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Neural and Behavioral Effects of Being Excluded by the Targets of a Witnessed Social Exclusion

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Abstract

The consequences of social exclusion can be extremely detrimental to physical and emotional well being, ranging from mild distress to extreme violence and aggression. Research findings indicate that witnessing exclusion is just as common as experiencing exclusion and can invoke similar levels of distress. As such, it is also important to examine responses and reactions to the targets after witnessing it. Accordingly, this study examined the association between witnessing and experiencing social exclusion and event-related brain potential (ERP) activity. ERPs were collected while participants played a game of Cyberball with the previous targets of a witnessed inclusion or exclusion and were either included or excluded themselves. Results showed increased N2 and decreased P3b to exclusionary throws regardless of the overall context of the social interaction and regardless of the context of the witnessed interaction. Additionally, participants who were excluded reported lower needs fulfillment and mood than those who were included providing support for the Need Threat model of social exclusion. Further, results showed increased P3b amplitude to inclusionary events after witnessing exclusion. This lends support to the Social Monitoring System suggesting that witnessed exclusion attunes individuals' attention to social cues in the environment that would increase inclusionary status.

Neural and Behavioral Effects of Being Excluded by the Targets of a Witnessed Social Exclusion

The silent treatment, a cold shoulder, a disapproving or dirty look: all of these are forms of social exclusion, or the act of being ignored, rejected, or isolated (Williams, 2007). Social exclusion is so common that most individuals will both engage in it and suffer the consequences of it (Williams, Cheung, & Choi, 2000; Williams, 2001). It is not unique to humans or American culture. In fact, social exclusion has been documented across time, cultures, and social species. It is prevalent among all age groups and in every level of society from institutions and small groups to interpersonal dyadic relationships (Williams et al., 2000; Williams, 2001). Social exclusion serves as a form of social control, punishing deviance and strengthening in-group cohesiveness (Williams, 2001). Much of human behavior is motivated by a desire to belong to a group and this is suggested to have stemmed from the early evolution of humans. Specifically, those ostracized from the group were less likely to survive because of the loss of protection and reproductive opportunities. However, members of the excluding group experience increased cohesiveness therefore increasing security and reproductive chances (Williams, 2007). As such, those skilled at detecting exclusion were the most likely to survive and flourish. It is theorized that humans developed an ostracism-detection system that signals an alarm directing one's attention to determining the extent of exclusion and allocating resources to cope with it (Williams, 2007). Pain is thought to be the signal that captures the person's attention, and research has shown that physical and social pain share an overlapping neural and computational basis (Eisenberger & Lieberman, 2004).

Exclusion even in the smallest form, by a computer, strangers, or even by despised out-group members, has been shown to be physically and psychologically distressing (Zadro,

Williams, & Richardson, 2004; Gonsalkorale & Williams, 2007; Williams, 2007). The consequences of social exclusion may range from mild distress to extreme violence and aggression seen in school shootings, and often include negative emotional experiences such as depression, anxiety, loneliness and feelings of isolation (Twenge, Baumeister, Tice, & Stucke, 2001, Leary, Kowalski, Smith, & Phillips, 2003; Masten, Telzer, & Eisenberger, 2011).

Given the frequency of social exclusion, most have used it, been targeted by it, or have observed it happening to others. In fact, witnessing social exclusion is just as common as experiencing it and may lead to feelings of distress similar to that felt when experiencing it (Masten et al., 2013). The ostracism detection system is theorized to aid in self- and other-detection and lead individuals to feel the pain of others' as their own (Wesselmann, Bagg, & Williams, 2009). As such, it is important to examine how witnessing exclusion may affect an individual's reactions to his or her own subsequent social experiences. Additionally, given that individuals may be sensitive to the exclusion of others, their own responses may be modified when they interact with the people that they just observed being excluded. Feeling the pain of these previously excluded individuals may impact how these individuals process their own social exclusion.

Therefore, the goal of the proposed study is to examine the neural and behavioral effects of being excluded by the targets of a witnessed social exclusion. The hope was that this study would shed light on how the social experience of witnessing exclusion and then interacting with the individuals who were just excluded influences individuals' reactions to their own social experiences.

This review will begin with the theoretical models of social exclusion. These models offer insight into the effects of social exclusion, responses to it, and mediators of exclusion-

related effects. A discussion of the literature on the neural and behavioral effects of witnessing social exclusion will follow in order to provide a basis possible effects witnessing exclusion will have on participants. Neuroimaging research revealing the neural correlates of social exclusion and how these neural indices relate to the processes of perceiving and responding to social exclusion will then be discussed followed by a discussion of event-related potentials and their advantages over neuroimaging research. The review will conclude with a description of the current study.

Models of Social Exclusion

Need-Threat Model. Proposed in 1997 by Williams and subsequently revised in 2001, the Need-Threat Model of social exclusion states that social exclusion threatens the fundamental human needs of belonging, self-esteem, control, and meaningful existence. These four needs are important for human motivation and survival and as such, individuals experience physical, emotional and social pain when they are threatened. Each one is unique and important and, according to Williams (2001), even short-term exposure to exclusion can immediately trigger a threat to these needs. The need to belong has been suggested to be the most fundamental of all human needs (Baumeister & Leary, 1995). Indeed, much of human behavior is motivated by a need to form and maintain social bonds to feel a desired sense of belonging. A lack of strong, stable interpersonal relationships is detrimental to one’s physical and mental health. Social exclusion serves as a threat to belonging more than any other unpleasant social response because it removes all feelings of connectedness. Even a strained sense of connectedness like that experienced in an argument is better than none at all (Zadro et al., 2004).

Social exclusion also poses a threat to an individual’s self-esteem because it often occurs without explanation, leaving the individual to notice that they were excluded and devise their

own reasoning for it (Williams, 2001). More than likely, the individual will attribute the reasons for exclusion to internal characteristics or something they did wrong. Actively ruminating on internal reasons for exclusion serves to threaten one's self-esteem and leads to feelings of inadequacy (Williams, 2001). Feelings of control are also threatened when one is excluded because the target no longer has control over interactions with the source because there is no opportunity for any kind of responsive exchange (Williams, 2001). Without feelings of control, an individual may develop learned helplessness and subsequently become depressed (Seligman, 1975 as cited in Williams, 2001). The last need that is threatened by social exclusion is the need for a sense of meaningful existence (Williams & Zadro, 2005). Social exclusion serves as a lens to what life would be like if the target did not exist and as such acts as a mortality salience cue threatening the individual's sense of importance (Williams & Zadro, 2005).

According to the Need-Threat model, there is a temporal progression of reactions to social exclusion. Immediate reactions to social exclusion include hurt feelings, anger, lowered self-esteem, negative mood, and physiological arousal (Williams, 2001). In the short term, the individual attempts to reduce these negative reactions and regain the needs threatened by social exclusion. Thus, an individual may try to form new social bonds, make assertions of self-importance, and exert control over others or some other aspect of the situation (Williams, 2001; Williams & Zadro, 2005). Continual exposure to exclusion thwarts an individual's attempts to regain threatened needs and the ability to recover becomes increasingly difficult. Thus, long-term exposure to social exclusion may lead to feelings of helplessness, worthlessness and despair, and isolation (Williams, 2001).

Although there is considerable evidence that immediate reactions to even minor instances of social exclusion are quick, powerful and invariant, short term and long term reactions are

dependent on several dimensions including visibility, motive, quantity, and causal clarity as well as various mediators and moderators such as situational and individual differences as well as internal or external attributions of responsibility for the exclusion (Williams, 2001; Williams & Zadro, 2005). For example, targets that view exclusion as being the fault of others or as arising from the situation are less likely to be affected than those who attribute it to something they did. Individual differences also serve as moderators of social exclusion (Williams, 2001).

Threats to the belonging, self-esteem, control, and a meaningful existence have been found time and again across studies of social exclusion. Thus, the proposed study will assess the threatened needs of participants after witnessing and experiencing social exclusion in hopes to better understand the effects of witnessing social exclusion on subsequent social interactions with the targets of the witnessed exclusion. Additionally, the relationship between neuroelectric activity and threatened needs will be assessed.

Social Monitoring System. Another model of social exclusion is the Social Monitoring System (SMS) proposed by Pickett and Gardner (2005). It provides a model for understanding the ways in which individuals cope with daily experiences of exclusion and how they ultimately avoid long-term exclusion. It is grounded on the idea that most individuals experience some form of mild exclusion in daily life and all of these experiences pose a threat to an individual's need for belonging (Baumeister & Leary, 1995; Pickett & Gardner, 2005). For humans to function at an optimal level, basic needs such as sleep, food, and water must be regulated. Just as our body naturally regulates these needs though an assessment of them and a signal when they are not met, the need for belonging is also regulated so that humans maintain a stable level of social inclusion (Pickett & Gardner, 2005). Leary (1995) argued with the sociometer theory that self-esteem serves as the gauge. Thus, an individual's level of self-worth is the signal

monitoring the quality of social relationships. A deficit in feelings of belonging activates the regulatory system attuning an individual to social information that may provide cues for increasing inclusion. This information may be both self-related such as noticing a friend's eagerness to end a social interaction with you or other-related such as noticing the response that another person received (Pickett & Gardner, 2005). Thus, even witnessing social exclusion can cause an individual to redirect attention to information that will help them navigate a social interaction in which they may subsequently be involved. The SMS is therefore considered to be an adaptive mechanism allowing individuals to take greater notice of factors leading to social exclusion as well as techniques for increasing belonging and inclusion (Pickett & Gardner, 2005).

Empirical support for the SMS has been shown in numerous studies. Gardner, Pickett, and Brewer (2000) conducted two separate studies using a simulated computer chat room to present situations in which participants were either included or rejected. The participants then read a diary containing individual and social information. In support of the SMS, results indicated that when individuals were excluded, they accurately recalled more positive and negative social information from the diary than those who were included in the chat room session. Thus, selective memory and sensitivity to social information varied as a result of current belongingness needs (Gardner et al., 2000). Additionally, Pickett, Gardner, and Knowles (2004) found that when individuals are excluded from working with other people, those high in the need to belong as measured by the Need to Belong Scale (NTBS) showed increased accuracy in interpreting subtle social cues such as facial expressions as well as vocal tone.

The current study will use time-locked ERPs to examine whether this model is supported when witnessing and then experiencing social exclusion. Because the SMS is theorized to

predict increased attentional allocation to social cues that could affect belongingness and lead to the intended goal of social connectedness, if this model is supported, it is predicted that after witnessing social exclusion, greater attention will be paid to goal relevant events in the environment such as inclusionary throws or exclusionary throws during the subsequent social interaction.

Effects of Witnessing Social Exclusion

Studies of vicarious exclusion have shown that observers not only recognize the exclusion, but also feel the distress of exclusion similar those experiencing it firsthand (Wesselmann et al., 2009; Masten et al., 2010; Masten, Morelli, & Eisenberger, 2011; Masten et al., 2011; Meyer et al., 2012; Will et al., 2013). Specifically, Wesselmann and colleagues (2009) had participants observe a three-player Cyberball game in which a target player was either included or excluded. They found that participants who viewed the exclusion and were asked to take the perspective of the target reported increased negative affect and need threat compared to those who viewed inclusion (Wesselmann et al., 2009). Similarly, Masten and colleagues (2010) used fMRI and had adolescents observe a game of Cyberball in which an individual was excluded. They found a positive association between trait empathy and prosocial behavior after witnessing exclusion suggesting that those high in empathy will feel a greater need to engage in positive helping behavior (Masten et al., 2010).

The same brain regions are activated when experiencing social exclusion and observing the exclusion of another person (Eisenberger et al., 2003; Eisenberger & Lieberman, 2004; Masten et al., 2010, 2011a,b; Meyer et al., 2012; Masten et al., 2013). Specifically, the anterior cingulate cortex (ACC) is activated in both self and observations of others' social pain and has been theorized to generate an affective link between the observer and target, allowing the

observer to experience the target's distress (Singer et al., 2004; Meyer et al., 2012). Additionally, witnessing someone being excluded causes increased activation in the dorsomedial and medial prefrontal cortexes and the precuneus (Masten et al., 2010; Masten et al., 2013). These brain regions are associated with mentalizing and thus may be involved in underlying cognitive processes that may take place during rejection including understanding why rejection is occurring, how the target is feeling, and why the sources are engaging in rejection (Masten et al, 2013).

Neural Correlates of Experiencing Social Exclusion

Evidence from Functional Imaging Research (fMRI). Research examining neural responses to social exclusion using fMRI suggests that, as mentioned above, increased activation in the ACC is associated with exclusion. Additionally, the right ventral prefrontal cortex (RVPFC) is associated with exclusion (Eisenberger et al., 2003; Masten et al., 2011). Specifically, levels of reported distress are positively correlated with increased activation in the ACC and negatively correlated with RVPFC activation. Additionally, the RVPFC negatively correlated with ACC activation. In fact, changes in the ACC mediate the correlation between the RVPFC and distress suggesting that the RVFPC helps to regulate the distress of social exclusion by disrupting ACC activity (Eisenberger et al., 2003; Eisenberger & Lieberman, 2004). While the RVPFC has an important role in experiences of social exclusion, the ACC is the primary focus of this study allowing for a more in depth examination of the ACC's role in the dynamic process of social exclusion.

The ACC as a Neural Alarm and Conflict Monitor. Because of its association to the distressing aspects of social exclusion as well as research linking it to the distressing affective experience of physical pain, the ACC is theorized to serve as a "neural alarm system" detecting

actual or potential threats and directing our attention and motivation towards dealing with the source of the threats (Eisenberger et al., 2003; Masten et al., 2011; Rainville et al., 1997). Research examining conflict monitoring suggests that the ACC acts as a conflict monitor and sounds a ‘neural alarm’ when a negative social interaction threatens our innate goals to belong to a social group (Botvinick et al., 2001; van Veen & Carter, 2002; Yeung et al., 2004). The activation of the ACC triggers adjustments in top-down control and an increase in the allocation of cognitive resources directed at effectively regulating thoughts and behaviors to aid in the attainment of desired goals (Botvinick et al., 2001; Yeung et al., 2004).

Research supporting the ACC as a conflict monitor has shown that ACC activation is increased during difficult tasks and those that are incongruent with expectations. Examples include the Stroop color naming task in which the color word is not printed in the color it reads and the Eriksen flanker task in which the centrally presented target symbol and flanking stimuli are activating different responses (Kerns et al., 2004; Yeung et al., 2004).

There is evidence of reactive adjustments in control reflecting a sort of conflict adaptation (Gratton, Coles, & Donchin, 1992; Kerns et al., 2004; Ullsperger, Bylsma, & Botvinick, 2005). Studies of trial-by-trial behavioral adjustments support the idea that current trial performance is influenced by previous trial congruency. That is, individuals tend to respond with greater speed and accuracy to incongruent trials following other incongruent trials than to incongruent trials following congruent trials (Gratton et al., 1992; Kerns et al., 2004; Ullsperger et al., 2005). This conflict adaptation, also known as the Gratton effect, has been shown to be independent of priming and has been suggested to stem from an increase in response conflict and subsequent intensification of top-down control (Botvinick et al., 2001). This suggests that once control is brought online, there is a more efficient adjustment and a greater level of self-

regulation and performance to subsequent events requiring control such as an experience of exclusion.

Event-Related Brain Potentials (ERPs). Event-related potentials (ERPs) are time-locked neuroelectric activity used to examine moment-to-moment changes in response to or in preparation of discrete events (Coles, Gratton, & Fabiani, 1990). Compared to functional neuroimaging techniques (fMRI) described previously, ERPs have a better temporal resolution and therefore can provide important insights into the dynamic responses occurring during personal and vicarious experiences of social exclusion such as neural alarm activity as well as attentional allocation to specific events. The N2 and P3 are important ERP components in the understanding of neural responses to social exclusion. The N2 is a frontocentral negative waveform that peaks between 200 to 350 ms after stimulus onset (van Veen & Carter, 2002; Yeung et al., 2004; Folstein & Van Petten, 2008). It has been linked to response conflict and reflects neural activity originating from the ACC. Thus, it is thought to reflect the 'neural alarm' activation in response to exclusionary events. Indeed, when examining neural activity to exclusion using Cyberball, Themanson, Khatcherian, Ball, and Rosen (2013) found a larger N2 amplitude during throws excluding participants even when participants were included during the game overall suggesting that the N2 is sensitive to any instance of exclusion. The P3, typically occurring in conjunction with the N2, is a positive going component occurring between 250 to 500 ms after stimulus presentation (Polich, 2007). Of specific interest is the P3b subcomponent, which is generated from temporal-parietal locations and has been theorized to index attentional allocation to task relevant stimuli (Polich, 2007). The P3b is proportional to the amount of attention needed to prepare for or engage in a task or stimulus. In response to inclusionary throws during the inclusion and exclusion blocks of Cyberball, Themanson and colleagues

(2013) found increased P3b amplitude suggesting increased attentional allocation to inclusionary events. While there has been research examining the neuroelectric indices of experienced social exclusion, there is no research to date examining ERPs during a social interaction after witnessing social exclusion. Therefore, the current study serves to expand the current neuroimaging research on witnessing social exclusion by providing insight into the moment-to-moment changes in neural activity during a social interaction after witnessing inclusionary and exclusionary interactions.

Current Study

While the aforementioned theories of social exclusion aid in a greater understanding of the effects of exclusion, there are still gaps in the existing literature. Additionally, though the brain regions related to self- and observed exclusion have been identified, there have been no studies to date examining the moment-to-moment changes in neural activity after witnessing social exclusion. Therefore, the current study examined how one's observation of social exclusion may impact a subsequent social interaction with the target of the observed exclusion. Specifically, participants observed a fully inclusive interaction or an exclusionary interaction via Cyberball. Then, the participants played Cyberball with the targets of the observed exclusion (or inclusion). In this second interaction, the participants themselves were either included or excluded.

It was hypothesized that after witnessing exclusion and then becoming the target of exclusion, participants may show increased N2 and P3b activation to inclusionary and exclusionary events compared to those who witnessed an inclusionary interaction. This would provide evidence for the SMS, as it will be apparent that participants increased their attentional allocation toward social cues to successfully process witnessed social exclusion in hopes of

becoming included in their social interaction. Conversely, if ACC activation is decreased following witnessing exclusion, reflected by a smaller N2 and P3b amplitudes to exclusionary events compared to following witnessing inclusion, the Gratton effect would be supported, indicating the neural alarm system has been brought online previously by witnessing the exclusion and participants are better prepared to regulate their reactions to their own social exclusion.

Methods

Participants

Fifty-two participants between the ages of 18 and 22 were recruited from General Psychology courses at Illinois Wesleyan University. They were awarded research credit toward their class requirement but received no other compensation. Three participants were discarded from analyses because they did not fully complete the study (i.e. did not complete both tasks or there was missing questionnaire data) and five were discarded from analyses because of excessive noise and artifacts obtained during event-related potential (ERP) data collection. The resulting sample size was 44 participants (27 females, 17 males). Each group consisted of 11 participants (See Figure 1). The study was approved by the Institutional Review Board at Illinois Wesleyan University.

Measures

Self-report assessments. After obtaining informed consent, each participant completed a set of preliminary questionnaires. These self-report questionnaires included a simple demographics questionnaire, the Edinburgh handedness questionnaire (Oldfield, 1971), the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996), the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), the Positive and Negative Affect

Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the Need-Threat Scale (NTS; Williams et al., 2000). The PANAS consists of two 10-item scales that assess positive affect (PA) and negative affect (NA) and was used to assess mood of participants at baseline and after witnessing and experiencing exclusion. The reported reliabilities are high for both scales ranging from .86 to .90 for PA and .84 to .87 for NA (Watson et al., 1988). The NTS was developed by Williams and colleagues (2000) specifically to measure the needs threatened by social exclusion. It has scales measuring each of the four needs described above as well as a manipulation check to assess whether the participants noticed the exclusion. Participants also completed several additional questionnaires as part of the preliminary measures including a personality assessment developed from the International Personality Item Pool scale (IPIP; Goldberg et al., 2006), the Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel, Dancu, & Stanley, 1989), the Rejection Sensitivity Questionnaire (RSQ; Downey & Feldman, 1996). Additionally, participants completed the Ten Item Personality Measure (TIPI; Gosling, Rentfrow, & Swann, 2003) and Reysen Likability Scale (RLS; Reysen, 2005) to rate the other participants following the observed social interaction and following their own social interaction. These questionnaires were part of a larger research project and will not be discussed further.

Cyberball manipulation. The Cyberball paradigm (Williams et al., 2000) was used to manipulate levels of inclusion and exclusion for the observation block as well as the playing block. The game was played between four undergraduate participants from two different universities (University of Illinois and Illinois State University). The other “participants” were computer-generated, however. Participants were told to pay attention to the two players on the sides of the monitor, as they would be playing a game of catch with them next. One group of participants was randomly assigned to watch a fully inclusive interaction while the other group

watched an interaction in which the top and bottom players excluded the players on the sides (Figure 1). In the witnessing inclusion block, the game was set for 100 throws and each of the four computer generated players received the ball equally. The witnessing exclusion block was set for 100 throws and the two players on the side were not thrown the ball for the rest of the game after receiving 10 throws each. The inclusion block was set for 100 throws and all players including the participant received the ball an equal number of times and the exclusion block was set for 156 throws and the participant stopped receiving the ball after 54 total throws (one third of the total interaction; approximately 20 inclusionary throws). Event-related markers were created on the computer collecting ERP data and were inserted at the first informational image in each ball toss. The first informational image showed which player would be the recipient of the ball toss (See Figure 2).

Neuroelectric assessment. An electroencephalogram (EEG) was recorded from 64 sintered Ag-AgCl electrodes in a fitted lycra cap (Neuro Inc., El Paso, TX). The electrodes are arranged in an extended montage based on the International 10–10 system (Chatrain, Lettich, & Nelson, 1985) and were prepared using Quik gel (Neuro Inc., El Paso, TX). An electrode between Cz and CPz served as the online reference and AFz served as the ground electrode. Additionally, vertical and horizontal bipolar electrooculographic (EOG) activity was recorded to monitor eye movements from electrodes above and below the right orbit as well as near the outer canthus of each eye. The impedances were kept at less than 10 kΩ for all electrodes. A Neuroscan Synamps2 bioamplifier (Neuro Inc., El Paso, TX) with a 24 bit A/D converter and +/- 200 millivolt (mV) input range was used to digitize, amplify, and filter neural activity as it was collected. Offline processing of the EEG data included eye blink correction using a spatial filter (Compumedics Neuroscan, 2003), creation of stimulus-locked epochs (-900 to 2250 ms relative

to an event marker placed within each throw sequence in the Cyberball game), baseline removal (800 ms pre-stimulus interval), and artifact rejection (epochs with signals that exceed $\pm 75\mu V$ was rejected). Neuroscan software (v 4.3.1) was used to record EEG activity and Neuroscan Stim (v 2.0) software was used to control stimulus presentation, timing, and measurement of behavioral response time and accuracy. The resulting output included grand-averaged stimulus-locked amplitudes of the FCz (N2) and Pz (P3) sites for witnessing and participating. However, the only neural data analyzed was that collected while participants played Cyberball.

Procedure

The experiment took place in one 120-minute session. The participants provided informed consent and then completed the preliminary questionnaires including the IPIP, SPAI, RSQ, BDI-II, STAI, PANAS, and NTS. Participants were then asked to take a seat one meter away from the computer monitor and were fitted with the cap in accordance with guidelines provided by the Society for Psychophysiological Research (SPR; Picton et al., 2000). Once the cap had proper impedance levels, the experimenter told the participant the cover story and dimmed the lights so that the participant could watch Cyberball. The cover story involved telling the participant that the purpose of the study was to examine neural activity during observation of and engagement in a social interaction. The experimenter also periodically stepped out to make or receive calls to coordinate the blocks with the others schools to help sell the cover story. Participants were given the names of those who they watched and were told that they would playing with the two located on the sides of the monitor next.

After watching the game, the experimenter came back into the room and gave the participants the PANAS, NTS, BDI-II, TIPI and RLS. After completion of the questionnaires, the research assistant explained how to play Cyberball and again dimmed the lights so that the

participant could play the game with the other players. Half of each group of participants were randomly assigned to participate in a fully inclusive interaction while the other half of each participant group were excluded from their social interaction (See Figure 1). After the game was over, the participant was given the PANAS, NTS, BDI-II, TIPI and RLS again. Following the completion of the last set of questionnaires, participants were completely briefed as to the purpose of the study and the use of deception. The participants then had the opportunity to ask any questions and were thanked for their time.

Statistical Analyses

Mean amplitudes from the FCz site for N2 component and the Pz site for the P3b component were analyzed using 2 (throw; inclusionary or exclusionary throw) × 4 (group; inclusion/inclusion, inclusion/exclusion, exclusion/inclusion, exclusion/inclusion) mixed model ANOVAs. Data from the NTS, PANAS, BDI-II, and STAI State subscale were analyzed using a 3 (time; baseline, after watching, after playing) × 4 (group) mixed model ANOVA. The alpha level was set at $p \leq .05$ for all analyses. Significant interactions for the neuroelectric and behavioral data were followed up with the appropriate ANOVA or t-test.

Results

Self-Report Assessments

Figure 1 summarizes participants' age and sex for each group. There were no significant differences between groups for the all scales of the NTS, PANAS, BDI-II, and STAI Trait subscale at baseline (F's(3.40) ≤ 1.23, p's ≥ .312, partial η^2's ≤ .084). Omnibus 3 × 4 ANOVAs revealed significant main effects for time for all scales of the NTS and PANAS (F's(2,39) ≥ 8.39, p's ≤ .001, partial η^2's ≥ .30) such that all needs and positive affect decreased and negative affect increased after participation in an exclusionary interaction. However, there was no main

effect for the STAI State and BDI-II. Additionally, there were significant interaction effects for the Positive Affect (PA) scale of the PANAS, all scales of the NTS, STAI State, and BDI-II (F's$(6,78) \geq 2.25$, p's $\leq .047$, partial η^2's $\geq .15$). Follow-up ANOVAs were conducted separately for each group to allow for a closer examination of the interaction effects (See Tables 1 and 2 for means and standard deviations). The two groups that experienced exclusion reported a decrease in feelings of belonging, self-esteem, meaningful existence, and control whereas the groups who were included reported no deficits in these needs. There was a general trend for reported decreased needs and positive affect after witnessing exclusion, however, they were not significant. Additionally, anxiety and depression related symptoms and negative affect were greatest when participants had witnessed inclusion and were subsequently excluded.

Neural measures

N2 Component. An omnibus 2 × 4 ANOVA revealed a significant main effect for throw type ($F(1,40) = 94.59$, $p < .001$, partial $\eta^2 = .70$), but no significant main effect for group or throw type × group interaction. Specifically, consistent with previous research (Themanson et al., 2013), N2 amplitude was greater (more negative) for exclusionary throws (M = .6 µV, SD = 1.6) than for inclusionary throws (M = 3.7 µV, SD = 2.4) regardless of whether participant had watched inclusion or exclusion and regardless of whether the overall Cyberball interaction was inclusionary or exclusionary (Figure 4). These findings suggest that, regardless of the overall context of the social interaction and previously viewed social inclusion or exclusion, there is a neural response to conflict from the ACC associated with social exclusion that is sensitive to momentary exclusionary events.

P3 Component. An omnibus 2 × 4 ANOVA revealed a significant main effect for throw type ($F(1,40) = 272.58$, $p < .001$, partial $\eta^2 = .872$) such that P3 amplitude was greater (more

positive) for inclusionary throws (M = 7.6 μV, SD = 3) compared to exclusionary throws (M = .02, SD = 2.4). There was no significant effect for group. However, there was a significant throw type × group interaction effect ($F(3,40) = 3.35$, $p = .028$, partial $\eta^2 = .201$). Follow-up univariate ANOVAs were conducted to examine specific relationships in the interaction. They revealed a significant effect for inclusionary throws ($F(3,40) = 2.99$, $p = .042$, partial $\eta^2 = .183$) but not for exclusionary throws. Specifically, P3b amplitude was greater during inclusionary throws for those who witnessed social exclusion (EI: M = 9 μV, SD = 3; EE: M = 8.6 μV, SD = 3.1) compared to those witnessed inclusion (II: M = 6.1 μV, SD = 2.5; IE: M = 6.5 μV, SD = 2.4) (Figure 3). Pairwise comparisons showed that both groups who witnessed exclusion (EI, EE) had significantly higher P3b amplitudes for inclusionary throws compared to the group who witnessed inclusion and was included (p's $\leq .042$). Additionally, the group who witnessed inclusion and was subsequently excluded had significantly lower P3b amplitude than the group who witnessed exclusion and was included ($p = .044$) and a marginal effect with the group who witnessed exclusion and was excluded ($p = .090$). We combined the two groups who witnessed exclusion (EI, EE) and the two groups who witnessed inclusion (II, IE) to further clarify the effect of witnessing social interactions. We were able to combine these two groups because in our methodology, both the inclusionary and exclusionary interactions involving the participants are identical until the point that the exclusion begins (i.e., after approximately 20 throws have been received by the participant). At this point, no more inclusionary throws exist in the exclusionary block. Accordingly, a univariate ANOVA was conducted with the combined groups (EI and EE compared to II and IE). Consistent with the previous analysis, it showed a significant effect for inclusionary throws ($F(1, 42) = 9.11$, $p = .004$, partial $\eta^2 = .178$) such that those who witnessed social exclusion showed significantly greater P3 amplitude to inclusionary

throws (M = 8.8 μV, SD = 3) compared to those who witnessed an inclusionary interaction (M = 6.3 μV, SD = 2.4).

Discussion

Being the target of social exclusion has been shown to be psychologically distressing leading to increased anxiety, depression, frustration, and loneliness (Williams, 2007). Even less severe instances of exclusion like that experienced in Cyberball have these negative effects (Zadro et al., 2004). Witnessing exclusion is as common as experiencing it and, individuals are sensitive to the exclusion of others (Masten et al., 2013). The neural correlates of experienced and witnessed social exclusion are well established (Wesselmann et al., 2009; Masten et al., 2010; Eisenberger et al., 2003). However, there is no research to date examining if and how individuals' responses are modified during subsequent interactions. Thus, the present study was conducted to examine how witnessing social exclusion may impact a subsequent social interaction with the target of the observed exclusion. Specifically, patterns of neural activation were examined while participants interacted with the targets of a witnessed social exclusion and were either included or excluded by those targets. Because this study was exploratory in nature, two competing hypotheses were proposed and explored. First, it was hypothesized that after witnessing social exclusion, participants would have greater N2 and P3b amplitudes to inclusionary and exclusionary throws than those who viewed an inclusionary interaction suggesting that witnessing social exclusion activates the SMS and leads to heightened sensitivity to social information. Pickett and Gardner (2005) theorized that the SMS is activated after a negative appraisal of one's current state of belonging. Activation of the SMS directs an individual's attention to monitoring his or her environment for verbal and nonverbal social cues that provide opportunities for social connectedness (Pickett & Gardner, 2005). Conversely, it

was suggested that there might be smaller N2 and P3b amplitudes to exclusionary throws following a witnessed exclusion compared to a witnessed inclusion indicating that witnessing exclusion leads to the implementation of cognitive control over the distressing social information prior to one's own social interactions. This finding would support conflict adaptation or the Gratton effect, which asserts that there are reactive adaptations of control in response to conflict that lead to a greater level of self-regulation and performance to subsequent events requiring control (Gratton et al., 1992).

Neural Responses

Results revealed larger P3b amplitudes to inclusionary throws for participants who witnessed an exclusionary interaction compared to those who witnessed inclusion. This provides evidence for the SMS (Pickett & Gardner, 2004; Pickett et al., 2005) as participants appeared to be sensitized to inclusionary events and attentional allocation, as reflected by P3b, appeared to be directed towards social cues signaling inclusion. However, the SMS model suggests that there should also be an increase in attentional allocation to cues signaling threats to inclusion (Pickett & Gardner, 2005), yet P3b amplitude was not increased in response to exclusionary throws. This difference may be due to the nature of how social inclusion and exclusion are processed. Each inclusionary event is a social cue of inclusion. Thus, it by itself can signify inclusion in an interaction. However, each exclusionary event is not a threat to inclusion by itself. In the Cyberball paradigm, even when an individual is completely included in a three-person interaction, there are instances when that person does not take part (exclusionary events). This does not cue "exclusion" since exclusion is typically understood as a process, not a discrete event. Therefore, the neural activity differences related to inclusionary events appear to be accurately assessed on an event-by-event basis, whereas any effects of sensitivity to social

exclusion cues or threats would be better assessed by examining sets of exclusionary events that can be interpreted to signify exclusion.

While the SMS seems to have some merit in this study, there is no evidence for the Gratton effect (Gratton et al., 1992). That is, the N2 and P3b did not decrease during exclusionary events after witnessing social exclusion. Thus, witnessing social exclusion of the targets does not seem to bring the neural alarm system online to better prepare for personal social exclusion. A possible explanation for this could the fact that the participants are interacting with the targets and may not be expecting the impending exclusionary interaction. Therefore, there is no need bring neural alarm online to better prepare and regulate feelings toward exclusion.

Additionally, results showed that there was an increased N2 and decreased P3b to exclusionary throws regardless of the overall context of the social interaction. These results, while not part of the hypotheses, are consistent with previous research conducted by Themanson and colleagues (2013). They suggest that the "neural alarm" elicited by the ACC (Eisenberger et al., 2003) is sensitive to any instance of social exclusion regardless of the context of either social interaction. This supports the idea that the "neural alarm" system (Eisenberger et al., 2003) is quick and crude and functions on a moment-by-moment basis, alerting an individual to their exclusion during specific instances irrespective of the overall context of the social interaction. Thus, it seems that any instance of exclusion, no matter how small or seemingly insignificant, causes social pain. This is also supported by the behavioral findings in the current study.

Behavioral Measures

While neural data provides evidence for the SMS, there was no clear behavioral evidence supporting it. Consistent with previous research and showing support for the "neural alarm system" and the Need Threat model (Williams, 2001), participants reported decreased needs

fulfillment and mood after exclusion, regardless of whether they had witnessed inclusion or exclusion previously. However, Pickett and Gardner (2005) suggested that decreased feelings of belonging and self-esteem activate the SMS. While there was a general trend of lowered feelings of belongingness, there was no significant difference after witnessing exclusion. The self-report measures may not have adequately captured these feelings and it would be necessary to examine neural activity when witnessing exclusion to further support the SMS.

After watching an inclusionary interaction and then being excluded by the two players previously watched (IE), there was an increase in depression and anxiety-related symptoms and negative affect compared to the other groups. This suggests that the participants who witnessed exclusion may not have experienced as much social anxiety, depression, and negative affect when the targets of the witnessed interaction excluded them. They did, however, report lower needs suggesting that all exclusionary interactions serve to threaten the four fundamental needs. Two potential explanations for this relate to the external attribution of exclusion. First, participants may have been engaging in victim blaming which serves as form of protection for the witness allowing individuals to feel as though they would never be subject to that same fate (Lerner & Miller, 1978). Blaming the targets of the witnessed interaction could have led the participants to not feel as bad about being excluded by them. Alternatively, another explanation could be that the participant attributed the cause of the exclusion to the situation. That is, participants may have thought that they were excluded because the targets were projecting the negative feelings experienced after exclusion onto them. These are only possible explanations and cannot be stated with confidence without examining participants' perceptions of the other players. Additionally, because these explanations are indicative of protective mechanisms brought on by the individual, if they are plausible, it seems as though the Gratton effect should

have some merit. However, the Gratton effect is not supported by neural responses after witnessing exclusion.

Limitations and future directions

One potential limitation of the current study is demographic composition of the participants. Seventeen of the 44 participants were male and 27 were female and one group (EE) was comprised of nine females and two males. Though not ideal to have an unequal distribution of sexes, follow-up *t*-tests revealed only one significant difference between the sexes for both the behavioral and neural measures. Specifically, males reported greater positive affect than females ($t(42) = 3.1$, $p = .003$). Another possible limitation is the small sample size. While the observed effects proved to be significant with the current sample of participants, preferably this study would have included more participants to aid in a closer analysis of the marginal relationships that may become significant with a larger sample size. Additionally, time constraints limited the examination of neural activity of participants while witnessing social exclusion. This data should be examined at a future time to further explore SMS activation to witnessed social exclusion. It is theorized that for SMS activation, N2 and P3b amplitudes would likely need to increase during witnessed exclusionary events and interactions. This would provide evidence for increased activation of the ACC and increased sensitivity to actual or potential threats of others' exclusion and social pain.

Another limitation was the lack of examination of demographics of the participants. Because social exclusion does not just happen among people of the same background (i.e., same sex, race, class, etc), examining how these affect neural and behavioral manifestations of social exclusion is important. Thus, future studies could take into account the demographics of the participants and other "players" within the Cyberball paradigm to determine the effects of race,

sex, and other individual difference variables on participants' perceptions of exclusion.

Summary

The neural and behavioral effects of witnessing social exclusion on subsequent interactions with the targets of the observed exclusion were examined in undergraduate students. Findings supported previous research (Themanson et al., 2013) demonstrating increased N2 and decreased P3b amplitudes to exclusionary events regardless of the global context of the social interaction Additionally, consistent with the Need-Threat model (Williams, 2001), results indicated decreased feelings of belonging, self-esteem, control, and meaningful existence and decreased mood after experiences of exclusion. Thus, these findings support the idea that the "neural alarm" (Eisenberger et al., 2003) is sensitive to any instance of social exclusion and, regardless of witnessed interaction, experiences of social exclusion threaten needs fulfillment and mood. The current study expanded on previous literature by examining neuroelectric indices during a social interaction after witnessing exclusion.

Results revealed support for the Social Monitoring System (SMS) proposed by Pickett and Gardner (2005). Specifically, P3b amplitudes increased during inclusionary events after witnessing exclusion. The P3b component indexes attentional allocation (Polich, 2007) and the SMS is theorized to alert individuals to changes in social information and redirect attention to social cues that provide evidence for increasing inclusion (Pickett & Gardner, 2005). Thus, increased P3b amplitude to inclusionary events suggests that the SMS was activated when participants witnessed exclusion and they are attuned to social information in their subsequent interaction. However, behavioral data were inconclusive. There were no reported decreases in belonging and self-esteem after witnessing exclusion. Future studies need to further examine the SMS.

Conversely, neural results do not support the Gratton effect (Gratton et al., 1992). That is, N2 and P3b did not decrease during exclusionary throws after witnessing exclusion. Thus, neural data do not support that idea that the “neural alarm system” is brought online by a witnessing social exclusion. Behavioral data showed some support for possible protective mechanisms, however. That is, those who viewed exclusion and were subsequently excluded reported lower BDI-II and STAI State scores and increased negative affect than those who viewed inclusion and were excluded. This may suggest that after witnessing exclusion, participants make external attributions for why they are being excluded.

References

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497- 529. doi:10.1037/0033-2909.117.3.497

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Manual for the Beck Depression Inventory – II. San Antonio, TX: Psychological Corporation.

Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review, 108*(3), 624-652. doi:10.1037/0033-295x.108.3.624

Chatrain, G. E., Lettich, E., & Nelson, P. L. (1985). Ten percent electrode system for topographic studies of spontaneous and evoked EEG activity. *American Journal of EEG Technology, 25*, 83-92.

Coles, M. G. H., Gratton, G., & Fabiani, M. (1990). Event-related brain potentials. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of psychophysiology: Physical, social and inferential elements* (pp. 413– 455). Cambridge, UK: Cambridge University Press.

Downey, G., & Feldman, S. I. (1996). Implications of rejection sensitivity for intimate relationships. *Journal of Personality and Social Psychology, 70*(6), 1327-1343. doi:10.1037/0022-3514.70.6.1327

Eisenberger, N.I., Lieberman, M.D. (2004). Why rejection hurts: a common neural alarm system for physical and social pain. *Trends in Cognitive Sciences, 8*(7), 294–300. doi:10.1016/j.tics.2004.05.010

Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. *Science, 302*, 290-292. doi:10.1126/science.1089134

Folstein, J.R., Van Petten, C. (2008). Influence of cognitive control and mismatch on the N2 component of the ERP: a review. *Psychophysiology, 45*(1), 152–70. doi:10.1111/j.1469-8986.2007.00602.x

Gardner, W. L., Pickett, C. L., & Brewer, M. B. (2000). Social exclusion and selective memory: How the need to belong influences memory for social events. *Personality & Social Psychology Bulletin*, *26*(4), 486-496. doi:10.1177/0146167200266007

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. C. (2006). The International Personality Item Pool and the future of public-domain personality measures. *Journal of Research in Personality, 40*(1), 84-96. doi:10.1016/j.jrp.2005.08.007

Gonsalkorale, K., & Williams, K. D. (2007). The KKK won't let me play: ostracism even by a despised outgroup hurts. *European Journal of Social Psychology*, *37*(6), 1176-1186. doi:10.1002/ejsp.392

Gosling, S., Rentfrow, P., & Swann, W. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research In Personality*, *37*(6), 504-528. doi:10.1016/s0092-6566(03)00046-1

Gratton, G., Coles, M. H., & Donchin, E. (1992). Optimizing the use of information: Strategic control of activation of responses. *Journal of Experimental Psychology*, *121*(4), 480-506. doi:10.1037/0096-3445.121.4.480

Kerns, J.G., Cohen, J.D., MacDonald, A.W.III, Cho, R.Y., Stenger, V.A., Carter, C.S. (2004). Anterior cingulate conflict monitoring and adjustments in control. *Science, 303*, 1023–1026. doi:10.1126/science.1089910

Leary, M. R., Kowalski, R. M., Smith, L., & Phillips, S. (2003). Teasing, rejection, and violence:

Case studies of the school shootings. *Aggressive Behavior, 29*(3), 202-214. doi:10.1002/ab.10061

Lerner, M. J., & Miller, D. T. (1978). Just world research and the attribution process: Looking back and ahead. *Psychological Bulletin*, *85*(5), 1030-1051. doi:10.1037/0033-2909.85.5.1030

Masten, C.L., Eisenberger, N.I., Pfeifer, J.H., & Dapretto, M. (2013). Neural responses to witnessing peer rejection after being socially excluded: fMRI as a window into adolescents' emotional processing. *Developmental Science*, *16*(5), 743-759. doi:10.1111/desc.12056

Masten, C.L., Eisenberger, N.I., Pfeifer, J.H, & Dapretto, M. (2010). Witnessing peer rejection during early adolescence: Neural correlates of empathy for experiences of social exclusion. *Social Neuroscience*, *5*(5-6), 496-507. doi:10.1080/17470919.2010.490673

Masten, C. L., Morelli, S. A., & Eisenberger, N. I. (2011). An fMRI investigation of empathy for 'social pain' and subsequent prosocial behavior. *Neuroimage*, *55.* 381-388. doi:10.1016/j.neuroimage.2010.11.060

Masten, C., Telzer, E., & Eisenberger, N. (2011). An fMRI investigation of attributing negative social treatment to racial discrimination. *Journal of Cognitive Neuroscience*, *23*(5), 1042-1051. doi:10.1162/jocn.2010.21520

Meyer, M.L., Masten, C.L., Ma, Y., Wang, C., Shi, Z., Eisenberger, N.I, & Han, S. (2012). Empathy for the social suffering of friends and strangers recruits distinct patterns of brain activation. *Social Cognitive and Affective Neuroscience*, *8*(4), 446-454. doi:10.1093/scan/nss019

Pickett, C. L., & Gardner, W. L. (2005). The social monitoring system: Enhanced sensitivity to

social cues as an adaptive response to social exclusion. In K. D. Williams, J. P. Forgas, & W. von Hippel (Eds.), *The social outcast: Ostracism, social exclusion, rejection, and bullying* (pp. 213-226). New York: Psychology Press.

Pickett, C.L., Gardner, W.L., & Knowles, M. (2004). Getting a cue: The need to belong and enhanced sensitivity to social cues. *Personality and Social Psychology Bulletin*, *30*(9), 1095-1107. doi:10.1177/0146167203262085

Picton, T. W., Bentin, S., Berg, P., Donchin, E., Hillyard, S. A., Johnson Jr., R., Miller, G. A., Ritter, W., Ruchkin, D. S., Rugg, M. D., & Taylor, M. J. (2000). Guidelines for using human event-related-potentials to study cognition: Recording standards and publication criteria. *Psychophysiology, 37*, 127-152. doi: 10.1111/1469-8986.3720127

Polich, J. P. (2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neuropsychology, 118*(10), 2128-2148. doi:10.1016/j.clinph.2007.04.019

Rainville, P., Duncan, G.H., Price, D.D., Carrier, B., Bushnell, M.C. (1997). Pain affect encoded in human anterior cingulate but not somatosensory cortex. *Science, 277*, 968–971. doi:10.1126/science.277.5328.968

Reysen, S. (2005). Construction of a new scale: The Reysen Likability Scale. *Social Behavior & Personality, 33*(2), 201-208. doi:10.2224/sbp.2005.33.2.201

Singer, T. (2004). Empathy for pain involves the affective but not sensory components of pain. *Science, 303*, 1157–1162. doi:10.1126/science.1093535

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press.

Themanson, J.R., Khatcherian, S.M., Ball, A.B., & Rosen, P.J. (2013). An event-related examination of neural activity during social interactions. *Social Cognitive and Affective*

Neuroscience, *8*(6), 727-733. doi:10.1093/scan/nss058

Turner, S. M., Beidel, D. C., Dancu, C. V., & Stanley, M. A. (1989). An empirically derived inventory to measure social fears and anxieties: The social phobia and anxiety inventory. *Psychological Assessment, 1*, 35-40. doi:10.1037/1040-3590.1.1.35

Twenge, J.M., Baumeister, R.F., Tice, D.M., & Stucke, T.S. (2001). If you can't join them, beat them: Effects of social exclusion on aggressive behavior. *Journal of Personality and Social Psychology*, *81*(6), 1058-1069. doi: 10.1037/0022-3514.81.6.1058

Ullsperger, M., Bylsma, L., & Botvinick, M. (2005). The conflict adaptation effect: It's not just priming. *Cognitive Affective & Behavioral Neuroscience*, *5*(4), 467-472. doi:10.3758/cabn.5.4.467

van Veen, V., & Carter, C. S. (2002). The timing of action-monitoring processes in the anterior cingulate cortex. *Journal of Cognitive Neuroscience, 14*(4), 593-602. doi:10.1162/08989290260045837

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063-1070. doi:10.1037/0022-3514.54.6.1063

Wesselmann, E. D., Bagg, D., & Williams, K. D. (2009). "I feel your pain": The effects of observing ostracism on the ostracism detection system. *Journal of Experimental Social Psychology, 45*(6), 1308-1311. doi:10.1016/j.jesp.2009.08.003

Will, G., Crone, E. A., van den Bos, W., & Güroğlu, B. (2013). Acting on observed social exclusion: Developmental perspectives on punishment of excluders and compensation of victims. *Developmental Psychology*, *49*(12), 2236-2244. doi:10.1037/a0032299

Williams, K. D. (2007). Ostracism. *Annual Review of Psychology*, *58*(1), 425-452.

doi:10.1146/annurev.psych.58.110405.085641

Williams, K.D. (2001). Ostracism: The Power of Silence. New York: Guilford Press.

Williams, K.D., Cheung, C.K.T., Choi, W. (2000). Cyberostracism: effects of being ignored over the internet. *Journal of Personality and Social Psychology, 79*(5), 748–62. doi:10.1037/0022-3514.79.5.748

Williams, K. D., & Zadro, L. (2005). Ostracism: The indiscriminate early detection system. In K. D. Williams, J. P. Forgas, & W. von Hippel (Eds.), *The social outcast: Ostracism, social exclusion, rejection, and bullying* (pp. 19-34). New York: Psychology Press.

Yeung, N., Botvinick, M. M., & Cohen, J. D. (2004). The neural basis of error detection: Conflict monitoring and the error-related negativity. *Psychological Review, 111*(4), 931-959. doi:10.1037/0033-295x.111.4.931

Zadro, L., Williams, K.D., Richardson, R. (2004). How low can you go? Ostracism by a computer lowers belonging, control, self-esteem, and meaningful existence. *Journal of Experimental Social Psychology*, *40*(4), 560-567. doi:10.1016/j.jesp.2003.11.006

Table 1.

Mean (Standard Deviation) Scale/Subscale Scores on the Need Threat Scale (NTS) for All Participants Categorized by Group and Time

	Group											
	Inclusion; Inclusion (II)			Inclusion; Exclusion (IE)			Exclusion; Inclusion (EI)			Exclusion; Exclusion (EE)		
Variable	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
Need to Belong	5.38 (1.2)	5.31 (1.3)	5.42 (1.1)	5.56 (1.1)	4.20 (1.4)	***2.95 (.91)***	5.69 (1.3)	4.89 (1.2)	6.05 (.72)	5.65 (.94)	5.33 (.81)	***3.44 (1.1)***
Need for Self Esteem	5.27 (.94)	4.96 (.91)	4.95 (1.3)	5.47 (1.0)	4.84 (1.4)	***3.71 (1.3)***	4.95 (1.2)	4.78 (.96)	5.25 (.65)	5.20 (1.1)	4.95 (1.2)	***3.73 (1.2)***
Need for Meaningful Existence	5.42 (1.3)	5.40 (1.0)	5.22 (1.1)	6.16 (.63)	5.67 (1.1)	***3.84 (1.7)***	5.82 (.79)	5.57 (.74)	6.04 (.51)	5.78 (.72)	5.38 (.85)	***3.36 (1.2)***
Need for Control	4.60 (1.0)	4.45 (1.2)	4.49 (1.3)	5.05 (.70)	4.15 (1.3)	***3.47 (1.0)***	5.02 (.86)	4.35 (1.1)	4.47 (.93)	4.62 (.83)	4.29 (.72)	***2.89 (.87)***
Mood	5.70 (.71)	5.74 (.81)	5.24 (1.1)	5.74 (1.0)	4.92 (1.5)	***3.99 (1.3)***	5.81 (.72)	5.77 (.56)	5.91 (.59)	5.74 (.87)	5.67 (.79)	***4.47 (.98)***

Significant time main effect at $p \leq .05$ = **bold;** Significant interaction effect at $p \leq .05$ = ***bold & italics***

Table 2.

Mean (Standard Deviation) Scale/Subscale Scores on the Positive and Negative Affect Scale (PANAS), State Trait Anxiety Inventory (STAI), and Beck Depression Inventory (BDI-II) for All Participants Categorized by Group and Time

	Group											
	Inclusion; Inclusion (II)			Inclusion; Exclusion (IE)			Exclusion; Inclusion (EI)			Exclusion; Exclusion (EE)		
Variable	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
Positive Affect (PANAS)	29.5 (6.7)	25.5 (8.8)	24.0 (11)	28.6 (6.8)	21.8 (10)	***19.5 (8.6)***	27.5 (6.8)	23.3 (7.9)	24.2 (7.7)	26.0 (5.2)	19.6 (5.8)	***15.0 (4.9)***
Negative Affect (PANAS)	14.3 (3.6)	12.1 (3.2)	11.7 (2.2)	13.8 (3.6)	13.2 (3.5)	**16.2 (7.6)**	14.5 (4.5)	11.7 (2.1)	11.4 (2.0)	15.5 (5.0)	11.9 (2.0)	12.6 (2.7)
STAI State	32.7 (6.8)	34.0 (9.7)	33.3 (11)	34.3 (11)	38.9 (14)	***44.0 (15)***	32.0 (6.6)	33.6 (6.3)	31.6 (9.5)	34.5 (9.6)	31.6 (6.5)	34.6 (7.3)
BDI-II	9.55 (8.6)	8.27 (9.2)	6.82 (9.6)	8.27 (6.2)	9.82 (13)	***13.0 (12)***	9.64 (7.9)	7.27 (7.5)	6.45 (7.4)	9.18 (5.8)	6.55 (4.8)	7.36 (4.9)

Significant time main effect at $p \leq .05$ = **bold;** Significant interaction effect at $p \leq .05$ = ***bold & italics***

		Participate	
		Inclusion	Exclusion
Witness	Inclusion	Inclusion; Inclusion (II) n = 11 Sex (M/F): 5/6 Age: 18.73 (.79)	Inclusion; Exclusion (IE) n = 11 Sex (M/F): 6/5 Age: 19.09 (1.38)
	Exclusion	Exclusion; Inclusion (EI) n = 11 Sex (M/F): 4/7 Age: 18.64 (.81)	Exclusion; Exclusion (EE) n = 11 Sex (M/F): 2/9 Age: 19.09 (1.22)

Figure 1. Demographic information by group including sex and mean (standard deviation) for age

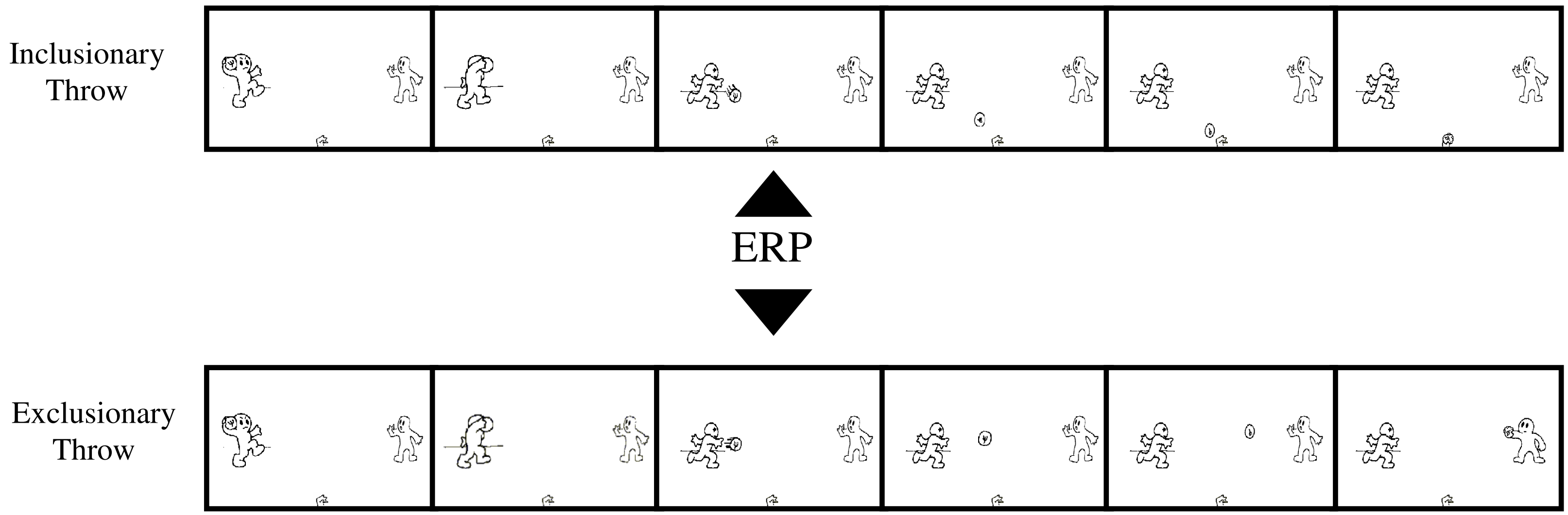

Figure 2. Frame-by-frame representation of inclusionary and exclusionary throws. Markers were inserted at the first informational frame providing information about the recipient of each throw.

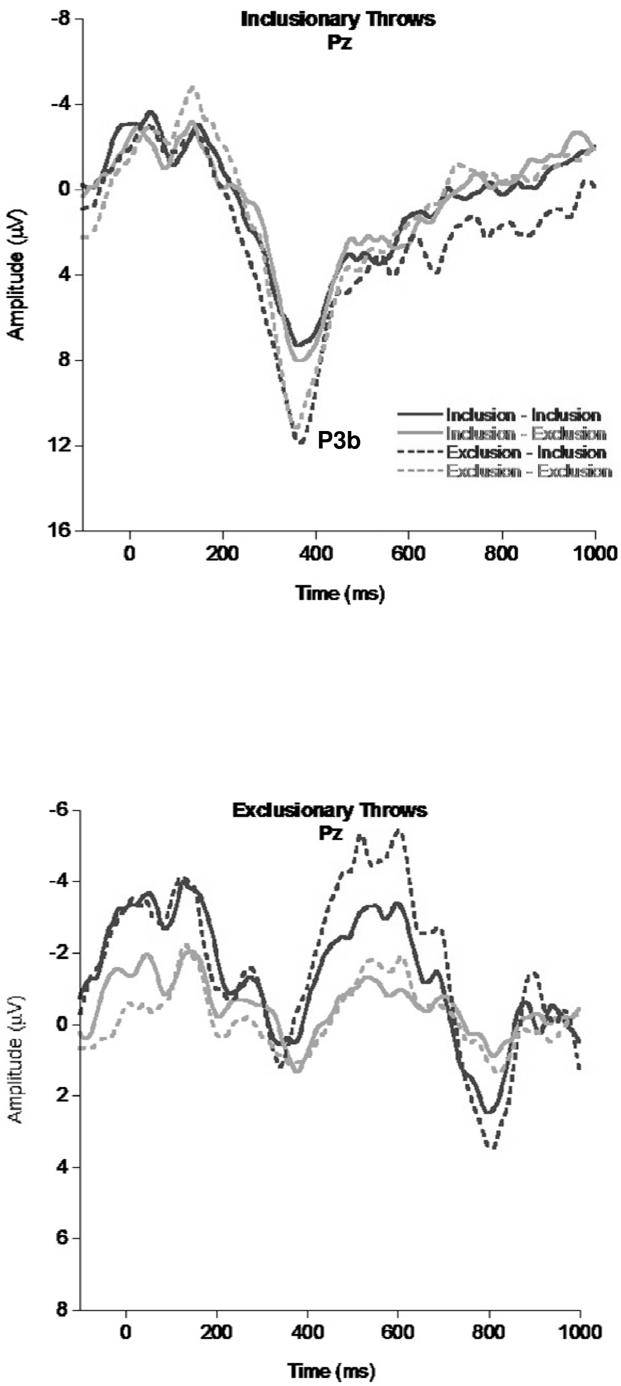

Figure 3. Grand-averaged stimulus-locked ERP waveforms for inclusionary and exclusionary throws by group at electrode site Pz (P3b component). Inclusion-Inclusion = witness inclusion, participate inclusion, Inclusion-Exclusion = witness inclusion, participate exclusion, Exclusion-Inclusion = witness exclusion, participate inclusion, Exclusion-Exclusion = witness exclusion, participate exclusion

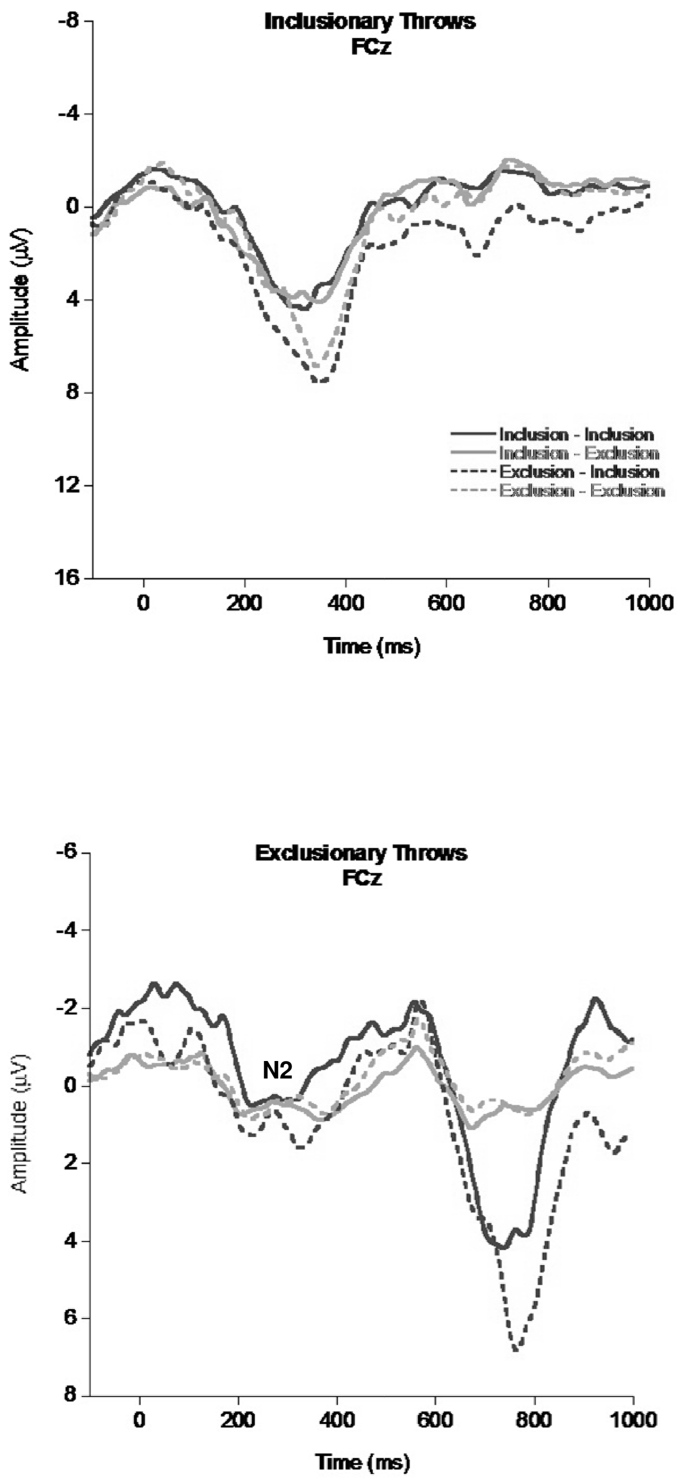

Figure 4. Grand-averaged stimulus-locked ERP waveforms for inclusionary and exclusionary throws by group at electrode site FCz (N2 component).