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EXAMINING P3 AND N2 AMPLITUDES FOLLOWING SOCIAL EXCLUSION AND PROVOCATION IN COLLEGE STUDENTS WITH HIGH AND LOW NARCISSISTIC TRAITS

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EXAMINING P3 AND N2 AMPLITUDES FOLLOWING SOCIAL EXCLUSION AND PROVOCATION IN COLLEGE STUDENTS WITH HIGH AND LOW NARCISSISTIC TRAITS

by

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ABSTRACT

Adults with narcissistic traits are prone to reacting aggressively following provocation due to elevations in emotional reactivity and perceived threat to their grandiose self-views. Prior studies have examined event-related potentials (ERPs) measures in college students with narcissistic traits in the context of risky decision making and facial emotion processing; however, no known studies have examined how those with narcissistic traits react to rejection and provocation at the neurophysiological level during an externally valid social rejection task (i.e., Cyberball). For the purposes of this study, it was predicted that participants with higher levels of narcissistic traits (both total narcissism and grandiose exhibitionism) would have larger P3 mean amplitudes during exclusion trials relative to inclusion trials (signaling more attention to emotionally salient stimuli) and smaller N2 mean amplitudes during provocation trials relative to inclusion trials (suggesting less inhibitory control). It was also hypothesized that narcissistic traits would moderate the relationship between N2 mean amplitudes and retaliatory aggression, and that narcissistic traits would predict retaliatory aggression. Although we were able to replicate prior research supporting grandiose exhibitionism as a predictor of retaliatory aggression, our results did not support our other hypotheses regarding how adults with narcissistic traits process social exclusion and provocation at the neurophysiological level due to potential limitations of our experimental paradigm and our selection of ERP measures. It is important to obtain a better understanding of what occurs at the neurophysiological level in adults with narcissistic traits during social exclusion and provocation to help establish the groundwork for how such information is processed leading up to the end behavioral response (e.g., aggression), as further research in this

area may allow us to identify or predict who may have these difficulties or assess how they respond to targeted intervention.

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DEDICATION

I would like to dedicate this dissertation to my loved ones who have supported me unconditionally and tirelessly throughout my graduate training. To my mother, who never ceases to remind me how proud she is of my accomplishments, no matter how small. To Whitson and Jonathan, for loving me always without any limitations or conditions, and for making each day a bit easier for me during such a hectic time in my life. Lastly, to Allison for our Stardew Valley dates, to Katelyn for our Animal Crossing island visits, to Sam and Peggy for trash television watch parties, to Jessica for our bad movie nights, and to Robyn, Larissa, and Lindsay for Bachelor Mondays (or MNM during off-seasons); these times have all reminded me not to take life too seriously and have given me the space to just be my authentic self. You have all played such an instrumental role in my life, and for that, I am forever grateful.

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ERP	Event-related potential
EEG	Electroencephalography
NPI	Narcissistic Personality Inventory
DASS-21	Depression, Anxiety, and Stress Scales
NTS	Need Threat Scale
WASI-II	Wechsler Abbreviated Scale of Intelligence

CHAPTER I - INTRODUCTION

Narcissism

Narcissism is characterized as a personality trait involving inflated and grandiose self-views (Baumeister, Bushman, & Campbell, 2000) and unstable self-esteem (Rhodewalt, Madrian, & Cheney, 1998). Narcissism can be viewed as on a continuum, ranging from normative to pathological; it is only deemed a personality disorder if there is significant distress or impairment in functioning (American Psychiatric Association, 2013). Although narcissism is characterized by some adaptive features (e.g., high self-esteem, extraversion, assertiveness) and may therefore be perceived more favorably than other dark personality traits (i.e., Machiavellianism, psychopathy; Rauthmann & Kolar, 2012), adults with high levels of narcissistic traits may also have an exaggerated sense of entitlement (i.e., the expectation of favorable outcomes or special treatment), grandiose self-views, less empathy, and be more argumentative and aggressive (Ackerman, Witt, Donnellan, Trzesniewski, Robins, & Kashy, 2011; Baumeister et al., 2000; Chester & DeWall, 2016; Holtzman, Vazire, & Mehl, 2010).

For adults with high levels of narcissistic traits, these more maladaptive features tend to interfere with their interpersonal functioning (Grubbs & Exline, 2016; Orth & Luciano, 2015). For example, adults high in narcissism tend to form relationships with others as a means to boost their ego by obtaining positive feedback (Back, Schmukle, & Egloff, 2010), and they tend to be less dependable than their non-narcissistic counterparts (Anderson et al., 2008; Vazire & Funder, 2006). If they receive feedback that does not align with their grandiose self-views, interpersonal conflict is more likely to occur (Twenge & Campbell, 2003). Due to their heightened sensitivity to social rejection, they

often respond with hostility or aggression, thus harming others who may or may not have threatened their self-views (Cascio, Konrath, & Falk, 2015; Twenge & Campbell, 2003).

Given that interpersonal interactions may lead to aggression if their self-views are threatened, it is important to better understand how adults with narcissistic traits process emotionally-valenced situations and make decisions about how to behaviorally respond. One way to achieve this goal is to examine how the brain processes this information at the neurophysiological level instead of only looking at the end behavioral response. Thus, the primary aim of the present study was to harness the advantages of electrophysiological measures (i.e., event-related potentials) to examine the neural cascade of cognitive processes in college students high and low in narcissistic traits when subjected to emotionally-valenced events such as rejection or provocation. As most of this work has been done with college students, we opted to test our hypotheses in a sample of college students in order to compare our results to the relevant extant literature.

Narcissism, Ego Threat, and Aggression

According to the threatened egotism theory of aggression, adults with maladaptive narcissistic traits are at an increased likelihood of acting aggressively when faced with ego threats, or potential damage to their grandiose self-views (Bushman & Baumeister, 1998). Ego threats may present themselves in the form of negative feedback or, more specifically, interpersonal exclusion or rejection, which compromises their need to belong, ability to maintain their dominance, and be favorably perceived in social contexts (Brown & Zeigler-Hill, 2004; Campbell, Rudich, & Sedikides, 2002). Their aggressive response serves many functions such as deflecting rejection or preserving their overly positive self-views by discounting negative feedback (Campbell, Brunell, & Finkel,

2006; Martinez, Zeichner, Reidy, & Miller, 2008). It is also less likely that they will receive negative feedback from others in the future, but ultimately this only serves to reinforce this type of responding in adults high in narcissistic traits (Barry, Chaplin, & Grafeman, 2006).

Empirical evidence in support of the threatened egotism theory of aggression has been found in both clinical and nonclinical samples and across different developmental periods (Barry et al., 2006; Martinez et al., 2008; Twenge & Campbell, 2003). In fact, a recent meta-analysis revealed that, across both clinical and nonclinical samples, adults with high levels of narcissism are at an increased likelihood of displaying objectively measured forms of aggression (e.g., noise blasts, electric shocks) following an ego threat (e.g., negative evaluation, social rejection; see review by Lambe, Hamilton-Giachritsis, Garner, & Walker, 2018). Most studies examining the link between narcissism and aggression have used the Narcissistic Personality Inventory (NPI) as a means of capturing both adaptive and maladaptive features of narcissism (Cain, Pincus, & Ansell, 2008). For example, it has been consistently found that college students with higher levels of narcissistic traits, as measured by total scores on the NPI, are more likely to act aggressively in response to negative feedback (e.g., Bushman, Baumeister, Thomaes, Ryu, Begeer, & West, 2009; Stucke & Sporer, 2002; Vaillancourt, 2013), including social rejection (Twenge & Campbell, 2003). In an experimental study by Barry and colleagues (2006), college students completed a virtual task encouraging them to maximize profits by either working cooperatively or damaging another player's progress. The results of this study found that male participants with higher total narcissism scores were more likely to react aggressively by damaging other players' progress after receiving negative

performance feedback; female participants, in contrast, exhibited only slight increases in aggression. Cale and Lilienfeld (2006) found that male inmates committed to a state prison who had higher total scores on the NPI were more likely to exhibit verbal aggression based on informant reports in response to ego threats (e.g., insults, negative feedback) relative to when ego threats were not present. Overall, it appears that aggression is a likely outcome when adults with narcissistic traits receive feedback that is incongruent with their overly positive self-views (Baumeister et al., 2000; Kernis, 2003).

Narcissism and Emotional Understanding and Regulation

Given that negative emotionality, particularly anger (Cale & Lilienfeld, 2006), drives aggressive behavior following ego threats, it is important to understand how emotion dysregulation plays a contributory role in the expression of aggression in adults with narcissistic traits. Although self-report measures suggest that adults with elevated narcissistic traits perceive themselves to possess emotional self-efficacy (Petrides, Vernon, Schermer, & Veselka, 2011), maladaptive narcissistic features, such as grandiosity and vulnerability, have been linked to self-reported emotional instability (e.g., adaptability, self-esteem, assertiveness; Besser & Zeigler-Hill, 2010; Emmons, 1987) and emotion dysregulation, as measured by the Difficulties in Emotion Regulation Scale (Akinci, 2015; Zeigler-Hill & Vonk, 2015; Zhang, Wang, You, Lü, & Luo, 2015). Relatedly, a study by Zeigler-Hill and Vonk (2015) found that the exploitation and entitlement subscales of the NPI were associated with poor impulse control and fewer emotion regulation strategies, whereas the exhibitionism subscale was associated with poor emotional awareness in a sample of college students. In studies prompting participants to recall a time in which they faced social rejection, college students who had

high total scores on the NPI were found to feel emotions more intensely and were more likely to feel emotions that provoke externalizing behaviors (e.g., anger, hostility) than internalizing behaviors (e.g., sadness, anxiety; Campbell, Foster, & Brunell, 2004; Twenge & Campbell, 2003). In general, it seems that emerging adults with elevated narcissistic traits not only feel emotions more strongly but are less equipped to regulate their emotions relative to those with less narcissistic traits. Moreover, they struggle with regulating or inhibiting their behaviors when experiencing strong emotions, which primes them for aggression.

Event-Related Potentials

While it has been consistently shown that adults with narcissistic traits often act aggressively when faced with ego threats (e.g., Barry et al., 2006; Bushman et al., 2009; Twenge & Campbell, 2003; Vaillancourt, 2013), it is less clear what happens at the neurophysiological level in response to social rejection and provocation leading up to an aggressive response. Using neuroimaging techniques, specifically event-related potentials given their high temporal resolution (Sanei & Chambers, 2013), it is possible to ascertain when social rejection and provocation events are processed in the brain and how that may differ across adults with varying levels of narcissism. Event-related potentials (ERPs) are neural signals reflecting time-locked responses to specific sensory, motor, or cognitive events and stimuli (Sur & Sinha, 2009). Two well-established ERPs are of interest for the purposes of this study: the P3 and N2, as they are neural correlates of attentional and inhibitory control in the context of decision making and they have been shown to be influenced by emotionally-valenced stimuli or events (Luck, 2014; Otten & Jonas, 2013; Polich, 2007).

The P3 is a positive deflection which becomes evident in the temporal parietal area approximately 300 to 500 milliseconds post-stimulus (Bokura, Yamaguchi, & Kobayashi, 2001; Bruin & Wijers, 2002) and is associated with attention and subsequent memory processing. A larger P3 amplitude is typically detected when more attentional resources are allocated to a given task (Polich, 2007). It has also been suggested that the P3 may be impacted by the emotional intensity of stimuli even when the frequency of the stimuli is held constant (Hajcak & Olvet, 2008; Yeung & Sanfey, 2004). For instance, in a study by Gardener and colleagues (2013), college students were shown a series of unpleasant images (e.g., injuries, mutilation) from the International Affective Picture System (IAPS) and were instructed to either "increase," "decrease," or "maintain" the intensity of their emotional response to these stimuli. The results of this study found that participants had significantly greater P3 peak amplitudes when they increased the intensity of their emotion as compared to when they maintained the intensity of their emotion. In a study using a modified Go/NoGo task in which negative, neutral, and positive images were displayed in the background, it was found that significantly larger NoGo P3 mean amplitudes were evoked when college students were presented with positive images relative to negative images, suggesting that this ERP can be modulated by emotionally-valenced stimuli (Albert et al., 2010). Moreover, another study by Zhang and Lu (2012) found significantly larger P3 mean amplitudes and significantly shorter P3 peak latencies for positive and negative facial expressions as compared to neutral facial expressions during Go and NoGo trials. Importantly, the novelty of the NoGo trials were taken into account in this study, as there was an equal number of Go and NoGo trials. Based on a review of the literature, Bradley and colleagues (2003) have suggested that the P3 may

reflect “motivated attention,” meaning that this ERP aids in facilitating emotion regulation processing by allocating attentional resources to significant emotional stimuli.

While both the P3 and N2 are both considered neural correlates of attentional control in the context of decision-making, the N2 has also been shown to be associated with inhibitory control (Falkenstein, Hoormann, & Hohnsbein, 1999). The N2 becomes evident in the frontal area approximately 200 to 350 milliseconds post-stimulus (Patel & Azzam, 2005) and is consistently evoked during tasks that require behavioral inhibition (e.g., Go/NoGo tasks; Bekker, Kenemans, Verbaten, 2005; Otten & Jonas, 2013; Vuillier et al., 2016). The N2 has also been examined in the context of aggression-provoking paradigms. For instance, in a study comprising a sample of college students, a competitive reaction time task was used to induce aggressive responses through provocation (i.e., noise blasts; Krämer, Büttner, Roth, & Münte, 2008). The experiment was set up to allow for half the trials to be lost; although noise blasts with low volumes (i.e., low provocation) were selected by the confederate opponent during half the trials, and noise blasts with high volumes (i.e., high provocation) were selected during the other half of the trials. During successful trials, participants were instructed to select the volume of the noise blast for their opponent. A greater N2 mean amplitude was observed during high provocation trials as compared to low provocation trials, and this ERP measure was significantly and positively correlated with participants ability to withhold a more aggressive response (i.e., louder noise blasts). Thus, when an individual is faced with the decision to retaliate aggressively and is able to withhold this behavior, a greater N2 amplitude is expected (for a review, see Chen & Chen, 2013).

ERPs and Social Rejection

A commonly used method to simulate social rejection is by means of a virtual ball-tossing game called Cyberball, which consists of inclusion trials (in which the ball is tossed to the participant) and exclusion trials (in which the ball is tossed to another player; Williams & Jarvis, 2006). The Cyberball paradigm has been used in studies evaluating the relationship between social rejection and mental health outcomes such as depression (e.g., Kumar, Waiter, Dubois, Milders, Reid, & Steele, 2017; Zhang et al., 2017) and aggression (e.g., Rajchert, Konopka, & Huesmann, 2017; Van Beest, Carter-Sowell, van Dijk, & Williams, 2012). Previous meta-analyses suggest that Cyberball is an externally valid measure of social rejection, as this paradigm directly threatens the basic need for social belonging (Hartgerink, Van Beest, Wicherts, & Williams, 2015; Gerber & Wheeler, 2009). This paradigm has also been used in numerous EEG studies where ERPs associated with attentional and inhibitory control are evoked and compared across inclusion and exclusion trials. (e.g., Cyberball; see review by Wang, Braun, & Enck, 2017). For instance, significantly greater P3 mean amplitudes were found for exclusion trials relative to inclusion trials during Cyberball in a sample of college students (Gutz Küpper, Renneberg, & Niedeggen, 2011). This ERP was also found to be positively correlated with perceived ostracism, suggesting that its amplitude is related to the perceived intensity of social rejection. In contrast, overinclusion may have the opposite effect (Niedeggen, Sarauli, Cacciola, & Weschke, 2014). Niedeggen and colleagues (2014) used a modified version of the Cyberball paradigm consisting of an inclusion condition (participants received 33% of ball throws) and an overinclusion condition (participants received 46% of ball throws). The results of this study found a significantly

reduced P3 mean amplitude during the overinclusion condition as compared to the inclusion condition, which may be attributed to increased satisfaction related to social belonging (Williams, Cheung, & Choi, 2000). It is also possible participants were directing less attention to overinclusion trials because they anticipated receiving the ball more frequently. Past studies have also examined the N2 in the context of the Cyberball paradigm. For example, Themanson and colleagues (2012) found a significantly larger mean N2 amplitude during exclusion trials as compared to inclusion trials during the Cyberball paradigm in a sample of college students. It was suggested that this larger N2 during social rejection events may be indicative of enhanced self-regulation in response to the pain felt when excluded and signals activation of the neural alarm system inclusive of self-regulatory processes (Eisenberger, Lieberman, & Williams, 2003; Eisenberger, Way, Taylor, Welch, & Lieberman, 2007). Another study used a modified version of the Cyberball paradigm where college students were randomized to a condition either consisting of all inclusion trials or all exclusion trials (Otten & Jonas, 2012). In the condition of all exclusion trials, a chat session was initiated where the other players referred to the participant as incompetent. During a Go/Nogo task, participants who experienced rejection elicited significantly larger N2 mean amplitudes during NoGo trials relative to those participants who experienced inclusion when playing Cyberball. Although prior studies have investigated the influence of social rejection on the N2 and P3, it is unclear how these results may present themselves in adults with varying levels of narcissistic traits.

ERPs and Narcissism

There are a handful of studies that have evaluated how individual differences in narcissistic traits may correspond to differing P3 responses elicited by emotionally-valenced stimuli or events. For instance, Yang and colleagues (2018) evaluated social decision-making in adults with high versus low levels of communal narcissism, a trait characterized by the tendency to engage in self-enhancement strategies through interpersonal means (e.g., cooperation, warmth) rather than agentic means (e.g., competence, ambition; Gebauer, Sedikides, Verplanken, & Maio, 2012). Considering adults with high levels of communal narcissism perceive themselves to be exemplars of fairness (Gebauer & Sedikides, 2018), it was predicted that participants with high levels of this trait (relative to low levels) would show significantly larger P3 mean amplitudes in response to inequitable offers as compared to equitable offers during a social decision-making game. Participants played this game in two phases across multiple trials, allowing them to both propose and respond to (i.e., accept or reject) offers on how to split points among other players. The results of this study supported their hypothesis in that participants with high levels of communal narcissism had significantly larger P3 mean amplitudes when receiving inequitable offers as opposed to equitable offers whereas no significant differences were found for P3 mean amplitudes across conditions (equitable vs. inequitable offers) for participants with low levels of communal narcissism. This mismatch between receiving inequitable offers and preconceived notions of fairness among participants high in communal narcissism may explain the differences in P3 mean amplitudes across conditions for this group. In a study evaluating emotional arousal in a sample of college students with high versus low levels of narcissistic traits, narcissism

was operationalized by specific subscales on the NPI (i.e., Leadership/Authority, Grandiose Exhibitionism, and Entitlement/Exploitativeness) (Nash, Johansson, & Yogeeswaran, 2019). After inducing social rejection by using a Cyberball task without inclusion trials, participants were randomly assigned to one of three conditions: receiving positive feedback (i.e., "likes") on a photo of themselves posted to social media; receiving no feedback on the posted photo; or viewing an emotionally neutral image. Those participants with high levels of Leadership/Authority narcissistic traits who received positive feedback had a significantly smaller P3 mean amplitude relative to those who did not receive any feedback or viewed an emotionally neutral image, suggesting that this positive feedback was consistent with their favorable self-views. Those with low levels of Leadership/Authority narcissistic traits who received positive feedback, on the other hand, had a significantly larger P3 mean amplitude relative to those who viewed an emotionally neutral image. No differences in P3 mean amplitudes were found across conditions for those participants with high and low levels of Grandiose Exhibitionism and Entitlement/Exploitativeness. Based on these results, it was concluded that those participants high in Leadership/Authority narcissism (who value social dominance) are likely able to regulate feelings of distress following rejection when provided with positive feedback that aligns with their self-views. In a study comparing adults diagnosed with narcissistic personality disorder (NPD) to healthy controls, Zhang and colleagues (2016) examined P3 latencies and peak amplitudes in response to facial expressions depicting various emotions (i.e., angry, happy, sad, neutral). The results of this study found no significant differences in these ERP measures elicited by these facial expressions between adults with NPD and healthy controls. Perhaps those participants

with NPD do not allocate their attentional resources to positive or negative facial expressions unless it affects them directly and may be related to their absence of empathy (Marissen, Deen, & Franken, 2012). In sum, previous ERP studies suggest that the P3 response does vary depending on individual differences in narcissistic traits. For those with high levels of narcissism, discrepancies between their preconceived notions or views about themselves and the information or feedback they receive produces an augmented P3 response, whereas an alignment between their internal beliefs and external sources of information produces an attenuated P3 response.

Current Study

There is ample evidence to suggest that when adults with high levels of narcissistic traits are socially rejected or provoked, they are likely to respond aggressively; however, it is unclear if their brain processes rejection and makes decisions after provocation differently than adults with low levels of narcissistic traits. Thus, the primary goal of this study was to examine two ERP measures (i.e., P3 and N2) sensitive to emotionally-valenced events in the context of an anger-provoking version of the Cyberball task and to compare these ERP measures across trials (i.e., inclusion vs. rejection, inclusion vs. provocation) in college students high and low in narcissistic traits. For the purposes of the present study, the Cyberball paradigm was modified to include a provocation block in which players hurl the ball at the participant, resulting in a loss of points as a means to provoke them. In prior ERP studies, larger P3 mean amplitudes have been observed in response to emotionally-valenced stimuli or events (e.g., inclusion versus exclusion, positive facial expressions versus neutral facial expressions; Hajcak & Olvet, 2008; Kawamoto et al., 2013). Further, a larger P3 mean amplitude is observed when there is a

mismatch between the internal beliefs held by adults high in narcissism and external sources of information (Nash et al., 2019; Yang et al., 2018). Therefore, it was predicted that college students with high levels of narcissism relative to low levels of narcissism would have significantly larger P3 mean amplitudes during exclusion trials as compared to inclusion trials (hypothesis 1). Prior work has also found significantly larger N2 mean amplitudes following provocation or rejection when participants are able to withhold retaliatory aggression or inhibit a response (Krämer et al., 2008; Themanson et al., 2012). However, reduced N2 mean amplitudes are expected when inhibition is difficult to achieve, which is particularly true for adults high in narcissism when they feel their ego has been threatened (Brown & Zeigler-Hill, 2004). As such, it was predicted that significantly smaller N2 mean amplitudes would be evoked in college students high in narcissism during provocation trials as compared to inclusion trials (hypothesis 2). Considering our ERP measures are expected to reflect the allocation of attentional resources to emotionally-valenced events and inhibitory control and high levels of narcissism corresponds to greater emotionality and impulsivity when feedback does not align with grandiose self-views, it was hypothesized that narcissistic traits would moderate the relationship between N2 mean amplitudes and retaliatory aggression (hypothesis 3). Finally, given the well-established link found between narcissism and aggression in prior studies (e.g., Cascio et al., 2015; Twenge & Campbell, 2003), it was hypothesized that self-reported narcissistic traits (i.e., total score on NPI) would significantly and positively predict retaliatory aggression (hypothesis 4). Understanding when emotionally-valenced events are processed and when decisions are made following rejection and provocation across varying levels of narcissism may help elucidate how to

objectively measure change associated with treatments aimed at reducing aggression among adults with narcissistic traits.

CHAPTER II – METHODS

Participants

Based on similar studies employing Cyberball tasks to evoke ERPs (e.g., Crowley et al., 2009; Crowley, Wu, Molfese, & Mayes, 2010; Gutz et al., 2011), a sample size of 40 participants was deemed sufficient to detect moderate sized effects. Given that some participants' data were likely going to be excluded due to EEG artifacts, and to obtain greater variability in narcissistic traits, we aimed to collect data from at least 20 additional participants, resulting in a target sample size of 60 participants. When data collection efforts came to an end, a total of 59 participants completed the study. Three participants' data were not analyzed due to poor quality data associated with hair texture interfering with electrode placement, which left a total of 56 participants. While it is recommended to obtain at a minimum 20 and 14 trials to acquire an internally consistent estimate of N2 and P3 respectively (Rietdijk, Franken, & Thurik, 2014), relying only on participant data with at least 20 trials would significantly reduce the sample size for analyses. As such, participants' data were excluded from analyses if there were less than 15 trials from any type of trial remaining to retain the largest sample size possible. Thirteen participants were excluded for this reason, resulting in a final sample size of 43 participants. Excluded participants were not significantly different from the original sample for any independent variables or covariates (e.g., sex, symptoms of anxiety or depression, NPI total score). Participants were English-speaking college students (N = 43) with a mean age of 19.72 years (SD = 2.68; range = 18-34). Of the participants comprising this sample, 41.9% classified themselves as freshmen; 30.2% as sophomores; 23.3% as juniors; and 4.7% as seniors. The majority of participants were undergraduate

psychology students, though other majors (e.g., nursing, criminal justice, education, social work) were also represented in the sample. Regarding biological sex, 44.2% percent of participants classified themselves as female and 55.8% of participants classified themselves as male. In terms of race, 76.7% identified as White, 16.3% identified as Black, 4.7% identified as Asian, and 2.3% identified as another race. Regarding ethnicity, 14% of the participants comprising this sample identified as Hispanic. These demographics are fairly consistent with the larger population of students attending the university at which this study took place (63.1% female; 61.1% White, 28.6% Black, 3% Hispanic/Latino, 1.3% Asian), though our sample had slightly more White and male participants. Participants denied having any major medical conditions or chronic illnesses that would impact neural signals (e.g., epilepsy, head injury with loss of consciousness), and they were pre-screened to verify that they did not take psychiatric medications (Boutros, 2013). They were administered the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II) to obtain an estimate of IQ and participants were found to be of average intellectual functioning (Mean FSIQ-2 = 111.25; SD = 10.52).

Procedures

The present research was an add-on study to an already ongoing large-scale study examining neural correlates of rumination and its predication of aggression. Participants were recruited through an online research participation system (SONA) maintained by the School of Psychology at the University where this study was conducted. Participants recruited via SONA received 8 research credits to apply to their courses for extra credit. Additionally, some participants from the larger undergraduate student population were recruited via email and flyers; these students were compensated with $30 Amazon gift

cards for their participation. Although college students are typically considered to be a sample of convenience, most of this research has been done with college students which allows for comparisons to be made between our findings and prior work. To minimize participants' time spent in the lab, some questionnaires (e.g., NPI) were administered online prior to participants coming into the lab and after signing an online consent form. The remaining study procedures were done in the lab after signing a long consent form. The in-lab study visit began with the administration of a test of intellectual functioning (WASI-II). Participants were randomly assigned to a rumination or distraction condition. They were fitted to an EEG net and electrode impedances were checked prior to beginning three experimental paradigms (i.e., Cyberball Block 1, Eyes Open/Eyes Closed, Cyberball Block 2).

At the start of the social rejection block of Cyberball (Block 1), participants were informed that they would be playing an online game with two other players. To encourage participants' investment in the game, participants were told that the player receiving the most points would receive a $20 Visa gift card. Additionally, they were prompted to choose their favorite baseball glove from an array of 6 images, and an image of their selected glove was placed at the bottom center area of the screen. The other players were portrayed as images of college students matched to each participant's identified sex and ethnicity, and these images along with their respective gloves were placed at the top left and top right areas of the screen. Once participants selected their favorite glove, they proceeded to a Google™ page containing a link to the Cyberball game, which generated a false loading screen once clicked. Before the game began, a pre-recorded male voice explained the instructions of the game, which was also shown in

writing on the screen. The social rejection block of Cyberball (Block 1) was then administered.

At the beginning of the Eyes Open/Eyes Closed (EOEC) task, participants were instructed to either engage in rumination (e.g., thinking about how they were treated by others during the game) or distraction (e.g., thinking about their morning routine) depending on their randomization assignment. They alternated between opening and closing their eyes four times for two-minute intervals while they ruminated about the game or distracted themselves from their feelings. A manipulation check was completed following the EOEC task to determine whether participants followed instructions by actively engaging in rumination or distraction. Afterward, the anger-provoking block of Cyberball (Block 2) was administered. The two blocks of Cyberball each took approximately 14 minutes to complete. Following the completion of all experimental tasks, participants completed additional study measures (e.g., Need Threat Scale) and were debriefed concerning the use of deception and the true nature of the study.

Quality Assurance Checks

Quality assurance checks were conducted to ensure participants were paying attention to questions and did not provide patterned or inauthentic responses. Four attention checks (e.g., Please select 1 – Almost Never) were embedded in the questionnaires administered online (i.e., NPI, demographics questionnaire), and following the completion of all questionnaires, participants were asked whether they answered all questions truthfully and to the best of their ability. Prior to data analyses, it was determined that any participant who did not pass more than one attention check (i.e., less than 75% passed) or reported that they did not respond truthfully and to the best of

their ability would be removed from our analyses. All participants passed at least 75% of the attention checks, and no participants endorsed answering questions in a careless manner. Additionally, there did not appear to be any clear patterns of responding on behalf of participants. As such, no participants were removed from analyses due to concerns about the content of their responses on study questionnaires.

Measures

Narcissistic Personality Inventory. The Narcissistic Personality Inventory – 40 (NPI-40; Raskin & Terry, 1988) is a 40-item self-report measure derived from the original 54-item measure (Raskin & Hall, 1979) that assesses subclinical levels of narcissistic traits (See Appendix A). The NPI-40 is comprised of seven first-order subscales: authority (e.g., I am a born leader), exhibitionism (e.g., I really like to be the center of attention), superiority (e.g., I know that I am good because everybody keeps telling me so), vanity (e.g., I like to look at myself in the mirror), exploitativeness (e.g., I can make anybody believe anything I want them to), entitlement (e.g., I will never be satisfied until I get all that I deserve), and self-sufficiency (e.g., I rarely depend on anyone else to get things done). The scores from these subscales are summed to yield a total score for narcissism. The NPI has demonstrated good internal consistency for the total score (α's range = .80-.83) and adequate internal consistency for the authority subscale (α's range = .72-.73); however, it has demonstrated questionable to unacceptable internal consistency for other subscales (α's range = .30-.68; del Rosario & White, 2005). It has been suggested that low internal consistency coefficients for some of the NPI subscales may be explained by having too few items per scale, which has limited the utility of the NPI primarily to the total score and the authority subscale score (Raskin &

Terry, 1988). Results of Cronbach's alpha for this sample revealed good internal consistency for items comprising the total NPI score (α=.845).

Interestingly, scores among samples of college students have been steadily increasing over time, as there has been a .33 standard deviation increase in scores between the 1982 (M = 15.06) and 2006 (M = 17.29; Twenge, Konrath, Foster, Campbell, & Bushman, 2008). In contrast, some studies using the NPI on undergraduate samples have yielded dissimilar results (M = 14.66, del Rosario & White, 2005), and there has been recent debate regarding a true increase in narcissistic traits (e.g., Wetzel, Brown, Hill, Chung, Robins, & Roberts, 2017). Therefore, mean scores from our study were compared to means of more recent studies using college student samples. On average, participants' total NPI scores were slightly lower than those reported in previous studies (M = 11.71, SD = 6.48, Median = 11, Range = 1-27). To determine high and low levels of narcissistic traits, scores above the median (12 and higher) were classified as "high," while scores at and below the median (11 and lower) were classified as "low."

Most studies using the NPI have relied on the total score rather than subscale scores to operationalize narcissism (e.g., Bushman et al., 2009; Twenge & Campbell, 2003; Vaillancourt, 2013). Although some subscales have been considered adaptive (e.g., self-sufficiency, authority), other subscales such as entitlement, exploitativeness, and exhibitionism have been deemed maladaptive (Ackerman et al., 2011). Considering that maladaptive narcissistic traits have consistently been found to predict aggression (e.g., Fossati, Borroni, Eisenberg, & Maffei, 2010; Reidy, Zeichner, Foster, & Martinez, 2007), exploration of the maladaptive subscales (i.e., grandiose exhibitionism and entitlement/exploitativeness; see Table 1 for items comprising these subscales) in

addition to the total score was considered. Split-half reliability estimates revealed extremely poor internal consistency for self-sufficiency (r=.34; total items = 5) and exploitativeness (r=.30; total items = 5) subscales; as such, items comprising these subscales were removed from the measure. Following removal of these items, results revealed good internal consistency for the total score (r=.87) and acceptable internal consistency for the grandiose exhibitionism subscale (r=.76; total items = 10) but unacceptable internal constancy for the entitlement/exploitativeness subscale (r=.22; total items = 4). Therefore, the total score and grandiose exhibitionism subscale of the NPI were used for the purposes of this study.

Table 1 *NPI Grandiose Exhibitionism Subscale Items*

Grandiose Exhibitionism	Entitlement/Exploitativeness
4. I know that I am good because everybody keeps telling me so.	*13. I find it very easy to manipulate people.*
7. I like to be the center of attention.	*14. I insist upon getting the respect that is due to me.*
15. I like to show off my body.	*24. I expect a great deal from other people.*
19. I like to look at my body.	*25. I will never be satisfied until I get all that I deserve.*
20. I will usually show off if I get the chance.	
26. I like to be complimented.	
28. I like to start new fads and fashions.	
29. I like to look at myself in the mirror.	
30. I really like to be the center of attention.	
38. I get upset when people don't notice how I look when I go out in public.	

Note. NPI = Narcissistic Personality Inventory; Numbers correspond to item numbers on NPI-40.

Depression, Anxiety, and Stress Scales. The Depression, Anxiety, and Stress Scales – 21 (DASS-21; See Appendix B) are a 21-item self-report measure comprised of 3 subscales that assess features of depression (e.g., *I couldn't seem to experience any positive feeling at all; I felt down-hearted and blue*), anxiety (e.g., *I felt I was close to panic; I experienced trembling*), and stress (e.g., *I tended to over-react to situations; I found it hard to wind down*). Each item is rated on a 4-point scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much or most of the time*) based on how much each statement has applied to the rater over the past week. These scores are summed to yield total scores for each subscale, ranging in severity from Normal to Extremely Severe. The DASS-21 has demonstrated good convergent validity when correlated with the Beck Depression Inventory and Beck Anxiety Inventory as well as moderate to high internal consistencies for its subscales (α's range = .82 to .93; Osman et al., 2012). Results of Cronbach's alpha for this sample revealed good internal consistency for items comprising the anxiety scale (α=.80) and the depression (α=.88) scale of the DASS-21.

Because symptoms of anxiety and depression have been found to impact P3 amplitudes (Cavanagh & Geisler, 2006; Sehlmeyer et al., 2010), the anxiety and depression subscales were examined as covariates in our primary analyses. On average, participants endorsed mild levels of depression (Mean = 12.32, SD = 4.29), with scores ranging from normal to severe (Range = 8-21), and moderate levels of anxiety (Mean = 10.30, SD = 3.08), with scores ranging from normal to severe (Range = 7-17).

Need Threat Scale. The Need Threat Scale (NTS) is a 20-item self-report measure used to assess distress following social rejection (van Beest & Williams, 2006; See Appendix C). This measure is comprised of 5 subscales based on Williams' (2009)

needs-threat model: belonging (e.g., *I felt I belonged to the group; I felt the other players interacted with me a lot*), self-esteem (e.g., *I felt good about myself; My self-esteem was high*), control (e.g., *I felt I had control over the course of the game; I felt I had the ability to significantly alter events*), victimization (e.g., *I felt the other players were just playing the game and not out to get me*), and meaningful existence (e.g., *I felt meaningless; I felt invisible*). Each item is rated on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Higher scores indicate greater levels of satisfaction for each fundamental need. The NTS has demonstrated acceptable internal consistency for the total score (Cronbach's $\alpha = .78$; Jamieson, Harkins, & Williams, 2010), in addition to good internal consistency for belonging (Cronbach's $\alpha = .85$), self-esteem (Cronbach's $\alpha = .85$), and meaningful existence (Cronbach's $\alpha = .83$) subscales but relatively weak internal consistency for the control subscale (Cronbach's $\alpha = .52$) (Tobin, Vanman, Verreynne, & Saeri, 2015). Social rejection has been shown to have a reliable effect on the NTS, as those who are rejected tend to yield lower scores suggestive of less satisfaction (Hartgerink et al., 2015; Jamieson et al., 2010; Mazinani, Shakiba, Pourshahbaz, & Vahedi, 2021). Results of Cronbach's alpha for this sample revealed good internal consistency for items comprising the NTS total score ($\alpha = .89$).

Anger-Provoking Cyberball Paradigm. The modified version of Cyberball used in the present study has been found to successfully induce social rejection and anger, thus enhancing the likelihood of aggression (Brennan et al., 2018; Hartgerink et al., 2015). Two blocks of trials comprise this paradigm: a social rejection block and an anger-provoking block. The social rejection block has both an inclusion phase (108 trials) and exclusion phase (47 trials) consisting of a total of 155 trials. During the inclusion phase,

participants earn points for catching the ball whereas during the exclusion phase, participants are not thrown the ball, so they do not earn points and never win the game to earn the $20 Visa gift card. The anger-provoking block begins with 10 inclusion trials and then half of the remaining 145 trials are provocation trials where the ball is hurled at the participants resulting in a loss of points. Participants are also given the opportunity to hurl the ball at the other players, which is our measure of retaliatory aggression. Modifications to this Cyberball paradigm were also made to align with ERP experimental design considerations. Namely, participants' eye movements were decreased by the tossed ball staying in the participant's glove for 1,000ms, then being shown for 500ms by the player's glove prior to the direction of the throw being displayed. The color of the ball reveals the direction and intent of the throw where a white ball signals inclusion, yellow ball signals exclusion, and red ball signals provocation. The presentation of stimuli and recordings of participant responses were performed by Eprime software (Psychology Software Tools, Inc.).

Manipulation Checks. Following the EOEC task, participants were asked "On a scale from 1 to 4, how often did you think about your morning routine (or "other things during the Cyberball game" for those in the rumination condition)?" and "On a scale from 1 to 4, how often did you think about how you were treated during the Cyberball game?" to determine whether participants followed instructions by actively engaging in rumination or distraction. Participants were provided the following Likert-scale response options: 1 = not at all, 2 = a little, 3 = quite a bit, and 4 = all the time. Overall, 82% of participants (N = 19) in the distraction condition thought about their morning routine whereas 4% of participants (N = 1) thought about their treatment during the Cyberball game as indicated

by their response of a “3” or a “4” to these two prompts. In contrast, 57% of participants (N = 11) in the rumination condition thought about their treatment during the Cyberball game while 52% of participants (N = 10) reported thinking about things other than how they were treated during the game. Importantly, only 5.3% of participants reported not ruminating at all in this condition. As such, while most participants in the rumination condition thought about how they were treated during the game at least some of the time, they appeared to be similarly distracted by other things during this portion of the study.

Similar to past studies using the NTS (e.g., Davidson et al., 2019), the mean item rating across all 20 items comprising the NTS was used as our measure of distress following social rejection and was used to determine if our Cyberball paradigm worked as expected. Participants’ total mean scores on the NTS (M = 2.74, SD = 0.62) were comparable to prior work examining the impact of social rejection on need satisfaction (e.g., Jamieson et al., 2010; M = 2.35, SD = 0.37), suggesting that our Cyberball paradigm successfully induced distress following social rejection.

Demographics. Basic demographic information (e.g., age, sex, race, ethnicity) were obtained by means of a demographic questionnaire (See Appendix D). Considering there are noted sex differences in emerging adults with narcissistic traits (Foster, Campbell, & Twenge, 2003), sex was examined as a covariate in our primary analyses.

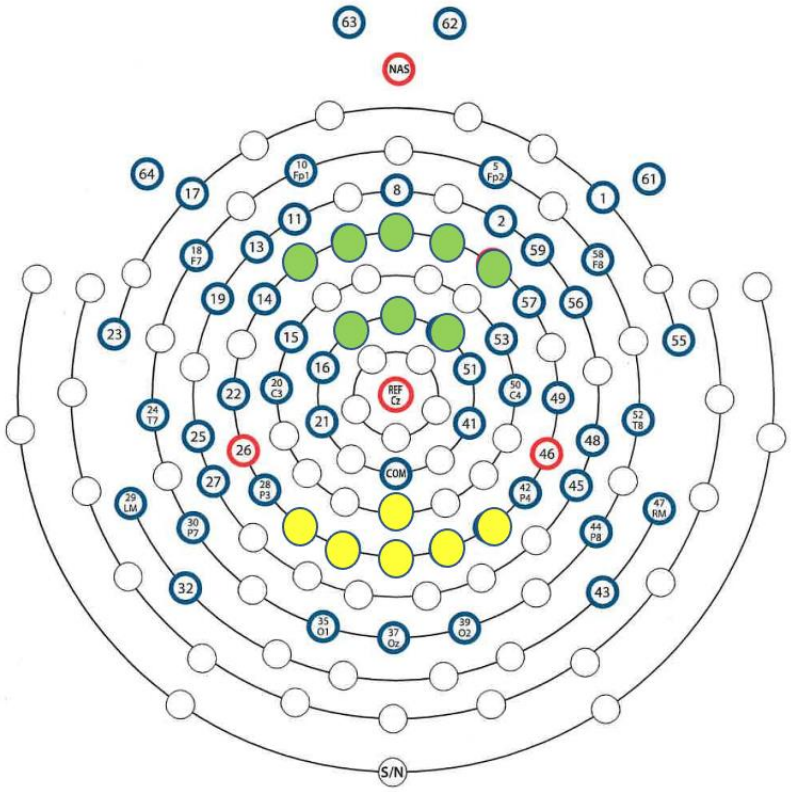
EEG Recording and Pre-processing. EEG data (i.e., electrical recordings of brain activity) were recorded via a high-density array of 64 electrodes located in a net (Geodesic Sensor Net, EGI Inc.) while participants completed an anger-provoking version of Cyberball (Williams & Jarvis, 2006). EEG channels were recorded using the NetStation 5.2.0.2 software package (EGI, Inc.) with a sampling rate of 1,000S/s through

high impedance amplifiers (0.01 Hz high-pass, 100 Hz low-pass). Impedances remained at or below 40KΩ, and all electrodes were referenced to Cz during recording. EEG data were pre-processed and prepared for statistical analyses using EEGLAB (an open-source MATLAB toolbox; Brunner, Delorme, & Makeig, 2013), where it was re-referenced to an average reference of all electrodes and filtered with a 0.5Hz high-pass filter. Next, sinusoidal noise (line noise of 60Hz) was addressed using the CleanLine plugin (Mullen, 2012). Poor segments (extreme fluctuations in voltage, greater than 200 μV) were identified and addressed using automated artifact rejection including the artifact subspace reconstruction (ASR; Chang, Hsu, Pion-Tonachini, & Jung, 2018) algorithm using a correlation threshold of 0.70 and a cutoff parameter of 30 to remove eye and muscle artifacts without removing excess brain activity (Chang, Hsu, Pion-Tonachini, & Jung, 2019). Next, data were re-referenced to an average reference of all electrodes, and removed channels were interpolated. The ICLabel plugin detected muscle artifacts, eye blinks, and lateral eye movements (exceeding 90% of channel variance), and these eye blinks and eye movements were corrected using independent component analysis (ICA; Mennes, Wouters, Vanrumste, Lagae, & Stiers, 2010) with the *picard* function. Finally, data were segmented to epochs of 100ms before and 900ms after stimulus onset.

The P3 was extracted from a cluster of electrodes situated in the temporal parietal area of the head between 200-500ms after stimulus onset for inclusion and exclusion trials (PZ (34), 31, 33, 36, 38, and 40), and N2 was extracted from a cluster of electrodes situated in the frontal area of the head between 150-350ms after stimulus onset for inclusion and provocation trials (FZ (6), 3, 4, 7, 9, 12, 54, and 60). See Figure 1 for a

representation of selected electrodes. ERPs were averaged separately for all trials within each trial type (i.e., inclusion, exclusion, provocation).

Figure 1. Selected Electrodes for P3 and N2.



Note. P3 channels are marked in yellow, and N2 channels are marked in green.

CHAPTER III - RESULTS

Preliminary Analyses

Descriptive analyses and relevant tests (e.g., Durbin-Watson, Cook's distance, Levene's test, Kolmogorov-Smirnov) were performed to ensure that no assumptions of the planned statistical tests were violated (e.g., General linear models: independence of each data point, homogeneity of variance, normality of residuals, influence of individual observations; Poisson regression analyses: dependent variables as count data, count data must be positive integers, independence of observations) and that all variables were within range of the expected values. Data were also screened for skewness, kurtosis, and outliers to identify extreme data points. The DASS-21 Anxiety and Depression subscale scores were positively skewed (skewness statistic = 1.07 for Depression and 1.53 for Anxiety) and kurtotic (kurtosis statistic = 1.72 for Anxiety). Five outliers were identified, and these values were replaced through winsorization (replacing the top 5% and bottom 5% data points with the nearest maximum or minimum values that are not considered outliers), which aided in resolving the skewness and kurtosis of these covariates.

Intercorrelations Between Predictor Variables and Covariates

Bivariate correlations were run to evaluate whether predictor and outcome variables were related to each other as expected and which variables should be retained as covariates. There was a significant and negative correlation between symptoms of anxiety and P3 mean amplitudes during inclusion (r = -.347, p = .024) and exclusion trials (r = -.374, p = .015). Sex was significantly and negatively correlated with N2 mean amplitudes during provocation trials (r = -.412, p = .007). Additionally, a significant and positive correlation was found between symptoms of depression and symptoms of anxiety (r =

.652, $p < .001$). NTS scores were significantly and negatively correlated with N2 mean amplitudes during inclusion trials. As expected, the P3 mean amplitudes were significantly correlated in the expected direction, whereas the N2 mean amplitudes were not significantly correlated. Narcissism, aggression, and sex were not significantly correlated with any study variables. Given that symptoms of anxiety and sex were significantly correlated with outcome variables, these variables were included in our primary analyses as covariates. Because symptoms of depression were not significantly correlated with our outcome variables, this was not included as a covariate. Correlations between predictor variables, covariates, and dependent variables are presented in Table 2.

Table 2 *Descriptive Statistics and Correlations of Study Variables*

Variables	M(SD)	Sex	NPI Total	NPI GE	Anxiety	Depression	NTS	N2 Incl	N2 Prov	P3 Incl	P3 Excl	Agg
Sex	--		.257	.102	.112	-.046	-.181	.222	-.412**	.191	.199	-.012
NPI Total	11.71(6.48)			.819**	-.110	-.262	.112	-.096	-.172	-.057	-.052	.068
NPI GE	2.25(2.38)				-.069	-.218	.063	-.133	-.017	-.108	-.126	.240
Anxiety	10.44(3.59)					.652**	-.044	.121	-.070	-.347*	-.374*	.163
Depression	12.46(4.79)						-.114	.077	.110	-.185	-.170	.123
NTS	2.74(0.62)							-.339*	-.113	-.049	-.049	.031
N2 Incl	0.38(2.70)								-.286	.065	.062	.078
N2 Prov	0.69(4.11)									.044	.054	-.208
P3 Incl	1.21(1.69)										.986**	-.208
P3 Excl	1.16(1.69)											-.177
Agg	44.58(11.74)											

Note. NPI Total = Narcissistic Personality Inventory total score; NPI GE = Narcissistic Personality Inventory grandiose exhibitionism subscale; Anxiety = Anxiety subscale of DASS-21; Depression = Depression subscale of DASS-21; NTS = Need Threat Scale Total Score; N2 Incl = N2 mean amplitude during inclusion trials; N2 Prov = N2 mean amplitude during provocation trials; P3 Incl = P3 mean amplitude during inclusion trials; P3 Excl = P3 mean amplitude during exclusion trials; Agg = Count data for instances of aggression

* $p < .05$, ** $p < .001$.

Data Analytic Strategy for Primary Analyses

Two repeated measures general linear models (GLMs) were conducted to test hypotheses 1 and 2 that P3 (during inclusion vs. exclusion trials) and N2 (during inclusion vs. provocation trials) mean amplitudes are significantly different at varying levels of narcissistic traits (i.e., NPI total score) and across two conditions (i.e., distraction vs. rumination). ERPs (P3 & N2) were subsumed within trial type and were entered as a within-subjects factor (inclusion vs. exclusion trials; inclusion vs. provocation trials) and NPI total score (mean-centered and standardized) and condition (only for analyses examining N2 mean amplitudes; rumination vs. distraction) were entered as between-subjects factors, and symptoms of anxiety (for P3) and sex (for N2) were entered as covariates. If the hypothesized 2-way or 3-way interaction terms (i.e., NPI x trial type and NPI x trial type x condition) were significant, tests of simple main effects were planned as a follow-up.

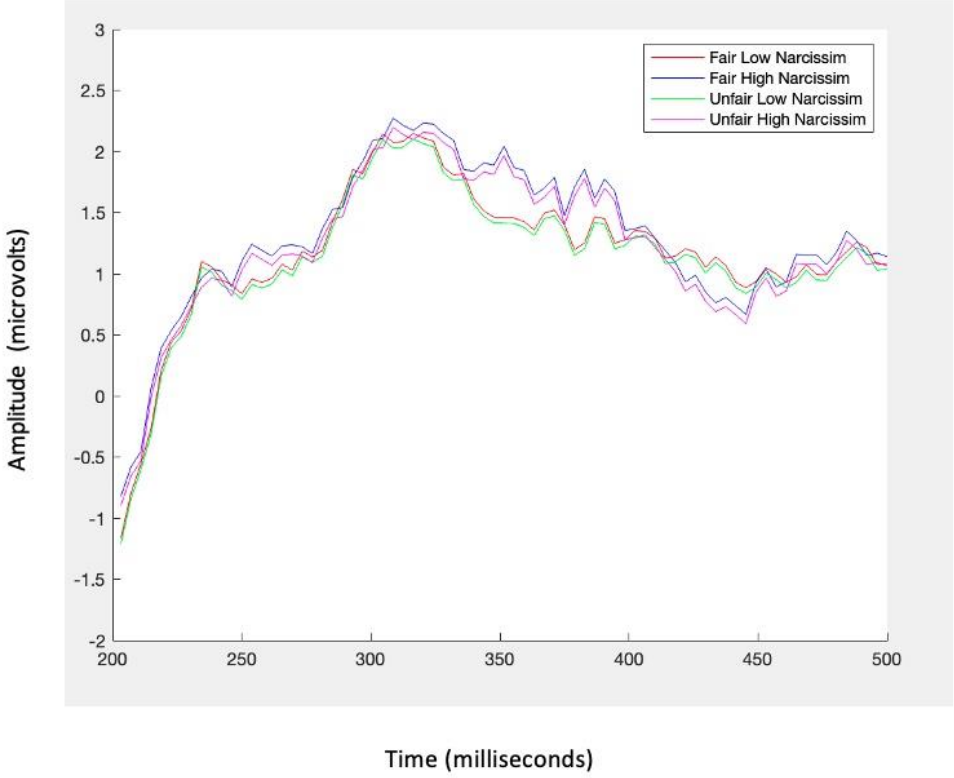
Given that the outcome variable (i.e., aggression) entered into the models testing hypotheses 3 and 4 was overdispersed count data and traditional linear regression models require that the residual errors follow a normal distribution, this method was not appropriate to test whether 1) narcissistic traits moderate the relationship between N2 mean amplitudes during provocation trials and retaliatory aggression (hypothesis 3) and 2) narcissistic traits significantly and positively predict retaliatory aggression (hypothesis 4). According to Beaujean and Morgan (2016), either a poisson regression or negative binomial regression are most appropriate for these types of data. While poisson regression analyses require the variance and mean to be similar, negative binomial regression analyses are equipped to analyze data when the variance is larger than the

mean. A one-sample Kolmogorov-Smirnov test indicated that the aggression data followed a poisson distribution, *K-S Z* = .115, *n* = 43, *p* = .182; as such, poisson regression analyses were run to test hypotheses 3 and 4. For the first poisson regression model, N2 mean amplitudes during provocation trials, narcissistic traits (NPI total score), and an interaction term comprising these two variables were entered as predictors, retaliatory aggression was entered as the outcome variable; and symptoms of anxiety were entered as a covariate. For the second poisson regression analysis, narcissistic traits (NPI total score) were entered as a predictor variable and retaliatory aggression was entered as the outcome variable.

Primary Analyses

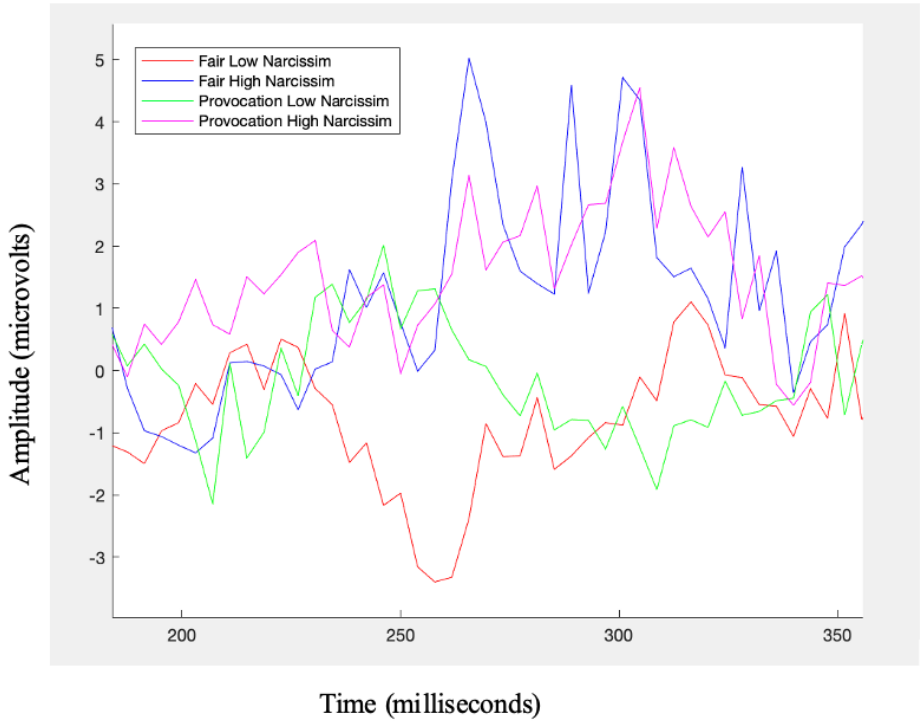
Results of the repeated measures GLM for P3 revealed that the 2-way NPI x trial type interaction was not significant, $F(1, 20) = .224$, $p = .999$, $\eta_p^2 = .175$. The main effects of trial type ($F(1, 20) = .501$, $p = .487$, $\eta_p^2 = .024$), NPI total score ($F(1, 20) = .342$, $p = .989$, $\eta_p^2 = .245$), and anxiety ($F(1, 20) = .136$, $p = .136$, $\eta_p^2 = .107$) were also not significant. See Figure 2 for plots with P3 mean amplitudes.

Figure 2. Average ERP waveform at selected electrodes for P3



Results of the repeated measures GLM for N2 revealed that the 3-way NPI x trial type x condition interaction term ($F(1, 14) = 1.720$, $p = .202$, $\eta_p^2 = .329$) and 2-way interaction terms (NPI x trial type: $F(1, 14) = 2.150$, $p = .073$, $\eta_p^2 = .754$; NPI x condition: $F(1, 14) = 1.184$, $p = .360$, $\eta_p^2 = .253$) were not significant. The main effects of trial type ($F(1, 14) = 2.924$, $p = .109$, $\eta_p^2 = .173$), condition ($F(1, 14) = 2.728$, $p = .121$, $\eta_p^2 = .163$), NPI ($F(1, 14) = 1.933$, $p = .105$, $\eta_p^2 = .734$, and sex ($F(1, 14) = .001$, $p = .982$, $\eta_p^2 < .001$) were also not significant. See Figure 3 for plots with N2 mean amplitudes. Results of GLMs are presented in Table 3.

Figure 3. Average ERP waveforms at selected electrodes for N2



Results of the poisson regression testing hypothesis 3 (i.e., narcissistic traits would moderate the relationship between N2 mean amplitudes during provocation trials and retaliatory aggression) revealed that the NPI x N2 interaction term was not significant, *B*(SE) = 7.498(.0007), p = .911, IRR = 1.000, 95% CI = -.001-.001; however, N2 mean amplitudes during provocation trials were a significant predictor of retaliatory aggression, *B*(SE) = -.015(.006), p = .021, IRR = .985, 95% CI = -.028--.002. The NPI total score (*B*(SE) = .003(.003), p = .479, IRR = 1.003, 95% CI = -.005-.010) and sex (*B*(SE) = -.071(.052), p = .178, IRR = .931, 95% CI = -.174-.032) were not significant predictors of retaliatory aggression.

To evaluate whether narcissistic traits significantly predicted retaliatory aggression (hypothesis 4), a second poisson regression analysis was conducted. To maximize sample size for this analysis, all participants from the original sample (N=59) were used, as ERP measures were not entered into the model. It should be noted that NPI total scores from the original sample (M=9.55, SD=5.81) were slightly lower on average as compared to the NPI total scores from the ERP sample (M=11.71, SD=6.48), though not significantly different (*t*(58) = 1.76, p = .08). Results of this regression model revealed that the NPI total score did not significantly predict retaliatory aggression, B(SE) = .005(.003), IRR = 1.005, 95% CI = -.001-.012, p=.119. Results of poisson regression analyses are presented in Table 4.

Table 3 *Differences in P3 and N2 Mean Amplitudes by Trial Type, Narcissism, Condition, and Anxiety*

	P3 Mean Amplitudes			N2 Mean Amplitudes		
Variables	F	*p*	η_p^2	F	*p*	η_p^2
Trial Type	.501	.487	.024	2.924	.109	.173
NPI total score	.342	.989	.245	1.933	.105	.734
Condition	--	--	--	2.728	.121	.163
NPI x Trial Type	.224	.999	.175	2.150	.073	.754
NPI x Condition	--	--	--	1.184	.360	.253
Condition x Trial Type	--	--	--	.169	.687	.012
NPI x Trial Type x Condition	--	--	--	1.720	.202	.329
Sex	--	--	--	.001	.982	< .001
Anxiety	2.408	.136	.107	--	--	--

Note. NPI = Narcissistic Personality Inventory; Condition variable only applies to N2 analyses.

Table 4 *Narcissism, N2 Mean Amplitudes, and their Interaction as Predictors of Retaliatory Aggression*

Variables	B(SE)	*p*	IRR	95% CI
NPI total score	.003(.003)	.479	1.003	-.005-.010
N2 Prov	**-.015(.006)**	**.021**	**.985**	**-.028--.002**
N2 x NPI	7.498(.0007)	.911	1.000	-.174-.032
Sex	-.071(.052)	.931	.840	-.174-.032

Note. B(SE) = Coefficient (standard error) for predicting the dependent variable from each independent variable; IRR = Incident rate ratio; 95% CI = 95% Confidence interval for each IRR; NPI = Narcissistic Personality Inventory; N2 Prov = N2 Mean Amplitudes during Provocation Trials

Exploratory Analyses

All analyses were re-run using the NPI grandiose exhibitionism (GE) subscale score instead of the NPI total score. Results of a repeated measures GLM for P3 revealed that the NPI GE x trial type interaction was not significant, $F(1, 33) = .426$, $p = .879$, $\eta_p^2 = .083$. Additionally, the main effects of grandiose exhibitionism ($F(1, 33) = .751$, $p = .631$, $\eta_p^2 = .137$) and trial type ($F(1, 33) = .292$, $p = .593$, $\eta_p^2 = .009$) were not significant; however, the main effect of anxiety ($F(1, 33) = 5.852$, $p = .021$, $\eta_p^2 = .151$) was significant. Although the high versus low anxiety contrast was not significant for either inclusion or exclusion trials, the magnitude of the P3 mean difference was more pronounced for exclusion trials where the P3 was more positive for participants with low levels of anxiety (Inclusion: M = 1.48; Exclusion: M = 1.51) relative to high levels of anxiety (Inclusion: M = .852; Exclusion: M = .714).

Results of a repeated measures GLM for N2 revealed that the 3-way (NPI GE x trial type x condition: $F(1, 24) = .547$, $p = .791$, $\eta_p^2 = .138$) and 2-way (NPI GE x trial type: $F(1, 24) = .197$, $p = .983$, $\eta_p^2 = .054$; NPI GE x condition: $F(1, 24) = 1.531$, $p = .224$, $\eta_p^2 = .300$) interaction terms were not significant.; however, there was a significant main effect for trial type ($F(1, 24) = 5.045$, $p = .034$, $\eta_p^2 = .174$), where N2 was more negative (really less positive) during inclusion trials (M = .389) relative to provocation trials (M = .697). There was also a significant 2-way interaction for trial type x sex ($F(1, 24) = 5.308$, $p = .030$, $\eta_p^2 = .181$), where N2 was more negative for females (M = -1.149) relative to males (M = 2.222) during provocation trials ($F(1, 41) = 8.195$, $p = .007$, $\eta_p^2 = .170$) but not during inclusion trials ($F(1, 41) = 2.015$, $p = .164$, $\eta_p^2 = .049$). No other main effects were significant. Results of exploratory GLMs are presented in Table 5.

Hypothesis 3 was retested to examine whether grandiose exhibitionism moderated the relationship between N2 mean amplitude for provocation trials and retaliatory aggression. Results of this model were not significant for the interaction term comprising N2 mean amplitude and grandiose exhibitionism, B(SE) = .002(.002)), IRR = 1.003, 95% CI = -.002-.006, p = .404; however, grandiose exhibitionism (B(SE) = .025(.009), IRR = 1.006, 95% CI = .006-.044, p = .010) and N2 mean amplitude for provocation trials (B(SE) = -.017(.006), IRR = .983, 95% CI = -.030--.004, p = .012) did significantly predict retaliatory aggression. No other predictor variables were found to be significant.

Finally, hypothesis 4 was retested to evaluate whether grandiose exhibitionism significantly predicted retaliatory aggression in the original sample without ERP measures included in the model. NPI grandiose exhibitionism subscale scores (M=2.25, SD=2.38) for the original sample were not significantly different from the ERP sample (M=2.63, SD=3.4; t(58) = .66, p = .50) Results of this regression model revealed that grandiose exhibitionism did not significantly predict retaliatory aggression, B(SE) = .012(.008), IRR = 1.01, 95% CI = -.004-.028, p =.141. Results of these models are presented in Table 6.

Table 5 *Differences in P3 and N2 Mean Amplitudes by Trial Type, Grandiose Exhibitionism, Condition, and Anxiety*

	P3 Mean Amplitudes			N2 Mean Amplitudes		
Variables	F	*p*	η_p^2	F	*p*	η_p^2
Trial Type	.292	.593	.009	**5.045**	**.034**	**.174**
NPI GE	.751	.631	.137	1.472	.224	.300
Condition	--	--	--	.572	.457	.023
NPI GE x Trial Type	--	--	--	.197	.983	.054
NPI GE x Condition	.426	.879	.083	1.531	.205	.309
Condition x Trial Type	--	--	--	.043	.837	.002
NPI GE x Trial Type x Condition	--	--	--	.547	.791	.138
Trial Type x Sex	--	--	--	**5.308**	**.030**	**.181**
Sex	--	--	--	3.317	.081	.121
Anxiety	**5.852**	**.021**	**.151**	--	--	--

Note. NPI GE = Grandiose Exhibitionism Subscale of Narcissistic Personality Inventory; Condition variable only applies to N2 analyses.

Table 6 *Grandiose Exhibitionism, N2 Mean Amplitudes, and their Interaction as Predictors of Retaliatory Aggression*

	Retaliatory Aggression			
Variables	B(SE)	*p*	IRR	95% CI
NPI GE	**.025(.009)**	**.010**	**1.025**	**.006-.044**
N2 Prov	**-.017(.006)**	**.012**	**.983**	**-.030--.004**
N2 X NPI GE	.002(.002)	.404	1.002	-.002-.006
Sex	-.075(.051)	.145	.928	-.175-.026

Note. B(SE) = Coefficient (standard error) for predicting the dependent variable from each independent variable; IRR = Incident rate ratio; 95% CI = 95% Confidence interval for each IRR; NPI GE = Grandiose Exhibitionism Subscale of Narcissistic Personality Inventory; N2 Prov = N2 Mean Amplitudes during Provocation Trials; N2xNPI = N2 Mean Amplitudes during Provocation Trials x Narcissistic Traits Interaction Term.

CHAPTER IV – DISCUSSION

The present study sought to examine ERP measures sensitive to emotionally-valenced events (P3 and N2) in the context of an anger-provoking version of the Cyberball task and to compare these ERP measures across trials (i.e., inclusion vs. rejection, inclusion vs. provocation) in college students high and low in narcissistic traits. This study also aimed to determine whether narcissistic traits would strengthen the relationship between N2 mean amplitudes and retaliatory aggression in college students after provocation. Although the current literature suggests that adults with elevated narcissistic traits tend to respond aggressively when socially rejected or provoked (e.g., Cascio et al., 2015; Twenge & Campbell, 2003), it is unclear whether those with high levels of narcissistic traits process rejection and make decisions after provocation differently than those with low levels of narcissistic traits. Such information may inform our ability to objectively measure treatment response targeting aggression among adults with narcissistic traits.

Although it was predicted that participants with high levels of narcissistic traits would have larger P3 amplitudes during exclusion trials relative to inclusion trials, our results did not support this hypothesis, as the trial type by narcissism (total narcissism and grandiose exhibitionism) interaction was not significant. Moreover, our study did not replicate prior findings that P3 amplitudes are significantly larger for exclusion relative to inclusion trials (e.g., Gutz et al., 2011), as there was no significant main effect for trial type. These results may be a reflection of the smaller than anticipated P3 mean amplitudes; an outcome that suggests the emotional salience of the stimuli (i.e., color of ball) was not enough to evoke a P3 at the time of its presentation (Bradley et al., 2003). Although the Cyberball paradigm did produce feelings of overall distress, participants

may have not equated the color of the ball with their inclusion or exclusion until the ball began to move towards or away from the participant or perhaps there were not enough trials to definitively capture the learned association between ball color and trial type. In fact, prior studies finding this P3 difference across trials had the ball appear next to the player prior to the ball being thrown so the outcome of the ball toss was directly tied to the appearance of the ball (Gutz et al., 2011). It is also possible that there was no longer an expectancy violation (i.e., anticipation of inclusion rather than exclusion) after participants were repeatedly excluded in later trials and exclusion became the expectation. (Dickter & Gyurovski, 2012; Weschke & Niedeggen, 2015). Therefore, when averaging across all trials, a difference in N2 mean amplitudes between inclusion and provocation trials was not detected. Furthermore, it is possible that narcissism did not have the intended differential effect on the P3 mean amplitude because our sample demonstrated relatively lower levels of narcissism (M = 11.71) as compared to other studies using samples of college students (M = 14.66-17.29; del Rosario & White, 2005; Twenge et al., 2008). The self-sufficiency and exploitativeness subscale scores were also not incorporated into the NPI total score given their poor internal consistency, so this measure was not equivalent to the NPI total score used in other studies. However, this study did examine one form of maladaptive narcissism (grandiose exhibitionism) that has been repeatedly used in the extant literature (e.g., Fossati et al., 2010; Reidy et al., 2007) and seemingly captured this construct of interest given its association with our measure of retaliatory aggression.

When grandiose exhibitionism replaced total narcissism in the model, a main effect of anxiety was revealed such that participants low in anxiety exhibited larger P3

mean amplitudes than participants high in anxiety particularly for exclusion trials. This finding is at odds with prior research, which suggests that larger P3 amplitudes are associated with emotionally-valenced stimuli given they demand more attentional resources for processing (Bradley et al., 2003). Thus, it would be expected that P3 amplitudes would be larger during exclusion trials for adults with high levels of anxiety given their attentional bias towards stimuli triggering an emotional reaction (Eldar & Bar-Haim, 2010). Perhaps participants with high levels of anxiety were more likely to anticipate social exclusion than those with low levels of anxiety, thus resulting in smaller P3 amplitudes for this group comprising our sample (Gutz, Renneberg, Roepke, & Niedeggen, 2015).

Although we anticipated a smaller N2 amplitude for provocation trials as compared to inclusions trials among participants who were randomized to the rumination condition and had high levels of narcissism, this 3-way interaction between trial type, narcissism, and condition was not found to be significant, which may be a reflection of the methodological limitations noted above (e.g., measure selection, emotional salience of stimuli, lack of expectancy violation) or that this interaction was underpowered given our modest sample size. Moreover, participant fatigue could have played a role in these results, given that these data were collected toward the end of in-person study procedures.

When grandiose exhibitionism replaced total narcissism in the model, there was a significant main effect for trial type where N2 was more negative for inclusion trials as compared to provocation trials, suggesting greater inhibitory control for participants when they were included during the Cyberball game. This aligns with prior research in which participants showed more negative N2 amplitudes during inclusion trials relative

to exclusion trials (Franz, 2020). There was also a significant interaction between trial type and sex, where the N2 mean amplitude was more negative for females relative to males during provocation trials. This suggests that females had greater inhibitory control as compared to males when provoked, which is consistent with the extant literature indicating that females are less likely to impulsively respond with aggression when provoked (Zeichner, Parrott, & Frey, 2003).

Given our findings for the model testing hypothesis 2, it was not surprising that narcissism did not strengthen the relationship between N2 mean amplitudes during provocation trials and retaliatory aggression. Specifically, narcissism did not have a differential effect on N2 mean amplitudes across trials, which would make a moderating effect of narcissism unlikely. While there was a significant main effect for trial type, N2 mean amplitudes were significantly more negative during inclusion trials relative to provocation trials, so this may explain our lack of findings for the moderation model examining N2 mean amplitudes during provocation trials.

For both regression models including total narcissism and grandiose exhibitionism as predictors, N2 mean amplitudes during provocation trials (which were less negative relative to inclusion trials) significantly predicted retaliatory aggression. This finding suggests that less inhibitory control during provocation trials resulted in greater retaliatory aggression, regardless of the type or degree of narcissistic traits. While total narcissism did not significantly predict retaliatory aggression, grandiose exhibitionism was a significant predictor of this outcome. Considering narcissism is comprised of traits that are both adaptive and maladaptive (Ackerman et al., 2011), it is reasonable to assume that outcomes such as aggression may be more likely to occur when

examining more interpersonally harmful dimensions of this construct rather than narcissistic traits more broadly. Given that scores from the entitlement/exploitativeness subscale were not included in the total narcissism score due to poor internal consistencies, it is more likely that results would be the same for both measures if this dimension of narcissism was represented in the total score because of its strong and well-established association with aggression (Reidy et al., 2008).

Limitations, Clinical Implications, and Future Directions

This is the first known study to examine P3 and N2 amplitudes in college students with varying levels of narcissistic traits within the context of an anger provoking Cyberball paradigm. Moreover, the potential moderating role of narcissistic traits in the relationship between N2 mean amplitudes and retaliatory aggression was investigated for the first time in the present study. Importantly, the present study used electrophysiological measures (i.e., ERPs) to examine what happens at the neurophysiological level during social rejection and provocation rather than only focusing on the end behavioral response of retaliatory aggression.

Despite these strengths, this study has several limitations. First, many participants could not be retained in the sample after pre-processing due to insufficient trials; as such, while the sample size was adequate, it may not have been large enough to detect significant effects (especially 3-way interaction effects). Future studies may consider increasing the sample size or including more trials of each trial type to improve statistical power (Meisler, Kahana, & Ezzyat, 2019), or making use of additional protocols to diminish artifacts (e.g., performing experiment in an electromagnetically isolated room such as a Faraday cage, shortening recording sessions, minimizing cable length

connecting electrodes to the amplifier, reducing cable movement). Second, approximately half of the participants assigned to the rumination condition thought about things other than how they were treated during the Cyberball game, which decreases our confidence as to whether our manipulation worked as intended. Third, two subscale scores (self-sufficiency and exploitativeness) did not comprise the NPI total score because of their extremely poor internal consistencies. Perhaps the reliability of this measure would be improved if collected in-person at the time of the other measures rather than administered online; however, while the NPI is the most commonly used measure to assess for narcissistic traits, it has been criticized due to concerns regarding its factor structure, poor reliability of certain subscales (e.g., exhibitionism, entitlement, exploitativeness; see Ackerman, Corretti, & Carson, 2018), and inability to assess for vulnerable narcissism (Ackerman et al., 2011; Cain et al., 2008). Forced-choice response sets, such as those used in the NPI, can negatively impact a measure's psychometric properties (Ackerman, Donnellan, Roberts, & Fraley, 2016). In fact, Likert formats of the NPI have been created to address this issue, and evidence suggests that this version of the measure produces stronger reliability estimates (Miller, Gentile, Carter, Crowe, Hoffman, & Campbell, 2018). Fourth, it is possible that having the color of the ball signal the pending trial type (inclusion, exclusion, or provocation) in our Cyberball paradigm was not emotionally salient enough to evoke our ERP measures; instead, using a paradigm such as the one depicted in Gutz and colleagues' (2011) study may more effectively set the stage for participants to anticipate the direction and type of throw. Future studies may also consider the incorporation of a chat function within the Cyberball game where other

players refer to the player as incompetent to increase the emotional salience of exclusion and provocation, similar to the research conducted by Otten and Jonas (2012).

Instead of focusing on the P3 and N2, future studies should instead consider examining the slow-wave ERP, which is considered to be more stable than other ERPs, has been found to be associated with increased distress and poorer coping in response to social exclusion (Crowley et al., 2010; Sreekrishnan et al., 2014) and may be more appropriate within the context of ego threats in narcissistic adults. For instance, to determine the relationships among psychopathic traits and behavioral (i.e., aggression) and neural responses (i.e., slow-wave ERP) to social exclusion, Brennan and colleagues (2018) used the Cyberball paradigm in a sample of adolescents and young adults with varying levels of psychopathy. A similar approach to this study may be taken where slow-wave amplitudes were examined in adults with varying levels of psychopathic traits in the context of an anger-provoking Cyberball paradigm; however, instead of assessing for psychopathic traits, maladaptive narcissistic traits may be explored given their association with retaliatory aggression, as this could clarify whether differences in processing social rejection explain retaliatory aggression in narcissistic adults.

The results of the current study have some noteworthy clinical implications. For instance, given that only grandiose exhibitionism (relative to the NPI total score) significantly and positively predicted retaliatory aggression, clinicians should not evaluate for narcissistic traits more broadly but instead should assess for the presence of different dimensions of narcissism with an emphasis on maladaptive traits (e.g., grandiose exhibitionism and perhaps entitlement/exploitativeness and vulnerable narcissism based on the extant literature), as this may inform their approach to treatment.

When considering targets for treatment, these maladaptive traits may be of interest considering the extent to which they may cause functional impairment in social contexts. For example, therapists may challenge patterns of dysfunctional behavior associated with grandiosity that result in interpersonal difficulties for narcissistic adults (Kealy, Goodman, Rasmussen, Weideman, & Ogrodniczuk, 2017), aid them in recognizing emotional triggers and regulating affective states associated with information that is incongruent with favorable self-views, and guide them in perspective-taking and identifying maladaptive interpersonal schemas (Dimaggio, Montano, Popolo, & Salvatore, 2015). Regarding implications for future research, it should be noted that not all social exclusion tasks are equivalent, as they differ with respect to how explicit they are about why a participant is excluded (Prendergast & Schubert, 2020). Therefore, future studies interested in examining emotionally-valenced ERPs may want to choose paradigms where the intent of the exclusion or provocation is clear to participants.

In sum, it is important to obtain a better understanding of what occurs at the neurophysiological level in adults with narcissistic traits during social exclusion and provocation to help establish the groundwork for how such information is processed leading up to the end behavioral response (e.g., aggression). Although we were able to replicate the well-established finding from previous studies that grandiose exhibitionism is predictive of retaliatory aggression, due to potential limitations of our experimental paradigm (i.e., emotional salience of stimuli associated with trial type) and selection of ERP measures (P3 and N2), our findings did not elucidate our understanding of how adults with narcissistic traits process social exclusion and provocation at the neurophysiological level. ERPs are usually used to assess neural correlates, or

biomarkers, of maladaptive characteristics or disorders (e.g., Lutz, Kok, & Franken, 2021; Rawls et al., 2018); given the paucity of research examining ERPs in narcissistic adults in the context of the Cyberball paradigm, further research in this area may allow us to identify or predict who may have these difficulties or assess how they respond to targeted intervention. Future studies should examine different ERP measures sensitive to social exclusion (such as the slow-wave ERP) and maladaptive narcissism within the context of an anger-provoking Cyberball paradigm to determine how differences in processing social rejection at the neurophysiological level may be related to retaliatory aggression.

APPENDIX

Narcissistic Personality Inventory – 40 Items

Narcissistic Personality Inventory – 40 Items (NPI-40)

This inventory consists of a number of pairs of statements with which you may or may not identify.

Consider this example:

A. I like having authority over people

B. I don't mind following orders

Which of these two statements is closer to your own feelings about yourself? If you identify more with "liking to have authority over people" than with "not minding following orders", then you would choose option A.

You may identify with both A and B. In this case you should choose the statement which seems closer to yourself. Or, if you do not identify with either statement, select the one which is least objectionable or remote. In other words, read each pair of statements and then choose the one that is closer to your own feelings. Indicate your answer by writing the letter (A or B) in the space provided to the right of each item. Please do not skip any items.

1. A. I have a natural talent for influencing people.

   B. I am not good at influencing people. 1. _____

2. A. Modesty doesn't become me.

   B. I am essentially a modest person. 2. _____

3. A. I would do almost anything on a dare.

   B. I tend to be a fairly cautious person. 3. _____

4. A. When people compliment me I sometimes get embarrassed.

   B. I know that I am good because everybody keeps telling me so. 4. _____

5. A. The thought of ruling the world frightens the hell out of me.

   B. If I ruled the world it would be a better place. 5. _____

6. A. I can usually talk my way out of anything.

   B. I try to accept the consequences of my behavior. 6. _____

7. A. I prefer to blend in with the crowd.

B. I like to be the center of attention. 7. _____

8. A. I will be a success.

B. I am not too concerned about success. 8. _____

9. A. I am no better or worse than most people.

B. I think I am a special person. 9. _____

10. A. I am not sure if I would make a good leader.

B. I see myself as a good leader. 10. _____

11. A. I am assertive.

B. I wish I were more assertive. 11. _____

12. A. I like to have authority over other people.

B. I don't mind following orders. 12. _____

13. A. I find it easy to manipulate people.

B. I don't like it when I find myself manipulating people. 13. _____

14. A. I insist upon getting the respect that is due me.

B. I usually get the respect that I deserve. 14. _____

15. A. I don't particularly like to show off my body.

B. I like to show off my body. 15. _____

16. A. I can read people like a book.

B. People are sometimes hard to understand. 16. _____

17. A. If I feel competent I am willing to take responsibility for making decisions.

B. I like to take responsibility for making decisions. 17. _____

18. A. I just want to be reasonably happy.

B. I want to amount to something in the eyes of the world. 18. _____

19. A. My body is nothing special.

B. I like to look at my body. 19. _____

20. A. I try not to be a show off.

B. I will usually show off if I get the chance. 20. _____

21. A. I always know what I am doing.

B. Sometimes I am not sure of what I am doing. 21. _____

22. A. I sometimes depend on people to get things done.

B. I rarely depend on anyone else to get things done. 22. _____

23. A. Sometimes I tell good stories.

B. Everybody likes to hear my stories. 23. _____

24. A. I expect a great deal from other people.

B. I like to do things for other people. 24. _____

25. A. I will never be satisfied until I get all that I deserve.

B. I take my satisfactions as they come. 25. _____

26. A. Compliments embarrass me.

B. I like to be complimented. 26. _____

27. A. I have a strong will to power.

B. Power for its own sake doesn't interest me. 27. _____

28. A. I don't care about new fads and fashions.

B. I like to start new fads and fashions. 28. _____

29. A. I like to look at myself in the mirror.

B. I am not particularly interested in looking at myself in the mirror. 29. _____

30. A. I really like to be the center of attention.

B. It makes me uncomfortable to be the center of attention. 30. _____

31. A. I can live my life in any way I want to.

B. People can't always live their lives in terms of what they want. 31. _____

32. A. Being an authority doesn't mean that much to me.

B. People always seem to recognize my authority. 32. _____

33. A. I would prefer to be a leader.

B. It makes little difference to me whether I am a leader or not. 33. _____

34. A. I am going to be a great person.

B. I hope I am going to be successful. 34. _____

35. A. People sometimes believe what I tell them.

B. I can make anybody believe anything I want them to. 35. _____

36. A. I am a born leader.

B. Leadership is a quality that takes a long time to develop. 36. _____

37. A. I wish somebody would someday write my biography.

B. I don't like people to pry into my life for any reason. 37. _____

38. A. I get upset when people don't notice how I look when I go out in public.

B. I don't mind blending into the crowd when I go out in public. 38. _____

39. A. I am more capable than other people.

B. There is a lot that I can learn from other people. 39. _____

40. A. I am much like everybody else.

B. I am an extraordinary person. 40. _____

SCORING KEY:

Assign one point for each response that matches the key:

1, 2 and 3: A

4, 5: B

6: A

7: B

8: A

9, 10: B

11, 12, 13, 14: A

15: B

16: A

17, 18, 19, 20: B

21: A

22, 23: B

24, 25: A

26: B

27: A

28: B

29, 30, 31: A

32: B

33, 34: A

35. B

36, 37, 38, 39: A

40: B

Subscales:

- Authority: 1, 8, 10, 11, 12, 32, 33, 36
- Self-sufficiency: 17, 21, 22, 31, 34, 39
- Superiority: 4, 9, 26, 37, 40
- Exhibitionism: 2, 3, 7, 20, 28, 30, 38
- Exploitativeness: 6, 13, 16, 23, 35
- Vanity: 15, 19, 29
- Entitlement: 5, 14, 18, 24, 25, 27

DASS21

Name: Date:

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you **over the past week**. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree or a good part of time
3 Applied to me very much or most of the time

1 (s)	I found it hard to wind down	0	1	2	3
2 (a)	I was aware of dryness of my mouth	0	1	2	3
3 (d)	I couldn't seem to experience any positive feeling at all	0	1	2	3
4 (a)	I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5 (d)	I found it difficult to work up the initiative to do things	0	1	2	3
6 (s)	I tended to over-react to situations	0	1	2	3
7 (a)	I experienced trembling (e.g. in the hands)	0	1	2	3
8 (s)	I felt that I was using a lot of nervous energy	0	1	2	3
9 (a)	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10 (d)	I felt that I had nothing to look forward to	0	1	2	3
11 (s)	I found myself getting agitated	0	1	2	3
12 (s)	I found it difficult to relax	0	1	2	3
13 (d)	I felt down-hearted and blue	0	1	2	3
14 (s)	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15 (a)	I felt I was close to panic	0	1	2	3
16 (d)	I was unable to become enthusiastic about anything	0	1	2	3
17 (d)	I felt I wasn't worth much as a person	0	1	2	3
18 (s)	I felt that I was rather touchy	0	1	2	3
19 (a)	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	0	1	2	3
20 (a)	I felt scared without any good reason	0	1	2	3
21 (d)	I felt that life was meaningless	0	1	2	3

Need Threat Scale

For each question, please circle the number to the right that best represents the feelings you were experiencing during the game	Not at all				Extremely
Belonging					
I felt "disconnected" (R)	1	2	3	4	5
I felt rejected (R)	1	2	3	4	5
I felt like an outsider (R)	1	2	3	4	5
I felt I belonged to the group	1	2	3	4	5
I felt the other players interacted with me a lot	1	2	3	4	5
Self-esteem					
I felt good about myself	1	2	3	4	5
My self-esteem was high	1	2	3	4	5
I felt liked	1	2	3	4	5
I felt insecure (R)	1	2	3	4	5
I felt satisfied	1	2	3	4	5
Meaningful existence					
I felt invisible (R)	1	2	3	4	5
I felt meaningless (R)	1	2	3	4	5
I felt nonexistent (R)	1	2	3	4	5
I felt important	1	2	3	4	5
I felt useful	1	2	3	4	5
Control					
I felt powerful	1	2	3	4	5
I felt I had control over the course of the game	1	2	3	4	5
I felt I had the ability to significantly alter events	1	2	3	4	5
I felt I was unable to influence the action of others (R)	1	2	3	4	5
I felt the other players decided everything (R)	1	2	3	4	5
Victimization					
I felt the other players were ganging up on me (R)	1	2	3	4	5
I felt the other players were just playing the game and not out to get me	1	2	3	4	5
I felt attacked by the other players (R)	1	2	3	4	5
I felt the other players were intentionally mean and unkind to me (R)	1	2	3	4	5
I felt the other players treated me fairly and let me take part in the game	1	2	3	4	5
Assuming that the ball should be thrown to each person equally (33% if three people; 25% if four people), what percentage of the throws did you receive?	—%				

Please enter your USM student ID without the w (e.g., 555555).

_____

What is your age?

_____

What is your sex?

- ○ Male
- ○ Female

What is your race?

- ○ White/Caucasian
- ○ Black/African American
- ○ Asian
- ○ Biracial _____
- ○ Other _____

What is your ethnicity?

- ○ Hispanic
- ○ Non-Hispanic

What is your classification?

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior

Have you ever been diagnosed with a mental illness (e.g., depression, anxiety, ADHD)?

- ○ Yes
- ○ No

Do you take any prescription medications for a mental illness (e.g., stimulant, antidepressant)?

- ○ Yes
- ○ No

Have you ever been diagnosed with a neurological condition (e.g., seizures/epilepsy, cerebral palsy, brain tumor)?

- ○ Yes
- ○ No

Have you ever had a head injury with loss of consciousness?

- ○ Yes
- ○ No

Sensor electrodes for EEG recording must be able to reach the scalp, so we ask that you describe your hairstyle. Please select all that apply.

- ☐ Short
- ☐ Medium
- ☐ Long
- ☐ Dreadlocks
- ☐ Cornrows
- ☐ Braids
- ☐ Afro
- ☐ Bald
- ☐ Shaved

Describe your hair texture:

- ○ Fine
- ○ Thick
- ○ Coarse

How many alcoholic beverages do you consume on average per day?

- ○ None
- ○ 1-2
- ○ 3-4
- ○ 5 or more

How many cigarettes do you smoke on average per day?

- ○ 1-3
- ○ 4-7
- ○ 7-9
- ○ 10 or more

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