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The Effects of Social Ostracism on Frontal Lobe Electroencephalogram Activity

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Abstract

The need for social connections is so critical for psychological well being that the brain has evolved neural mechanisms that elicit a pain response whenever one is excluded from social situations. To determine the neural correlates of social ostracism, female college students ($N = 68$) entered a chat room environment where they experienced phases of inclusion and exclusion while their theta electroencephalographic (EEG) activity was recorded in the frontal lobe. Recordings were taken from three frontal regions (F3, Fz, and F4). Results indicated that the paradigm was successful in creating a feeling of exclusion in the participants. Participants contributed less to the conversation during the exclusion phase, and they also were less interested and enjoyed this phase less. EEG data further confirmed the experience of exclusion. Significant decreases in theta power were seen in the midline and left frontal regions in the exclusion phase as compared to the inclusion phase. Similar non-significant trends were also seen in the right frontal region. The differential EEG activity during inclusion and exclusion suggests that neural processing changes during an experience of social ostracism.

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As a species, human beings require social interactions and belonging as some of their most basic requirements. Maslow acknowledges this necessity by placing it early in his hierarchy of needs (Maslow, 1943). Evolutionarily, creating social bonds ensured protection for all group members, and pariahs faced overwhelming odds against success. Neuronal mechanisms have likewise evolved to provide incentive for individuals to seek and maintain social bonds (Eisenberger, Lieberman, & Williams, 2003; Eisenberger & Lieberman, 2004). Without social connections, individuals are more likely to have a mental illness as well as a shorter life span (House, Landis, Umberson, 1988). Ostracism involves losing social connectedness, as it is the experience of being ignored or excluded by others (Williams, 2001). Experiencing ostracism is common among school shooters, further emphasizing its damaging effects (Leary, Twenge, & Quinlivan, 2006). Given the significance of ostracism as a construct, the current study sought to investigate further how ostracism is processed in the brain, using electroencephalogram (EEG) activity. A situation of ostracism was created using a chat room where participants were excluded by two peers. There are many powerful consequences of experiencing ostracism, affecting both social and neurobiological systems. The social consequences manifest themselves as negative responses to emotional situations, and social interactions are subsequently altered after an experience of ostracism. The negative emotional response is processed by the brain, particularly in the anterior cingulate cortex (ACC), the amygdala, and the prefrontal cortex (PFC; LeDoux, 1996).

Social Effects of Ostracism

Ostracism is a common technique used by humans and non-human primates alike to promote appropriate social behaviors. One survey indicated that 67% of Americans had used "the silent treatment," a form of ostracism, against a loved one, and 75% had reported they had been the target of such ostracism (Faulkner, Williams, Sherman, & Williams, 1997 as cited in Williams, Cheung, & Choi, 2000). The high prevalence indicates its effectiveness as a punishment by making the experience of ostracism uncomfortable for the target; the negative emotional aspect consequently alters behavior in future interactions.

Reactions to ostracism. Psychologically, ostracism produces a myriad of negative effects. Williams (1997) proposed that ostracism jeopardizes four essential needs: belonging, self-esteem, control, and meaningful existence. These needs are paramount to being psychologically well-adjusted, and when they are threatened, depression, anxiety, stress, physical illness, and mental illness are common (Baumeister & Leary, 1995). Even the experience of short-term exclusion leads to negative mood, decreased acceptance, frustration, loneliness, boredom, and negative self-evaluations (Buckley, Winkel, & Leary, 2004; Geller, Goodstein, Silver, & Sternberg, 1974). The need to belong supersedes even monetary rewards. In a study where participants received monetary gains for being excluded, the negative effects of ostracism still occurred (van Beest & Williams, 2006).

The experience of anger and aggression after being excluded is well documented. The Surgeon General reported that social ostracism was the most significant risk factor leading to youth violence (Office of the Surgeon General, 2001). Other empirical results

support this finding. Following being told they were destined to end up alone, participants were more likely to prevent an individual who had previously evaluated them negatively from gaining a desired job. Participants were also more likely to blast this individual with an aversive noise following the negative evaluation (Twenge, Baumeister, Tice, & Stucke, 2001). Likewise, ostracized participants allocated significantly more hot sauce to the individual who had ostracized them as compared to included participants. In this research, it was clear that the allocated amount was unwanted and harmful to the recipient of the hot sauce, but the ostracized individual proceeded with the aggression (Warburton, Williams, & Cairns, 2006). However, it seems that allowing the individual some aspect of personal control following the experience of ostracism moderates the aggression (Leary et al., 2006; Warburton et al., 2006).

While anger and aggression may be obvious reactions to ostracism, conformity and other pro-social behaviors are also common responses (Williams et al., 2000). These responses allow the participant to recover from the experience of social ostracism and attempt to re-establish themselves in the group. These results follow Schachter's (1959) postulate that exclusion increases such pro-social tendencies as affiliation. These mechanisms most likely relate back to the evolutionary advantage of avoiding ostracism; re-establishing oneself with the group was the best chance for survival (Gruter & Masters, 1986). The long standing need for inclusion has lead to the development of neural mechanisms that encourage individuals to avoid ostracism, as it elicits a pain response.

Neurobiological Effects of Ostracism

Ostracism affects brain structures and patterns which underlie the multitude of negative psychological outcomes from this experience. Being rejected may be described as experiencing social pain, which has been shown to activate similar brain areas as physical pain (Eisenberger & Lieberman, 2004). Several studies have suggested that this common neural mechanism serves to be evolutionarily advantageous. Animals are likely to avoid ostracism and social pain because it is detrimental to their survival (Eisenberger et al., 2003; Kling, 1986; Panskepp, 1998; Raleigh & McGuire, 1986). The brain areas implicated in these constructs are the ACC, the amygdala, and the PFC, though activation in these areas may display hemispheric differences in the processing of emotion. Activation of these areas after an experience of ostracism can be studied using EEG, in particular the theta rhythm, as this waveform is implicated in emotional processing.

Anterior cingulate cortex. The processing of pain on a neural level has lead to a distinction between the sensory experience of pain from the affective experience of unpleasantness, and the ACC appears to play a role in the affective, but not the sensory aspects (Price, 2000; Rainville & Duncan, 1997). That is, the ACC is responsible for assigning a disagreeable or unpleasant component to the sensory stimuli causing the pain. This is evidenced by lesion studies, where patients with lesioned ACCs reported that they were able to feel pain, but that it did not bother them (Foltz & White, 1968 as cited in Eisenberger & Lieberman, 2004). These data further support the role of ACC activation during ostracism, as there is a negative emotional component to social ostracism with no sensory component of pain. Eisenberger et al. (2003) empirically confirmed the role of the ACC in social pain using fMRI. ACC activation was positively related to self-reports

of social distress during the exclusion. Connections between physical and social pain were further demonstrated by finding that pain sensitivity was directly related to the social distress and other negative outcomes of being ostracized. Participants who were more sensitive to physical pain were also more distressed by social ostracism (Eisenberger, Jarcho, Lieberman, & Naliboff, 2006).

Activation of the ACC occurs even when ostracism is not explicit. Using a virtual ball tossing game and functional magnetic resonance imaging (fMRI), Eisenberger et al. (2003) found that participants demonstrated similar brain activity as that seen in the overt ostracism condition when they were told that they were not included due to technical difficulties. Distress was also correlated with the ACC activation during the explicit exclusion, indicating a relationship between these factors. This demonstrates that any exclusion at all, intentional or unintentional, elicits a response in the ACC indicating that something is wrong. Similarly, Zadro, Williams, & Richardson (2004) established that when participants were told that they were excluded by a computer program, or if they were told that the exclusion was scripted, the same outcomes occurred. The powerful need for inclusion on a biological level appears to take precedence over logical justifications for the exclusion. ACC activation is responsible for eliciting a pain response once it receives emotional input, which it gets from subcortical areas, such as the amygdala.

Amygdala. The amygdala is an essential structure for emotional processing. It is generally accepted that the amygdala assigns an affective component to sensory information received by the brain. When the amygdala is lesioned, animals were found to have a decreased fear response as well as impaired social behavior (Kolb & Whishaw,

1996). When the amygdala is lesioned in humans, difficulties are seen in recognizing emotion in facial expressions (Adolphs, Tranel, Damasio, & Damasio, 1995). Imaging studies provide further evidence for amygdala activation during emotional situations. When people are shown fearful, angry, or disgusting images, amygdala activation ensues (Hamann, Ely, Hoffman, & Kilts, 2000). Amygdala activation occurs even when emotional stimuli are processed subconsciously. Rats and humans alike produce emotional responses to stimuli they were not consciously aware of due to lesions in the sensory cortices (Anders et al., 2004; LeDoux, 1996). These data confirm the role of the amygdala in the neural processing of emotion.

Connections with other brain structures elucidate how the amygdala processes emotion. The amygdala receives information via two routes: one directly from the thalamus (the sensory relay station) and another that travels to the sensory cortices and then back to the amygdala (Davis, 1992). The initial affective judgment and reaction follows from the information coming directly from the thalamus. The connections with cortical areas allow the amygdala to reassess the primary emotional reaction and determine its appropriateness. This communication between the amygdala and the cerebral cortex is essential for accurate emotional processing.

Prefrontal cortex. The PFC is one of the cortical areas that receive input from the amygdala, and it is responsible for the conscious experience of emotion. The PFC is the interface between the control exerted by the ACC and the primal response to aversive emotions in the amygdala. The PFC receives emotional input from the amygdala and passes it through efferent connections to other cortical areas, including the ACC (Lewis & Todd, 2005). Hariri, Bookheimer, and Mazziotta (2000) demonstrated a relationship

between regional cerebral blood flow between the amygdala and the PFC in response to emotional facial expressions. The PFC likewise has connections to the ACC. Its connections to these structures implicate its regulatory role in social and physical pain.

While the ACC is involved in the affective component of pain, the PFC is involved in higher cognitive processes, such as motivation, planning, and worrying in response to pain (Gray, 2007). Goal directed behaviors, such as making changes to avoid pain in the future, require PFC activation (Cardinal, Parkinson, Hall, & Everitt, 2002). PFC activation may relate to either the anger/aggression or the pro-social responses to ostracism. Because of this, the PFC is said to underlie secondary emotional processing.

Further evidence implicates the PFC in social and emotional processing. PFC activation is seen using positron emission tomography (PET) while participants read emotional scripts (Schaefer et al., 2003). Similarly, activation of the PFC is seen in individuals with social phobias prior to public speaking, indicating a role in affective processes (Davidson, Marshall, Tomarken, & Henriques, 2000 as cited in Tillfors, 2004). Compared with controls in a neutral mood, participants in either an elevated or depressed mood demonstrated increased regional cerebral blood flow (rCBF) in the PFC (Baker, Frith, & Dolan, 1997). Conversely, decreased activation of the PFC is seen criminal psychopaths, suggesting a lack of emotional processing in these individuals (Veit et al., 2002 as cited in Tillfors, 2004).

However, the PFC does not process emotion holistically, and hemispheric differences are noted. In particular, the right ventral prefrontal cortex (RVPFC) is involved in pain processing. In Eisenberger et al. (2003), RVPFC activation was negatively correlated with ACC activity during explicit exclusion. However, no RVPFC

activation was seen during implicit exclusion, demonstrating that although the ACC recognized the exclusion, a regulatory response by the RVPFC did not occur because the exclusion was not overt. Activation of the RVPFC has been linked to the reduction of pain in other contexts as well. Electrically stimulating the RVPFC reduces pain behaviors following a painful stimulus in rats (Zhang, Tang, Yuan, & Jia, 1997). Also, increased RVPFC activation correlated with pain improvement during a placebo study (Lieberman et al., 2004).

Hemispheric differences. The lateralization of function of the two hemispheres extends beyond the RVPFC to incorporate emotional processing in its entirety. The valence hypothesis suggests that positive and negative emotions are processed by the left and right hemispheres, respectively. Adolphs, Damasio, Tranel, and Damasio (1996) analyzed the ability of patients with unilateral damage and found that patients with right hemisphere lesions were impaired in their ability to recognize fear and other negative emotions, such as sadness. Reaction time, event-related potential (ERP), and implicit attitude data all support this hypothesis that negative emotions are processed more efficiently by the right hemisphere as compared to the left (Borkenau & Mauer, 2006; Pizzagalli, Regard, & Lehmann, 1999; Sato & Aoki, 2006).

The existing neurophysiological data have not investigated the valence hypothesis with regards to ostracism, which has been shown to cause negative emotions. However, hemispheric differences have been noted within electrical activity in the brain with regards to emotional processing, suggesting that differential activity may be seen hemispherically. While this hypothesis has empirical support, it is not without its critics. Some researchers argue that motivation, and not affect, is what contributes to the lateral

differences (Harmon-Jones & Allen, 1998). More support is needed to fully justify or discredit this hypothesis.

Electroencephalogram Activity- Theta

EEG machines record electrical activity of the brain by placing electrodes on the scalp that detect the voltage of the underlying brain area; the wavelengths detected correspond with the activity occurring in that region (Kolb & Whishaw, 1996). Wavelengths detected by EEG represent a large population of neurons firing in synchrony. The theta rhythm is one waveform detected by an EEG machine; its frequency is between four and eight Hertz (Hz; cycles per second). The theta rhythm is thought to play a significant role in the induction of long-term potentiation (LTP), a method by which neuronal connections are strengthened (Hasselmo, Bodelon, & Wyble, 2002). LTP is considered to be a cellular mechanism underlying learning and memory. Theta activity has been studied extensively in both animal and human models, providing a solid background for its role in emotion and behavior.

Theta activity has significance in emotional processing. For example, theta rhythms are particularly prevalent in the amygdala during fear conditioning (Pape, Narayanan, Smid, Stork, & Seidenbecher, 2005). The theta waveform has likewise been linked to discerning emotional stimuli in humans, with greater activity in the right hemisphere than the left (Nishitani, 2003 as cited in Knyazev, 2007). These findings are consistent with the valence hypothesis. Theta power, or the amplitude of the wave, has also been shown to increase when individuals are presented with emotionally charged, as opposed to neutral, stimuli (Doppelmayr et al., 2002 as cited in Knayazev, 2007). The

increase in theta power reflects an increase in neural synchrony in the region investigated (Klimesch, 1999).

Theta activity occurs in the ACC and PFC, and the rhythms produced reflect the activity of these brain areas (Asada, Fukuda, Tsunoda, Yamaguchi, & Tonoike, 1999). Theta is also seen in the amygdala; however this research has been done with animals because of limitations of electrical recording in subcortical structures in humans. In the ACC, changes in theta activity have been found during conflict monitoring, or knowing that something is wrong (Tzur & Berger, 2007). Other functions of the ACC, such as recognizing ostracism, could potentially induce theta changes as well. Theta activity has likewise been noted in the prefrontal cortex, and the activity correlates with emotional regulation (Knyazev, 2007). Individuals with ADHD demonstrate increased frontal lobe theta activity, implicating its role in impulsive behaviors (Bresnahan, Anderson, & Barry, 1999). Theta activity has not yet been studied in relation to ostracism, though it would be an appropriate measure as it plays a role in the brain regions thought to be involved with this construct. The various paradigms employed to study ostracism have, however, addressed a number of other issues that elucidate emotional reactions to exclusion.

Mechanisms of Studying Ostracism

Ostracism has been studied using a variety of methods within the laboratory setting. Some studies have been able to document the negative reactions to ostracism using indirect means. These designs included imagining a situation in which the participant had either given or received the silent treatment, having participants provide a narrative of a time in their personal lives where they were ostracized, and providing bogus feedback or evaluations to the participant from others regarding their opinion of

the participant (Buckley et al., 2004; Sommer et al., 2001). In other paradigms, the participant is actively excluded. Williams (2001) describes the methodology in detail, but it entails having an impromptu ball tossing game, in which two confederates actively pass a ball back and forth, failing to recognize the participant's presence. Other studies have utilized a makeshift train in which the participant sits in between two confederates. The confederates engage in a conversation without including the participant (Zadro, Williams, & Richardson, 2005). Recently, technological advances have enabled the Internet to be used to study ostracism.

The invention of the Internet has revolutionized communication, and research regarding social behavior has utilized its popularity to expand its capacities. Williams et al. (2000) began using the Internet to study ostracism through two means: a virtual interactive game, Cyberball, as well as through a chat room. The initial research helped clarify many issues relating to this new medium. Both forms of cyberostracism (Cyberball and the chat room) produced the expected negative responses to being rejected, in particular decreases in self-esteem, decreased control, negative mood, and greater discomfort in the situation. In a direct comparison of cyberostracism and to face-to-face ostracism, few differences were found between the methodologies in terms of producing the same reactions to ostracism, demonstrating the effectiveness of these online methodologies (Williams et al., 2002). The similarity of effects in term of psychological outcome variables and manipulation checks validates cyberostracism as a method for investigating social ostracism and its implications. Chat rooms, in particular, present a setting within which ostracism can naturally occur. It is quite feasible to imagine an individual being excluded from a conversation within a chat room setting.

Current Research

The aim of the current research was to use a chat room paradigm to examine the effects of being ostracized on EEG activity, particularly the theta rhythm. These methods addressed the issues of external validity found in previous research as well as provided further evidence for the effects of exclusion, a common occurrence in social interactions. Previous studies investigating the neurobiology of ostracism have utilized fMRI, which allows for the imaging of brain activity. However, the confines of the machine prevent a realistic experience of ostracism from occurring, as participants are lying stationary and flat on their backs. Using EEG to assess brain functioning addressed these issues because it is a relatively noninvasive procedure; this allowed participants to behave quite naturally within the chat room setting. The chat room environment was a realistic setting for the experience of ostracism given the popularity of the Internet as a medium for communication, and it was also ideal for collecting EEG data since participants are relatively stationary. It was hypothesized that the experience of social exclusion would alter theta power and frequency as compared with periods of inclusion, reflecting activation of the ACC and the PFC during these phases.

Method

Participants

Sixty-eight female participants, between the ages of 18 and 23 (M = 19.0, SD = 1.13), were recruited from General Psychology sections at Illinois Wesleyan University in Bloomington, Illinois. Sixty-six of these participants completed the EEG portion of the experiment, and 62 of these participants completed every measure entirely. Participants

received two research experiencing program (REP) credits for their participation in this experiment.

Year in school and area of study varied across many domains; all classes were represented, and the sample contained over 30 major areas of study. Of the 68 participants, 42.6% (29) were freshman, 35.3% (24) were sophomores, 8.8% (6) were juniors, 11.8% (8) were seniors, and 1.5% (1) participant did not provide their year in school. The majority of the participants were Caucasian (72.1%; 49 participants), with African (4.4%; 3 participants), Asian (5.9%; 4 participants), and mixed ethnicity representation (2.9%; 2 participants) as well; 14.7% (10) of the participants did not disclose their ethnicity. Most participants reported being right handed (85.3%; 58 participants); a few were left-handed (13.2%; 9 participants), and one participant (1.5%) reported being ambidextrous.

Procedure

The experiment was conducted in a psychology research laboratory at Illinois Wesleyan University in Bloomington, Illinois. The laboratory contained two computers and a one-way mirror which connected to an adjacent room where the experimenters were located. The EEG data was collected on a computer in the experimenter room. Participants were told that the study examined the relationship between personality and communication styles and their EEG correlates, using an internet chat room setting. The actual goal of this research was to examine EEG correlates of experiencing social ostracism within a chat room paradigm. The cover story was given to ensure that the reaction to being ostracized was genuine. Participants were asked if they had any prior knowledge of the experiment, and if they had, their data would have been analyzed

separately to prevent contamination (for a script of introducing the participant, see Appendix A). However, no participants indicated that they had any prior knowledge of the experiment. Participants were told that they would be in a chat room with two other students: one from the University of Illinois at Urbana-Champaign and one from Illinois State University. They believed that the other students were concurrently undergoing the same procedure. In actuality, the confederates were enacted by two research assistants (see Appendix B for details about the confederate chat room members).

After informed consent was obtained, demographic information and personality questionnaires (measuring locus of control and sociability, among others) were administered (see Appendix C). A video camera was also set up and permission was granted by the participants to record chat room activity. However, the video recordings and personality measures were analyzed for another experiment, and the results will not be discussed here.

Participants were then seated in front of a computer and given time to fill out their online profile for the chat room. A picture of the participant was taken using a digital camera, and the picture was added by a research assistant to their online profile. The profile consisted of nickname, age, gender, university, favorite movies, favorite books, favorite bands, favorite sports, and activities/interests. Participants were able to view the online profiles of the other chat room members, and the participant also believed that the other participants would be viewing their profile (see Appendix B for examples of online profiles).

To enhance the cover story that this research was being conducted in conjunction with other universities, a phone call was staged in the presence of the participant. A

phone in the research lab rang while the participant was filling out their personality measures, and an experimenter pretended to talk to another researcher at Illinois State University (for a script of the conversation, see Appendix D).

EEG Recording

While the participant was filling in their online profile, an experimenter attached the EEG cap. The procedure for attaching the EEG cap followed the guidelines from the instruction manual provided by the Electro-Cap International, Inc. (Eaton, OH). The circumference of the head was measured in centimeters from the center of the forehead to the back of the inion, the part of the back of the skull protruding out; this determined the size of cap the participant needed. Measurements were collected with a cloth measuring tape. If the measurement was between 54 and 58 centimeters, the medium sized cap was appropriate. The large sized cap was used for head circumferences between 58 and 62 centimeters.

The next measurement obtained was from the nasion, the point between the eyebrows where the two skull bones fuse, to the inion. This was collected in centimeters as well, and the initial measurement was multiplied by 0.1. The new measurement was used to determine electrode placement on the participant's forehead. The obtained distance was measured up from the nasion, and markings were made on the forehead, indicating electrode placement. Two sponge pads were placed on the FP1 and FP2 electrodes, and the sponges were placed over the markings previously made. The cap was then pulled over the participant's head, and the chin strap was adjusted for a secure fit. The gel was added next to electrodes at areas F3, Fz, and F4 (see Appendix E). The gel was applied using a syringe with a blunt needle, and enough gel was added so that it

filled the electrode. Participants were given the opportunity to feel the needle to reduce any distress caused by the syringe. The needle was used to massage the gel into the scalp, and good connectivity was ensured before EEG recording began. A small amount of gel was added to a grounding electrode, which was placed on the participant's left earlobe.

The cap was connected next to a computer in an adjacent room which collected the data. The program *AcqKnowledge 3.9.0* was used to collect the EEG data. The chat room portion of the experiment began as soon as the EEG cap was ready.

Chat Room

The chat room had four members: the participant, two confederates, and an administrator. The participant was told that the administrator was independent from any of the universities involved, and it was the administrator who was responsible for providing all instructions regarding chat room behavior. The confederates followed guidelines with regards to their conversation style and content of their communication in order to achieve consistency in their responses. Once all members entered the chat room, the administrator welcomed everyone and instructed the members to start the first phase of the chat room, which was labeled as the introduction phase. Members were told to introduce themselves, including major, year in school, hometown, and future plans. Each phase of the chat room lasted eight minutes. The next phase was labeled the inclusion phase, and the administrator instructed the members to talk about their interests and extracurricular activities. The third phase was the exclusion phase, where the topic was favorite television shows. The two confederates followed a script during this phase, and any communication from the participant was completely disregarded (for a copy of the script, see Appendix F). The script was developed during pilot testing, and was an actual

conversation between two prior participants. This ensured that the exclusion script followed a natural flow of a conversation. The final phase of the chat room, the re-inclusion phase, had the topic of ideal relationship or relationship partner. In all phases except the exclusion phase, the confederates strived to include the participant, referring to her by name as much as was feasible. The goal of these three phases was to have relatively equal participation by all chat room members.

At the end of every phase, the administrator announced that another paper measure was to be filled out; these measures were referred to as concurrent measures. These measures were a quick questionnaire gauging the participant's interest in the phase, the participant's assessment of the contributions of the other chat room members, the participant's assessment of their own contributions to the phase, and their enjoyment of the phase. The measures were kept in a manila folder on the participant's desk. These measures served as a manipulation check that the exclusion was effectively recognized by the participant. Participants were given one minute to complete this questionnaire after every phase of the chat room. In summary, the chat room portion of the experiment progressed as such: Introduction (8 minutes), concurrent measures (1 minute), inclusion (8 minutes), concurrent measures (1 minute), exclusion (8 minutes), concurrent measures (1 minute), re-inclusion (8 minutes), and concurrent measures (1 minute).

Once the final phase of the chat room was completed, the administrator instructed the participant to wait for a research assistant to assist with the removal of the EEG cap as well as bring the participant their final paper measure. This questionnaire assessed the participant's experience in the chat room as a whole, including their belief in the chat room paradigm and how aversive they found the experience to be. It also asked directly if

the participant felt excluded and their reactions to being excluded (see Appendix G for complete questionnaire). Following this questionnaire, participants completed an Implicit Association Task (IAT) on another computer in the research lab. This data was collected for another experiment, and the results are not discussed in this paper.

Following the IAT, participants were debriefed and dismissed. In the debriefing process, experimenters took care to assure the participant that it was simply the research design that warranted the exclusion. Participants were informed of the confederates and their role in the chat room. Given the sensitive nature of social ostracism, participants were encouraged to ask questions or express concerns during debriefing. Once the true purpose of the experiment was revealed to the participant, confidentiality was stressed.

Data Analysis

In order to determine if the social ostracism construct was successfully created, behavioral data was analyzed using planned comparison analyses. Behavioral data consisted of the concurrent measures, which assessed participants' enjoyment, interest, and perceived contribution to each phase, and the number of lines typed in each phase. The number of lines typed gave an objective measure of the participant's contribution. Three planned comparisons analyses were conducted between the different pairs of phases (inclusion- exclusion, exclusion- re-inclusion, inclusion- re-inclusion). The p value was set at .0167 for these analyses so that an overall p value of .05 was maintained.

All EEG data was manually inspected for excessive noise, and all non-neuronal activity was removed from the data file prior to analysis. Theta power and frequency were determined for each phase of the chat room (inclusion, exclusion, and re-inclusion) using power spectral density analysis. The maximum frequency between the four to eight

Hertz range was located in each individual phase, and the power (amplitude) was recorded at this point. These power spectral density analysis results were compared using three planned comparisons analyses (inclusion- exclusion, exclusion- re-inclusion, and inclusion- re-inclusion). The *p* value was set at .0167 for all analyses to maintain an overall *p* value of .05. These analyses determined whether the experience of social ostracism affected frontal lobe theta activity.

Planned comparisons analyses were performed instead of an omnibus analysis of variance (ANOVA) given that specific hypotheses existed regarding the individual phases. Based on previous research findings, the exclusion phase was expected to differentiate from the inclusion and re-inclusion phases with regards to the behavioral data and theta power and frequency. No differences were expected between the inclusion and re-inclusion phases. Type I error was controlled using a Bonferroni adjustment, and *p* values for each planned comparison analysis were set at .0167. This maintained an overall alpha value of .05.

Results

Behavioral Measures

To detect whether participants effectively perceived the period of exclusion, the concurrent measures were administered; these assessed enjoyment, interest in, and perceived contribution to the conversation in any given phase (Figure 1). No participants revealed that they had any prior knowledge of the experiment, so all data were analyzed together. In total, 65 participants completed the concurrent measures entirely. Planned comparisons analyses revealed significant differences in all three variables between inclusion and exclusion phases [enjoyment, $t(64) = 8.873$, $p = .000$;

interest, $t(64) = 7.081, p = .000$; perceived contribution, $t(64) = 9.482, p = .000$] and between exclusion and re-inclusion phases [enjoyment, $t(64) = -11.722, p = .000$; interest, $t(64) = -11.475, p = .000$; perceived contribution, $t(64) = -11.033, p = .000$]. In comparing the inclusion and the re-inclusion phases, there were significant differences in the enjoyment and interest in the phase, but there were no significant differences between inclusion and re-inclusion phases with regard to the participant's perceived contribution [enjoyment, $t(64) = -2.737, p = .008$; interest, $t(64) = -3.997, p = .000$; perceived contribution, $t(64) = -1.271, p = .208$] (Table 1). This suggests that enjoyment, interest, and level of participation decreased during the exclusion phase. The inclusion phase was also found to be less enjoyable and interesting than the re-inclusion phase, while there were no differences in the participants' perceived contribution between these two phases.

Motor activity was assessed to gain an objective look at the level of participation by the participant. Chat room conversations were saved, and lines typed were counted in each phase to determine the participation's actual contribution to the conversation (Figure 2). Due to experimenter error, four conversations were not saved. Given this, motor activity analyses were determined by $N = 62$. The lines counted in each phase were subjected to a planned comparisons analysis, which revealed significant differences between the inclusion and exclusion phases [$t(61) = 5.681, p = .000$], and the exclusion and re-inclusion phases [$t(61) = -7.220, p = .000$]. No significant differences between the inclusion and re-inclusion phases were found [$t(61) = -1.411, p = .163$] (Table 2). This indicates that during the exclusion phase, participants contributed less to the conversation than during the inclusion and re-inclusion phases.

EEG

The exclusion criteria for EEG analysis were determined *a priori*, and the value was set at 50%. That is, if half or more of the data from each phase was removed due to excessive noise, the participant was excluded from analysis. Also, inclusion in the analysis was dependent on having values of theta power and frequency in all three phases (inclusion, exclusion, and re-inclusion) in all recording regions (left, midline, and right). Due to these criteria, 31 participants were removed from analysis. Human error also resulted in the exclusion of the data from 13 additional participants. In these instances, either the experimenter failed to mark each phase of the chat room on the EEG data, or the cap was poorly placed on the participant, resulting in flat line data. The strict criteria for inclusion in the analyses decreased the participant population significantly, so data collected previously was included. There were no procedural differences in the collection of data from the previous experiment to the current paradigm. As a result, the left, midline, and right frontal theta power and frequency were determined by $N = 35$ and $N = 34$, respectively, during all planned comparisons analyses.

Theta power. Planned comparison analyses were conducted for theta power in each region (left, midline, right) between all three pairs of phases (inclusion- exclusion, exclusion-re-inclusion, and inclusion-re-inclusion; Tables 3-5). Significant differences were found between the inclusion and exclusion phases in the left frontal [$t(34) = 2.683$, $p = .012$] and midline regions [$t(34)= 3.142$, $p = .003$] (Figures 3-4). No significant differences were found between the inclusion and exclusion phases in the right frontal region, though the results show a trend toward significance [$t(34)= 2.468$, $p = .019$; Figure 5]. In comparing the exclusion phase to the re-inclusion phase, no significant

differences were found in any of the regions [left, $t(34) = -.596$, $p = .556$; midline, $t(34) = -1.043$, $p = .304$; right, $t(34) = -1.508$, $p = .141$]. Likewise, no significant differences were found in any of the regions in comparing the inclusion phase to the re-inclusion phase [left, $t(34) = .162$, $p = .872$; midline, $t(34) = 1.827$, $p = .076$; right, $t(34) = 1.343$, $p = .188$]. These results indicate a decrease in theta power during the exclusion phase as compared to the inclusion phase in the midline and left frontal region.

Theta frequency. A series of planned comparisons analyses were conducted on theta frequency in all three regions during the phases of the chat room (Tables 6-8). In comparing the inclusion to exclusion phase, no significant differences were found in any of the regions [left, $t(33) = .111$, $p = .912$; midline, $t(33) = .515$, $p = .610$; right, $t(33) = 1.382$, $p = .176$]. No differences were seen in comparing the exclusion phase to the re-inclusion phase as well [left, $t(33) = 1.314$, $p = .198$; midline, $t(33) = -1.340$, $p = .189$; right, $t(33) = -2.233$, $p = .032$]. Similarly, there were no significant differences in theta frequency between the inclusion and re-inclusion phases in any of the regions investigated [left, $t(33) = 1.324$, $p = .195$; midline, $t(33) = -.732$, $p = .469$; right, $t(33) = -1.244$, $p = .222$] (Figures 6-8). This suggests that theta frequency was not affected by the experience of exclusion.

Discussion

The hypothesis that frontal lobe EEG activity would change as a result of experiencing social ostracism was supported. Theta power was lower in the exclusion phase in the midline and left frontal regions than in the inclusion phase. Trends towards significance were also seen in the right frontal region, with decreased theta power during the exclusion phase as compared to the inclusion phase. No significant differences were

seen in theta power or frequency between the exclusion and re-inclusion phases or the inclusion and re-inclusion phases in any brain region. There were also no significant differences in theta frequency between the inclusion and exclusion phases in any brain region.

The stability of theta frequency throughout the various phases of the chat room is not surprising. Klimesch (1999) acknowledges that EEG recording in humans makes it very difficult or almost impossible to detect changes in theta frequency. When detected, changes in theta frequency are most commonly associated with changes in memory load, as the theta rhythm is involved with the induction of long-term potentiation (LTP; Hasselmo et al., 2002). However, theta power was the primary focus of the data analysis, and these results indicated that the exclusion phase had an effect on frontal lobe EEG. Effects of the exclusion phase are further highlighted by the behavioral data results.

The behavioral data results indicate that the exclusion phase was distinct from the other phases of the chat room. Participants enjoyed the exclusion phase less than the other phases. They were less interested and contributed less to the conversation in this phase as well. These findings suggest that the exclusion was accurately perceived, and participants responded to the exclusion in the expected manner. Geller et al. (1974) saw great decreases in conversation participation after only four minutes, and almost three-fourths of their participants reported feeling ignored after 10 minutes of exclusion. Williams and Gerber (2005) report that many other experiments have demonstrated a negative response to ostracism after only a few minutes of the manipulation as well. Other common responses to ostracism include emotional distress, decreases in self-esteem, and decreases in confidence (Buckley et al., 2004). Given the decreases in

enjoyment, interest, and contribution during the exclusion phases, it appears that the chat room effectively produced a feeling of exclusion.

Success of Social Ostracism Construct

Prior to its implementation, one major concern for this experiment was whether or not the participants would recognize that they had been excluded and subsequently, would react in an appropriate manner after the exclusion. Williams (1997) developed a model of ostracism, which predicts that an experience of ostracism will threaten the need to belong, lower self-esteem, decrease feelings of control, and decrease the feeling of having a meaningful existence. It was essential that the chat room paradigm produce these feelings so that frontal lobe EEG activity could be assessed. Given the small general student body population at Illinois Wesleyan University, it would be possible for information regarding the true nature of the experiment to reach future participants. This could potentially change their reaction to the ostracism.

In order to address these concerns, experimenters took care to ask the participant if they had any previous knowledge of the experiment before the procedure began. If the participant was aware of the purpose of the experiment, they were not analyzed with the rest of the data. Fortunately, no participants revealed that they had any prior information about the experiment. During the debriefing period, experimenters stressed to the participants the importance of being discreet with the true nature of the experiment. Despite all of these precautions, it is still possible that participants were aware that they were going to be excluded prior to their participation.

However, even if participants had come into the experiment with certain expectations, it is not likely that their reactions to ostracism would have differed

significantly than if they were excluded with no expectations. Zadro et al. (2004) found no differences in the reactions to ostracism between those who thought the ostracism was unscripted to those who knew it was scripted. This indicates that even having a rational explanation for why one is being excluded is not enough to prevent the negative outcomes. This is further supported by fMRI data that showed activation of the anterior cingulated cortex (ACC) while participants are implicitly excluded (Eisenberger et al., 2003). This activation occurred when participants were told that they could not engage in a virtual ball tossing task due to technical difficulties; they simply had to watch two other individuals toss the ball. This situation of implicit exclusion was enough to elicit a neural response, indicating some level of social pain.

Even though implicit and explicit ostracism produce similar results, the behavioral data collected indicates that the experiment successfully created an experience of ostracism. The ostracism was overt, and participants responded in ways in accordance with the previous literature. Participants self-reported the exclusion phase to be less enjoyable, interesting, and they felt they contributed less to the conversation during this phase. Objectively, participants also typed significantly less lines during this phase. All measures demonstrate that the chat room paradigm is an appropriate method for creating feelings of exclusion.

Theta Power and Emotional Processing

The creation of an experience of exclusion resulted in changes in frontal lobe theta power. The decrease in theta power during the exclusion phase represents a decrease in neural synchrony in the midline and left frontal regions as compared to inclusion (Klimesch, 1999). Neural synchrony is thought to underlie complex information

processing, and it contributes to the generation of consciousness (Ward, Doesburg, Kitajo, MacLean, & Roggeveen, 2006). Exclusion leads to a decrease in the synchronization of neurons in the frontal lobe. This opposes previous research findings. Aftanas, Pavlov, Reva and Varlamov (2004) reported increases in theta power in response to emotionally charged stimuli. Likewise, theta band synchronization following emotional stimulation through visual means has been noted (Krause, Viemerö, Rosenqvist, Sillanmäki, & Åström, 2000). However, these studies primarily investigated theta activity in parietal and occipital brain regions. It is possible that theta activity in the frontal lobe may differ from these regions, given its distinct role in emotional processing. The findings of the current study also oppose other hypothesis regarding emotional processing, such as the valence hypothesis.

The valence hypothesis was not supported by the results of this experiment. While decreases in activity were seen in the left hemisphere during the exclusion phase, theta power in the right hemisphere also decreased, although not significantly, during the exclusion phase. The valence hypothesis would have predicted an increase in EEG activity in the right frontal region during the exclusion phase, as this hypothesis suggests that the right hemisphere processes negative emotions more efficiently than the left hemisphere. However, this hypothesis has been challenged by research that implicates motivational aspects, and not emotional aspects, as contributing to the asymmetrical processing of emotion in the frontal lobe (Harmon-Jones & Allen, 1998). If motivation is the most significant factor affecting differential lateral processing, hemispheric differences would not be expected in relation to an experience of ostracism. The relationship between motivation and ostracism has yet to be elucidated. Given these

considerations, the results of this experiment are not an anomaly. Also, Davidson (2004) argues that frontal lobe involvement in emotional processing is only one portion of the system, and all brain regions involved with this processing need to be analyzed in conjunction with each other. In this aspect, the valence hypothesis in the frontal lobe is not satisfactory in explaining emotional processing. Further, data supporting the valence hypothesis have noted the lateralization of activity in more posterior regions of the brain, in parietal-temporal, parietal, and occipital regions (Aftanas et al., 2004).

Attentional and Motor Effects on Theta

Emotional input is not the only factor that can influence theta activity. Attention and motor activity can also affect theta. While participants recognized that they were being ostracized during the exclusion phase, it is also true that they were paying less attention to the conversation as well as typing less. Previous research has indicated that theta power increases in response to a mental task. In animals, increases in theta power correspond with increasing task demands in a memory task (Klimesch, 2004). In humans, theta activity was observed during various mental tasks in the midline (Fz) region. The authors hypothesized that theta originates in the anterior cingulate cortex (ACC) and the prefrontal cortex (PFC) in these circumstances (Asada et al., 1999). Thus, the decrease in theta power seen during the exclusion phase may reflect the lack of cognitive demands during this period.

Motor activity may also influence theta power. Bland (2004) has demonstrated changes in theta power in response to bar pressing in animals. Decreases in amplitude and frequency of EEG activity have also been seen in the hippocampus following small behavioral movements (Vanderwolf, 1969). Changes in amplitude and frequency vary

depending on the size of movement (Whishaw & Vanderwolf, 1973). Given this, motor activity cannot be ruled out as an influence on theta power without empirical support.

Thus, these variables need to be considered to ensure that the experience of exclusion is the sole factor contributing to the decrease in theta power during this phase. Concurrent projects within the laboratory have investigated both motor and cognitive, specifically attentional, aspects. In these tasks, participants performed long and short motor and cognitive tasks. The motor tasks involved typing sentences that appeared on the screen while the cognitive tasks involved reading a conversation and taking a quiz afterward to ensure they were paying attention. Efforts were made to conserve as much of the chat room environment, such as set up, number of lines in a conversation, and conversation topic, as possible. Their results indicate that cognitive and motor tasks did not affect theta power in the frontal lobe, meaning that the changes observed during the exclusion phase are the result of the experience of exclusion.

Reactions to the Exclusion Phase

The lack of differences in theta power between the exclusion and re-inclusion phases was a surprising finding. Based on pilot results, it was expected that the exclusion phase would yield completely different results from the both inclusion and re-inclusion phases. While all behavioral indices indicate that the participant felt included during the re-inclusion phase, there was not a recovery in theta power. It was expected that theta power would at least return to inclusion levels, or perhaps even be higher than in the inclusion phase, given that this phase yielded the most enjoyment and interest. The enduring neurobiological effects may reflect a slower recovery from the ostracism. This merits future research looking at discrepancies between behavioral and neural reactions

to ostracism, as they appear to be different. One way to address this issue may be to lengthen the time of the re-inclusion phase to determine when, if at all, theta power returns to inclusion levels.

However, personality variables may also influence how one responds to ostracism. Williams and Gerber (2005) have developed a model depicting stages of responses to ostracism, including both short term and long term reactions. The initial reaction is painful, with many negative psychological outcomes. However, the next stage of reaction involves learning to cope with the ostracism, and this can be modified by a number of personality variables. For example, individuals with high social anxiety do not recover from an experience of ostracism as quickly as those with low social anxiety (Zadro et al., 2006). Self-esteem is another variable that can modulate one's use of, and reaction to, ostracism (Sommer et al., 2001). As a concurrent project, many personality variables were investigated on all participants, and these data may elucidate more factors relating to the recovery from an experience of ostracism. Based on these findings, future studies may be warranted to investigate mediating factors affecting responses to exclusion. Regardless, the exclusion stood out distinctly from the inclusion phase. Other limitations are more pressing, such as the amount of non-neuronal activity in the EEG data.

Excessive Noise in the EEG Data

One major concern with this research was the excessive amount of noise in the EEG data leading to a significant number of participants being removed from data analysis. Contributing to this were the *a priori* criteria standards that required participants to have complete data in all phases in all three regions to be included in the analyses.

These standards ensured that all non-neuronal activity was eliminated from the data analyzed so that the within subjects design was not affected by missing data. Human error also contributed to participant attrition. Improper EEG cap attachment and failure to correctly mark phase changes in the EEG data caused a considerable number of participants to be excluded from analysis. More stringent training of the undergraduate research assistants responsible for data collection may help reduce this type of error.

However, the excessive noise may be, in part, a result of the nature of the experimental design. While typing at a computer does not require significant movement, recording EEG data is very sensitive. Any muscle movement is detected by the electrodes, skewing the data collection process. While participants were instructed to be as still as possible and to keep their hands on the keyboards at all times, it is unreasonable to assume that participants would be able to remain absolutely motionless for over 30 minutes of data collection. Further, EEG tasks for humans typically account for the sensitivity to movement by having their participants complete tasks using a response pad or by hitting a single key; very few studies actually require participants to type in a normal fashion (de Araújo, Baffa, & Wakai, 2002; Osipova et al., 2006; Tzur & Berger, 2007). However, this experiment required that participants be allowed this range of movement, and this extra movement likely contributed to the amount of noise seen in the data.

To compensate for the required movement during the chat room, experimenters extended the length of each phase. Phases were set at eight minutes with the understanding that noise would be inherently present in the data and require removal.

Despite the large amounts of non-neuronal activity, significant results were achieved, attesting to the robust nature of the experience of exclusion.

Limitations

Aside from the large amount of noise in the EEG data resulting in the excessive exclusion of data from analysis, one limitation of the experimental design was the lack of counterbalancing of conversation topics during the chat room phases. While this does not appear to have affected the successful creation of exclusion, it may have played a role in the differences between the inclusion and re-inclusion phases. Pilot results did not indicate any differences between these phases, but participants were found to rate their enjoyment and interest lower in the inclusion phase than the re-inclusion phase when the sample size was increased. The topic of the inclusion phase was interests and activities, while the topic of the re-inclusion phase was ideal relationship and relationship partner. The topic of the re-inclusion phase may have been intrinsically more enjoyable and interesting to the sample population of young adult females.

Since the exclusion phase was set apart from both the inclusion and re-inclusion phases with regards to enjoyment, interest, perceived contribution, and actual contribution, it can be assumed that the lack of counterbalancing of topics did not influence the creation of an exclusion experience. However, future research with this paradigm should include this counterbalancing to account for the differences between the inclusion and re-inclusion phases.

Future Research Directions

The current research created a new paradigm in which to study social ostracism; these methods are ideal for collecting EEG data, and the experimental design has wide

applications. The current study only included young adult female participants in their sample. Future directions may extend the sample population to include males. Sex differences have already been noted in reactions to ostracism; females look to socially compensate and make adjustments to be re-included in the group, while males tend to socially loaf and not make efforts to get back into the graces of other group members (Williams & Sommer, 1997). These differences may become apparent in the re-inclusion phase of the current paradigm. However, no sex differences have been found with regards to theta processing, which may indicate that sex differences are only apparent with the psychosocial aspect of being ostracized (Güntekin & Başar, 2007; Shepherd, 1982).

Including adolescents in the sample population is another potential future direction. Adolescence is a particularly vulnerable time, and experiencing exclusion by peers at this stage in life may be more damaging than it would be to older adults. Numerous examples abound in the literature linking inadequate social behaviors in adolescence with poor outcomes in adulthood. This formative time in one's life is especially susceptible to social influences. Likewise, the PFC is not fully developed in adolescents, which may impact how ostracism is processed by the brain (Huebner, 2000).

Another way to utilize the chat room setting would be to assess the role that attractiveness has in social ostracism. That is, if someone perceived to be attractive is the excluder, it may be more painful than if someone is ostracized by a less attractive individual. Research on attraction and social ostracism has not directly assessed this concept, though the perception of one's own attractiveness has been shown to relate to one's sensitivity to being rejected (Park, 2007). Using the online profile portion of the chat room would allow for this investigation. Uploading pictures of the participant and

other chat room members are already staples in the experimental design, and altering the attractiveness of other chat room members could be carried out easily.

Finally, assessing the length of time for the perception of ostracism to occur may be an avenue for future research. Given that ostracism results in behavioral and neurobiological effects, it would be useful to investigate the time frame for the occurrence of these effects. One way to achieve this within the current experimental design would be to analyze the first half of the exclusion phase separately from the second half of the phase. If decreases are noted in theta power during the first half of the exclusion phase, it would indicate that humans are very sensitive to this construct, and react quickly to its occurrence. However, it may be that more time is needed to accurately perceive that one is being ostracized, in which case theta power changes would not be noted until the second half of the exclusion phase.

Conclusions

Ostracism is a powerful mechanism on both a social and neurobiological level. This experiment successfully created an experience of ostracism for its participants, as changes in enjoyment, interest, participation in the conversation, and frontal lobe EEG activity were noted. These changes implicate frontal brain regions in the processing of social pain. While the experimental design it not without limitations, it puts in place the framework for future investigations. Research on social ostracism and its implications will allow for a better understanding of this damaging social phenomenon.

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Appendix A

Script for Introduction

Hi, I'm (insert your name here), and we are upstairs today, so let's head on up. So, just to give you a little background on what we're doing today, we're looking at the effect of different communication styles on EEG activity and to see if there is a relationship between personality types and communication styles. To test this we've created a chat room with ISU and U of I, and today you're going to be talking to a student from each of these universities in our chat room. You will be given topics and you're just going to be talking to these two other participants. You are going to be hooked up to and EEG machine during your conversations so we can observe what areas of your brain are active when you're chatting online versus the areas that research has shown are activated during verbal conversations. We're also going to give you some measures before, during, and after the chat room experience to look at personality types in relation to chat room conversational behavior. Any questions?

Appendix B

Confederate Characteristics

Nickname: Steph

Age: 18

Gender: Female

University: Illinois State University

Favorite Movies: The Big Lebowski, Bridget Jones Diary 1 and 2

Favorite Books: The Great Gatsby, Fountain Head, and The Brothers K

Favorite Bands: Johnny Cash, Willie Nelson, and Bob Dylan

Favorite Sports: Running, Intramural softball

Activities/Interests: shopping!!!

Nickname: Jenny

Age: 19

Gender: Female

University: University of Illinois- Urbana-Champaign

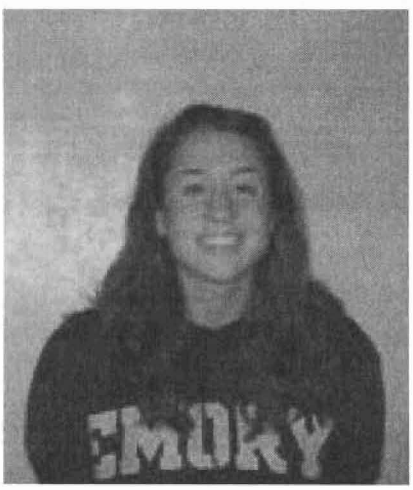
Favorite Movies: Pirates of the Caribbean, Wedding Planner

Favorite Books: Harry Potter, Lord of the Rings

Favorite Bands: DMB, SR71, John Mayer

Favorite Sports: I'm not really that athletic :)

Activities/Interests: Choir, Volunteering for Habitat for Humanity, Watching movies, hanging out with friends



Appendix C

Demographic Information and Personality Questionnaires

Demographic Information

Age _______

Year in School: ____________________

Ethnicity (optional): _________________________

Right or left handed: ____________________

Major(s): _____________________________

____

Minor(s): _____________________________

____

Loneliness

Instructions: The following statements describe how people sometimes feel. For each statement, please indicate how often you feel the way described by writing a number in the space provided. Here is an example:

How often do you feel happy?
If you never felt happy, you would respond "never"; if you always feel happy, you would respond "always".

1	2	3	4
NEVER	RARELY	SOMETIMES	ALWAYS

____ 1. How often do you feel you are "in tune" with people around you?

____ 2. How often do you feel you lack companionship?

____ 3. How often do you feel there is no one you can turn to?

____ 4. How often do you feel alone?

____ 5. How often do you feel part of a group of friends?

____ 6. How often do you feel you have a lot in common with the people around you?

____ 7. How often do you feel you are no longer close to anyone?

____ 8. How often do you feel your interests and ideas are not shared by those around you?

____ 9. How often do you feel outgoing and friendly?

____ 10. How often do you feel close to people?

____ 11. How often do you feel left out?

____ 12. How often do you feel your relationships with others are not meaningful?

____ 13. How often do you feel no one really knows you well?

____ 14. How often do you feel isolated from others?

____ 15. How often do you feel you can find companionship when you want it?

____ 16. How often do you feel there are people who really understand you?

____ 17. How often do you feel shy?

____ 18. How often do you feel people are around you but not with you?

____ 19. How often do you feel there are people you can talk to?

____ 20. How often do you feel there are people you can turn to?

Fear of Negative Evaluation

Instructions: The following statements describe how people sometimes react to social situations. For each statement, please indicate how often you feel the way described by writing a number in the space provided. Here is an example:

I am excited to meet new people.
If you never feel excited to meet new people, you would respond "never"; if you always feel excited to meet new people, you would respond "always".

1	2	3	4	5
NOT AT ALL CHARACTERISITIC OF ME				EXTREMELY CHARACTERISTIC OF ME

____ 1. I worry about what people will think of me when I know it doesn't make any difference.

____ 2. I am unconcerned even if I know people are forming an unfavorable impression of me.

____ 3. I am frequently afraid of other people noting my shortcomings.

____ 4. I rarely worry about what kind of impression I am making on someone.

____ 5. I am afraid that others will not approve of me.

____ 6. I am afraid that people will find fault with me.

____ 7. Other people's opinions of me do not bother me.

____ 8. When I am talking to someone, I worry about what they may be thinking about me.

____ 9. I am usually worried about what kind of impression I make.

____ 10. If I know someone is judging me, it has little effect on me.

____ 11. Sometimes I think I am too concerned with what other people think of me.

____ 12. I often worry that I will say or do the wrong things.

Locus of Control

Instructions: Each following item contains two different statements. Please circle which statement you agree with more.

1. a. Children get into trouble because their parents punish them.
   b. The trouble with most children nowadays is that their parents are too easy with them.

2. a. Many of the unhappy things in people's lives are partly due to bad luck.
   b. People's misfortunes result from the mistakes they make.

3. a. One of the major reasons why we have wars is because people don't take enough interest in politics.
   b. There will always be wars, no matter how hard people try to prevent them

4. a. In the long run people get the respect they deserve in this world
   b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

5. a. The idea that teachers are unfair to students is nonsense.
   b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

6. a. Without the right breaks one cannot be an effective leader.
   b. Capable people who fail to become leaders have not taken advantage of their opportunities.

7. a. No matter how hard you try some people just don't like you.
   b. People who can't get others to like them don't understand how to get along with others.

8. a. Heredity plays the major role in determining one's personality.
   b. It is one's experiences in life which determine what one is like.

9. a. I have often found that what is going to happen will happen.
   b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10. a. In the case of the well-prepared student there is rarely if ever such a thing as an unfair test.
    b. Many times exam questions tend to be so unrelated to course work that studying is really useless.

11. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.

b. Getting a good job depends mainly on being in the right place at the right time.

12. a. The average citizen can have an influence in government decisions.
    b. This world is run by the few people in power, and there is not much the little guy can do about it.

13. a. When I make plans, I am almost certain that I can make them work.
    b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

14. a. There are certain people who are just no good.
    b. There is some good in everybody.

15. a. In my case getting what I want has little or nothing to do with luck.
    b. Many times we might just as well decide what to do by flipping a coin.

16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.
    b. Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.

17. a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand nor control.
    b. By taking an active part in political and social affairs, the people can control world events.

18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.
    b. There really is no such thing as "luck."

19. a. One should always be willing to admit mistakes.
    b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.
    b. How many friends you have depends on how nice a person you are.

21. a. In the long run the bad things that happen to us are balanced by the good ones.
    b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a. With enough effort we can wipe out political corruption.
    b. It is difficult for people to have much control over the things politicians do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.

b. There is a direct connection between how hard I study and the grades I get.

24. a. A good leader expects people to decide for themselves what they should do.
    b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.
    b. It is impossible for me to believe that chance or luck plays an important role in my life.

26. a. People are lonely because they don't try to be friendly.
    b. There's not much use in trying too hard to please people, if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.
    b. Team sports are an excellent way to build character.

28. a. What happens to me is my own doing.
    b. Sometimes I feel that I don't have enough control over the direction my life is taking.

29. a. Most of the time I can't understand why politicians behave the way they do.
    b. In the long run the people are responsible for bad government on a national as well as local level.

Social Competence

Instructions: The following items consist of statements about how people sometimes characterize themselves. For each statement, please indicate the extent to which the statement is characteristic of you. Here is an example:

I am excited to meet new people.

If you never feel excited to meet new people, you would respond, "not at all characteristic of me." If you always feel excited to meet new people, you would respond, "extremely characteristic of me."

1	2	3	4	5
NOT AT ALL CHARACTERISTIC OF ME				EXTREMELY CHARACTERISTIC OF ME

____ 1. I am not likely to speak to people until they speak to me.

____ 2. I would describe myself as self-confident.

____ 3. I feel confident about my appearance.

____ 4. I am a good mixer.

____ 5. When in a group of people, I have trouble thinking of the right things to say.

____ 6. When in a group of people, I usually do what the other wants rather than make suggestions.

____ 7. When I am in disagreement with other people, my opinion usually prevails.

____ 8. I would describe myself as one who attempts to master situations.

____ 9. Other people look up to me.

____10. I enjoy social gatherings just to be with people.

____ 11. I make a point of looking other people in the eye.

____ 12. I cannot seem to get others to notice me.

____13. I would rather not have very much responsibility for other people.

____ 14. I feel comfortable being approached by someone in a position of authority.

____ 15. I would describe myself as indecisive.

____ 16. I have no doubts about my social competence.

Instructions: Below are some statements regarding public issues with which some people agree and others disagree. Please give us your own opinion about these items, that is, whether you agree or disagree with the items as they stand. Please check in the appropriate black, as follows:

_____ A (Strongly Agree)
_____ a (Agree)
_____ U (Uncertain)
_____ d (Disagree)
_____ D (Strongly Disagree)

1) I worry about the future facing today's children.

    _____ A _____ a _____ U _____ d _____ D

2) Sometimes I have the feeling that other people are using me.

    _____ A _____ a _____ U _____ d _____ D

3) It is frightening to be responsible for the development of a little child.

    _____ A _____ a _____ U _____ d _____ D

4) There is little or nothing I can do towards preventing a major "shooting" war.

    _____ A _____ a _____ U _____ d _____ D

5) There are so many decisions that have to be made today that sometimes I could just "blow up."

    _____ A _____ a _____ U _____ d _____ D

6) There is little chance for promotion on the job unless a person gets a break.

    _____ A _____ a _____ U _____ d _____ D

7) We're so regimented today that there's not much room for choice even in personal matters.

    _____ A _____ a _____ U _____ d _____ D

8) The future looks very dismal.

    _____ A _____ a _____ U _____ d _____ D

9) We are just so many cogs in the machinery of life.

    _____ A _____ a _____ U _____ d _____ D

Instructions: For the next statements, decide whether it describes you or your situation or not. If it does seem to describe you or your situation mark it TRUE (T). If not, mark it FALSE (F).

_____ 1. I usually wait for a friend to call me up and invite me out before making plans to go anywhere.
_____ 2. Most of my friends understand my motives and reasoning.
_____ 3. I have at least one good friend of the same sex.
_____ 4. Some of my friends will stand by me in any difficulty.
_____ 5. My trying to have friends and to be liked seldom succeeds the way I would like it to.
_____ 6. I don't have many friends in the city where I live.
_____ 7. I don't feel that I can turn to my friends living around me if I need it.
_____ 8. My friends are generally interested in w hat I am doing, although not to the point of being nosy.
_____ 9. I allow myself to become close to my friends.
_____ 10. Few of my friends understand me the way I want to be understood.
_____ 11. A lot of my friendships ultimately turn out to be pretty disappointing.
_____ 12. I don't get invited out by friends as often as I'd really like.
_____ 13. Sometimes I wish I could connect to my friends on a deeper level than I do now.

Appendix D

Script for Phone Conversation

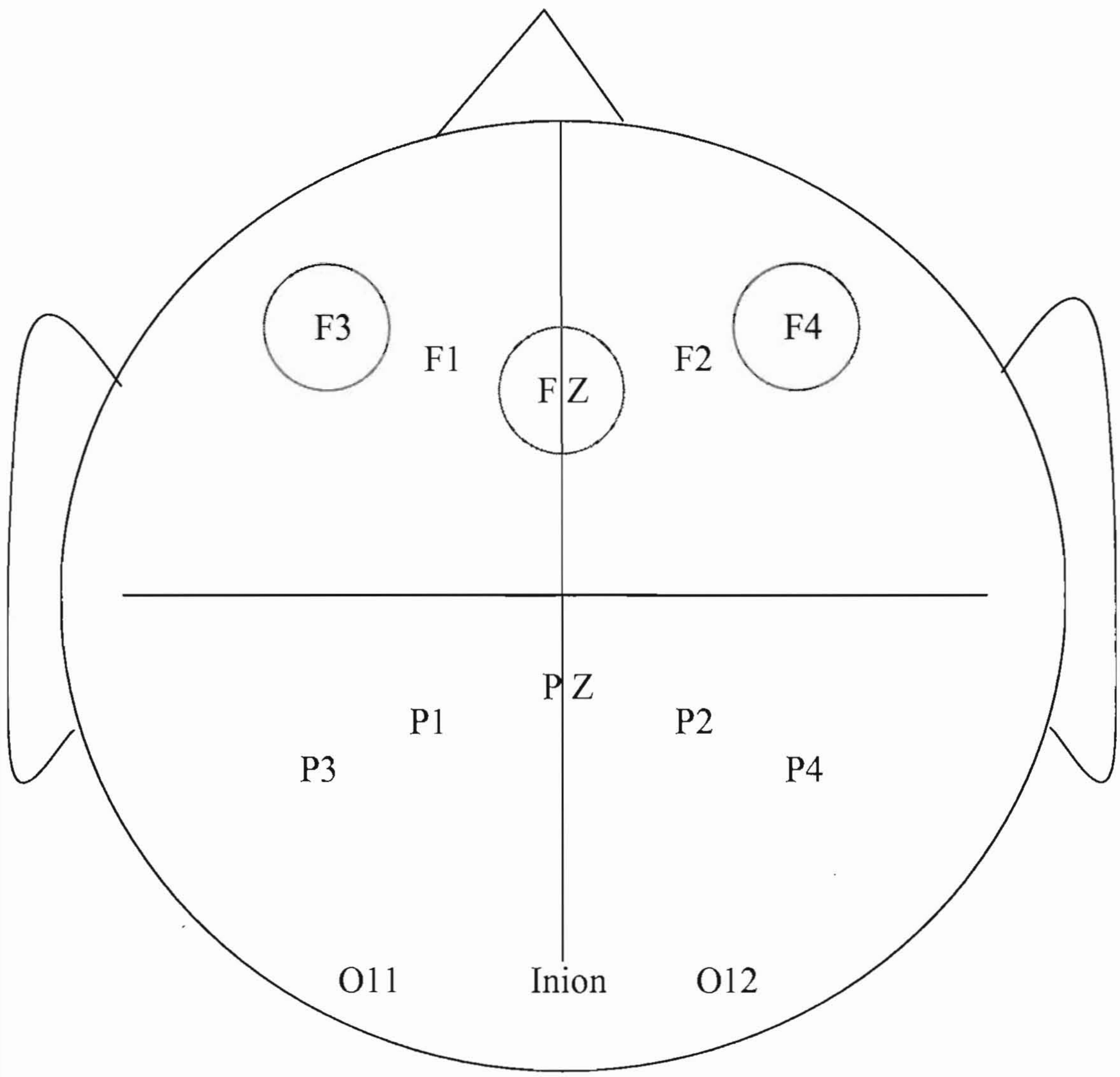
Phone rings

Once you pick it up say, "Hey Melissa." (short pause)

"Yep everything's going great here. We're just finishing up with the chat room profile and then she'll be ready to go. Is everything set over there? (pause) Ok, how about U of I, have you talked to their lab yet? (pause) Ok great. We'll be set in just a minute or two. Thanks. (pause) Bye.

Appendix E

Electrode Placement



Appendix F

Exclusion Script

Admin: Ok, time's up. Please take the next eight minutes to talk about your favorite TV shows.
Jenny: ok, well this is a hard one for me, I don't really watch tv shows regularly.
Steph: hmmm, I don't watch that much tv either.
Jenny: although I am obsessed with practically everything on the food network and the travel channel
Steph: when I was younger it used to be friends
Steph: haha the food network just makes me hungry
Jenny: see I never even got into friends
Steph: it was hard not to when that's all my friends ever talked about
Jenny: yeah I know what you mean
Steph: I think we watched seasons 1-6 in 3 weeks senior year of high school
Jenny: wow, that's impressive
Steph: Jenny have you ever watched america's next top model
Steph: that's a fun one I sometimes catch
Jenny: yep, that is a fun one
Jenny: before I came here I was watching the girls next door
Steph: I don't think I know that one
Steph: what is it about?
Jenny: its on E, and its about hugh hephners 3 girlfriends, its pretty stupid like all reality tv shows are but its amusing most of the time
Steph: oh hahaha…I think I have seen some previews for it
Steph: they are all blondes right?
Steph: that live at the mansion
Jenny: yep
Steph: reality tv is scarily addicting
Steph: I feel like I just get so wrapped up in it, even if I know its stupid
Jenny: yea I know, its definitely a love hate relationship
Steph: ☺
Steph: exactly
Jenny: yeah me too
Steph: there was a show on mtv last weekend that I got hooked on… I don't know the name
Steph: but the parents picked out 2 people for their kid to go on dates with
Jenny: oh I know that one steph, I can't remember the name either
Jenny: oh wait its called parental control
Steph: there was like a marathon of it on…bad news
Jenny: haha, no kidding

Appendix G

Post Chat Room Questionnaire

Instructions: To complete this survey, please rate each statement on its corresponding five-point scale. When you are finished, place face down in the folder provided. If you need extra room, please use the back side of the sheet.

1) How would you rate your experience in this experiment?

1	2	3	4	5
Didn't enjoy at all		Moderately enjoyed		Enjoyed immensely

2) How upsetting (aversive) did you find this experiment to be?

1	2	3	4	5
Not at all upsetting		Moderately upsetting		Extremely upsetting

3) If yes, what about the experiment in particular was upsetting (aversive) to you?

4) Would you choose to participate in this experiment again?

1	2	3	4	5
Definitely no		Maybe		Definitely yes

5) Would you recommend to a friend that they participate in this study?

1	2	3	4	5
Definitely no		Maybe		Definitely yes

6) How much like a real chat room was the chatting experience?

1	2	3	4	5
Not at all like it		A little like it		Just like a real chat room

7) Do you believe the experimenters were completely honest with you?

1	2	3	4	5
Definitely no		Maybe		Definitely yes

8) If not, in what ways do you think the experimenters were not honest?

9) Did you ever at any time feel left out of the chat room?

1	2	3	4	5
Definitely no		Maybe		Definitely yes

10) What was your reaction if/when you felt you were being left out of the chat room?

Table 1

Concurrent Measures Data Indicating Level of Enjoyment, Interest, and Perceived Contribution in Each Phase

Pairings	*t* value	*p* value
Level of Enjoyment		
Inclusion-Exclusion	8.873	.000*
Exclusion- Re-inclusion	-11.722	.000*
Inclusion- Re-inclusion	-2.737	.008*
Level of Interest		
Inclusion-Exclusion	7.081	.000*
Exclusion- Re-inclusion	-11.475	.000*
Inclusion- Re-inclusion	-3.997	.000*
Perceived Contribution		
Inclusion-Exclusion	9.482	.000*
Exclusion- Re-inclusion	-11.033	.000*
Inclusion- Re-inclusion	-1.271	.208

*$p < .0167$.

Table 2

Motor Activity (determined by the number of lines typed) in Each Phase

Pairing	*t* value	*p* value
Inclusion- Exclusion	5.681	.000*
Exclusion- Re-inclusion	-7.220	.000*
Inclusion- Re-inclusion	-1.411	.163

$^*p < .0167$.

Table 3

Planned Comparisons for Theta Power at the Left Frontal Region (F3)

Pairing	*t* value	*p* value
Inclusion- Exclusion	2.683	.012*
Exclusion- Re-inclusion	-.596	.356
Inclusion- Re-inclusion	.162	.872

$^{*}p < .0167$.

Table 4

Planned Comparisons for Theta Power at the Midline Region (Fz)

Pairing	*t* value	*p* value
Inclusion- Exclusion	3.142	.003*
Exclusion- Re-inclusion	-1.043	.304
Inclusion- Re-inclusion	1.827	.076

*$p < .0167$.

Table 5

Planned Comparisons for Theta Power at the Right Frontal Region (F4)

Pairing	*t* value	*p* value
Inclusion- Exclusion	2.468	.019
Exclusion- Re-inclusion	-1.508	.141
Inclusion- Re-inclusion	1.343	.188

Table 6

Planned Comparisons for Theta Frequency at the Left Frontal Region (F3)

Pairing	*t* value	*p* value
Inclusion- Exclusion	.111	.912
Exclusion- Re-inclusion	1.314	.198
Inclusion- Re-inclusion	1.324	.195

Table 7

Planned Comparisons for Theta Frequency at the Midline Region (Fz)

Pairing	*t* value	*p* value
Inclusion- Exclusion	.515	.610
Exclusion- Re-inclusion	-1.340	.189
Inclusion- Re-inclusion	-.732	.469

Table 8

Planned Comparisons for Theta Frequency at the Right Frontal Region (F4)

Pairing	*t* value	*p* value
Inclusion- Exclusion	1.382	.176
Exclusion- Re-inclusion	-2.233	.032
Inclusion- Re-inclusion	-1.244	.222

Figure Captions

Figure 1. During the exclusion phase, participants rated their enjoyment, interest, and perceived contribution lower than in the inclusion and re-inclusion phases.

Figure 2. The participants typed fewer lines in the conversation in the exclusion phase as compared to the inclusion and re-inclusion phases.

Figure 3. Theta power decreased significantly between the inclusion and exclusion phase in the left frontal (F3) region.

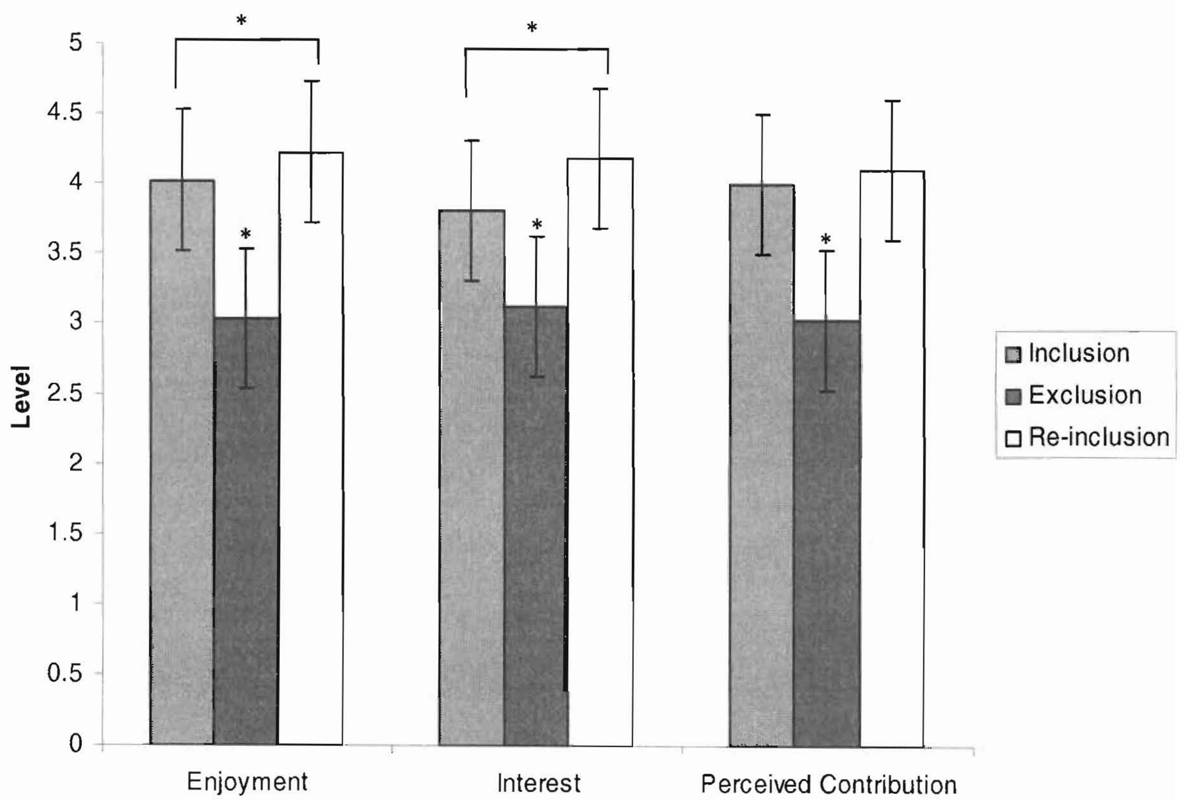
Figure 4. Theta power decreased significantly between the inclusion and exclusion phase in the midline (Fz) region.

Figure 5. Theta power did not vary across the phases in the right frontal (F4) region.

Figure 6. No significant differences were seen among the three phases with regards to theta frequency in the left frontal (F3) region.

Figure 7. No significant differences were seen among the three phases with regards to theta frequency in the midline (Fz) region.

Figure 8. No significant differences were seen among the three phases with regards to theta frequency in the right frontal (F4) region.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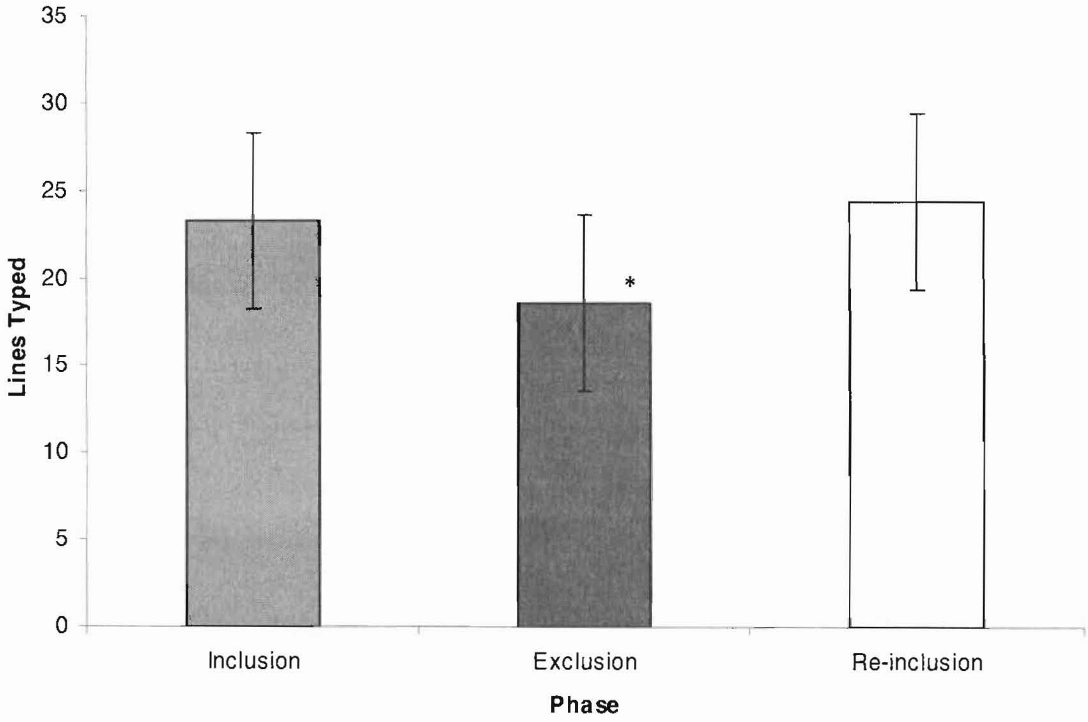
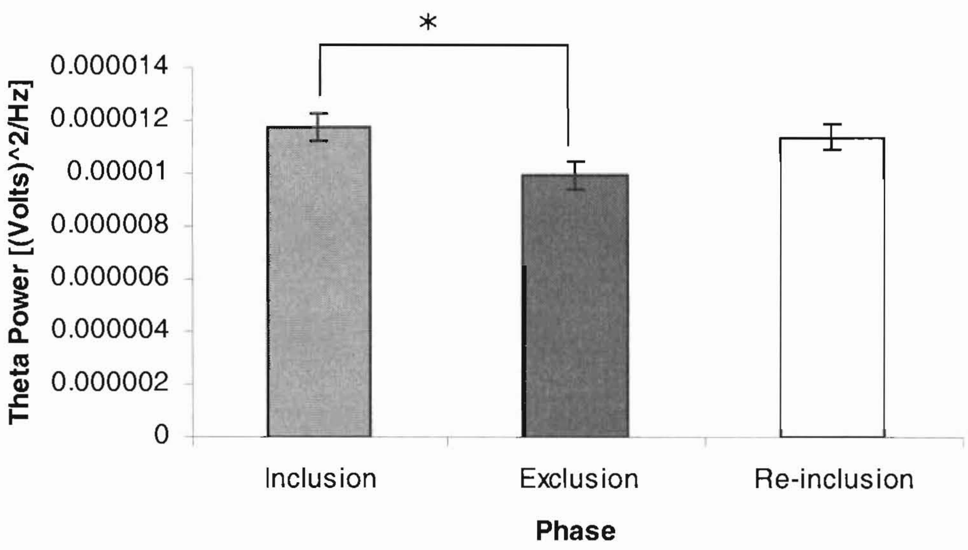
*
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Level
*
*
*
Inclusion
Exclusion
Re-inclusion
Enjoyment
Interest
Perceived Contribution

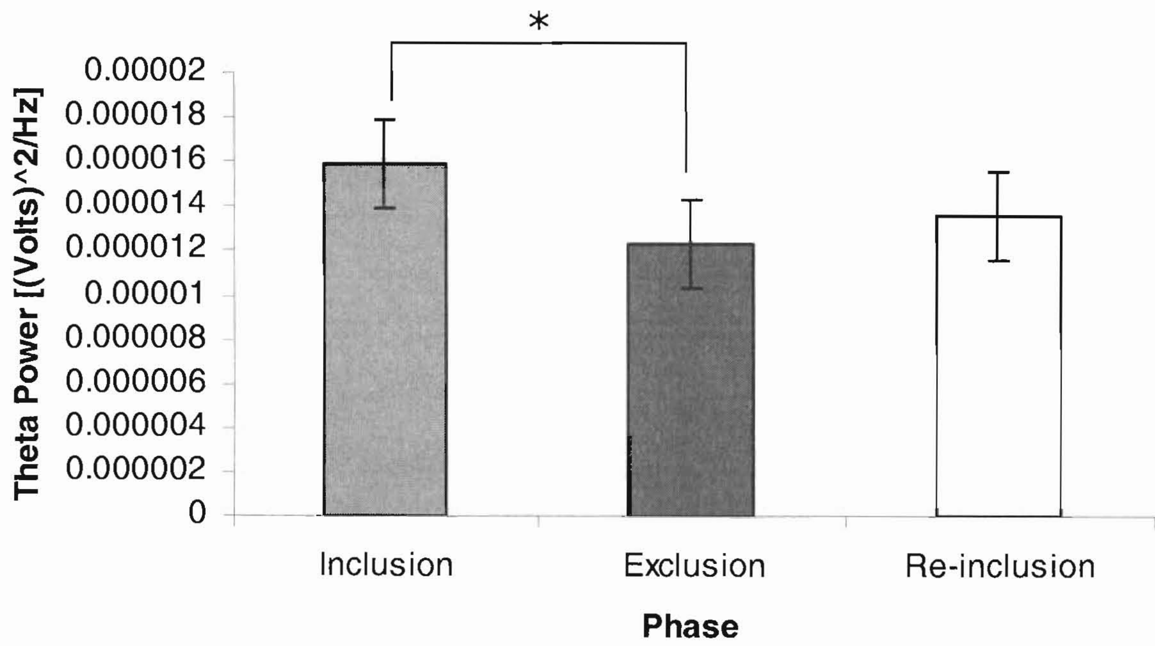
*p <.0167


35
30
25
20
15
10
5
0
Lines Typed
*
Inclusion
Exclusion
Re-inclusion
Phase

*p <.0167


*
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
Theta Power [(Volts)^2/Hz]
Inclusion
Exclusion
Re-inclusion
Phase

*$p < .0167$


*
0.00002
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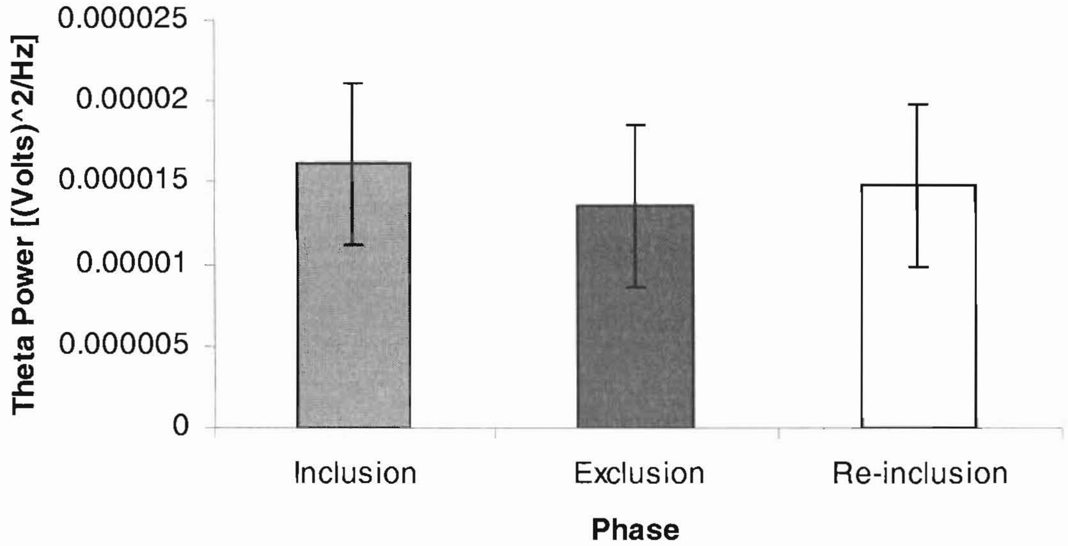
Theta Power [(Volts)^2/Hz]
Inclusion
Exclusion
Re-inclusion
Phase

*$p < .0167$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0.000005
0
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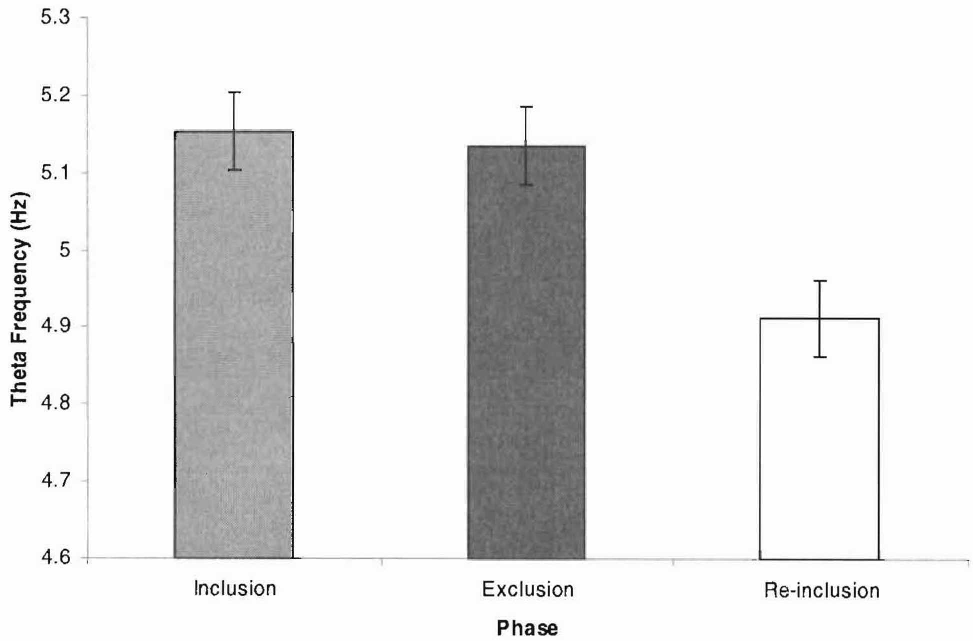
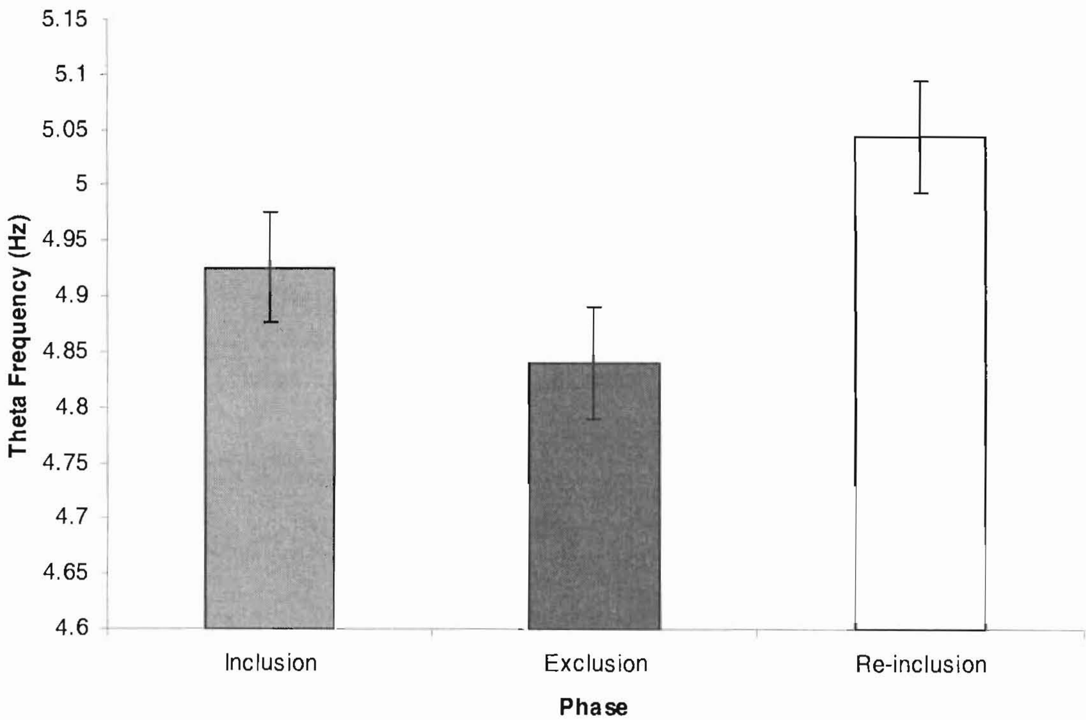
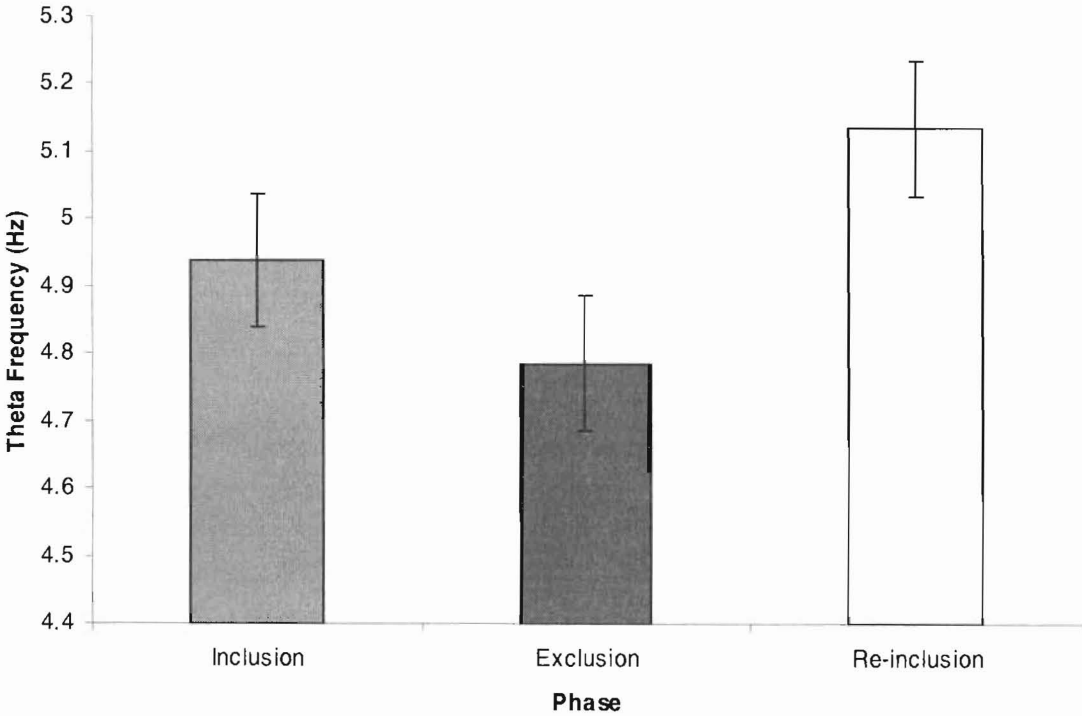
Inclusion
Exclusion
Re-inclusion
Phase


5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
Theta Frequency (Hz)
Inclusion
Exclusion
Re-inclusion
Phase


5.15
5.1
5.05
5
4.95
4.9
4.85
4.8
4.75
4.7
4.65
4.6
Theta Frequency (Hz)
Inclusion
Exclusion
Re-inclusion
Phase


5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
Theta Frequency (Hz)
Inclusion
Exclusion
Re-inclusion
Phase