other hand, several psychopathic traits including fearlessness and alienation were found to be more related to reactive aggression, which agrees with the past findings indicating that psychopathic offenders may also act in a stress-reactive way in some cases (Cale, E. M., & Lilienfeld, 2006 & Blackburn & Lee-Evans, 1985; Cima & Raine, 2009). Taken together, these findings suggest that proactive aggression might be a better representation of the behavior exhibited by psychopathic individuals.

Research on developmental trajectories of aggression also found that stressful early life events are more frequently associated with murders that involve anger compared to murders committed during instrumental acts later in life (Cornell et al., 1986). In line with this research, Dodge and his colleagues found that early histories of physical abuse, rejection by parents or loss of parents, social rejection by peers and disorganized home life would likely characterize children with reactive aggression, while exposure to aggressive role models, as proposed by

Bandura (1983) would characterize proactively aggressive children (1997). Furthermore, they showed that the behavior problems of reactively aggressive children had an earlier age of onset than the behavioral patterns of proactively aggressive children (Dodge et al., 1997).

While overall, psychopathy is thought to be more closely related to proactive aggression, the close alignment of the impulsive and antisocial dimension of psychopathy with reactive aggression raises the question of how different subtypes of psychopathy exhibit aggressive behavior. For instance, secondary psychopaths were found to exhibit higher somatic arousal and more intense reactions in response to hypothetical anger-evoking situations (Blackburn & Lee-Evans, 1985), which suggests a link between antisocial traits associated with secondary psychopathy and reactive aggression.

Social Exclusion

An important area of research in psychopathy is interpersonal interactions and social decision-making. Research has shown that youth engage in risky behaviors more when they are with their peers than when they are alone (Gardner & Steinberg, 2005). Exclusion and rejection by peers is a particularly distressing form of social interaction (Williams, 2007), and may have negative influences on the individual's behaviors through various mechanisms (Peake et al., 2013), including aggression (Ayduk et al., 2008) and decreased self-regulation (Baumeister et al., 2005).

Ostracism or social exclusion —the act of being excluded and ignored— has been identified as a strong force affecting human feelings and behavior. Humans feel a fundamental need for a sense of belonging, as it is a requirement for security, mental health and reproductive success (Baumeister & Leary, 1995; Smith, Murphy & Coats, 1999; Williams, 2007).

Exclusion and peer rejection also have a strong influence on adolescent development trajectory. It affects a child's academic and social functioning (Buhs & Ladd, 2001), can cause interpersonal difficulties (Downey et al., 1998), lead to increased levels of anxiety and depression (Ladd, 2006), and is associated with violence in extreme cases (Crowley et al., 2010). Past research has shown that individuals who experienced ostracism in the laboratory environment for a short period of time report worsened mood and anger, as well as lower levels of belonging, control, self-esteem and meaningful experiences (Williams, 1997, 2001). In a study on adjustment problems, Zimmer-Gembeck and Skinner found that adolescents with different thought and behavioral patterns responded differently to rejection threat. Specifically, adolescents with heightened social anxiety had the most maladaptive responses to rejection threat, whose behavior included coping with more social isolation and rumination and elevated emotional responses, adolescents with more depressive symptoms felt less control and anticipated using less adaptive coping, and aggressive adolescents displayed more anger and opposition (Zimmer-Gembeck & Skinner, 2015).

Various paradigms have been designed to study social exclusion in the laboratory. One such paradigm, Cyberball, is an online ball-toss game designed to study ostracism and social exclusion (Williams et al., 2000). Because it simulates being excluded from a group in virtual environment, people report feeling of distress and anxiety after completing the game. Past research has demonstrated that adolescents took more risks following social inclusion and subsequent exclusion in the Cyberball task, albeit not significantly (Peake et al., 2013). Furthermore, teens with greater susceptibility to peer influence took significantly more risks after social exclusion, pointing to the importance of studying individual differences in the social exclusion context (Peake et al., 2013).

Past studies have investigated the neural correlates of the phenomenon of social exclusion. With an event-related potential (ERP) study, Crowley and his colleagues showed that there are time-dependent associations between slow-wave activity (500-900 ms) in left prefrontal/medial frontal cortical regions for exclusion events and self-reported distress (2009). They also found that "micro-rejections," or small rejection events that occur during long periods of non-exclusion events, indicate a similar ERP-distress link (420-580 ms). An fMRI study demonstrated that brain areas responsible for processing social exclusion develop over time, and social exclusion is less present in children (Bolling et al., 2011). Another fMRI study using the same paradigm in adolescent participants demonstrated that during social exclusion, adolescents displayed activity in insula and subgenual anterior cingulate cortex, which was positively related to self-reported distress. On the other hand, activity in the ventral striatum seemed was related to less distress and to play a role in regulating activity in brain areas involved in emotional distress (Masten et al., 2009).

Various researchers have studied the link between anxiety and social exclusion. Baumeister and Tice put forth the "exclusion theory" of anxiety, which suggests that anxiety in essence is a form of adaptation induced by actual or threatened exclusion from social groups (1990). Anxiety has been hypothesized to make an organism reevaluate an ongoing course of action, and alter it accordingly if needed. As such, anxiety can be thought as an adaptation to prevent social exclusion (Buss, 1990).

Moreover, conceptually, ostracism has been shown to drive irrational, antisocial and even violent behavior (Williams, 2007). Chronic social rejection in the form of ostracism, bullying and rejection by a romantic interest has been shown to be a major contributing factor in 87 % of 15 U.S. school shooting cases post-1995 (Leary et al., 2003). Research has shown that the

maladaptive and antisocial behaviors caused by ostracism can in turn be used to garner social approval or increase the likelihood of social inclusion (Williams, 2007). Ostracism can cause a strong desire to be approved, and can drive an individual to seek approval from groups of which the individual otherwise would not have initially approved. For instance, individuals who join terrorist groups are often people who feel isolated or marginalized in their societies, and they seek to fulfill needs for recognition (Williams, 2007).

Research has explored the links between antisocial behavior and responses to social exclusion. A study investigating antisocial behavioral responses to ostracism showed that participants who experienced unfair, rather than fair, exclusion reported more anger and engaged in more antisocial behaviors, demonstrating that anger in particular (as opposed to negative emotions in general) mediates the link between social exclusion and antisocial behavior (Chow, Tiedens & Govan, 2008). Rajchert and Winiewski studied the role of personality traits in aggressive reaction to ostracism and rejection. They found that ostracism induced displaced aggressive responses (aggressive behaviors directed against a target different from the initial source of provocation, Denson, Pedersen & Miller, 2006) only in participants who scored high on approach motivation, while high inhibition was associated with restrained retaliatory aggression after rejection (2016). Research has also shown an association between psychopathy and aggressive humor style, which was mediated by the experience of social exclusion (Masui, Fujiwara & Ura, 2013), demonstrating that psychopathic individuals, when faced with social exclusion, might tend to opt for a more aggressive communication style.

While there is evidence that anger and revenge (feelings that correspond to reactive and proactive aggression, respectively) may be expressed differently in subtypes of psychopathy, the exact mechanism as to how this happens in primary and secondary psychopaths has not yet been

investigated. The goal of the current project was to examine the effect of social exclusion on subtypes of psychopathic adolescents, and how the feelings of anger and revenge are manifested differently in these subtypes. Given that the phenotypic differences between primary and secondary psychopathy are largely associated with the level of anxiety, we were also interested in seeing the potentially moderating effects of anxiety in different subtypes of psychopathy on the feelings and behaviors after social exclusion.

The Present Study

The goal of the present study is to examine how subtypes of psychopathic individuals relate to the experience of social isolation. While past research has focused on social exclusion in adolescents in various contexts, no study has investigated the interaction between psychopathic traits and social exclusion in different subtypes of psychopathy. In the present study, a sample of at-risk adolescents and young adults completed a social exclusion task, Cyberball, while neural activity (ERP) and self-reported angry rumination and revenge were assessed. We hypothesized that individuals who score high on psychopathic traits would display smaller (less negative) ERP responses to social exclusion, but would give higher reports of anger. Furthermore, we predicted that this pattern would be different in primary versus secondary psychopaths. Given the social ramifications of antisocial behavior exhibited by psychopathic youth, learning the exact mechanism by which psychopaths with different traits express anger and revenge is crucial for treatment, and would benefit the communities of which these individuals are a part.

Method

Participants

Participants were 91 adolescents (34 female) between the ages of 15-25 (mean age=19.45). Recruitment flyers were posted around New Haven and described the research as a

study on risk-taking behaviors in individuals. Participants were from various racial backgrounds, including White (n=9), African American/Black (n=65), 1 Asian (n=1), Native Hawaiian/Other Pacific Islander (n=1) and mixed race (n=15). The Human Investigation Committee of the Yale University School of Medicine approved this study. Each participant provided written informed consent.

The study consisted of two sessions. In the first session, evaluated individual differences, including psychopathy and anxiety, through self-report measures. In the second session, participants completed the Cyberball task.

Measures

We used the Youth Psychopathic Traits Inventory (YPI), a 50-item questionnaire designed specifically for use with community samples of adolescents to assess the presence of psychopathic traits in adolescents (Andershed et al., 2002). The questionnaire is based on the three-factor model of psychopathy and focuses on 10 out of the 13 previously identified core traits (Andershed, H., Hodgins, S., & Tengström, 2007; Cooke & Michie, 2001). 50 items are categorized into 10 subscales. Within the YPI interpersonal domain, labeled subscales aim to measure dishonest charm, grandiosity, lying and manipulation. Within the affective domain, subscales assess callousness, unemotionality, and remorselessness; and in the behavioral domain, subscales measure impulsivity, thrill seeking tendencies, and irresponsibility (Andershed, H., Hodgins, S., & Tengström, 2007).

We used the State-Trait Anxiety Inventory (STAI), a commonly used measure of trait and state anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), to assess the anxiety levels of the participants. Trait anxiety is defined as an individual's predisposition to respond to situations in general, and state anxiety is defined as a transient, situation-dependent emotion

characterized by physiological arousal and consciously perceived feelings of apprehension, dread, and tension (Spielberger, 1985; Endler & Kocowski, 2001). The inventory includes 20 items for assessing trait anxiety and 20 for state anxiety. State anxiety items include: "I am tense; I am worried" and "I feel calm; I feel secure." Trait anxiety items include: "I worry too much over something that really doesn't matter" and "I am content; I am a steady person." All items are rated on a 4-point scale (e.g., from "Almost Never" to "Almost Always"), and higher scores indicate greater anxiety. For the purposes of this study, we only took into account the score from the trait anxiety items, in order to investigate the role of stable, constant levels of anxiety rather than that of a situation-dependent emotion.

Cyberball

In the second session, electroencephalogram data was collected while participants completed the Cyberball task, developed by Williams and his colleagues (Williams & Sommer, 1997). Each participant sat 60 cm before a 17-inch CRT monitor in a dimly lit (60 W bulb) sound-attenuated room. Cyberball task was administered, followed by questionnaires in which they rated phrases assessing angry rumination or revenge feelings. Cyberball is an interactive online ball toss game where the participant makes and receives throws from two other cyber players (Crowley et al, 2009), and is designed to test responses to ostracism and social exclusion. Later in the game, the two other players exclude the participant and continue to play, an experience that individuals have reported to be distressing on the Need Threat Scale (Williams, 2007; Eisenberger, Lieberman & Williams, 2003), which we also used in this study. Prior to the beginning of the game, participants were asked their gender and ethnicity, which were later used to generate virtual players with photos of people of same race on the computer. Following the procedure described in Crowley et al., participants first saw an actual Google™ webpage,

followed by a “Cyberball” web page, followed by a screen with a green status bar (2009). Several other modifications were introduced to make the original Cyberball game (Crowley et al., 2009) more engaging to children, including the opportunity to choose from one of six different ball gloves to be his or her personal glove throughout the game (Crowley et al., 2010). A female voice narrated instructions on the computer screen. Before starting, participants were told that they would be playing against real people to enhance realism, and were debriefed afterwards. Participants then overheard one experimenter telling a second experimenter that s/he would knock on the door when the other players were ready to play on the internet. Three to five minutes elapsed before the knock occurred (Crowley et all, 2010).

At the beginning of the game, the participant's glove was at the bottom center of the screen; the names of the other players and their gloves appeared to the left and right of the screen center. Pictures of the other “players” and their gloves appeared above their names. Participants used their left and right index fingers on a response pad to throw to the player on the left or right. To make the game more realistic, the ball traveled randomly along different paths from throw to throw (straight line, arc or sine wave); life-like sound effects occurred as the ball traveled (swoosh) and landed in a glove (Crowley et all, 2010).

We used the ERP version of Cyberball designed by Crowley and his colleagues, consisted 137 trials across two blocks, a 90-trial fair play block and then a 47-trial exclusion block (Crowley et al., 2009). During the 90-trial fair play block, the cyber players threw to the participant 30 times (inclusion events). Whether a ball was thrown to the participant during any one trial was pseudorandom and predetermined within a list such that the participant waited for either 0, 1, or 2 throws by the other players before receiving the ball again (with a frequency of 8, 14, and 8, respectively). Cyber players threw to one another and not to the participant 30 times

during the fair trials, which were named "microrejection" events, corresponding to mini-exclusion events during the context of a longer inclusion trial. This was followed by the exclusion block, in which, of the 47 exclusion trials, the ball only came to the participant twice to maintain attention, once on trial 16 and again on trial 32.

Immediately after the game, participants completed the Need Threat Scale, a reliable and valid 20-item ostracism distress measure (Van Beest & Williams, 2006), and has been related to fMRI BOLD signal (Eisenberger, Lieberman & Williams, 2003). In addition, questions assessing angry rumination and revenge were also asked. The Need Threat Scale gauges feelings of distress along four dimensions: belonging ('I felt rejected'), self-esteem ('I felt liked'), meaningful existence ('I felt invisible'), control ('I felt powerful'), on a 5-point choice, from 'Not at all' to 'Extremely.' Angry rumination questions aimed to assess the participants' likelihood to think and ruminate about the negative feelings after being excluded, and they include ("It's going to annoy me for a while that they did not throw to me.") On the other hand, revenge questions evaluated participants' desire to retaliate against the other players ("The other players deserve to be left out of something, or worse," see Appendix for the full list of questions). The Need Threat Scale and Cyberball questions were administered twice with other questionnaires in between, in order to assess how people's feelings about social exclusion differ right after the incident versus at approximately 30 minutes later. The scores from the Cyberball questions were used to measure the feelings of anger and revenge experienced immediately after the game (time 1) and after time had passed (time 2).

EEG Procedure

Using the procedures from Crowley experiment (2009), a high-density EEG was recorded from 128 Ag/AgCl electrodes [Electrical Geodesics Inc., (EGI), Eugene, Oregon, USA] with

Netstation v.4.2 software (EGI) and EGI high-impedance amplifiers, sampled at 250 Hz (0.1 Hz high pass, 100 Hz, low pass). All electrodes were referenced to Cz for recording. All impedances remained at or below 40 kΩ. The E-prime v.1.2 (Psychology Software Tools, Pittsburgh, Pennsylvania, USA) software package controlled the stimulus presentation.

Before segmentation, EEG data were low-pass filtered at 30 Hz. ERPs were derived only when the ball reappeared after leaving the glove of the cyber players, but before traveling on the screen (100 ms baseline, 900 ms poststimulus onset). The EEG for each trial was corrected for blinks and eye movements. Artifact rejection was used to eliminate ERPs contaminated by movement and eye artifacts. Data from electrodes identified with poor signal quality (50% or more trials) were replaced using spherical spline interpolation. For data to be included in the analyses, a total of no more than 20 channels could be interpolated. Averaged data were baseline-corrected by subtracting the average microvolt value across the 100-ms prestimulus interval from the poststimulus segment. After artifact rejection, the single trial data were re-referenced from the vertex (Cz) to an average reference of all electrodes. The trial-by-trial data were then averaged separately for each of the 128 electrode sites and each of three stimulus conditions: inclusion, rejection and micro-rejection. Inclusion refers to the "fair-play" periods during Cyberball, rejection refers to the social exclusion events, and micro-rejection is the term for the mini-periods of not receiving the ball intermittently during ongoing fair play (Crowley et al., 2009).

Data Reduction and Analysis

Event Related Potential Analysis. Following the procedure from Crowley et al. (2009) and Dien (1997) we ran temporal principal component analysis (PCA) to identify time windows of correlated neural activity in the frontal cortex during exclusion and micro-rejection events.

ERPs from 30 frontal electrodes were clustered into two regions by averaging the data for electrodes within the frontal region in each hemisphere. Then we examined the mean voltage values resulting from the ERP windows in the frontal region with Pearson's product moment correlations for exclusion events, and for micro-rejection events with regards to the ostracism distress measure. An analogous approach was used for examining the microrejection events with temporal PCA for the frontal brain region.

Statistical Analyses. Regression analyses were conducted to extract main and interaction effects between anger/revenge, psychopathy and trait anxiety controlled for various independent variables, including age. These analyses were replicated after adding the exclusion ERP, which is the overall estimate of the left-prefrontal/medial frontal ostracism effect as the average of signals from significant electrodes. They were replicated after adding microrejection ERP to the model as well. All analyses were conducted using SPSS v.22 software (SPSS Inc., Chicago, Illinois, USA).

Results

Total Psychopathy Score by Anxiety

Angry Rumination Time 1. There was no significant main effect of psychopathy. We found a significant main effect of anxiety on angry ruminations ($F(3, 73)=9.067$, $p=0.004$), whereby individuals who scored high on anxiety showed higher levels of angry rumination (henceforth anger). This effect remained when exclusion ERP ($F(6,69)= 6.748$, $p=0.011$) and microrejection ERP ($F(6,69)=8.099$, $p=0.006$) were added to the model.

Angry Rumination Time 2. There was no significant main effect of psychopathy, but we observed a trend ($F(6, 69)=3.057$, $p=0.085$) in the initial model. We observed an interaction effect of psychopathy and microrejection ERP ($F(6,69)=4.975$, $p=0.038$) when we added

microrejection ERP to the model, whereby individuals who scored high on psychopathy and had stronger neural responses to microrejection (represented by more negative ERP) reported more anger at time 2 (after time had passed, see Figure 1). We also observed a significant main effect of anxiety (F(3,73)= 6.226, p=0.015) on anger, whereby high anxiety predicted higher levels of anger after time had passed.

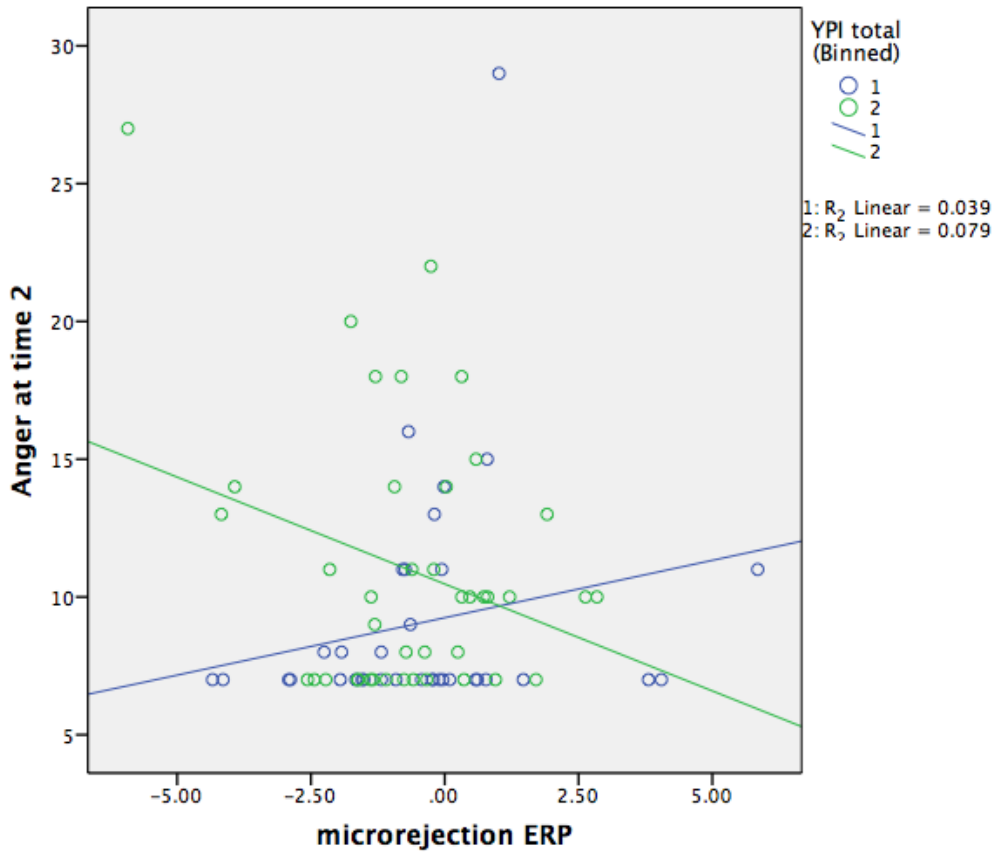

Figure 1: The interaction effect of psychopathy (total score) and microrejection ERP on anger after time had passed

Revenge Time 1. There was no significant main effect of psychopathy. We observed a significant main effect of anxiety (F(3,73)=5.212, p=0.025) on revenge, whereby high anxiety predicted higher levels of vengeful feelings (revenge). This effect remained when we added exclusion ERP (F(6,69)=5.393, p=0.023, and microrejection ERP (F(6,69)= 2.550, p=0.013) to the model.

Revenge Time 2. There was no significant main effect of psychopathy. We observed a significant main effect of anxiety ($F(3,73)=4.791$, $p=0.032$), whereby high anxiety predicted more vengeful feelings after time had passed. This effect remained when we added exclusion ERP ($F(6,69)=5.225$, $p=0.025$) and microrejection ERP ($F(6,69)=2.442$, $p=0.017$) to the model. We also found a significant effect of exclusion ERP ($F(6,69)=3.978$, $p=0.050$), with stronger neural responses to exclusion (more negative ERP) predicting more vengeful feelings after time had passed.

Interpersonal Traits by Anxiety

Angry Rumination Time 1. There was no significant main effect of interpersonal traits. We observed a significant main effect of anxiety ($F(3,73)=8.188$, $p=0.005$), whereby high anxiety predicted higher levels of anger. This effect remained when we added exclusion ERP ($F(6,69)=6.329$, $p=0.014$) and microrejection ERP ($F(6,69)=7.450$, $p=0.008$) to the model.

Angry Rumination Time 2. There was no significant main effect of interpersonal traits, although there was a trend (($F(3,73)=3.342$, $p=0.072$). We observed a main effect of anxiety ($F(3,73)=5.953$, $p=0.017$), with higher anxiety predicting higher levels of anger after time had passed. There was also an interaction effect of anxiety and interpersonal traits ($F(3,73)=4.943$, $p=0.029$), whereby individuals with higher anxiety levels and higher scores on the interpersonal dimension reported more anger after time had passed (see Figure 2). This interaction effect remained ($F(6,69)=4.516$, $p=0.037$) after we added exclusion ERP to the model. We also observed an interaction effect of microrejection ERP and interpersonal traits ($F(6,69)=4.714$, $p=0.033$), whereby individuals with higher scores on the interpersonal dimension and stronger neural responses to microrejection reported more anger after time had passed (see Figure 3).

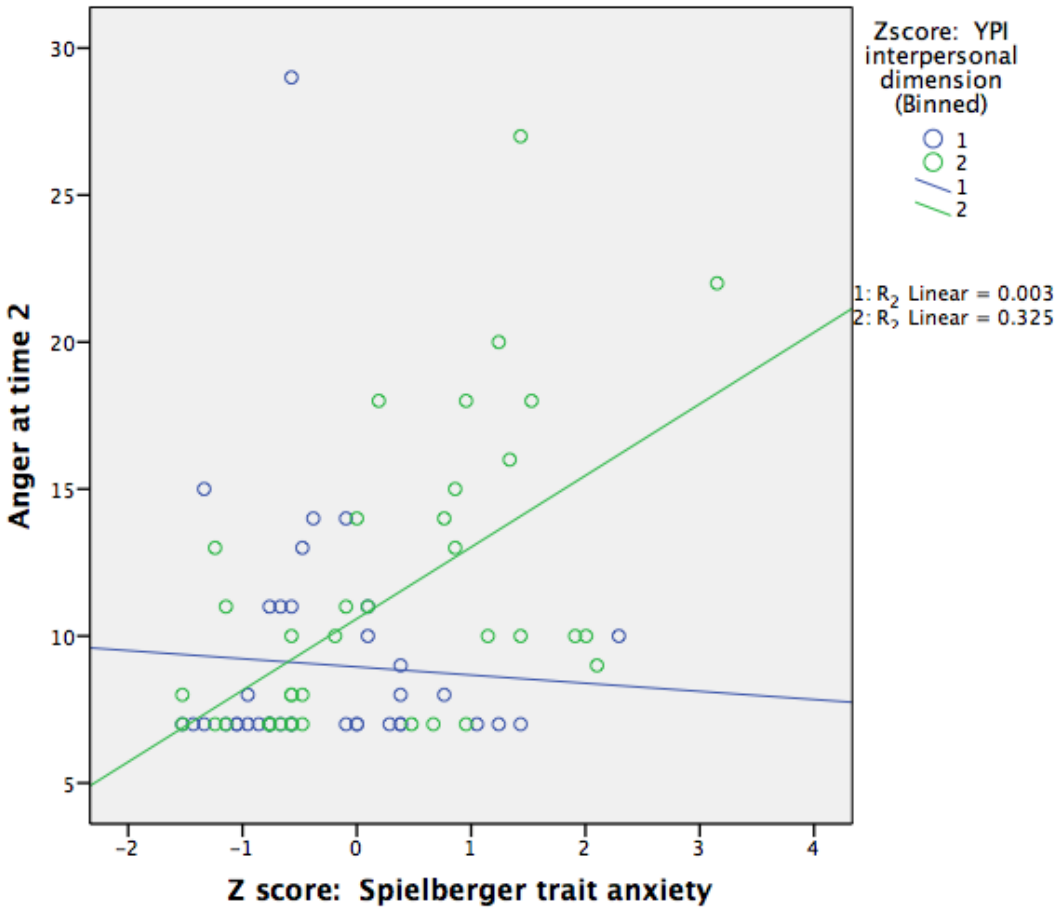

Figure 2: The interaction effect of the interpersonal traits and trait anxiety on anger after time had passed

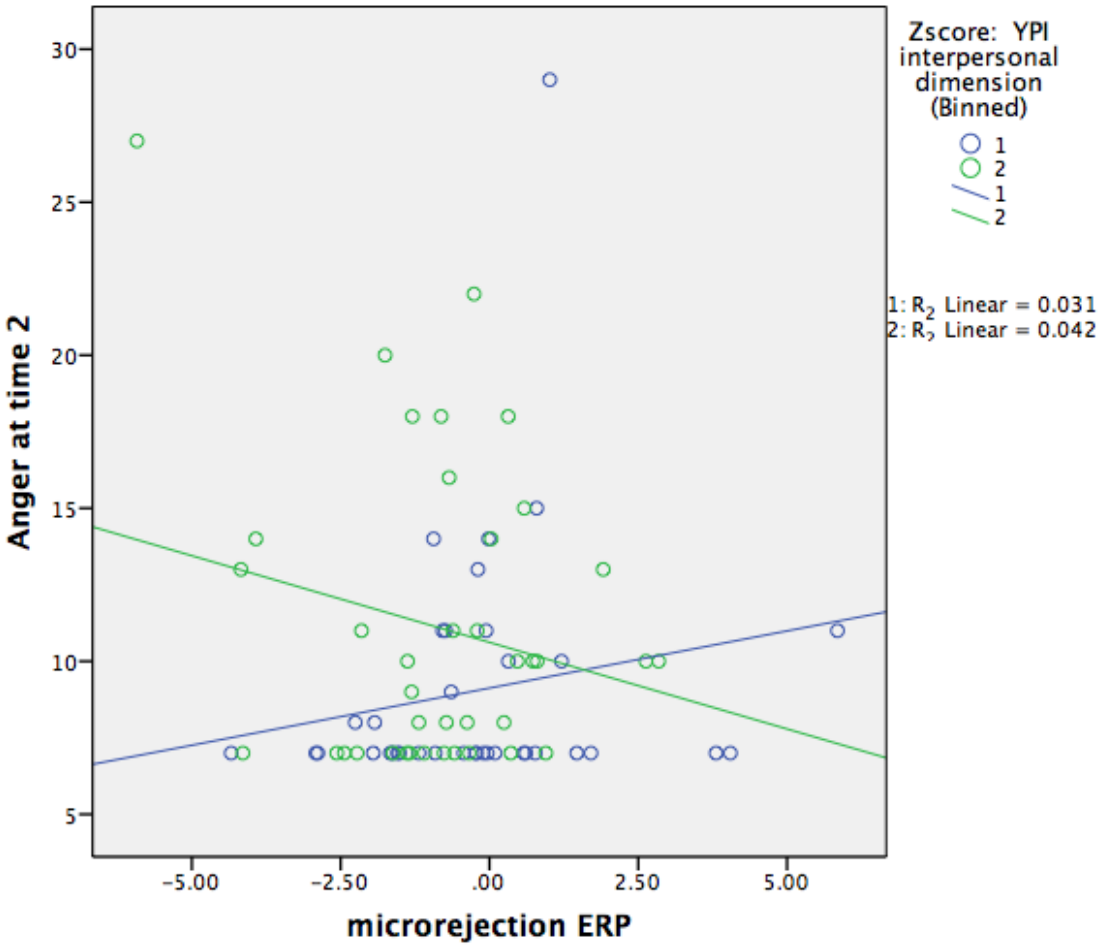

Figure 3: The interaction effect of the interpersonal traits and microrejection ERP on anger after time had passed

Revenge Time 1. There was no significant main effect of interpersonal traits**,** although there seemed to be a trend (F(3,73)=3.396, p=0.069). We also observed a significant main effect of anxiety (F(3,73)=4.474, p=0.038), with high anxiety predicting higher levels of vengeful feelings. This effect remained when we added exclusion ERP (F(6,69)=4.792, p=0.032) and microrejection ERP (F(6,69)=6.069, p=0.016) to the model.

Revenge Time 2. There was no significant main effect of interpersonal traits. When we added exclusion ERP to the model, we obtained no significant effects. When we added microrejection ERP to the model, we observed a significant main effect of anxiety

(F(6,69)=5.223, p=0.025), whereby individuals with high anxiety showed higher levels of vengeful feelings after time had passed. We also found a trend for the interaction of anxiety and interpersonal traits in the model with microrejection ERP (F(6,69)=3.570, p=0.063).

Affective Traits by Anxiety

Angry Rumination Time 1. There was no significant main effect of affective traits. We observed an interaction effect of microrejection ERP and affective traits (F(6,69)=5.605, p=0.021), whereby individuals with higher scores on the affective dimension and stronger neural responses to microrejection reported more anger right after the game. We also found a main effect of anxiety (F(3,73)= 13.146, p=0.001), with high anxiety predicting higher levels of anger. This effect remained after we added exclusion ERP (F(6,69)=14.192, p<0.001) and microrejection ERP (F(6,69)=14.145, p<0.001) to the model.

Angry Rumination Time 2. There was no significant main effect of affective traits. We observed an interaction effect of microrejection ERP and affective traits (F(6,69)=11.026, p=0.001), whereby individuals with higher scores on affective traits and stronger neural responses to microrejection reported more anger after time had passed. We also found a main effect of anxiety (F(3,73)=11.450, p=0.001), with high anxiety predicting higher levels of anger. This effect remained when we added exclusion ERP (F(6,69)=12.935, p=0.001) and microrejection ERP (F(7,68)=11.784, p=0.001) to the model.

Revenge Time 1. There was no significant main effect of affective traits. We observed an interaction effect of microrejection ERP and affective traits (F(6,69)=5.427, p=0.023), whereby individuals with higher scores on affective dimension and stronger neural responses to microrejection felt more vengeful right after the game. We also found a significant effect of anxiety (F(3,73)=8.703, p=0.004), with high anxiety predicting higher levels of anger. This

effect remained after we added exclusion ERP (F(6,69)=11.139, p=0.001) and microrejection ERP (F(6,69)=10.860, p=0.002) to the model.

Revenge Time 2. There was no significant main effect of affective traits in the initial model. When we added exclusion ERP to the model, we observed a significant main effect of exclusion ERP (F(6,69)=6.275, p=0.015), with stronger neural responses predicting higher levels of revenge after time had passed. There was also a significant main effect of affective traits (F(6,69)=3.990, p=0.050), with higher scores on the affective dimension predicting lower levels of revenge after time had passed (see Figure 4). This effect remained after we added microrejection ERP to the model (F(6,69)=4.943, p=0.029), and we also observed a trend for the interaction of psychopathy and microrejection ERP (F(6,69)=3.918, p=0.052) in this new model. We also observed a significant main effect of anxiety (F(3,73)=7.700, p=0.007), with high anxiety predicting higher levels of revenge after time had passed. This effect remained after we added exclusion ERP (F(6,69)=10.017, p=0.002) and microrejection ERP (F(6,69)=9.013, p=0.004) to the model.

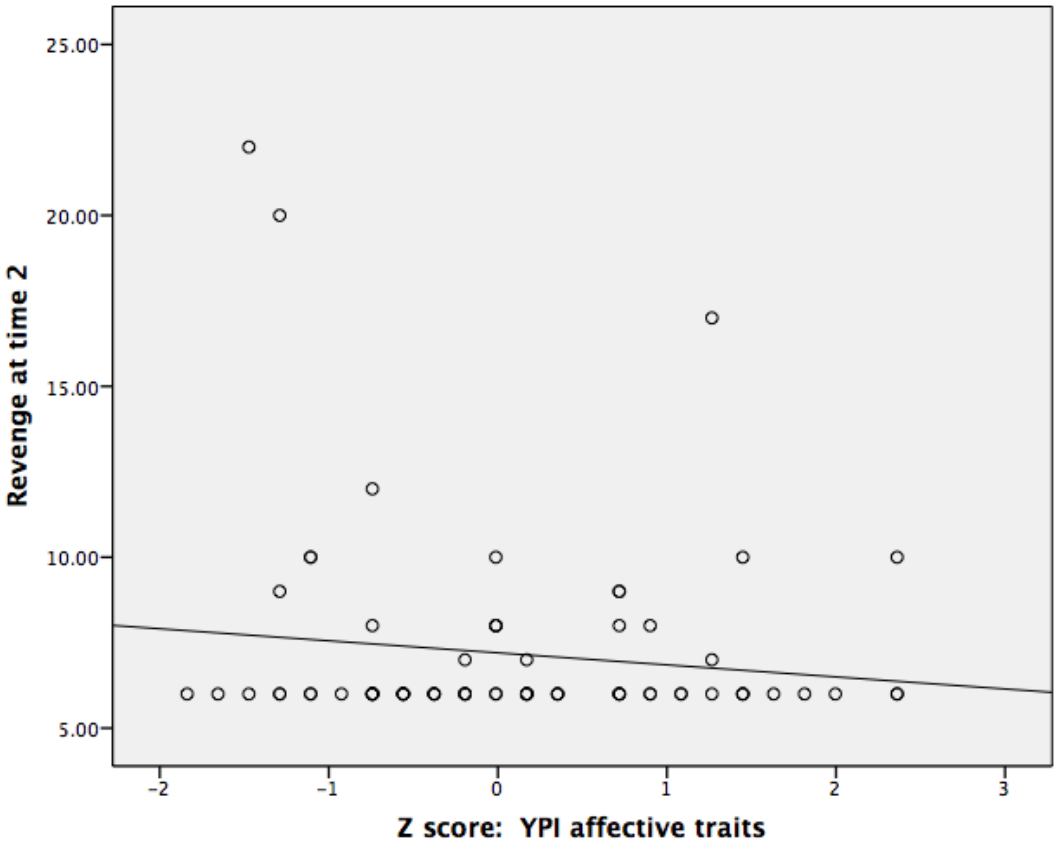

Figure 4: Relationship between the affective traits and revenge feelings after time had passed

Antisocial Traits by Anxiety

Angry Rumination Time 1. There was no significant main effect of antisocial traits. We observed a main effect of anxiety ($F(3,73)=9.638$, $p=0.003$), with high anxiety predicting higher levels of anger. This effect remained after we added exclusion ERP ($F(6,69)=8.625$, $p=0.005$) and microrejection ERP ($F(6,69)=9.270$, $p=0.003$) to the model.

Angry Rumination Time 2. We observed a main effect of antisocial traits ($F(3,73)=6.927$, $p=0.045$), with higher scores on the antisocial dimension predicting higher levels of anger after time had passed (see Figure 5). This effect was no longer signficant after we added exclusion and microrejection ERP to the model. However, there was a trend for antisocial traits after adding exclusion ERP ($F(6,69)=3.072$, $p=0.084$). We also observed a main effect of

anxiety, with high anxiety predicting higher levels of anger after time had passed (F(3,73)=6.927, p=0.010). This effect remained after we added exclusion ERP (F(6,69)=6.715, p=0.012) and microrejection ERP (F(6,69)=6.468, p=0.013) to the model.

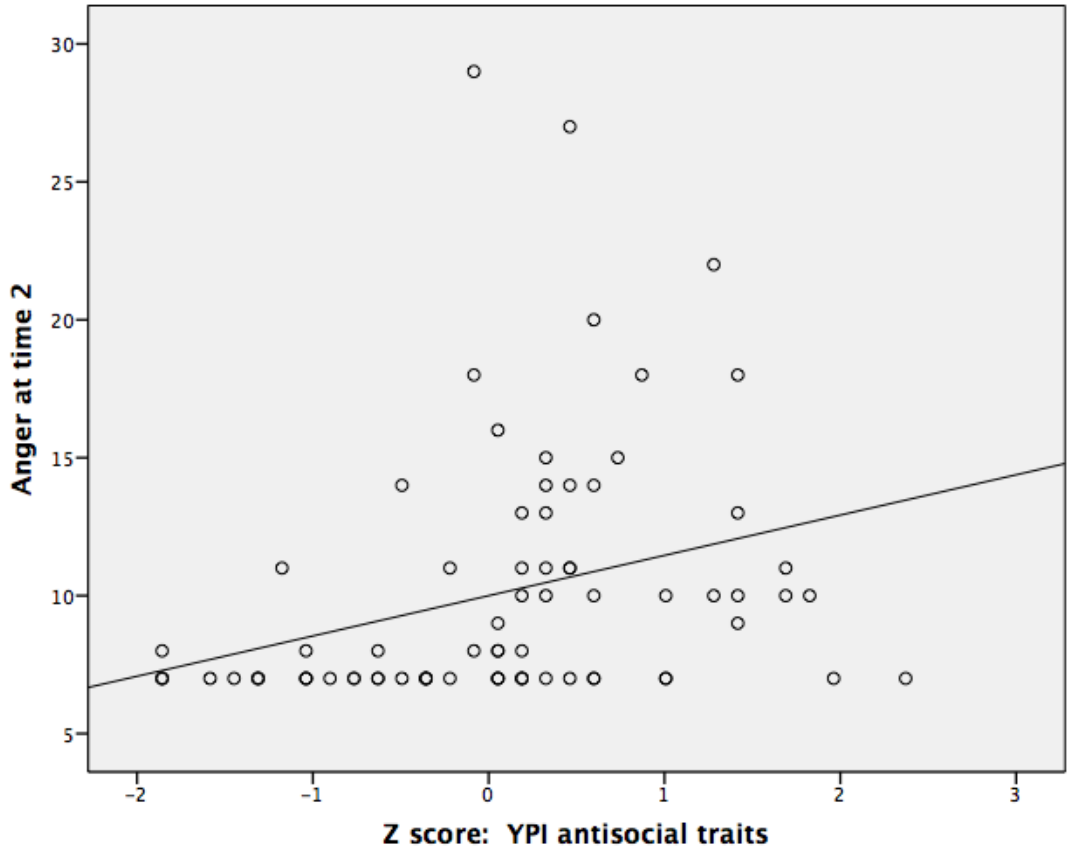

Figure 5: Relationship between the antisocial traits and angry rumination after time had passed

Revenge Time 1. There was no significant main effect of antisocial traits. We observed a main effect of anxiety (F(3,73)=4.968, p=0.029), with high anxiety predicting higher levels of vengeful feelings. This effect remained after we added exclusion ERP (F(6,69)=6.203, p=0.015) and microrejection ERP (F(6,69)=5.949, p=0.017) to the model. We also found a significant effect of exclusion ERP (F(6,69)=4.135, p=0.046), whereby individuals who had stronger neural responses to exclusion experienced more vengeful feelings right after the game.

Revenge Time 2. There was no significant main effect of antisocial traits.

When we added exclusion ERP to the model, we observed a significant effect of exclusion ERP ($F(6,69)=4.356$, $p=0.041$), with stronger neural responses to exclusion predicting higher levels of revenge after time had passed. We also found a significant anxiety main effect ($F(6,69)=4.015$, $p=0.049$), with high anxiety predicted higher levels of vengeful feelings after time had passed, which was not present in the initial model. This effect remained when we added microrejection ERP to the model ($F(6,69)=4.068$, $p=0.048$).

Discussion

The goal of the present study was to investigate the effects of subtypes of psychopathy on angry ruminations and revenge following social exclusion. We did not find any main effects of psychopathy on feelings of anger or revenge. However, we did find a significant interaction effect of psychopathy and microrejection ERP on anger expressed after some time (i.e. time 2) had passed after the game. For psychopathic traits, we observed a main effect of antisocial traits on anger after some time had passed after the game, whereby individuals who scored high on antisocial traits reported more anger. We also found that there was a significant interaction of interpersonal traits and anxiety, as well as a significant interaction of interpersonal traits and microrejection ERP on anger expressed after some time had passed. Finally, we found a main effect of affective traits on revenge after time had passed, with lower scores on affective traits predicting higher levels of revenge, and we observed an interaction of microrejection ERP and affective traits on anger and revenge right after the game, as well as on anger later on. Specifically, individuals who scored high on psychopathy and component traits who also had a more negative ERP (indicating stronger neural response to exclusion) reported more anger and revenge. Finally, consistent with previous research on the relationship between anxiety and social exclusion, we observed a main effect of anxiety on angry and vengeful feelings. Taken

together, these results indicate that individuals with affective traits (e.g. callousness, unemotionality), as well as those with interpersonal traits (e.g. superficial charm, glibness) are more likely to have sustained feelings of anger, and that psychopathic traits overall qualify the effect of neural responses to social exclusion on sustained anger. The findings also suggest that individuals with high levels of trait anxiety are more likely to exhibit anger and vengeful feelings, both right after an exclusion event and after a "cool-down" period.

Overall, we did not find any main effects of psychopathy on feelings of anger or revenge. This suggests that adolescents and young adults with psychopathy do not exhibit differentially angry or vengeful feelings and behavior after social exclusion compared to the non-psychopathic individuals. As for the various dimensions of psychopathic traits, we found a main effect of psychopathic traits in the affective dimension on revenge after time had passed. However, this effect was in the opposite direction of what we expected: individuals who scored *lower* on affective traits reported higher levels of vengeful feelings after time had passed. In general, the affective traits of psychopathy are related to the unemotional, remorseless traits and increased proactive aggression (Berkowitz, 1993; Blair, 2003; Cima & Raine, 2009). However, this finding suggests that individuals with higher scores on the affective traits do not necessarily experience sustained feelings of revenge, which may indicate that despite experiencing a desire to take revenge right after the instance of social exclusion, these individuals might not sustain the need to act on the desire in the long run. This interpretation is in line with a past study that demonstrated that while psychopathic individuals experience regret, they do not use the negative affect experienced in the past to inform their future decisions (Baskin-Sommers, Stuppy-Sullivan & Buckholtz, 2016). Alternatively, this result is also in accord with the general low-fear stereotype of individuals with callous and unemotional traits, which proposes that individuals

with psychopathic traits have affective deficits, resulting in lack of proper responses to incidents that would normally elicit negative feelings. As such, these individuals might not place much emphasis on individual events that bother them, such as in the instances of exclusion.

We also found that individuals who score high on psychopathy and show stronger neural response to exclusion in the microrejection condition (more negative ERP) reported more anger after time had passed. We observed the moderating effect of microrejection ERP across other dimensions as well—for instance, individuals with high scores on interpersonal and affective traits and stronger neural responses to exclusion reported more anger after time had passed. Interestingly, we observed these effects only in microrejection events and not in the larger exclusion blocks. Previous studies have shown a similar link between the distress that individuals experience and the neural responses to social exclusion (ERP) for both the exclusion and microrejection events, whereby higher levels of post-exclusion distress was associated with more negative ERP signals in both cases (Crowley et al., 2009). This would lead us to predict that neural responses would be a moderator in both exclusion and microrejection events in our study. One explanation for this discrepancy in our findings could be that because microrejection events are "mini-exclusions" that occur during fair trials, they might have a subtler effect to which individuals with psychopathic traits might be more reactive. In other words, individuals who score high on the interpersonal or affective dimensions of psychopathy might demonstrate a differential sensitivity compared to the normal population and experience anger for a sustained period of time even after small instances of exclusion, whereas individuals who do not have these traits might respond strongly only to major exclusion events.

Moreover, we found a significant interaction effect of interpersonal traits and anxiety on anger after some time had passed. This demonstrates that while interpersonal deficits (e.g.

grandiosity, manipulative tendencies) do not directly affect negative feelings after time had passed, they might heighten the effect of trait anxiety on angry and vengeful feelings. This in turn might result in more aggressive behavior in individuals with psychopathic tendencies.

As indicated by the findings discussed above, the presence of psychopathic traits seems to augment the relationship between neural responses to social exclusion and self-reported anger and revenge. It seems to be the case that in psychopaths, neural correlates of social exclusion more strongly predict anger and revenge compared to the normal population. This is in line with the previous findings on antisocial behavior, aggression and social exclusion: since anger mediates the link between social exclusion and antisocial behavior (Chow, Tiedens & Govan, 2008), we might also expect psychopaths showing stronger responses to social exclusion and report more anger after the exclusion event compared to the normal population. Furthermore, since psychopaths (unlike individuals with solely antisocial tendencies) typically use instrumental (calculated and goal-directed) aggression (Cornell et al., 1996), it makes sense that individuals who score high on psychopathic traits also exhibited more vengeful feelings in addition to more anger in our study.

We also found a main effect of traits in the antisocial dimension on angry feelings—specifically, individuals who scored higher on the antisocial dimension reported more anger after time had passed. Since antisocial dimension relates to the individual's tendency to engage in irresponsive, impulsive and thrill-seeking behavior, rather than callousness and unemotionality, this finding is in line with our predictions. It is also in accord with past research, which showed a positive association between anxiety/fear and the antisocial dimension of psychopathy (Patrick, 1994; Frick et al., 1999). Furthermore, secondary psychopaths, who exhibit more antisocial behavior compared to primary psychopaths, were shown to have more intense reactions and

somatic arousal in response to hypothetical anger-inducing situations (Blackburn & Lee-Evans, 1985). This agrees with the heightened levels of angry rumination experienced by the participants in our study who scored high on the antisocial traits.

While the goal of our research was primarily to investigate the effects of psychopathy on social decision making, it is hard to ignore the consistent main effect of anxiety on feelings of anger and revenge. This is in line with the past research demonstrating that social exclusion is closely related to anxiety, and anxiety is thought to be an adaptation that arose in response to social exclusion, and works to prevent social exclusion (Baumeister & Tice, 1990; Buss, 1990). Here, being ostracised in a virtual reality game seems to induce a feeling of anxiety and a strong neural response, which might prompt people to reevaluate their feelings and behavior. This might be adaptive in the long run insofar as it reinforces the adoption of optimal behavior rather than opting for violence. In the short run, however, it seems to induce more negative feelings.

It is also important to note that our findings did not clarify the impact of psychopathic subtypes on aggressive reactions following social exclusion. Primary psychopaths are thought to have lower levels of anxiety, while secondary psychopaths are characterized as highly anxious individuals (Newman et al., 2005); however, our results demonstrated that anxiety has a direct link to anger and revenge across all the subtypes, and anxiety did not qualify the effects of psychopathy or the psychopathic traits in general. Despite this, some researchers have operationalized primary psychopathy as the interpersonal and affective dimensions, while secondary psychopathy has been thought to be related to the antisocial traits (Hicks et al., 2004). In this framework, our finding that there is a link between the affective traits on revenge, and between the antisocial traits and anger, might seem to support the notion that subtypes of psychopathy have different reactions to exclusion.

There are several limitations of our study that need to be considered. First, we conducted the study within a community sample. It is possible that within a prison population in which offenders presumably exhibit more angry and vengeful behavior, individual differences would manifest in a different way. Second, we had a disproportionally higher number of men in our study. Thus, we cannot infer how gender relates to psychopathic traits and antisocial behavior differentially. Furthermore, since a large majority of our participants were African Americans, our sample is not a perfect representation of the population. Finally, we used a self-report scale to assess the feelings of anger and revenge (corresponding to the two aggression subtypes) after the Cyberball game. It is possible that participants chose not to adequately report how they were feeling after the game if they thought that experiencing certain feelings about an online game was not appropriate or necessary. However, this is unlikely to have skewed our results in a significant way, since many of the participants seemed to express their feelings openly, as apparent from their answers in the questionnaires. There are also inconsistencies between different types of anger measures. For example, past research has shown differences in the anger levels of psychopaths and non-psychopaths when presented with hypothetical situations, and in the attributes of hostile intent towards others (Serin, 1991; Blackburn & Lee-Evans, 1985); however, other studies also demonstrated that there are significant differences only in the responses to attack and not in the anger levels of these two groups (Blackburn & Lee-Evans, 1985). Future research should thus investigate the presence of angry and vengeful feelings with other scales and measuring techniques. Studying aggression with varying laboratory methods will provide a more robust body of evidence that will enhance our understanding of aggressive behavior in these populations.

While it is important to consider these methodological issues, the study is the first to provide evidence for the link between different psychopathic traits and proactive and reactive aggression following social exclusion. The mixed results in subtypes of aggression and exclusion effects might suggest that in some contexts, it is difficult to parse out the feelings and the related social decision-making mechanisms for primary and secondary psychopaths. Overall, social exclusion seems to affect the youth with psychopathic traits, and further investigating individual differences as to how adolescents respond to social exclusion can greatly reduce the social ramifications of antisocial behavior.

Acknowledgements

I would like to express my gratitude to Professor Arielle Baskin-Sommers and Grace Brennan for their guidance and mentorship. I am also thankful to the staff at the Mechanisms of Disinhibition Lab at Yale for their help throughout the process of data collection. Finally, I want to thank Professor Joshua Knobe and Professor Mark Sheskin for their invaluable advice throughout my time in the major and the thesis process.

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Appendix

Need Threat Scale

Angry Rumination Questions:

- It's going to annoy me for a while that they did not throw to me.
- During the game I got frustrated and then angry.
- Thinking about how they did not throw to me gets me "worked up."
- I found myself thinking over and over that they did not throw the ball to me and this annoyed me.
- Even though the game is over, it was still on my mind.
- This game is like other situations where people are fools.
- During the game, I wanted to damage things.
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Revenge Questions:

- I *thought* about how to get back at the other players.
- The other players deserve to be left out of something, or worse.
- I would enjoy leaving the other players out so they could know how it feels.
- Because they left met out, they deserve "pay back."
- I hope something negative happens to the other players.
- If I could, I would *actively* do something to put the other players in a bad situation.