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NEURAL ASPECTS OF MINDFULNESS IN CLINICAL PATIENTS WITH PERSONALITY DISORDERS

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ABSTRACT

Mindfulness is a heightened awareness and acceptance of the present moment without judgment or reaction. Deficits in mindfulness have been shown as a core mechanism in a number of clinical disorders including personality disorders and major depressive disorder. Therapies aimed at improving mindfulness, dialectical behavior therapy (DBT) for BPD and mindfulness-based cognitive therapy (MBCT) for MDD, have been shown to be effect treatments for these disorders. The present study set out to investigate the neural correlates of mindfulness in a clinical sample after a social exclusion task. We hypothesized that greater levels of mindfulness would be associated with less prefrontal asymmetry after a simulated social exclusion. Participants completed a self-report measure to assess their level of mindfulness. After participating in a simulated social rejection task, electroencephalography (EEG) data was collected to calculate prefrontal asymmetry. Using correlation analysis, a negative significant relationship was found between prefrontal asymmetry and the nonjudging subscale of the mindfulness questionnaire; $r(10) = -.59$, $p = .05$. A negative trend was found between prefrontal asymmetry and the nonreacting subscale; $r(10) = -.54$, $p = .07$. Results suggest that the more mindful a person is, the less likely they are to react, as exhibited by prefrontal asymmetry, to a social rejection. Future research should utilize informant and therapist rated measures of mindfulness.

KEYWORDS: Mindfulness, asymmetry, electroencephalography, borderline personality disorder, major depressive disorder

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Neural Aspects of Mindfulness in Clinical Patients with Personality Disorders

Mindfulness has been described by Kabat-Zinn (1982) as attention, awareness, and complete acceptance of the present moment without judging or reacting to it. A person who is mindful will be aware and completely accepting of their internal experiences and external environment at any given moment without judgment or reaction. Increased levels of mindfulness have been associated with increased immune function (Davidson et al., 2003), decreased chronic pain (Kabat-Zinn, Lipworth, & Burney, 1985), increased ability to cope with serious disorder or distress, improvements on standardized mental health measures, and increased physical wellbeing (Grossman, Niemann, Schmidt, & Walach, 2004).

On the other hand, deficits in mindfulness has been found to underlie a number of clinical disorders, including personality disorders (Wupperman, Neumann, & Axelrod, 2009) and major depressive disorder (MDD; Sheppard & Teasdale, 2000). Even after controlling for relevant personality traits including neuroticism, passive and impulsive emotion-regulation, and interpersonal effectiveness, Wupperman et al. (2009) showed that deficits in mindfulness predicted borderline personality disorder (BPD) features. Consistent with the idea that deficits of mindfulness underlie BPD, dialectical behavioral therapy (DBT) focuses on improving these deficits (Robins, Ivanoff, Linehan, 2001) and has been shown to be an effective treatment for BPD (Linehan et al., 2006). Likewise, treatments for depression which focus on mindfulness deficits such as mindfulness-based cognitive therapy (MBCT) reduce the risk of relapse in individuals previously diagnosed with MDD (Williams, 2008). Studies have shown MBCT to be effective for not only

preventing relapse (Teasdale, Segal, & Williams, 1995; Ma & Teasdale, 2004), but also for treating MDD (Finucane & Mercer, 2006).

Mindfulness-based stress reduction (MBSR) is another treatment that focuses on cultivating mindfulness (Kabat-Zinn, 1990). Research has shown that this program is effective in increasing the participant's level of mindfulness (Anderson, Lau, Segal, & Bishop, 2007). Heppner et al. (2008) used MBSR techniques to induce mindfulness in participants before a social rejection. Research on ostracism has shown that social rejection can result in feelings of either anger or sadness (Williams, Forgas, von Hippel, Zadro, 2005). Those in Heppner et al.'s study receiving MBSR showed less aggression following the social rejection. Research has shown that anger and sadness show characteristic EEG patterns of asymmetrical prefrontal activation (Harmon-Jones & Sigelman, 2001; Light et al., 2009). Therefore, prefrontal asymmetry could be used to examine an individual's emotional response to a social rejection.

Initially, research on prefrontal asymmetry struggled to identify whether this phenomenon is a result of emotional valence or motivation. Some researchers suggested that asymmetry was due to the valence of the emotion, with right-prefrontal activity associated with negative emotions and left-prefrontal activity associated with positive emotions (Heller, 1990; Gotlib, Ranganath, & Rosenfeld, 1998; Nitschke, Heller, Palmieri, & Miller, 1999). Other researchers have argued that asymmetry is the result of the motivational direction of the emotion with right-prefrontal activity associated with withdrawal motivation and left-prefrontal asymmetry associated with approach motivation (Davidson, 1995; Fox, 1991; Harmon-Jones & Allen, 1997, 1998; Sutton & Davidson, 1997). The two theories are congruent when the tested emotion has a negative

valence and withdrawal motivation (e.g. sadness) or positive valence and approach motivation (e.g. joy). However, anger is one emotion that does not fit the negative valence and withdrawal motivation or positive valence and approach motivation prototype. Anger is associated with a negative valence (Ekman & Davidson, 1994) and an approach motivation (Levenson, 1994), meaning that it could not support both theories. Work by Harmon-Jones & Sigelman (2001) has shown that trait anger is related to left-prefrontal asymmetry suggesting that asymmetry is consistent with the motivational direction rather than emotional valence model.

Although research has found deficits in mindfulness in clinical patients and that increases in mindfulness before a social rejection can reduce the amount of aggression after the rejection, no research that we know of has examined the neural correlates of mindfulness following a social rejection. Thus, in the present study we set out to examine the neural correlates of mindfulness in a clinical sample following a social rejection. A better understanding of the neural underpinnings of mindfulness following rejection could help clinical researchers identify mechanisms leading to certain clinical dysfunction and lead to more effective treatments.

We hypothesize that participants who rate themselves higher on a mindfulness scale will show less prefrontal asymmetry, in either direction, following a social exclusion. Our reasoning behind this is that the social rejection will have less of an effect on those who are more mindful. They will have less of an emotional response because they will be less judgmental of and less reactive to their experiences. Participants who have higher levels of mindfulness will also be less likely to ruminate on the negative social interaction they just experienced when we are assessing asymmetry after the

rejection. This reduction in emotional response to the rejection will result in reduced prefrontal asymmetry. To test this hypothesis, we collected mindfulness data on participants using a self report questionnaire, exposed them to a simulated social rejection, and then measured their prefrontal asymmetry.

Method

Participants

Participants were women recruited from the Psychological Clinic at Penn State University as part of a larger study examining the physiological response of social rejection. Participants were screened to ensure they were right-handed, the study was described to them, and they were asked if they would like to participate. Participants needed to be diagnosed with either BPD or MDD. Patients' diagnoses were confirmed through separate structured clinical interviews for axis I (Structured Clinical Interview for DSM-IV, SCID-I) and axis II (International Personality Disorders Examination, IPDE) disorders. Exclusion criteria for participants with BPD included a second axis II disorder, while exclusion for participants diagnosed with MDD included a diagnosis of an axis II disorder. Participants received a compensation of twelve dollars per hour or any part of an hour for their time. A total of 12 (10 BPD, 2 MDD) participants took part in the study. As can be seen in Table 1 located in Appendix A, participants in the sample were primarily Caucasian (67%) and their ages ranged from 21-49 years old with a mean age of 32.42 years.

Measures

Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2008; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). The FFMQ is a 39 question 5-point Likert-type scale

measure, which consists of five factors. These factors include: a) Observing; b) Describing; c) Acting with awareness; d) Nonjudging; e) Nonreacting. Observing includes attending to external and internal experiences, thoughts, sensations, emotions, sounds, sights, and smells. Describing refers to the ability to label internal experiences with words. Acting with awareness includes attending to one's present moment and activities. Nonjudging of inner experience refers to not evaluating thoughts or feelings one may have. Nonreactivity to inner experience refers to the ability to let thoughts and feelings come and go without ruminating on them. The FFMQ demonstrated adequate to excellent internal consistency with alphas ranging from 0.75 to 0.91 (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) Research by Baer et al. (2008) also shows significant negative correlations between the describing, acting with awareness, nonjudging, and nonreacting facets and psychological symptoms for a student, community, highly educated, and meditating sample. These facets are also significantly positively correlated with psychological well-being in a sample of students, highly educated individuals, and meditators (Baer et al. 2008).

Cyberball (Williams, Cheung, & Choi, 2000). In this task, participants are led to believe that they are playing a simulated game of catch over a network with two other participants who are set up similar to themselves and also participating in the experiment. In reality, they are playing against a computer program. At the beginning of the program the participant has a 50% chance of receiving a throw from either 'participant', as the task progresses the chance of receiving a throw drops to 25% and then the participant is eventually excluded. Williams, Cheung, & Choi (2000) demonstrated that this program was perceived by individuals as a rejection and increased negative mood.

Procedure

Participants were brought in as a part of a larger study and only the procedures related to the current study are discussed below. Initially, participants were brought into the lab and consented. Upon completion of consents, participants were instructed to remove all jewelry and wash their face in preparation for the application of a high-density (128 channel) EEG net. The participant's head size was measured to determine the net size and marks with a wax pencil were made on their scalp for net placement. After the net was soaked in a solution of water, potassium chloride, and baby shampoo for five minutes, the net was placed on the participant's head. Impedances were checked and determined to be below a threshold of 50kΩ. While impedances were being checked, participants completed the (FFMQ). Participants then took part in Cyberball, after which they were asked to sit quietly for one minute with their eyes open and one minute with their eyes closed. Prefrontal asymmetry was calculated from this period of recording. In total, the procedure took approximately three hours to complete.

Results

To examine the relationship between mindfulness and prefrontal asymmetry the participant's level of mindfulness was first examined using the (FFMQ). Scores ranged from 1.38-4.88 between all facets with a mean score of 3.04 for observing, 3.27 for describing, 2.86 for acting with awareness, 2.76 for nonjudging, and 2.64 for nonreacting.

Prefrontal asymmetry was assessed from a two-minute segment after the simulated social rejection. This two-minute segment consisted of one-minute of the participant's eyes open and one-minute with their eyes closed. EEG data was collected using a high-density net. Data collection was performed using Net Station 4.4 (EGI,

Eugene OR). Data analysis was conducted using Brain Analyzer 2 (Brain Products, Gilching Germany). Continuous EEG data was exported from Net Station in simple binary format in order to be imported by Brain Analyzer 2. Once in Brain Analyzer 2, the data was first filtered using 60 Hz notch, 1 Hz low, and 30 Hz high filters. Channels were re-referenced using the average of all channels and this new reference was applied to all channels. Data was then segmented to contain only the one-minute segment after the eyes open and eyes closed started. These segments were then divided into 1.024 second epochs that overlap by 75%. Automatic artifact rejection was conducted to remove any artifacts. A baseline correction along with a hamming window was then applied to all epochs. A fast Fourier transformation was performed to each segment to convert the data from time to frequency domain. The values for each segment from a single channel were then averaged together to obtain a value for the alpha band (8-12 Hz) for each channel.

As can be seen in Figure 1 located in Appendix C, electrodes of interest were identified using the International 10-20 system. The electrodes denoted as the left and right frontal poles (Fp3 and Fp4 respectively) and the few electrodes immediately surrounding these areas were included in the analysis. The values for these electrodes for each participant were then averaged together for a value of Fp3 and Fp4. A measure of relative activity was calculated by subtracting the power of alpha activity on the right side from the left side. This asymmetry will either result in greater relative right activity represented by a positive value and more avoidant activity or greater relative left activity represented by a negative value and more approach activity. For the purposes of this

study we examined the absolute value of this variable, representing the magnitude of asymmetry in either direction.

Correlations between all five facets and prefrontal asymmetry can be seen in Table 2 located in Appendix A. As hypothesized, correlation analysis revealed a significant, negative relationship between nonjudging and asymmetry ($r = -.59$, $p = .05$). In addition, there was a trend towards a significant, negative relationship between nonreacting and asymmetry ($r = -.54$, $p = .07$) at the trend level. There was not a significant relationship between observing, describing, or acting with awareness and asymmetry. The correlations for observing and describing were both negative, -.31 and -.27, respectively, while the correlation for acting with awareness was positive with a value of .18.

Discussion

The objective of this experiment was to examine the neural correlates of mindfulness in a clinical population in an effort to understand possible mechanisms underlying this important clinical construct. Clinical participants diagnosed with either BPD or MDD completed a 39-item questionnaire used to assess their level of mindfulness while EEG activity was recorded following a simulated social rejection to examine prefrontal asymmetry. It was hypothesized that individuals who scored higher on mindfulness would exhibit less prefrontal asymmetry in either direction. This could provide insight into the role mindfulness plays in clinical disorders. Correlation analysis supported our hypothesis on two of the five subscales of the FFMQ.

A significant negative relationship was found between nonjudging and prefrontal asymmetry. In addition, a trend level negative relationship between nonreacting and

prefrontal asymmetry was found. These findings suggest that when an individual who scores higher on the nonjudging and nonreacting subscales of the FFMQ, they are less likely to exhibit prefrontal asymmetry. These findings are consistent with the idea that a person who is more mindful will not have as large of a reaction to the social rejection as someone who is less mindful. If people score high on these two subscales, it follows that they will not react as intensely to the social rejection.

Mindfulness-based cognitive therapy, used to treat and prevent the relapse of MDD, focuses on awareness that is purposefully nonjudgmental and nonreactive (Dimidjian, Kleiber, & Segal, 2009). It is thought that when someone who has already experienced a depressive episode is experiencing dysphoria, they may relapse into a major depressive episode. However, it is thought that mindfulness-based cognitive therapy prevents this person from engaging in these depressive cycles of thought (Ma, & Teasdale, 2004). This is similar to dialectical behavior therapy, where the patient uses mindfulness techniques to reduce the rate of which they judge their experiences (Bohus et al., 2000). Both have been shown to be effective treatments for their respective disorders and the idea of not judging your experiences is an important aspect in both. This research exhibits the relationship between mindfulness and one's capacity to self-regulate in a socially distressing situation. This ability and the role that mindfulness plays should be further investigated in clinical disorders.

Strengths of this study include the inclusion of both a BPD and MDD population along with a multi-faceted mindfulness questionnaire. However, there are several limitations of the study suggesting that the results should be interpreted cautiously. One of those limitations includes the small sample size of 12 patients, which reduced the

statistical power of our analysis. A second limitation regarding the sample is the greater proportion of BPD participants compared to MDD. A third limitation is assessing mindfulness through self report measures. The FFMQ is high in face validity and is therefore susceptible to response bias. Further studies should focus on larger sample sizes with an even proportion of BPD and MDD participants. In addition, future studies might consider another way to assess mindfulness. Future studies might also want to investigate mindfulness and resting asymmetry before and after treatments containing mindfulness components. This could provide important insight into possible mechanisms of treatment.

In addition to the explanations discussed above, there are alternative ways to interpret the findings. Someone who has a greater ability to regulate their emotions might exhibit less prefrontal asymmetry and greater mindfulness. The reduction in prefrontal asymmetry could be associated with a broader construct such as emotion regulation rather than mindfulness. Another possibility is that mindfulness and prefrontal asymmetry might covary with a third variable such as severity of mental illness. Finally, prefrontal asymmetry could be a biological trait and due to this biological disposition, some patients may have a particularly difficult time being mindful and might not show improvements in mindfulness-based treatments.

Despite these limitations, the study shows preliminary data suggesting that mindfulness is related to prefrontal asymmetry. Treatments for BPD and MDD may be effective through their reduction of prefrontal asymmetry. If these findings can be replicated, they may provide important insight into the mechanisms of mindfulness-based therapies for clinical disorders.

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Appendix A

Table 1.

Sample Demographics

		Clinical Sample (N = 12)	
Age (in years)			
Mean		32.42	
SD		7.94	
Range		21-49	
		N	%
Race			
	Caucasian	8	67
	African-American	1	8
	Asian	1	8
	Hispanic	1	8
	Other	1	8

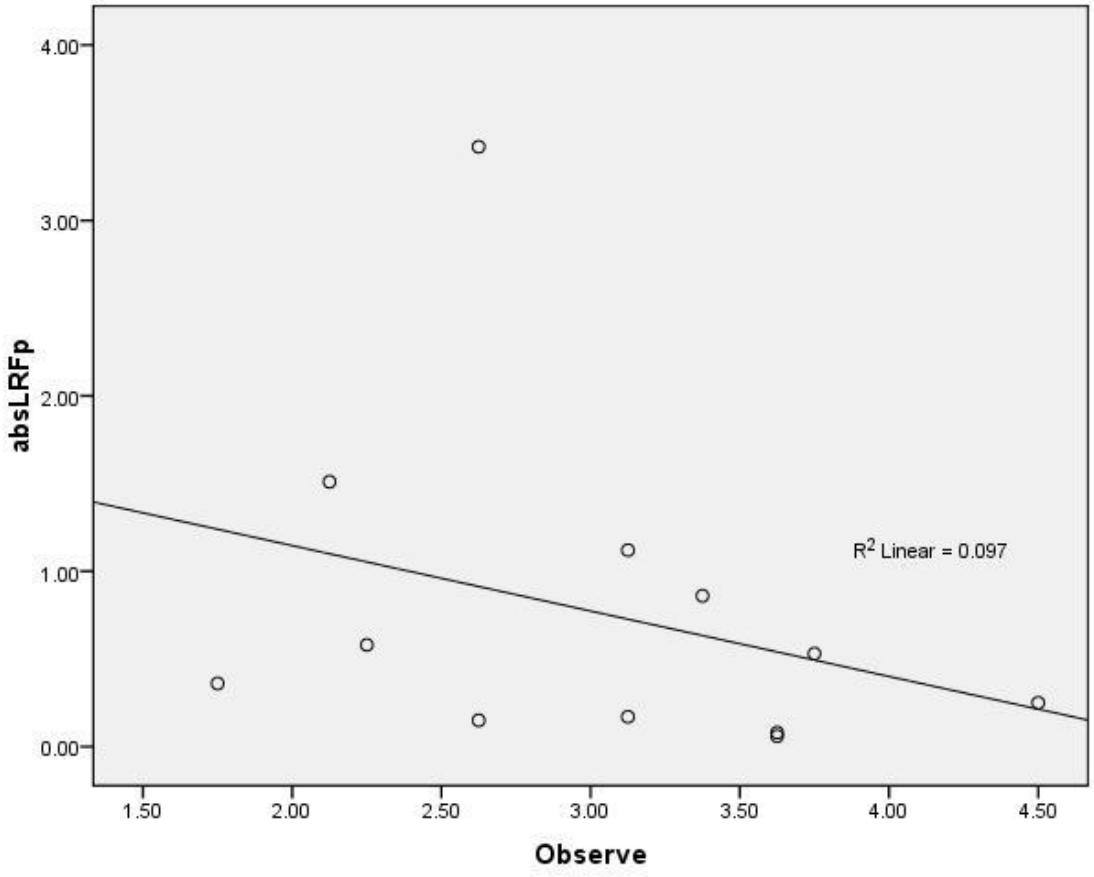
Table 2
Correlations between absolute prefrontal asymmetry and FFMQ subscales

FFMQ Subscale	Pearson Correlation	Significance
Observe	-.311	.325
Describe	-.274	.389
Awareness	.177	.583
Nonjudge	-.585	.046
Nonreact	-.544	.068

Appendix B

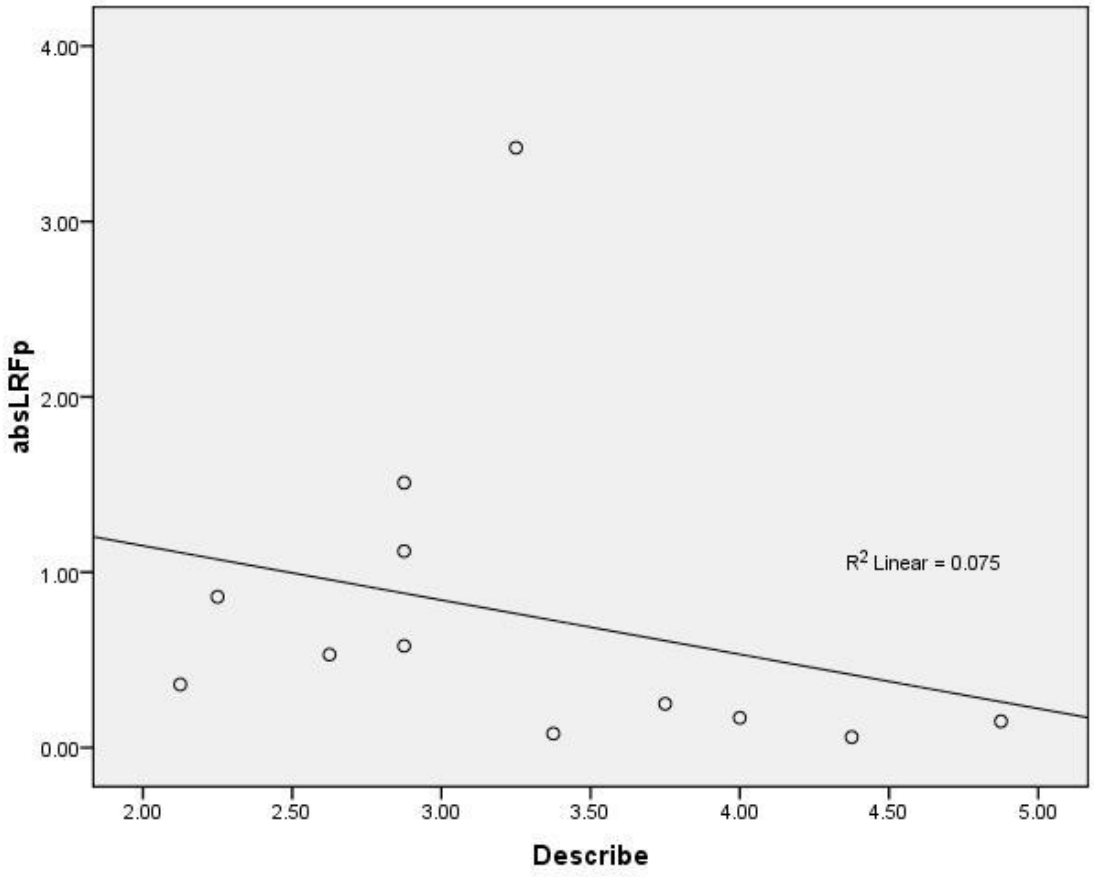
Graph 1

Observing and Absolute Value of Prefrontal Asymmetry



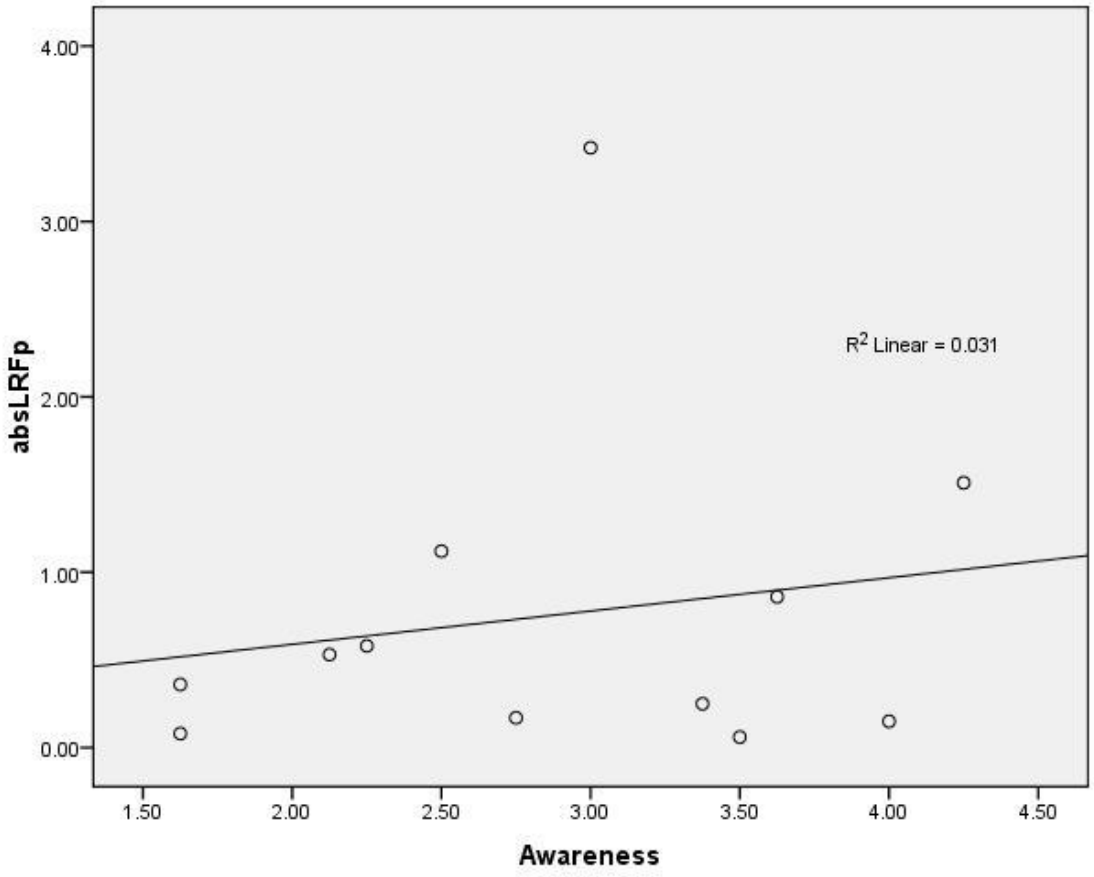
Graph 2

Describing and Absolute Value of Prefrontal Asymmetry



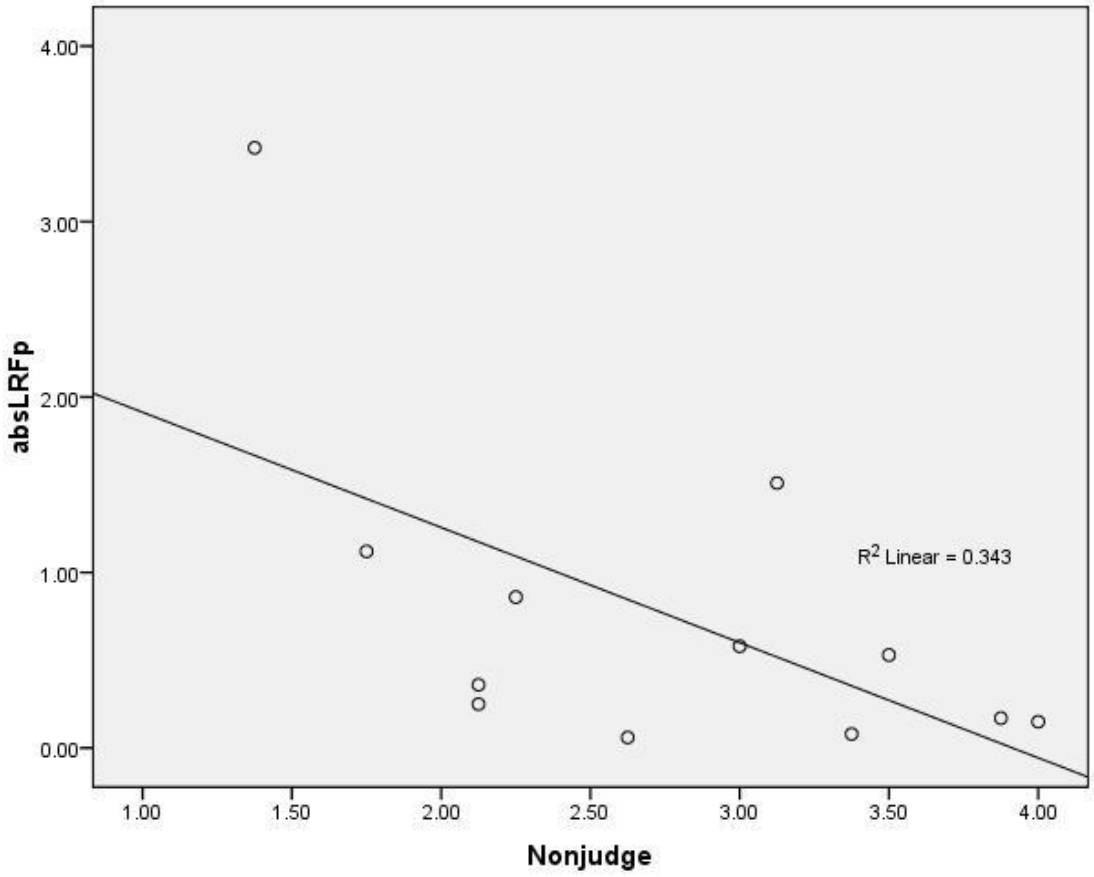
Graph 3

Awareness and Absolute Value of Prefrontal Asymmetry



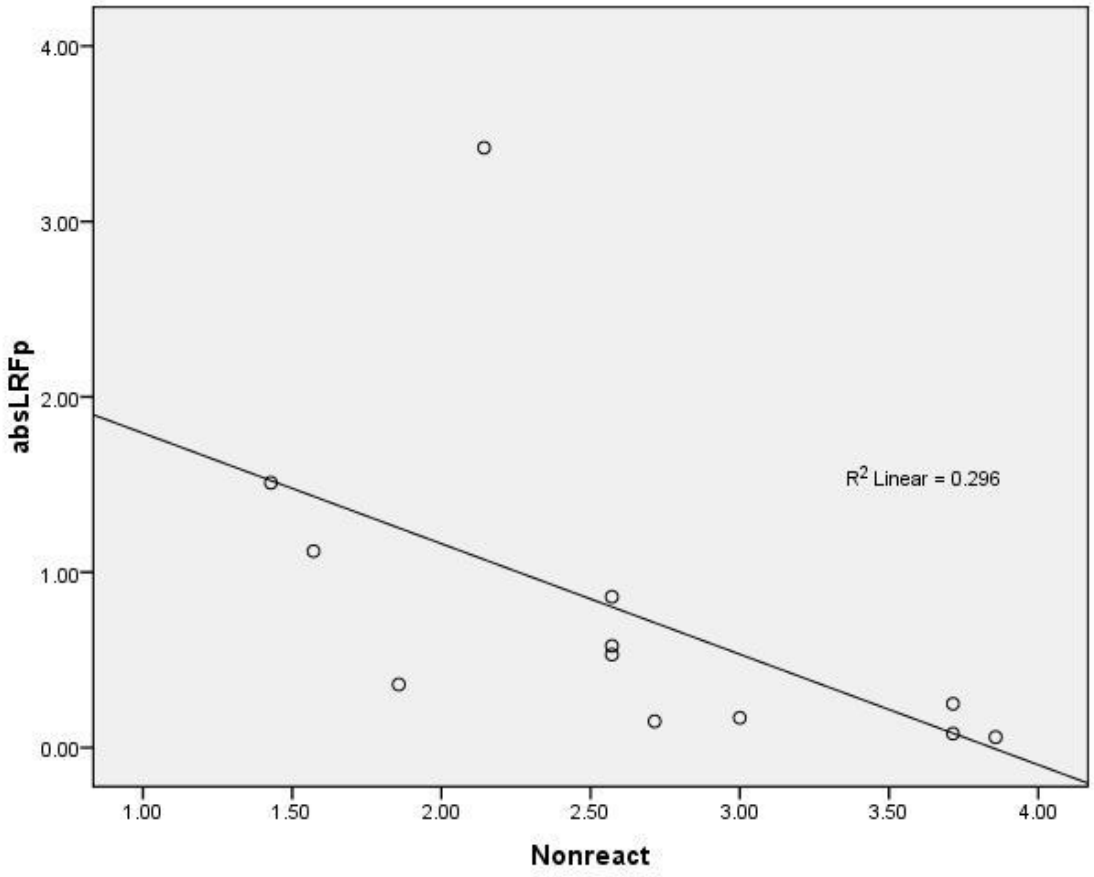
Graph 4

Nonjudging and Absolute Value of Prefrontal Asymmetry



Graph 5

Nonreacting and Absolute Value of Prefrontal Asymmetry



Appendix C

Figure 1

Electrodes used for asymmetry measurements

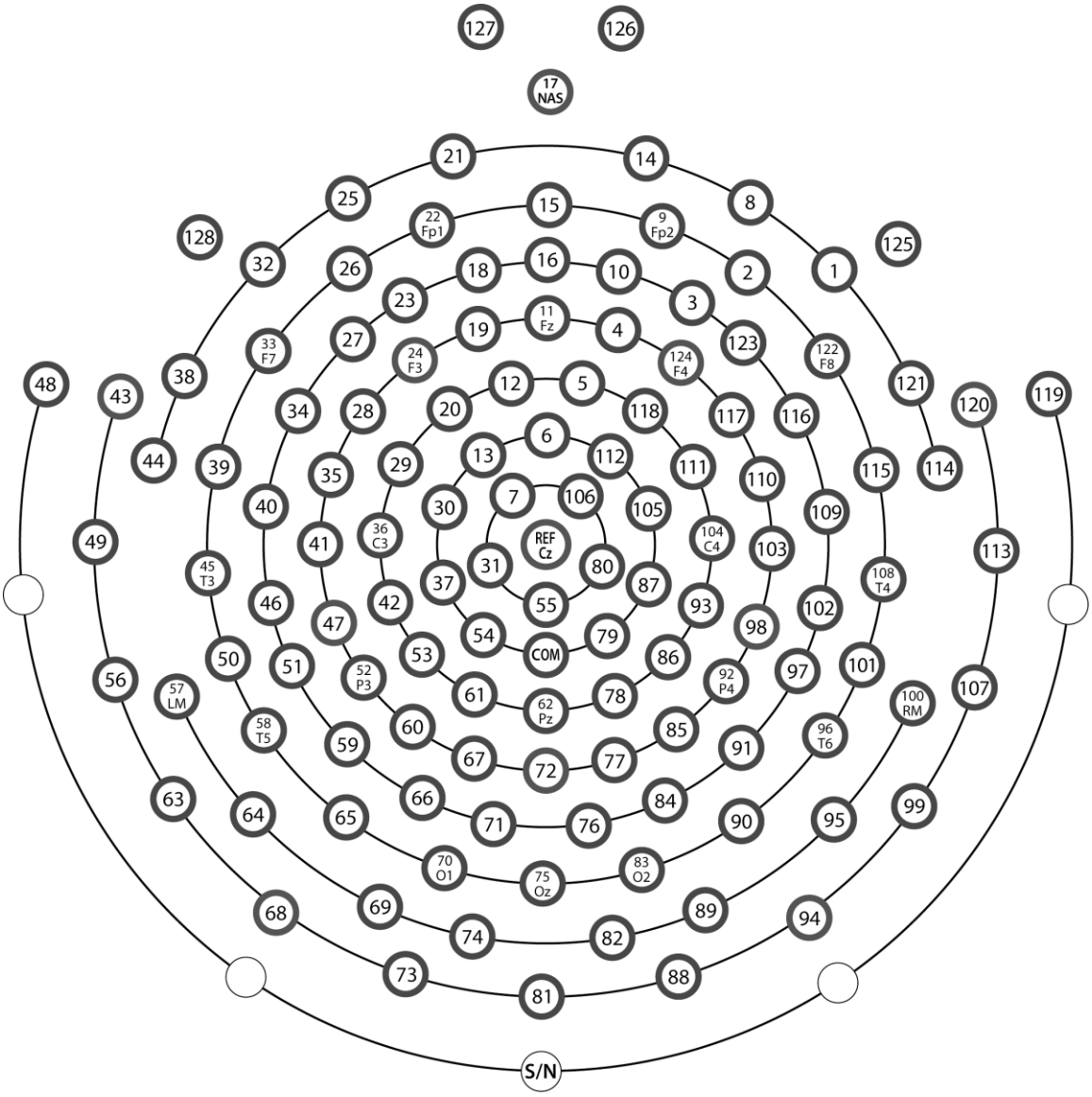


Figure 1. Electrodes for the left prefrontal area included 18, 21, 22, 23, 25, 26. Electrodes for the right prefrontal area included 2, 3, 8, 9, 10, 14

Appendix D

Measures Used

Five Facet Mindfulness Questionnaire

Description:

This instrument is based on a factor analytic study of five independently developed mindfulness questionnaires. The analysis yielded five factors that appear to represent elements of mindfulness as it is currently conceptualized. The five facets are observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. More information is available in:

Please rate each of the following statements using the scale provided. Write the number in the blank that best describes <u>your own opinion</u> of what is <u>generally true for you</u>.

1	2	3	4	5
never or very rarely true	rarely true	sometimes true	often true	very often or always true

_____ 1. When I'm walking, I deliberately notice the sensations of my body moving.

_____ 2. I'm good at finding words to describe my feelings.

_____ 3. I criticize myself for having irrational or inappropriate emotions.

_____ 4. I perceive my feelings and emotions without having to react to them.

_____ 5. When I do things, my mind wanders off and I'm easily distracted.

_____ 6. When I take a shower or bath, I stay alert to the sensations of water on my body.

_____ 7. I can easily put my beliefs, opinions, and expectations into words.

_____ 8. I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.

_____ 9. I watch my feelings without getting lost in them.

_____ 10. I tell myself I shouldn't be feeling the way I'm feeling.

_____ 11. I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.

_____ 12. It's hard for me to find the words to describe what I'm thinking.

_____ 13. I am easily distracted.

_____ 14. I believe some of my thoughts are abnormal or bad and I shouldn't think that way.

_____ 15. I pay attention to sensations, such as the wind in my hair or sun on my face.

_____ 16. I have trouble thinking of the right words to express how I feel about things

_____ 17. I make judgments about whether my thoughts are good or bad.

_____ 18. I find it difficult to stay focused on what's happening in the present.

_____ 19. When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it.

_____ 20. I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.

_____ 21. In difficult situations, I can pause without immediately reacting.

_____ 22. When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words.

_____ 23. It seems I am "running on automatic" without much awareness of what I'm doing.

_____24. When I have distressing thoughts or images, I feel calm soon after.

_____ 25. I tell myself that I shouldn't be thinking the way I'm thinking.

_____ 26. I notice the smells and aromas of things.

_____ 27. Even when I'm feeling terribly upset, I can find a way to put it into words.

_____ 28. I rush through activities without being really attentive to them.

_____ 29. When I have distressing thoughts or images I am able just to notice them without reacting.

_____ 30. I think some of my emotions are bad or inappropriate and I shouldn't feel them.

_____ 31. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.

_____ 32. My natural tendency is to put my experiences into words.

_____ 33. When I have distressing thoughts or images, I just notice them and let them go.

_____ 34. I do jobs or tasks automatically without being aware of what I'm doing.

_____ 35. When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.

_____ 36. I pay attention to how my emotions affect my thoughts and behavior.

_____ 37. I can usually describe how I feel at the moment in considerable detail.

_____ 38. I find myself doing things without paying attention.

_____ 39. I disapprove of myself when I have irrational ideas.

Zachary Infantolino

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EDUCATION

2006-Present **The Pennsylvania State University**, University Park, PA
Bachelor of Science in Psychology, Neuroscience Option with Honors and Minors in Statistics and Neuroscience
Expected Degree Date: May 2010

RELEVANT COURSEWORK

PSYCHOLOGY

(31 Credits) Introductory Psychology, Introduction to Developmental Psychology, Introduction to Abnormal Psychology, Psychology as a Science and Profession, Neurological Bases of Human Behavior, Introduction to Clinical Psychology, Introduction to Social Psychology, Personality Theory, Honors Course in Psychology (Research Methods), Senior Seminar in Psychology: The Mind and Brain of Madness: Psychological and Neuroscience Perspectives on Psychopathology

SCIENCE

(38 Credits) Introductory Physics I, Introductory Physics II, Chemical Principles I, Experimental Chemistry I, Chemical Principles II, Experimental Chemistry II, Introductory Physiology, Mammalian Anatomy, Genetics and Evolution of the Human Species, Elementary Microbiology, Fundamentals of Organic Chemistry I, Pharmacological Influences on Health, Neurobiology

MATHEMATICS/STATISTICS

(27 Credits) Honors Calculus with Analytic Geometry I, Honors Calculus with Analytic Geometry II, Elementary Statistics, Calculus of Several Variables, Introduction to Probability Theory, Intermediate Applied Statistics, Applied Regression Analysis, Introduction to SAS

AWARDS, GRANTS, AND HONORS

2010	Selected as student Marshall for the Department of Psychology
2010	Awarded The Charles N. Cofer Memorial Award in Psychology
2010	Awarded The Evan Pugh Scholar Award (recognized for being in the top 0.5% of class)
2009	Awarded Mona Shibley Bird Memorial Scholarship in Psychology
2009	Awarded Summer Discovery Grant for proposed work on the neural correlates of mindfulness
2009	Awarded The Costello Family Award
2009	Awarded The Evan Pugh Scholar Award (recognized for being in the top 0.5% of class)
2008	Awarded The President Sparks Award (recognized for a 4.0 GPA in the first three semesters)

2008	Inducted in Psi Chi (National Honor Society in Psychology)
2008	Inducted in Golden Key International Honour Society
2008	Inducted in Phi Kappa Phi Honor Society
2007	Awarded The President's Freshman Award (recognized for 4.0 GPA in first semester)
2007	Inducted in National Residence Hall Honorary (Top 1% of residence hall leaders)
2006-Present	Academic Excellence Scholarship

RESEARCH EXPERIENCE

Research Assistant for Dr. Kenneth Levy
Fall 2007 – Present
Cortisol Project Coordinator, Summer 2009
EEG Project Coordinator, Summer 2009 – Present

As a member of Dr. Levy's Personality, Psychopathology, and Psychotherapy Lab I have been exposed to a diverse set of psychotherapy and personality studies. I was initially responsible for transcribing Adult Attachment Interviews, data entry, literature searches, and maintaining the lab website. As my responsibilities increased, I have had the opportunity to work with different clinical populations including patients with borderline personality disorder and major depressive disorder as well as healthy and temperamentally matched control populations. I have been exposed to these populations in the context of studies that examined executive functioning and impulsivity, cortisol and alpha-amylase response to the Trier Social Stress Test, and utilizing electroencephalography (EEG) to examine frontal asymmetry and ERP after a simulated social exclusion paradigm. This past summer I was project coordinator for the study mentioned above involving the measurement of stress hormones, cortisol and alpha-amylase. This two-phase study consisted of three clinical interviews (e.g. Adult Attachment Interview, International Personality Disorder Examination, Structured Clinical Interview for DSM-IV) in the initial phase and the Trier Social Stress Test for the second phase. My responsibilities included recruitment and scheduling of participants, conducting the Trier Social Stress Test, and collecting saliva samples. In addition to these responsibilities, I was also selected as the project coordinator on a study examining frontal asymmetry in patients with either borderline personality disorder or major depressive disorder. Through this experience I have received training in EEG net application, data collection (Netstation), and basic spectral and ERP analysis (Netstation, Neuroscan, and Brain Vision Analyzer).

Research Assistant at Integrated Electronics Engineering Center (IEEC) Laboratory
Binghamton University
Supervisor: Bahgat Sammakia, Ph.D., Director of the Integrated Electronics Engineering Center
Summers 2006, 2007

Over the course of two summers I designed an apparatus for the assembly of test samples for a thermal conductivity tester. Test samples were comprised of the thermal interface material of interest sandwiched between two aluminum blocks fitted with five thermocouples each. Special care needed to be taken to ensure that the surfaces of each aluminum block were flat so that there was uniform heat conduction through the block. In addition, it was imperative that the surfaces of the aluminum blocks that were in contact with the thermal interface material were parallel when the test sample was prepared to obtain accurate measurements. X-rays were taken to verify that thermocouples were placed in the center of each cube. I also operated the thermal

conductivity tester to investigate the feasibility of obtaining accurate measurements of the thermal conductivity of a known material. For data collection, I set up a data acquisition system and wrote a macro in Microsoft Excel to take measurements at regular intervals while the apparatus heated up and then recognize when the test sample had reached a steady state and stop recording measurements. After receiving the necessary measurements, I calculated the thermal conductivity and compared it to the manufacturer's stated value. Regression analysis was also performed to assess the heat flow through the test sample and check for evidence of heat loss. At the end of each summer I wrote a report and presented my findings to Dr. Sammakia.

PRACTICAL EXPERIENCE

Summer 2008 — **The Greater Binghamton Health Center**
Volunteer

The Greater Binghamton Health Center provides inpatient and outpatient services for mentally ill adults and children. While at The Greater Binghamton Health Center, I split my time between various areas including one of several treatment malls where inpatients would spend two hours during the morning and two hours during the afternoon, the recreation area, and the physical therapy unit. My role in the treatment mall was to help facilitate different treatment programs including cognitive rehabilitation, social skills, and relapse prevention. While with the recreation department, I would provide assistance during outings with patients to a park owned by the health center. During the summer, patients were taken on a biweekly basis for several hours and would have an opportunity to eat, relax, and play games. This, along with helping in the physical therapy unit, allowed me to interact with the patients and get a sense of who they are and what life was like for them with a particular disorder and being on medication.

August-May 2008 — **Resident Assistant**
Schreyer Honors Living and Learning Community Special Living Option

I was selected to be a resident assistant for a floor of 45 males in the Schreyer Honors Living and Learning Community. My responsibilities included planning and implementing a safety, educational, and diversity program along with many activities focused on building community on the floor. I also provided support for students in times of stress and need. Approximately half of my floor was freshmen who were adjusting to college and life away from home. The majority of students handled this transition well but there were a couple who needed additional assistance and this is where I came in. I could provide a person to listen to them or, if it was a more serious matter, direct them to professionals who could help. In addition, my responsibilities included being on duty every other week which consisted of walking around the building to ensure the safety of the residents and being on call during the night should a concern arise.

REFERENCES

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