2007

Social Ostracism and the Effect on Electroencephalogram Waves

Genevieve Nehrt '07
Illinois Wesleyan University

Running Head: Social Ostracism and EEG

Social Ostracism and the Effect on Electroencephalogram Waves

Gen Nehrt

Illinois Wesleyan University

Abstract

Twenty one female Illinois Wesleyan students participated in an experiment examining changes in brain activity following social ostracism in a chat-room environment. More specifically theta EEG activity was recorded from three frontal areas (the Fz, F3, and F4 sites) and theta power and frequency were compared during three phases: inclusion, exclusion, and re-inclusion. The social ostracism paradigm was successful in creating a feeling of exclusion in participants. Participants had a lower level of interest, participation, and enjoyment during the exclusion phase than the inclusion and re-inclusion phases. Participants also typed fewer lines during the exclusion phase than in the other phases. The results of this ongoing study show a trend in the EEG data collected from the three areas. An increase in theta power was seen in the right frontal (F4) area, which is opposite to decreased theta power seen in the left frontal (F3) and midline (Fz) data seen between the inclusion and exclusion phase. These changes in EEG activity suggest that social ostracism effected participants emotionally and cognitively and decreased their feeling of inclusion in the chat-room and that different brain areas play different roles in the processing of social rejection.

Social inclusion or a feeling of belongingness is one of the most basic needs of human beings. When deprived of relationships, people have an increased chance of mental illness, deleterious response to life events, and even an abbreviated life span (Hein, Proulx, and Vohs, 2006). Newman (2004) argues that social ostracism can be linked to school shootings and other acts of violence that have become more prevalent amongst the youth of America. When extensive case studies were done concerning four cases of school violence in suburban areas, researchers found that a common factor between the shooters was ostracism (Newman, 2004). Maslow even recognizes belongingness as one of the most basic steps on his pyramid to self-actualization. The desire to belong to a group is so strong that if an individual is ostracized, the person may suffer from psychological, behavioral, and physiological effects.

Psychological Effects of Ostracism

Lewis and Todd (2005) suggest that emotions are a biological development that causes socially appropriate behavior by steering attention toward useful options for conforming to societal norms. When an individual is subjected to social ostracism, that person can develop negative emotions including self-deprecating internalized attributions, loss of control, and anger (Baumeister, Twenge, and Ciarocco, 2003; Sommer, Williams, Ciarocco, and Baumeister, 2001).

Social ostracism can result in a myriad of self-deprecating internal attributions to account for the ostracism (Williams and Sommer, 1997). The need to belong to a group is so strong that when participants were ostracized, whether moderately or completely, they reported lower self-esteem and social worth than non-ostracized counterparts

(Buckly, Winkle, and Leary, 2004). Sommer et al. (2001) believes that interpersonal rejection is painful, causes lowered self-esteem, depression, and feelings of hurt and loneliness which can lead to social withdrawal. Being ostracized can be very detrimental to a person's overall personality development. If an individual is constantly rejected, negative feelings occur which can be internalized, leading to the creation of a negative self-image (Sommer et al., 2001). Because ostracism threatens the ability to maintain high self-esteem, an individual might experience more sadness, rejection, loneliness, and feelings of unworthiness than included individuals (Williams and Sommer, 1997). Reactions of decreased feelings of self worth and self-esteem can be seen during short-term periods of exclusion. Even the slightest hint of ostracism in any form is enough to cause emotional reactions that activate coping strategies to fight off the feeling of exclusion (Zadro, Williams, and Richardson, 2004). Williams, Cheung, and Choi (2000) set up a virtual ball toss where participants threw a ball to virtual players on a screen. When participants were excluded from the game, they felt hurt and alone and showed a decrease in feelings of belonging and self-esteem. Even in this case, where individuals had no real connection with the virtual others, the participants felt ostracized and had negative reactions to the ostracism.

Self-deprecating feelings can be very detrimental to the development of a positive self-identity especially if these are associated with the feelings of loss of control. When participants are ostracized in a chat room environment, they feel a loss of control which leads them to be less comfortable in the chat-room and causes them to like the other participants less (Zadro et al., 2004). Feelings of self deprecation associated with a loss of control can become a permanent personality fixture if individuals are constantly

ostracized or believe that they will not have control in the future (Warburton and Cairns, 2006). If an individual feels they have no control, then their ability to cope with big stressors in life will be decreased and they will find external causes to explain any problems that may exist in their lives. Sommer et al. (2001) hypothesized that individuals would begin to withdraw from social situations once they have been exposed to social ostracism because their feeling a loss in control was so strong. When participants continually attempt to enter a conversation and are consistently denied, they will begin to not only feel excluded, but also will feel a great loss of control. These feelings will worsen as the ostracism continues, especially if the participant still attempts to enter into the conversation. When these feelings of negative self worth are consistent, an individual can begin to feel a loss of control and this feeling can lead individuals to develop permanent personality changes or other emotions, like anger.

One of the most common and potentially dangerous reactions to social rejection is anger, which can be directed inwards or towards a peer group or person. Zadro et al. (2004) found that when participants were subjected to cyberostracism for a short period of time, their mood worsened and they became angry. In other studies, Williams and Sommer (1997) found that females who were ignored during conversations with two other female confederates reported feeling more alone, frustrated, anxious, and angry than females who were not ignored. Other researchers, like Leary, Twenge, and Quinlivan (2006) believe that social rejection plays a large role in the anger present in individuals today, which has a negative impact on society as a whole.

Researchers have found that the capacity for social exclusion is in fact so powerful that simply witnessing a scene of rejection was sufficient to illicit a response

from an individual (Buckley, Winkle, and Leary, 2004). Baumeister, Twenge, and Ciarocco (2003) found that social exclusion creates emotional numbness and self-regulatory deficits, and that continual exposure to these types of psychological traumas depletes ones restraint against aggressive impulses. Overall, ostracism can create a decreased sense of self worth and self esteem, decrease feeling of control in situations and cause persons to feel anger. All of these psychological effects can be manifested and cause behavioral reactions to social ostracism.

Behavior Reactions to Ostracism

The psychological trauma that social ostracism creates can lead to several different behavioral responses. Researchers suggest that when people are excluded from a social experience they begin to feel angry and may exhibit aggression towards those who have rejected them (Buckly, Winkel, and Leary, 2004; Leary, Twenge, and Quinlivan, 2006). During on cyberostracism, participants paired their feelings of anger and aggression with bravado and exhibited agitation by walking around the room, talking back to their computers, making comments about other cyber-participants, and showing facial signs of agitation or annoyance (Williams, Govan, Croker, Tynan, Cruickshank, Lam, 2002; Williams, Cheung, and Choi, 2001). Twenge, Baumeister, Tice, and Stucke (2001) believe that people will typically restrict their impulses and modify their behaviors in public settings to follow social norms. But, researchers believe that social exclusion weakens normal social restraints on aggressive behavior, which can lead to violent altercations such as domestic violence or school shootings (Leary, 2001). Especially in younger aged individuals, the desire to be accepted into peer groups at school is very strong. If this is denied to them, they may begin to lash out at others, which can cause

fights between students, both physical and psychological, and in the worst cases can lead to school shootings (Newman, 2004).

Though some may react to social ostracism through aggression, others may attempt to combat feelings of social ostracism by regaining a sense of belongingness to a group by conforming to the group's standards (Sommer et al., 2001). Williams and Sommer (1997) believe people will conform, obey, inhibit their socially undesirable behaviors, and even change their attitudes or beliefs to present themselves in a favorable manner to avoid social exclusion. Williams, Cheung, and Choi (2000) conducted a study to look at the effect of cyberostracism on conformity. During an initial conversation, participants were ostracized in a chat room environment. When the participants entered a second chat room, after being ostracized in the previous room, they were more likely to conform to the ideals of the new group members in order to refortify their need of belonging.

Sometimes this outside pressure to conform is apparent within a social group or society, but other times the pressure to conform may be very subtle. Researchers believe that the desire for social acceptance is so strong that just the perceived attitudes and behaviors from others can lead to social conformity (Cohen and Prinstein, 2006). Individuals (especially younger individuals) may be so desperate to belong to an in-group that they will begin to conform to fit into that group. Once accepted into the group, the desire to belong and the fear of ostracism are so great that the peer group can dictate the actions of its members. Both the psychological and behavioral effects of ostracism are thought to be rooted in the functioning of several brain areas, suggesting a physical cause for these behaviors and cognitions.

Physiological Effects of Social Ostracism

Social ostracism elicits the physical pain that captures attention, disrupts ongoing behavior, and motivates an individual to regain safety and mitigate painful experiences. These effects from social ostracism lead to the activation of multiple brain areas (Wall, 2000). The thalamus, prefrontal and parietal cortex constitutes mechanism that is utilized for pain intensity processing (Coghill, Sang, Maisog, and Iadarola, 1999). Among the more important areas in the pain processes mechanism are the dACC which inputs cues for social ostracism from the prefrontal cortex and the amygdala.

The dorsal anterior cingulate cortex. Before technologies advanced to allow for unobtrusive neuroimaging techniques; researchers found a connection between physical and social pain located in the dorsal anterior cingulate cortex (dACC). In 1953, Tow and Whitty reported that social behavior changed when the dACC was lesioned in patients suffering from chronic pain or anxiety. Patients became less socially inhibited, less shy, and less socially sensitive, once the dACC had been lesioned, thus suggesting a connection between the dACC and social behavior. Researchers believe the dACC is essential for recognizing situations, which mediates the "proper response" to these environmental clues.

Recent experiments have been conducted that look at the effect of social ostracism on brain activity using neuroimaging techniques. Researchers found that dACC activity was specifically correlated with feeling social distress (Eisenberger et al., 2003; Panksepp, 2003). Further research showed that the magnitude of the dACC activity was correlated with self-reports of social distress felt during the exclusionary phase of a virtual ball toss experiment (Eisenberger et al., 2003).

The dACC has become an area of interest to researchers looking at social ostracism and its role in violence today. The dACC is hypothesized to have a wide range of possible functions. Botvinick (2001) believes that the primary function of the dACC is to serve as a conflict/discrepancy detector that is activated during conflicts between ones behavior and the reaction of others. The dACC recognizes emotional distress that occurs when the individual is being ostracized from a person or group (Phan et al, 2002). Lane, Reiman, Axelrod, Yun, Holmes, and Schwartz (1998) agree with Botvinick, (2001) view that the function of the dACC is to facilitate appropriate responses and to suppress inappropriate responses when activated. The dACC does this by filtering competing inputs from throughout the brain and then allocating attentional resources to optimize socially acceptable behaviors to decrease the social ostracism. Once a discrepancy between an individual's behavior and the response from the social environment is detected, the dACC activates other brain areas, specifically the prefrontal cortex, so that contextually appropriate responses can reduce the discrepancy (Carter, 2000) and override automatic processes (Miller and Cohen, 2001).

The prefrontal cortex. The prefrontal cortex relays aggression and anger cues to the cingulate cortex. The prefrontal cortex has been implicated in planning complex cognitive behaviors, controlling personality expression, and moderating correct social behavior. The basic activity of this brain region is considered to be orchestration of thoughts and actions in accordance with internal goals (Miller and Cohen, 2001). Liberzan and Phan (2003) found that lesions to the prefrontal cortex led to difficulty in impulse control and a loss of the ability to ascertain the appropriate social context for behavior. Thus, the prefrontal cortex is extremely important in the reaction to a perceived

threat. If the functioning of the prefrontal cortex is poor, environmental stimuli can be misinterpreted and perceived as dangerous and threatening, leading to unreasoned violent behavior (Raine, Meloy, Bihrle, Stoddard, Lacasse, and Buchsbaum, 1998). Researchers believe that there is a direct connection between the PFC and the dACC that may be involved in the acquisition of appropriate avoidance responses to predictably noxious stimuli (e.g., Vogt, Derbyshire, and Jones, 1996). The prefrontal cortex receive input from several different brain areas, the most important of these areas for the pain processing system is the amygdala.

Subcortical areas. Liberzan and Phan (2003) asserts that the amygdala is vital in the evaluation of salience in action and the stimulus ambiguity used for assessing painful situation (Jackson, Mueller, Dolski, Dalton, Nitschke, Urry, Rosenkranz, Ryff, Singer, and Davidson, 2003). Once the information is processed by the amygdala, it is sent to the PFC and leads to an activation of this area. When the PFC inhibits the amygdala, the individual is able to regulate the automatic and voluntary emotional reactions to a situation. Researchers do agree that the connection between the prefrontal cortex and the amygdala is involved in pain perception, in both physical and social pain. Raine, Meloy, Bihrle, Stoddard, Lacasse, and Buchsbaum (1998) found that when there is increased subcortical activity without relatively equal activation of the prefrontal cortex, an individual becomes more prone to violence.

Purpose of Study

Currently researchers have linked an increase in activation of the dACC through functional magnetic resonance imaging (fMRI) studies to the participants' experience of social ostracism. However, this study gains a more realistic environment in which to test

social ostracism. By creating a more realistic environment for participants to engage in conversation researchers can analyze honest reactions to social exclusion. Using electroencephalogram (EEG) equipment instead of fMRI allows for fewer restrictions on the participant and allows researchers to look at theta activity, which has been linked to cognitive and emotional brain activity in previous research. This study also uses self-report measures and motor activity to better analyze the participants feelings towards the chat-room environment and their level of participation, interest, and enjoyment during all three of the phases of the experiment.

Method

Participants

Twenty one female students ranging in the age of 18-23 from Illinois Wesleyan University participated in this experiment. The participants were recruited in two ways: 1) through a General Psychology course for class credit and 2) through advertisements on the campus web page and around campus in which participants were given a ten dollar gift certificate for completing the experiment. Because of the different types of recruitment styles, there was also a wide range of class standing (freshmen through seniors) and majors (including biology, accounting, chemistry, psychology, sociology, education, English, history, and computer science) represented in our participant pool.

Procedure/Materials

This study looked at the effects of social rejection on frontal lobe EEG activity using an online chat room setting. The study was performed at the Center for Natural Sciences at Illinois Wesleyan University in a psychology research lab. Participation in

the experiment was voluntary, and participants were allowed to terminate their involvement at any time during the experiment. The participants were told that they would be involved in a study that examined the neurological patterns of chat room conversations. Upon entering, they read and signed informed consent documents that allowed us to videotape their behaviors and that explained the EEG procedures. The administrator of the study then explained the procedure of the study to the participant. All procedures adhered to those approved by the Institutional Review Board (IRB) at Illinois Wesleyan University.

The participants were taken into a room and sat behind a desk with only a PC computer present on the desk. A video camera was hung from the ceiling of the room to allow for researchers to record the participants' actions throughout the study. The participants were then told that we were conducting a research project with two other schools in Illinois (Illinois State University and University of Illinois) to look at the effect of chat room communication styles on neuronal patterns. The roles of both the students from ISU and U of I were enacted by confederates in the study. Before they began, participants completed a personality questionnaire, which was part of a concurrent study that collected data from this experiment. Results from the personality questionnaire were not be analyzed in this paper. After the participants finished the questionnaires, a picture was taken of the participant using a digital camera and the picture was uploaded onto the computer. This picture completed the participant's online profile, which could be seen by all the chat room participants. The profile included their name, major, location, hobbies, favorite movies and TV shows, and finally the uploaded picture. Once this was completed, subjects were prepared for the EEG recording portion of the experiment.

ELECTROPHYSIOLOGICAL RECORDING

The directions for the EGG preparation specifically in the manual provided by the Electro-Cap International, Inc. (Eaton, OH) were followed. The circumference of the subject's head was obtained by measuring around the head from one inch above the nasion (bridge of the nose) and around from the inion (the protrusion directly above the eye brow) to designate which cap size would best fit them. A large cap was selected if the head circumference was 58-63cm and a medium sized cap was selected if the head circumference was 54-58cm.

A reference electrode was then attached to the left earlobe in the indentation where the ear joins the head with a small amount of Electro-Gel applied to assist in conductance. The distance between the nasion and the inion was measured with a centimeter tape; this distance was divided by 10 to be able to mark these points to ensure the best placement of the frontal electrode mounts of the cap. The frontal electrode mounts (Fp1 and Fp2) were attached to the cap in order to correspond with the markings made on the participant's forehead. Using both hands, the cap was pulled onto the participants' head until it was properly centered and comfortable for the participant. Then the sponge disks were attached around the inside of the cap using two frontal electrode mounts to absorb perspiration and prevent the spread of electrode gel onto the forehead.

We recorded from the Fz, F3, and F4 areas located in the frontal lobe (Appendix A). Fz specifically looks at the midline theta, while F3 and F4 record the areas adjacent to Fz (specifically the left and right hemispheres respectively). The cap connector was then connected to the electrode board adapter connector, and then each electrode cavity was filled with ECI electro-gel using a blunt needle. Once the needle was in the

electrode a small amount of gel came out. Then the needle was rocked rapidly back and forth to fill each electrode. Any excess gel was cleaned off the cap to ensure that electrode shunts (a flat or nearly flat channel) were not created. The EEG cap was connected to a computer in the adjoining room that collected the data. A Biopac Systems interface was used to collect the EEG data. The results were recorded in waveform outputs and were analyzed separately for each of the three separate areas (see Appendix B for an example of EEG output). Once the participant was properly fitted with the EEG cap, the chat room portion of the experiment began.

CHATROOM PARTICIPATION

To ensure that each participant received the same information and behavioral protocol, the experimenters followed a detailed script and step-by-step instructions for using each piece of equipment. To ensure that the experimenters told each participant the same thing upon beginning the study they followed a script of introduction (Appendix C). The participant then logged in under her screen name to the simulated chat room. Once logged in, the participants were able to view the other individuals in the room ("Steph", "Jen", and the Administrator) who were all confederates. If the participant clicked on each screen name, a profile would come up and the subject could read about the other people in the chat room. Pictures of non-Illinois Wesleyan or Illinois State students were used for the confederate personalities (see Appendix D for profiles).

Once all three of the chatters (the participant and two confederates) were in the room, the Administrator instructed the participants to begin by introducing themselves for eight minutes. The confederates followed a predetermined method of conversation and procedure for addressing the individuals in the chat room. The confederates included the

participant during this introduction phase, referring to her as much as to each other. The Administrator announced in the chat room that the introduction phase had ended and that they were given one minute to complete the concurrent measures. The concurrent measures assessed the level of interest, level of participation, and level of enjoyment the participant experienced during that phase of the experiment. This concurrent measure was done after each phase of the experiment in order to gauge the individual's perceptions of these topics. Once this measure was completed, the Administrator announced a new topic. The chatters then discussed extra-curricular activities for the next eight minutes. This was the first phase of the ABA design; here the participant was included as much or more than the other confederates.

When eight minutes had passed, the Administrator returned to the chat room, informed the participant that their time was up for this topic, instructed the participants to complete the concurrent measure and instructed the chatters to talk about favorite TV shows for eight minutes. In this phase of the experiment, the two confederates excluded the participant from the conversation. The two confederates did not respond to the participant's questions or comments in any way and the confederates specifically addressed each other when asking and answering questions about the TV shows. The confederates followed a pre-written script for as much of the time as possible. This script was created from previous pilot studies to ensure a natural conversation flow (see Appendix E for script).

After eight minutes, the Administrator again announced the conclusion of this section of the conversation, allowed one minute for the completion of the concurrent measures, and then told participants to begin the next subject of conversation (the ideal

romantic relationship/relationship partner). In this phase, the two confederates included the participant just as during the first topic. At the end of this eight-minute segment, the Administrator instructed the participants to fill out the final concurrent measure, thanked them for their time, and told them that an assistant would be with them shortly to help them remove the EEG equipment and to help them log off the chat room site. In summary, there were four phases that occurred during the chat-room experience and each phase was followed by a one minute session during when participants filled out concurrent measures. The experiment progressed as follows: Introduction (8 min.) → Complete concurrent measures (1min.) → Inclusion (8 min.) → Complete concurrent measures (1 min.) → Exclusion (8 min.) → Complete concurrent measures (1 min.) → Re-inclusion (8 min.) → Complete concurrent measures (1 min.) → End of experiment.

The experimenter who hooked the participant up to the EEG returned and began to unhook the participants. The cap and ear electrode was removed and the gel was cleaned off of the participants. After the participants were unhooked from the EEG, they were instructed to follow the prompts on a computer on a different desk in the room to complete an Implicit Association Task (IAT). The results from the IAT were collected and used in a concurrent study and will not be discussed in this paper. Finally, participants were given a survey which assessed how aversive they felt this experiment was (Appendix F). After the participants had finished with the questionnaire, the experimenter debriefed them about the experiment and informed them that the study was really looking at the effect of social rejection on EEG activity.

Analyses

All electrophysiological data was analyzed using software developed by Data Wave System, Inc (Longmont, CO). Each set of data records (inclusion, exclusion, and inclusion) were examined for noise and all data records containing non-neural signals were removed before and the theta waves were examined. A Power Spectral Density (PSD) analysis was performed on the eight-minute segments of data to determine if there was any change in EEG waves between the inclusion, exclusion, and re-inclusion phases. The dominant frequency located within the 4-8 Hz range and the power (amplitude) at the frequency was recorded. The PDS results were subjected to a repeated measures ANOVA, followed by multiple paired t-tests using theta power and frequency as dependent variables and the specific phase (inclusion, exclusion, and re-inclusion) of the experiment as the independent variable to determine whether social ostracism affected frontal theta EEG activity. Effect size was also determined using Cohen's D to assess the significance of the results without taking the small sample size into account.

Results

Behavioral

To measure whether social rejection was successful, participants completed a survey after each phase of the experiment (inclusion, exclusion, re-inclusion) detailing 1) their level of enjoyment, 2) how interesting they found the discussion, and 3) the level of their participation (Fig. 1). The results of this self-report data were subjected to a one-way repeated measures ANOVA which showed a significant main effect of phase on the level of enjoyment [F (2, 53) = 4.04, p=.024], interest [F (2, 53) = 3.62, p= .034], and level of participation [F (2, 53) = 4.67, p = .014] (Table 1). Subsequent t-tests tests revealed that significant differences between the inclusion-exclusion pairing and

exclusion-re-inclusion pairings appeared among all three variables: level of enjoyment [$t(17) = 3.88$, $p = .002$ and $t(17) = -3.80$, $p = .001$ respectively], level of interest [$t(17) = 2.60$, $p = .019$ and $t(17) = -3.43$, $p = .003$ respectively], and level of participation [$t(17) = 4.27$, p = .001 and $t(17) = -3.33$, $p = .004$ respectively]. A Bonferroni test was also completed to control alpha, dictating that $p = .17$. However, when the pairing of inclusion-re-inclusion were examined, no significance was found in either level of enjoyment [t (17) = -.33, $p = .75$], level of interest [t (17) = -1.56, $p = .138$], or level of participation [t (17) = .37, $p = .717$]. These numbers suggest that participants felt a lower level of enjoyment, interest, and participation during the exclusion phase, but not during the inclusion and re-inclusion phases.

To examine motor activity and to gain a more objective measure of participant involvement, after the participants completed the experiment, their conversations were saved and printed out. The lines the participant typed were counted for each phase of the experiment and were subjected to a series of repeated measures ANOVA which revealed a significant main effect for phases (F (2, 16) = 11.86 p =.001). Subsequent t-tests revealed a significant difference in the number of lines typed during the inclusion and exclusion phase [t (1, 17) = 4.10, $p = .001$] and the exclusion phase and re-inclusion phase [t (1, 17) = -4.69, $p = .000$]. There was no significant difference between inclusion and re-inclusion phases in the number of lines typed [t (1, 17) = -.356, $p>.05$]. This illustrates that once the participants were excluded, they did not participate as much in the chat, but when they were re-included they participated as much as in the inclusion phase (Fig. 2).

At the end of the experiment the participants were given a debriefing survey that measured the level of distress they felt at participating in this experiment and how they felt if/when they were being excluded. Out of thirteen participants that responded only two wondered if the exclusion was planned or natural. Two other participants noted that the phase where the participants talked about TV shows (the exclusion phase) was really boring and that the other two participants seemed to have more in common with each other. Two more participants indicated that they felt angry or apathetic if/when they were being excluded in the conversation.

EEG

Four participants were excluded from the EEG analysis due to excessive noise in the EEG records. Four more participants were excluded specifically from the midline analysis due to recording problems with the midline electrode. Therefore, the midline, left, and right frontal EEG analysis were based on N=13, N=17, and N=17 respectively.

Theta power. Overall, a series of repeated measure ANOVAs, revealed no significant differences in the theta power with $p > .05$ (Table 2, 3, and 4). For both the midline (Fz) and left electrodes (F3), a decrease in theta power was seen during the exclusion phase compared to the inclusion and re-inclusion phases (Fig. 3 and Fig. 4). The inclusion and re-inclusion phases show similar amounts of theta activity. The data recorded from the right frontal (F4) electrode showed an opposite pattern, with exclusion leading to a greater degree of theta power than the inclusion and the re-inclusion phases. Though the repeated measures analysis run between the inclusion and exclusion phase in midline, left frontal, and right frontal areas using theta power were insignificant, a moderate effect size was calculated for the midline and right frontal areas (.4468 and

.5822) with a low effect size present in the left frontal (.1680). Effect size is typically categorized as follows: a small effect size is below 0.4, a moderate effect size between 0.4-0.7, and a high effect size is above 0.7. This suggests that had there been more participants the results would have been significant in the midline and right frontal data given that 60 participants are required for significance at small effect sizes and 30 at moderate sizes (Table 2, 3, and 4).

Theta frequency. Data on theta frequency of the EEG activity was also collected during the study (Fig 6, 7, and 8). A repeated measures ANOVA revealed no significant main effect of phases at either the midline, left frontal or right frontal electrodes [F (1, 13) = .037, $p > .05$, F (1, 16) = 1.00, $p > .05$, and F (1, 16) = .714, $p > .05$ respectively]. Effect size was also calculated for the midline, left frontal and right frontal sites (.1019, .2702, .043), which indicates that even with more participants included in the analysis, there would be a very small effect, suggesting no significant findings would occur in the frequency data (Table 5, 6, and 7).

Discussion

Although not statistically significant, possibly due to small sample sizes because the study is still ongoing, the data revealed a trend that supports the hypothesis that during the period of exclusion, there would be a change in the level of theta EEG activity in correspondence with the feeling of social ostracism. This hypothesis has been based on previous work which has supported that the dACC is activated by the recognition of social ostracism based on the reactions of others (Botvinick, 2001) and the emotional distress from the ostracism (Phan et al., 2002). The left frontal (F3) and midline (Fz) areas showed a decrease of activity from the inclusion to exclusion phase, while the right

frontal (F4) area showed an increase in the theta power from the inclusion to exclusion phase. For all three areas, the re-inclusion phase showed similar activity as the inclusion phase.

Interestingly, the change in theta power also corresponds with the behavioral data collected during the experiment. Surveys given throughout the experiment illustrate that participants enjoyed the chat room less, found the discussion less interesting, and participated less in the conversation during the exclusion phase than in either the inclusion or re-inclusion phases. After the participants had completed the study, experimenters printed out their conversations and counted the number of lines that were typed during each phase of the experiment. Researchers found that the participants typed less during the exclusion phase than during the inclusion or re-inclusion phases. However, it should be noted that the present study is still ongoing and that several factors including low participant numbers, success of the social ostracism construct, emotions effects, cognitive effects, or motor activities may all explain the pattern of results observed thus far.

Low Number of Participants

Due to computer problems and time-dependent issues, only a few participants were able to complete all of the measures. Thus, a very low number sample sizes (13 for the midline data and 17 for both the left and right frontal area data) for the various data groups were analyzed. There were also difficulties in properly recording data from the midline electrode and approximately one-third of the data collected from this area was removed from analysis due to excessive noise or lack of EEG activity. However, effect sizes were calculated using Cohen's D, which specifically calculates the level of

significance without taking sample sizes into account. For the frequency data, low effect sizes were calculated which suggests that no significant findings would occur for frequency data if more participants were added. For the power data, a low effect size was calculated for the left frontal area, while moderate effect sizes were calculated for the right fontal and midline areas. The effect sizes calculated suggest that when more participants are added to the study, the trends found in the data may become significant for the right frontal and midline areas.

Success of ostracism construct

A large concern for this study was whether the study would cause individuals to feel excluded. It was possible that the participants would figure out the true purpose of the study, would disclose the purpose of the study to the rest of the population once the task had been completed, or would not feel ostracized during the exclusion phase of the experiment.

To lessen the impact of a contaminated subject, the experimenters took great care to ask each participant if they had heard about the study and were to mark the demographic measures accordingly (this was never marked on the surveys). To verify that participants did not have previous knowledge of the experiment, participants completed a debriefing survey that asked if she thought the experimenter had not been honest with her about something during the experiment (Appendix C). Only two out of thirteen participants wondered if the exclusion had been natural or purposeful. In order to further ensure that the true purpose of the study was kept confidential, experimenters stressed the importance of discretion to the participants during the debriefing period. Though these precautions were put in place to lessen the population's awareness of the

purpose of the experiment, it is possible that this information may be available to the population. However, Eisenberger et al. (2003) demonstrated that even when participants knew they were to be ostracized during an experiment, they still had an increase in fMRI activity. Thus, even if the information was released to the population there should still be an effect in dACC activity due to social ostracism.

To better measure the effectiveness of the social ostracism construct, researchers instructed participants to complete concurrent measures after each phase of the chat room. The concurrent measures observed their levels of interest, participation, and enjoyment during these phases. These measures were intended to inconspicuously determine whether participants felt ostracized during the different phases of the experiment without divulging the true purpose of the study and outright asking the participants if they felt rejected. Previous research has shown that even short term internet ostracism can illicit a negative response from participants (Zadro et al., 2004).

Analysis showed significant differences in all three variables between the inclusion and exclusion phases, with no significant differences between the inclusion and re-inclusion phases. These results suggest that the participants felt a level of ostracism that caused them to rate their experience in the exclusion phase of the chat room lower than the experiences in the inclusion and re-inclusion phases. Other studies have also recorded ostracism data through self report measures. Buckley et al. (2004) used self-report measures to look at the effect of social ostracism on participant's self-esteem, and found that participants reported lower self-esteem when ostracized than their non-ostracized counter parts. Zadro et al. (2004) found that during cyber-ostracism in chat

rooms, participants displayed emotional reactions and engaged coping strategies to fight off their feelings of exclusion.

Besides self-report measures, the present study also utilized objective measures (counting the number of lines typed during each phase) to determine whether participants felt discouraged from participating once they were excluded from the conversation. The lines typed during the inclusion phase and re-inclusion phase were very similar (24.00 and 24.56 respectively), but much lower during the exclusion phase (17.00 lines). Sommer et al. (2001) suggests that once participants are socially excluded, they withdrawal from social situations in which they can be rejected from. This suggests that once participants realized that they were being ostracized, they stopped attempting to enter the conversation so they would not be rejected again.

Emotional Effects

Previous research has shown that theta activity is related to emotional input. Knyazeu (2007) demonstrated that theta activity increases when participants are shown an emotionally prompting image compared to neutral stimuli, indicating that theta activity should reflect any emotional changes that occur during the experiment. The differences observed between the right and left/midline recording sites may be due to differences in how the brain processes social pain. This possibility is supported by previous studies which found that social ostracism led to different patterns of activation between the left and right frontal areas of the dACC (Eisenberger et al., 2003; Davidson, 1995; Root, Wong, and Kinsbourne, 2006; Hagerman, Hewing, Naumann, Seifort, and Bartusses, 2005). During an fMRI experimentation with the virtual ball toss, researchers noticed an increased activity in the right ventral prefrontal cortex, a site that is associated with

negative affect regulation (Eisenberger et al., 2003). Further research has hypothesized that each hemisphere is responsible for processing different emotions; specifically the left hemisphere processes positive emotions, while the right hemisphere processes negative emotions (Davidson, 1995). Researchers believe that the right ventral prefrontal cortex is responsible for processing visual and auditory stimuli that convey emotions with negative valence (Root et al., 2006; Hagerman et al., 2005). The idea of right valence is supported in the EEG data collected from participants in the current study. During the exclusion phase, an increase in activity in the right hemisphere was observed. The right hemisphere valence theory would suggest that the participants were processing negative emotions during the exclusion phase due to the social ostracism they were experiencing, thus increasing the activation of the right hemisphere. The theory would continue to suggest that the left hemisphere would have a decreased amount of activity recorded because the participant is processing the negative emotions associated with the ostracism and not positive emotions. This is supported in the present data where a decrease in activity in the left hemisphere is seen.

Attentional Effects

Though emotional effects may explain the patterns seen in the results, attentional effects may also play a role in the outcome of the observed results. The midline data collected in the EEG shows a decrease in activity as does the left frontal region. The decrease seen in the midline may be attributed to a decrease in attention during the exclusion phase. Simply because the participants find the exclusion phase of the experiment less interesting and less enjoyable, their level of attention focused on this task may decrease, causing the decrease in EEG activity. Researchers have found that midline

theta is associated with concentration and can have an increase in activation during tasks that require a high level of attentional energy (de Araujo, Oswaldo, and Wakai, 2002). The midline theta may also be connected to cognition during the exclusion phase. The midline area is reported to have an attentional role (Asada, Fukuda, Tsunoda Yamaguchi, and Tonoike (1999), and with the decrease in attention and interest during this phase, may have less activity. Because the participant is not focusing on the conversation, they may process information less thoroughly, leading to a decrease in activation in the midline area. This change in cognition can also be seen in more objective measures when looking at the lines typed data. During the exclusion phase of the experiment participants had significantly less activity in the chat-room, typing less lines than in either the inclusion and re-inclusion phases; showing a possible decrease in interest in the chat-room.

Motor Activities

Emotional and attentional activity may affect the patterns of the results observed in this study, however; motor activity may also be associated with the theta power. Previous research indicates that small amounts of movements, like using a mouse to navigate through a virtual maze, are not enough to cause a change in theta rhythm (de Araujo et al., 2002). Precautions were taken to decrease the noise in the EEG data collected from participants. This was done by requesting the participants to move as little as possible while the EEG was recording and by removing any excess noise from the recorded data once the participant had finished the experiment. More objective measures were also used to account for motor activity by counting the number of lines that were typed during each phase of the experiment.

During the experiment, the researchers were careful to inform the participants that excessive movement during the chat-room could create interference in the collection of the EEG data. The researchers requested that the participants reduce movement as much as possible during the chat-room by keeping their wrists on the table in front of the keyboard until the Administrator of the chat-room gave them instructions to complete the concurrent measures. Also, before the data was analyzed, excessive noise was removed from the EEG to help ensure the data was as accurate as possible. The EEG data that was removed due to noise had, on average about 50% of the recordings removed, making analysis of these participants unreliable. These two precautions were put in place to reduce the interference that motor activity could have caused in EEG data collection from the dACC. However, even with the precautions put in place, motor activity could still be a possible explanation for the changes in theta power.

To further compare motor activity to theta power, experimenters counted the number of lines that participants typed during each phase of the experiment. The data shows a difference in the number of lines typed in exclusion phase relative to both the inclusion and re-inclusion phase, while the number of lines typed during the inclusion phase and re-inclusion phase are almost identical. Thus, it is possible that the decrease in the theta power observed during the exclusion phase is due to decreased motor output rather than emotional or attentional factors.

However, several factors suggest the results aren't solely due to the motor differences. The data also shows that there is a difference in the pattern of the dACC activity between the midline and left frontal electrode and the right frontal electrode. The midline and left frontal electrode show a decrease in activity during the exclusion phase

while the right frontal electrode shows an increase in activity. If motor activity had an effect on the EEG data, then the left and right frontal electrodes should be more similar than the midline electrode due to hemispheric similarities. Motor activity also tends to be similar in both hands when typing, especially for those in the age range of our participants. Thus it is unlikely that motor differences caused the differences seen in between the left and right frontal areas because similar amount of motor activity in both hands would lead to the same level of activation in each hemisphere. However, the current study cannot explicitly rule out motor contributions. This is a preliminary study with an extremely small sample size. Studies that have used human EEG recordings typically have 60 participants included to control for variability, and thus the sample size of this experiment will need to be increased. Future studies will have to more directly assess the effect of the motor activity on theta power.

Future Research

This study focused on looking at the change in EEG activity when participants were being excluded from a chat-room environment. Though trends were found in the data, future studies should address possible confounds. To address the low number of participants, it will be necessary to include more participants in future studies, to more accurately assess whether the hemispheric effects found in the current data reach statistical significance. In addition, it will be important to address whether social ostracism is the key variable behind changes in frontal theta power or whether alternative explanations such as attentional or motor factors are the critical variables. Ways to asses the effect of attentional variables would include having the participant actively engage in reading a page of information, and by having participants simply read a conversation

occurring in the chat room. Assessing the effect of motor activity during the experiment could also be controlled by having participants retype a paragraph provided for them, thus allowing researchers to compare these findings to the inclusion, exclusion, and re-inclusion phases of the experiment.

As well as controlling for possible confounding variables it would be interesting to include different types of measures that would look at the participants' reaction and emotions towards the other participants. Zadro et al. (2004) found that when participants were excluded during an experiment that they liked the confederates less than controls. Though the level of the participant's perceived participation was measured in the current study, it may be fruitful to look at the participants' attitude towards the individuals who were excluding her. A broader range of subjects may also be interesting to include in future research. It would be interesting to look at both males and females to see if their reactions to social ostracism differ from one another. Including adolescents in this study could also lead to information about the importance of inclusion during this developmental period of life. Other research could include changes in the type of chat room experience, including a more romantic chat room setting to look at the effects of rejection there.

References

Asada, H., Fukuda, Y., Tsunada, S., Yamaguchi, M., and Tonoike, M. (1999). Frontal midline theta rhythms reflect alternative activation of prefrontal cortex and anterior cingulate cortex in humans. *Neuroscience Letters 274.* 29-32.

Baumeister, R. F., Twenge, J. M., and Ciarocco, N. (2003). The inner world of rejection: Effects of social exclusion on emotion, cognition, and self-regulation. In J.P. Forgas and K. D. Williams (Eds.), *The social self: Cognitive, interpersonal and intergroup processes* (pp. 161-174). New York: Psychology press.

Botvinick, M. M., Braver, T. S., Barch, D. M.,; Carter, C. S., Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review. Vol 108(3) Jul 2001,* 624-652.

Buckly, K.E., Winkel, R. E., Leary, M.R., (2004). Reactions to acceptance and rejection: Effects of level and sequence of relational evaluation. *Journal of Experimental Social Psychology, 40,* 14-28.

Carter, C.S. et al. (2000). Parsing executive processes: strategic vs. evaluative functions of the anterior cingulate cortex. *Proc. Natl. Acad. Sci. U.S.A. 97,* 1944-1948.

Coghill, R. C., Sang, C. N., Maisog, J. M.; Iadarola, M. J. (1999). Pain intensity processing within the human brain: A bilateral, distributed mechanism. *Journal of Neurophysiology. Vol 82(4) Oct 1999,* 1934-1943.

Cohen, G. L. and Prinstein, M. J. (2006). Peer contagion of aggression and health risk behavior among adolescent males: an experimental investigation of effects of public conduct and private attitudes. *Child Development, 77* 967-983.

Davidson, R. J.(1995). Cerebral asymmetry, emotion, and affective style. In Davidson and K. Hungahl (Eds.), *Brain Assymetry* (p.361-389). Cambridge, MA: The MIT Press.

De Araujo, D.B., Oswaldo, B., and Wakai, R. J. (2002). Theta oscillations and human navigation: a magneticencephalography study. *Journal of Cognitive Neuroscience 14:1.* 70-78.

Eisenberger, N. I., Lieberman, M.D., and Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. *Sciences, 302, 5643,* 290-292.

Hagerman, D., Hewig, J., Naumann, E., Seifert, J., and Bartuss, K. D. (2005). Resting brain assymetry and affective reactivity: aggregated data support the right hemisphere hypothesis. *Journal of IndividualDifferences,26 (3),* 139-154.

Heine, S. J., Proulx, T., and Vohs, K. D. (2006). The meaning maintenance model: on the coherence of social motivations. *Personality and Social Psychology Review, 10, 2,* 88-110.

Jackson, D.c., Mueller, C.J., Dolski, I., Dalton, K.M., Nitschke, J.B., Urry, H.L., Rosenkranz, M.A., Ryff, C.D., Singer, B.H., and Davison, R.J., (2003). Now you feel it, now you don't: frontal brain electrical asymmetry and individual differences in emotion regulation. *American Psychological Society, 6, 24,* 612-617.

Knyazev, G. G. (2007). Motivation, emotion, and their inhibitory control mirrored in brain oscillations. *Neuroscience and Biobehavioral Reviews. 31.* 377-395.

Lane, R.D., Reiman, E.M., Axelrod, B., Yun, L., Holmes, A., and Schwartz, G.E. (1998). Neural correlates of levels of emotional awareness: evidence of an interaction

between emotion and attention in the ACC. *Journal of Cognitive Neuroscience, 10:4,* 525-535.

Leary, M. R. (2001). Toward a conceptualization of interpersonal rejection. In M.R. Leary (Ed.), *Interpersonal rejection* (pp. 3-20). New York: Oxford University Press.

Leary, M.R., Twenge, J. M., and Quinlivan, E. (2006). Interpersonal rejection as a determinant of anger and aggression. *Personality and Social Psychology Review, 10, 2,* 111-132.

Lewis, M. D. and Todd, R. M. (2005). Getting emotional- a neural perspective on emotion, intention, and consciousness. *Journal of consciousness studies; controversies in science and the humanities, 12,* 210-235.

Liberzon, I. and Phan, K.L. (2003). Brain imaging studies of posttraumatic stress disorder. *CNS Spectrums, 8, 9,* 641-650.

Miller, E. K. and Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24, 167-202.*

Newman, K. S. (2004). Rampage: The social roots of school shootings. *(2004). xvi, 399 pp. New York, NY, US: Basic Books.*

Panksepp, J. (2003). Feeling the pain of social loss. *Science, 32,* 237-239.

Phan, K. L. (2002). Functional neuroanatomy of emotion: A meta-analysis of emotion activation studies in PET and fMRI. *NeuroImage 16 :* 331.

Raine, A., Meloy, J.R., Bihrle, S., Stoddard, J., Lacasse, L., and Buchsbaum, M.S., (1998). Reduced prefrontal and increased subcortical brain functioning assessed using PET in predatory and affective murderers. *Behavioral Sciences and the law, 16,* 319-332.

Root, J.C., Wong, P.S., Kinsbourne, M. (2006). Left hemisphere specialization for response to positive emotional expressions: A divided output methodology. *American Psychology Association, 6 (3),* 473-483.

Sommer, K. L., Williams, K. D., Ciarocco, N. J., and Baumeister, R. F. (2001). When silence speaks louder than words: explorations into the intrapsychic and interpersonal consequences of social ostracism. *Basic and Applied Social Psychology, 23, 4,* 225-243.

Tow, P. M., Whitty, C. W. M. (1953). Personality changes after operations on the cingulate gyrus in man. *Journal of Neurology, Neurosurgery and Psychiatry. 16 1953,* 186-193.

Twenge J. M., Baumeister, R. F., Tice, D.M., and 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,* 1058-1069.

Vogt, B.A., Derbyshire, S., and Jones, A.K.P., (1996). Pain processing in four regions of human cingulated cortex localized with co-registered PET and MR imaging. *European Journal of Neurosciences, 8,* 1461-1473.

Wall, Patrick. (2000). *Pain: The science of suffering. New* York, NY, US: Columbia University Press.

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

Williams, K.D., Cheung, K.T., and Choi, W. (2000). Cyberostracism: Effects of being ignored over the internet. *Journal of Personality and Social Psychology, 79, 5,* 748-762.

Williams, K.D., Govan, C.L., Croker, V., Tynan, D., Cruickshank, M, and Lam, A. (2002). Investigations into differences between social- and cyberostracism. *Group Dynamics: Theory, Research, and Practice, 6, 1,* 65-77.

Williams, K.D and Sommer, K.L. (1997). Social ostracism by coworkers: does rejection lead to loafing or compensation. *PSPB, 23, 7,* 693-706.

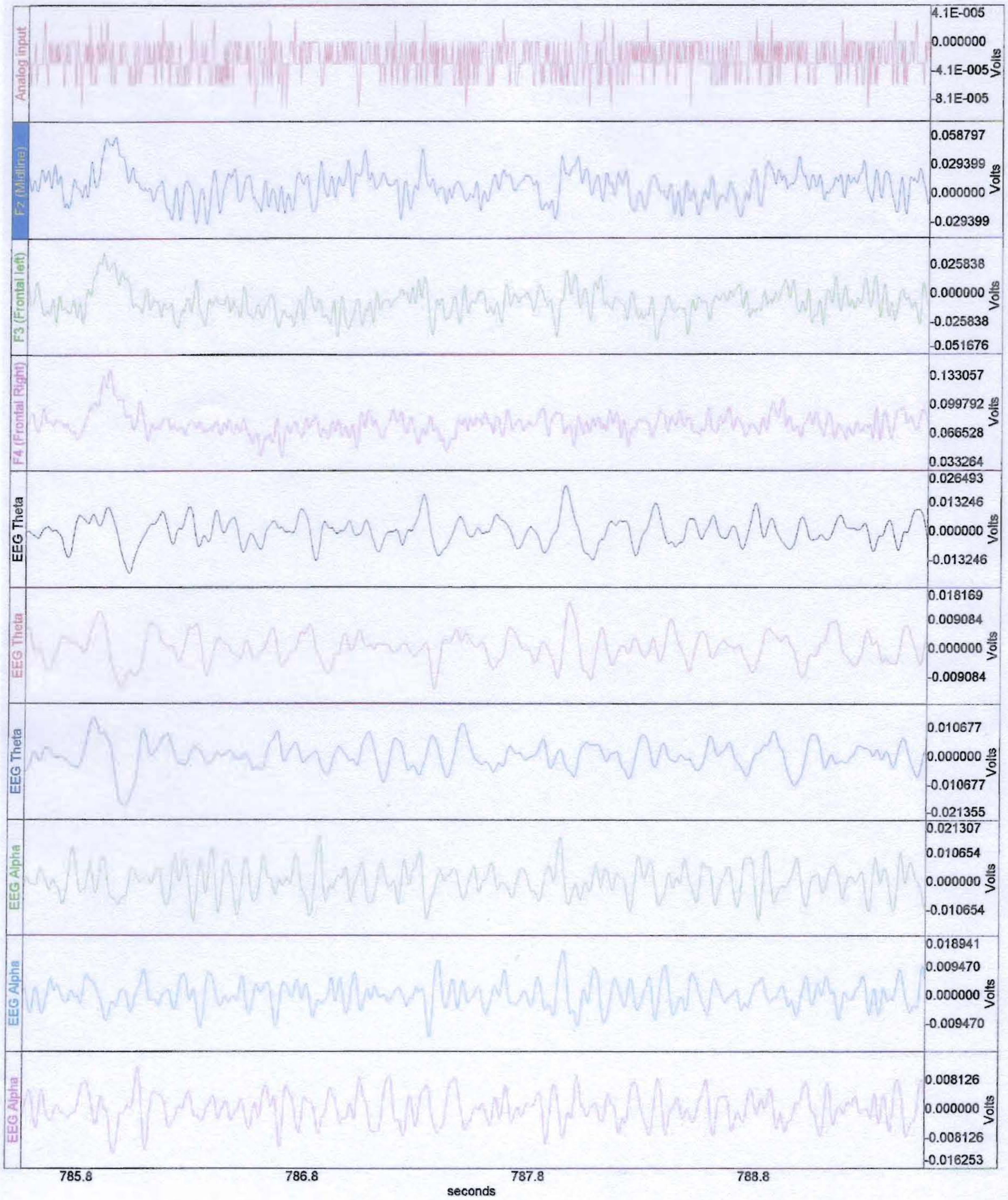
Zadro, L., Williams, K. D., and Richardson, R. (2004). How low can you go? Ostracism by a computer is sufficient lower self-reported levels of belonging, control, self-esteem, and meaningful existence. *Journal of Experimental Social Psychology, 40,* 560-567.

Author Note

Without the help of the following individuals this study would not have been A success. I would first like to thank Dr. Joe Williams for acting as my adviser for this project. Without his support and guidance this study would not have been accomplished. I would also like to thank Kelly Sanderson my co-researcher on this project, whom without this study would have been unorganized and far behind schedule. Jen Morozink, Ruchira Gupta, Christine Garcia, Courtney Lee, Jenna Sanderson, Rachel Follmer, Carolyn Hull, Justin Barber, Kelly Kujawa, Kelsey Elgas, Kerry Gremo, Liz Riggs, Melinda Mallory, Sajari Simmons, and Jaclyn Verticchio were instrumental in collecting data. Without the hard work of these individuals the data collection for this project would have been impossible. I would like to thank my committee members Dr. Doran French, Dr. Loni Walker, Dr. Dave Hibbard, and Dr. Joe Williams for taking time out to serve on my defense and for all of their feedback along the way. Lastly, I would like to give a special thanks to Mom, Dad, Ashley, and all of my friends for supporting me through everything.

Appendix A

Appendix B


Analog input
Fz (Midline)
F3 (Frontal left)
F4 (Frontal Right)
EEG Theta
EEG Theta
EEG Theta
EEG Alpha
EEG Alpha
EEG Alpha
4.1E-005
0.000000
-4.1E-005
-8.1E-005
0.058797
0.029399
0.000000
-0.029399
0.025838
0.000000
-0.025838
-0.051676
0.133057
0.099792
0.066528
0.033264
0.026493
0.013246
0.000000
-0.013246
0.018169
0.009084
0.000000
-0.009084
0.010677
0.000000
-0.010677
-0.021355
0.021307
0.010654
0.000000
-0.010654
0.018941
0.009470
0.000000
-0.009470
0.008126
0.000000
-0.008126
-0.016253
Volts
785.8
786.8
787.8
788.8
seconds

Appendix C

Script for Introduction

Hi, I'm ______(Insert your name here)_, and we are up stairs today, so lets head on up. So, just to give you a little back ground 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 an EEG machine during your conversations so we can observe what areas of your brain are active when you're chatting online vs. 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 D

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

Nickname: Steph

Age: 18

Gender: Female

University: Illinois State University

Favorite Movies: The Big Lebowski, Bridget Jones Diary

Favorite Books: The Great Gatsby, Fountain Head, The Brother's K

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

Favorite Sports: Running, Intramural Softball

Activities/Interests: Shopping!!

Appendix E

Admin: Ok, time's up. Please take the next eight minutes to talk about your favorite TV shows.
Jen: Ok, well this is a hard one for me, I don't really watch TV shows regularly.
Steph: hmmmmm, I don't watch that much TV either.
Jen: 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: hahaha the food network just makes me hungry
Jen: see I never even got into friends
Steph: it was hard not to when that's all my friends ever talked about
Jen: yeah I know what you mean
Steph: I think last semester we watched seasons 1-6 in the first 3 weeks of school
Jen: wow, that's impressive
Steph: Jen have you ever watched america's next top model
Steph: That's a fun one I sometimes catch
Jen: yep, that is a fun one
Jen: 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?
Jen: It's 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
Jen: 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.
Jen: yea I know, its definitely a love hate relationship
Steph: ☺
Steph: exactly
Jen: 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
Jen: Oh I know that one Steph, I can't remember the name either
Jen: Oh wait, its called parental control
Steph: there was like a marathon of it on…bad news
Jen: hahaha, no kidding

Appendix F

Student ID #________________________
Instructions: To complete this survey, please rate each statement on its corresponding five-point scale. When you are finished, place is face down in the folder provided.

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) Would you choose to participate in this experiment again?

1	2	3	4	5
Definitely no		Maybe		Definitely yes

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

1	2	3	4	5
Definitely no		Maybe		Definitely yes

5) 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

6) Do you believe that the experimenters were completely honest with you?

1	2	3	4	5
Definitely no		Maybe		Definitely yes

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

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

1	2	3	4	5
Definitely no		Maybe		Definitely yes

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

Table 1

Results from concurrent data analysis that shows significant findings between the inclusion-exclusion pairings and re-inclusion-exclusion pairings for all three variables using p-values for significance. The data also reveals no significant difference between the inclusion-re-inclusion pairings.

Pairings	*t*-value	*p* value
Level of Enjoyment		
Inclusion-Exclusion	3.688	.002
Exclusion-Re-inclusion	-3.796	.001
Inclusion-Re-inclusion	-.325	.749
Level of Interest		
Inclusion-Exclusion	2.600	.019
Exclusion-Re-inclusion	-3.432	.003
Inclusion-Re-inclusion	-1.558	.138
Level of Participation		
Inclusion-Exclusion	4.274	.001
Exclusion- Re-inclusion	-3.332	.004
Inclusion-Re-inclusion	.369	.717

Table 2

Results from repeated measures test for theta power pairing inclusion – exclusion, inclusion-re-inclusion, and re-inclusion-exclusion from the midline (Fz) electrode. Effect size was also reported to show the significance of the data without taking the small sample size into consideration.

Pairing	*F* Value	*p* Value	d
Inclusion-Exclusion	1.017	.333	.4468
Inclusion-Re-inclusion	1.214	.292	.0248
Re-inclusion- Exclusion	1.006	.336	.4221

Table 3

Results from repeated measures test for theta power pairing inclusion – exclusion, inclusion-re-inclusion, and re-inclusion-exclusion from the left frontal (F3) electrode. Effect size was also reported to show the significance of the data without taking the small sample size into consideration.

Pairing	*F* Value	*p* Value	d
Inclusion-Exclusion	3.484	.080	.1680
Inclusion-Re-inclusion	.0040	.9534	.0122
Re-inclusion- Exclusion	1.246	.281	.1803

Table 4

Results from repeated measures test for theta power pairing inclusion – exclusion, inclusion-re-inclusion, and re-inclusion-exclusion from the right frontal (F4) electrode. Effect size was also reported to show the significance of the data without taking the small sample size into consideration.

Pairing	*F* Value	*p* Value	d
Inclusion-Exclusion	.173	.683	.5822
Inclusion-Re-inclusion	.510	.485	.2278
Re-inclusion- Exclusion	.231	.638	.8094

Table 5

Results from repeated measures test for theta frequency pairing inclusion – exclusion, inclusion-re-inclusion, and re-inclusion-exclusion from the midline (Fz) electrode. Effect size was also reported to show the significance of the data without taking the small sample size into consideration.

Pairing	*F* Value	*p* Value	d
Inclusion-Exclusion	.037	.851	.1019
Inclusion-Re-inclusion	.084	.776	.1224
Re-inclusion- Exclusion	.222	.646	.2263

Table 6

Results from repeated measures test for theta frequency pairing inclusion – exclusion, inclusion-re-inclusion, and re-inclusion-exclusion from the left frontal (F3) electrode. Effect size was also reported to show the significance of the data without taking the small sample size into consideration.

Pairing	*F* Value	*p* Value	d
Inclusion-Exclusion	1.00	.332	.2702
Inclusion-Re-inclusion	2.512	.133	.4801
Re-inclusion- Exclusion	.338	.569	.2099

Table 7

Results from repeated measures test for theta frequency pairing inclusion – exclusion, inclusion-re-inclusion, and re-inclusion-exclusion from the right frontal (F4) electrode. Effect size was also reported to show the significance of the data without taking the small sample size into consideration.

Pairing	*F* Value	*p* Value	d
Inclusion-Exclusion	.714	.410	.043
Inclusion-Re-inclusion	.025	.875	.002
Re-inclusion- Exclusion	.0638	.436	.043

Figure Captions

Figure 1: The concurrent measures indicate that during the exclusion phase the participant always rated the lowest level of enjoyment, interest, or participation for herself ($p = .002$, $p = .019$, and $p = .001$ respectively). Error bars were calculated using standard error for each variable.

Figure 2: During the exclusion phase the participant typed less than in the inclusion and re-inclusion phases ($p < .01$). Error bars were calculated using standard error for each variable.

Figure 3: This data shows activity recorded during the exclusion phase being the smallest and the activity during the inclusion and re-inclusion phases being the highest in the Fz electrode ($p > .05$, d = 0.4) . Error bars were calculated using standard error for each variable.

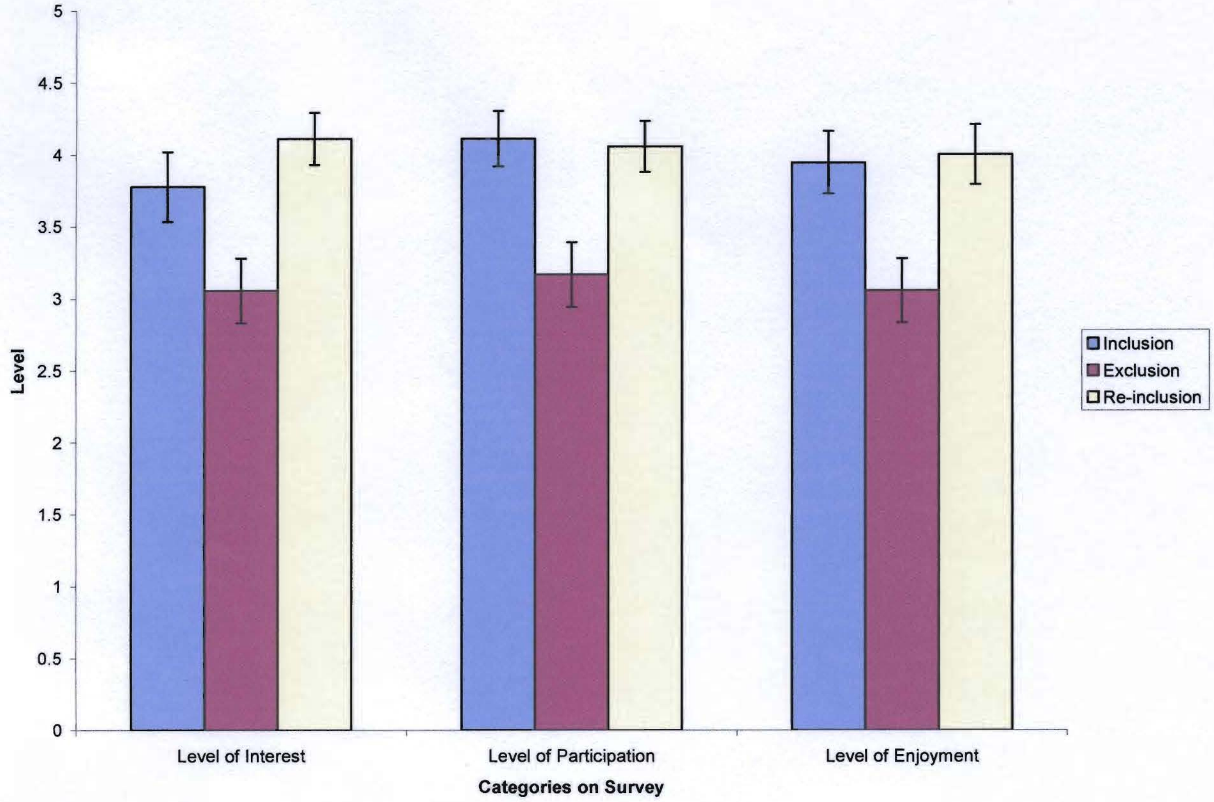
Figure 4: This data shows the data from the left frontal electrode and the expected results can be seen with a decrease of activity during the exclusion phase compared to the inclusion phase and the difference in the re-inclusion activity is also seen ($p > .05$, d = .02). Error bars were calculated using standard error for each variable.

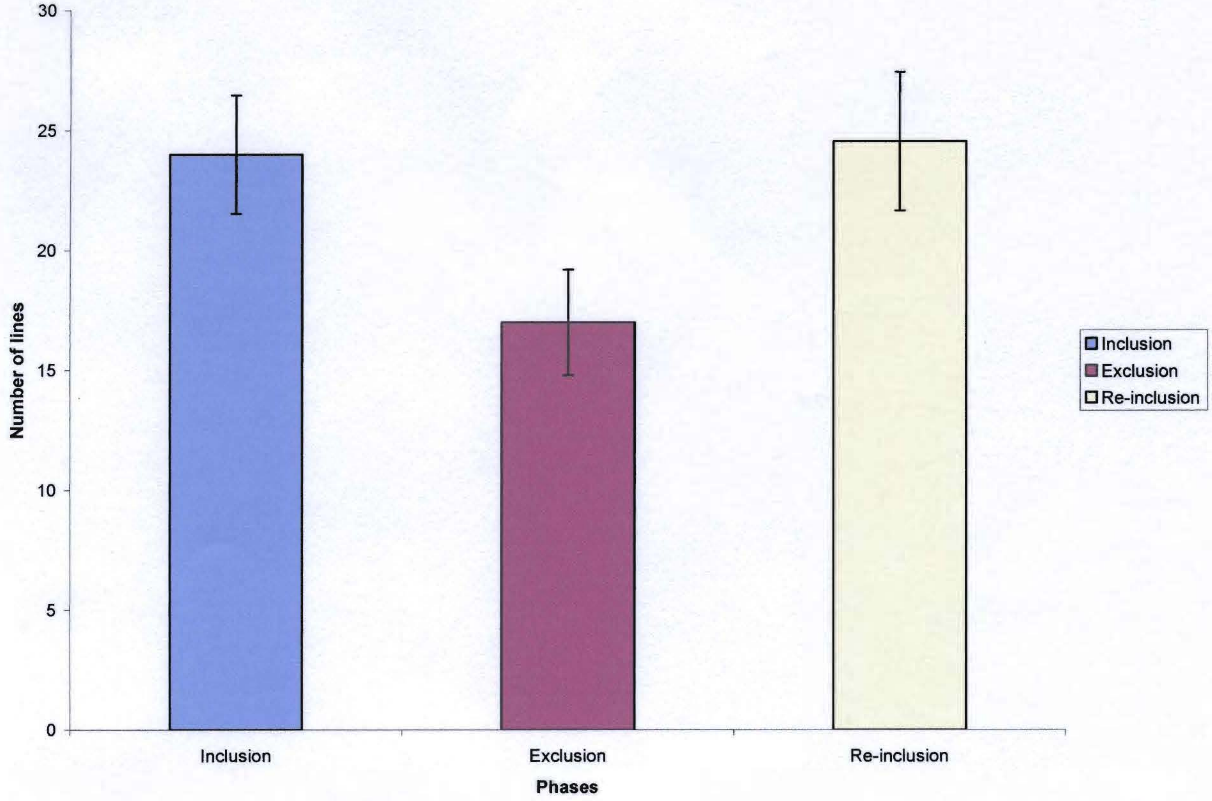
Figure 5: This data also shows the expected results with the largest activity in the exclusion phase and the difference in the inclusion and re-inclusion phases of the experiment in the right frontal electrode ($p > .05$, d = .5 for inclusion-exclusion and d = .8 for re-inclusion-exclusion). Error bars were calculated using standard error for each variable.

Figure 6: No difference was found between the three phases based on frequency collected during the experiment in the Fz electrode ($p > .05$, d <0.2). Error bars were calculated using standard error for each variable.

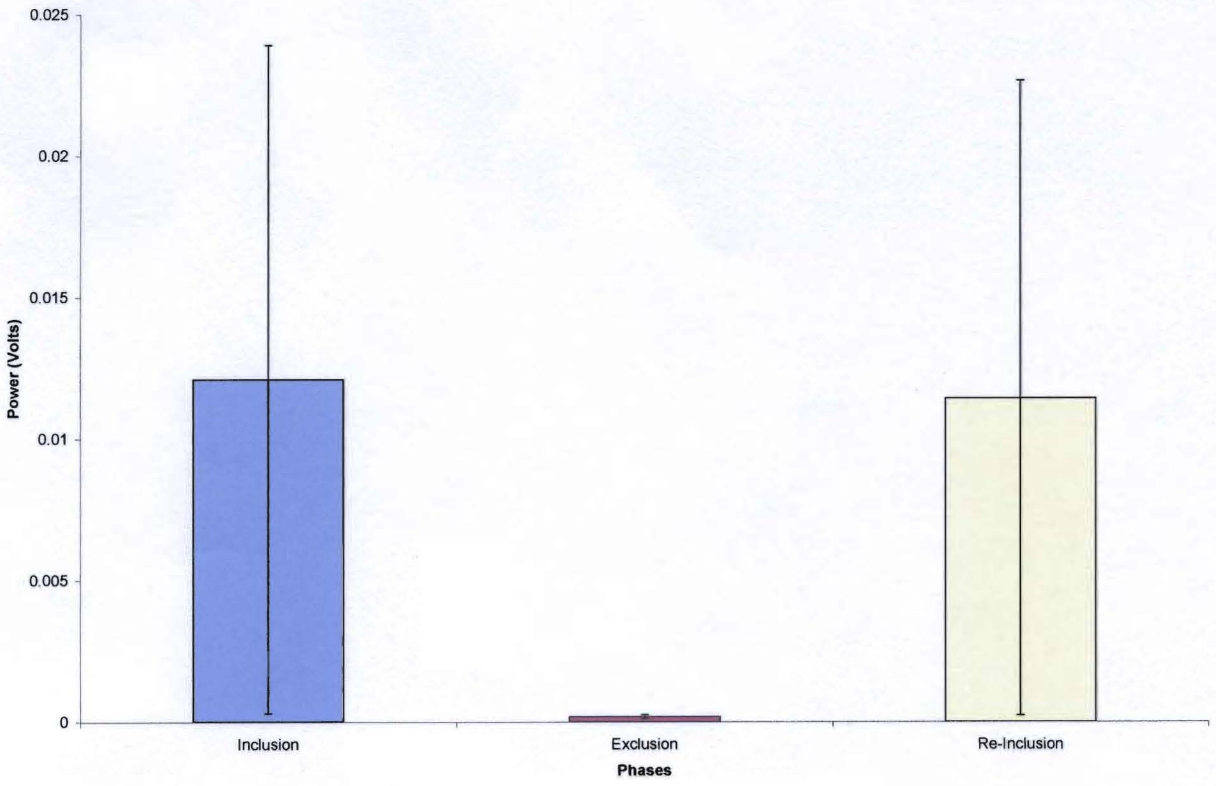
Figure 7: No difference was found between the three phases based on frequency collected during the experiment in the F3 electrode ($p > .05$, d < .3 for inclusion-exclusion and re-inclusion-exclusion and d = 0.5 for inclusion-re-inclusion). Error bars were calculated using standard error for each variable.

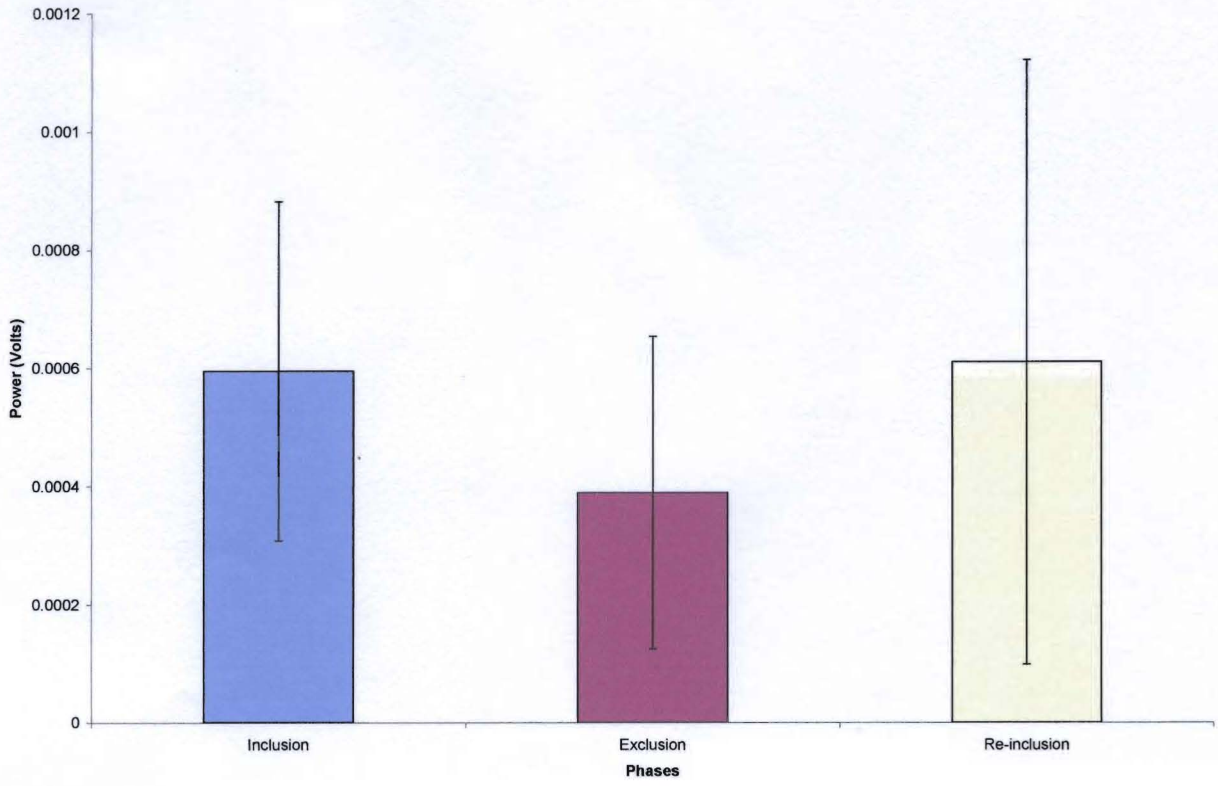
Figure 8: No difference was found between the three phases based on frequency collected during the experiment in the F4 electrode ($p > .05$, d <0.04). Error bars were calculated using standard error for each variable.

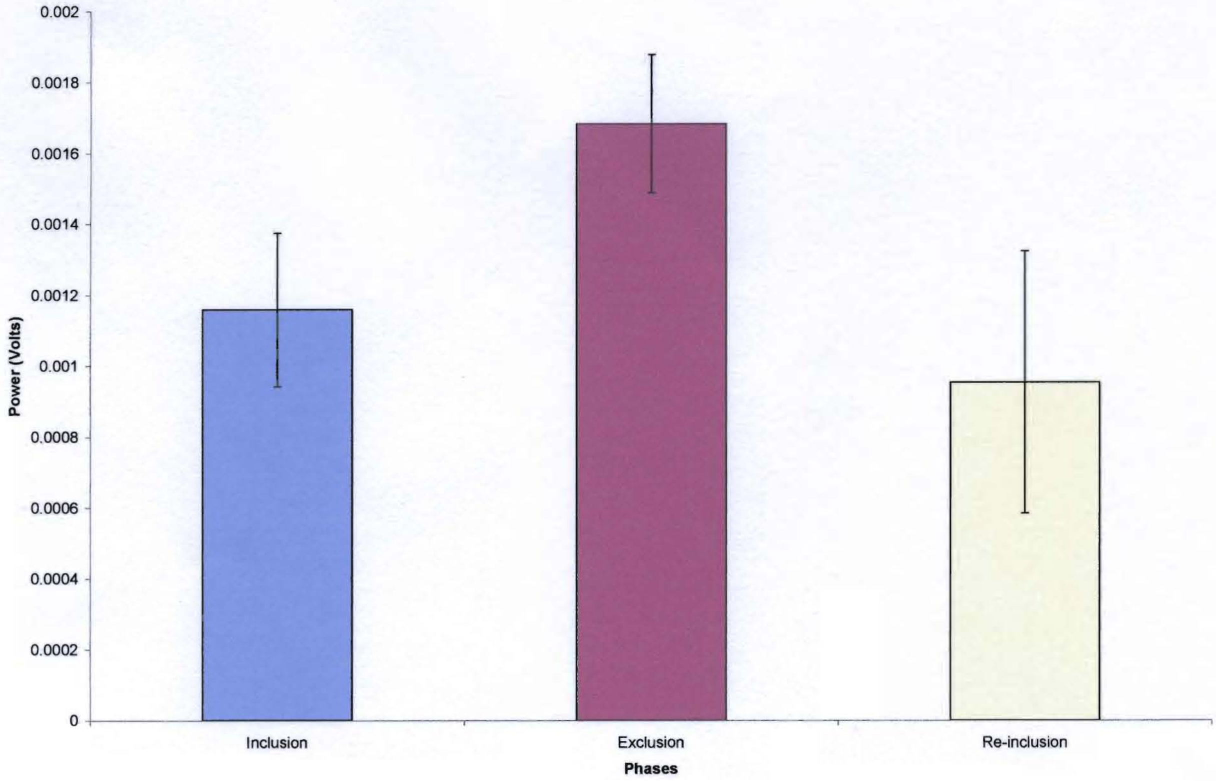

5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Level
Level of Interest
Level of Participation
Level of Enjoyment
Categories on Survey
Inclusion
Exclusion
Re-inclusion

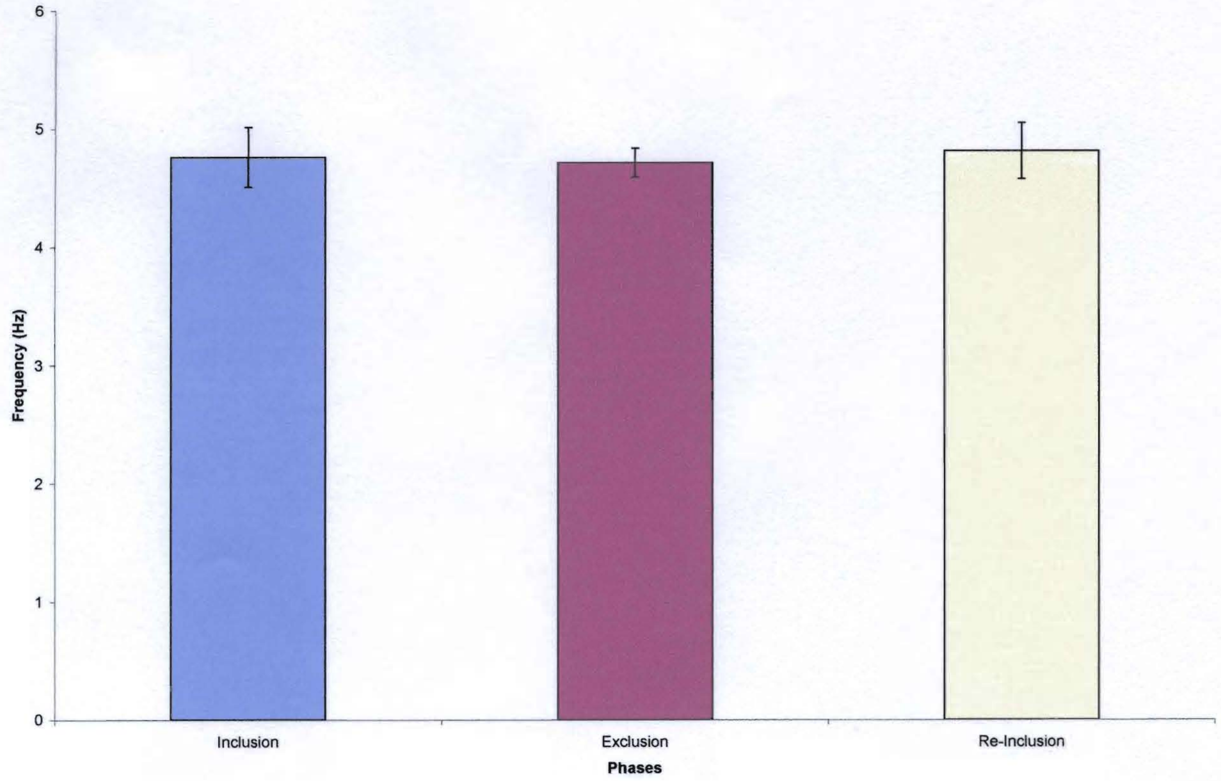


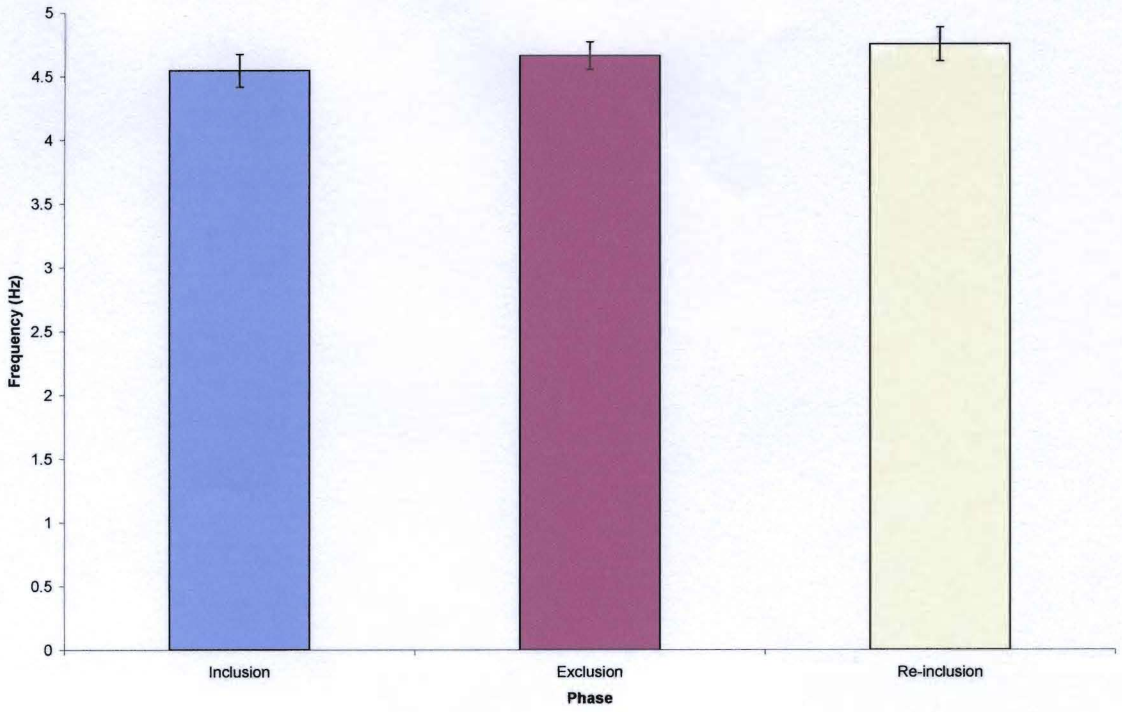
30
25
20
15
10
5
0
Number of lines
Inclusion
Exclusion
Re-inclusion
Phases
Inclusion
Exclusion
Re-inclusion

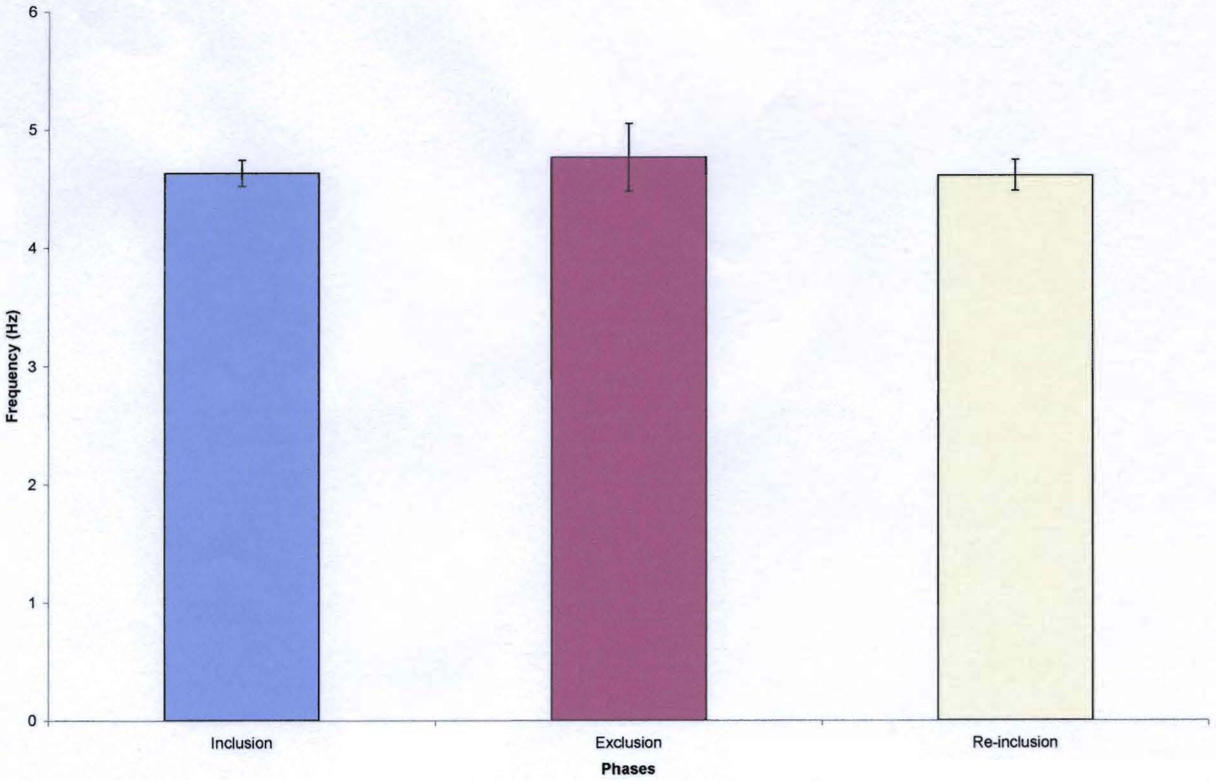

0.025
0.02
0.015
0.01
0.005
0
Power (Volts)
Inclusion
Exclusion
Re-Inclusion
Phases


0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Power (Volts)
Inclusion
Exclusion
Re-inclusion
Phases


0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Power (Volts)
Inclusion
Exclusion
Re-inclusion
Phases


6
5
4
3
2
1
0
Frequency (Hz)
Inclusion
Exclusion
Re-Inclusion
Phases


5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Frequency (Hz)
Inclusion
Exclusion
Re-inclusion
Phase


6
5
4
3
2
1
0
Frequency (Hz)
Inclusion
Exclusion
Re-inclusion
Phases