

MMPI-2-RF AND qEEG DIFFERENCES AMONG WOMEN WITH EATING DISORDERS

A thesis presented to the faculty of the Graduate School of Western Carolina University in partial fulfillment of the requirements for the degree of Master of Arts in Psychology

By

Katy Anne Wormley

Director: Dr. Winford Gordon
Assistant Professor of Psychology
Psychology Department

Committee Members: Dr. David McCord, Psychology
Dr. L. Alvin Malesky Jr., Psychology

April 2016

TABLE OF CONTENTS

LIST OF FIGURES	iv
ABSTRACT.....	v
CHAPTER 1: INTRODUCTION	1
CHAPTER 2: LITERATURE REVIEW	3
History of Eating Disorders	3
Current Diagnostic Criteria for Eating Disorders	4
Personality, Psychopathology, and Eating Disorders.....	6
Personality Assessment and Development of the MMPI.....	8
MMPI and Eating Disorders	10
Development of the MMPI-2	13
MMPI-2 and Eating Disorders	14
Development of the RC Scales and MMPI-2-RF	16
MMPI-2-RF and Eating Disorders.....	18
Electroencephalography and quantitative Electroencephalography	20
Electroencephalography and Eating Disorders	22
Statement of the Problem	23
Hypotheses	25
Hypothesis 1	25
Hypothesis 2	25
Hypothesis 3	26
Hypothesis 4	26
CHAPTER 3: METHODOLOGY	27
Participants	27
Measures.....	27
Procedure.....	28
CHAPTER 5: DISCUSSION.....	31
REFERENCES	34
APPENDICES	42
Table 1.....	42
Table 2.....	43
Figure 1. <i>Eating Disorder Symptom Checklist</i>	44

LIST OF TABLES

Table 1. Bivariate correlations between the emotional and internalizing dysfunction MMPI-2-RF scales and the eating disorder symptom checklist.....	42
Table 2. Bivariate correlations between the emotional and internalizing dysfunction MMPI-2-RF scales and the eating disorder symptom checklist.....	43

LIST OF FIGURES

Figure 1. Eating Disorder Symptom Checklist.....	44
--	----

ABSTRACT

MMPI-2-RF AND qEEG DIFFERENCES AMONG WOMEN WITH EATING DISORDERS

Katy Wormley, BA

Western Carolina University (April 2016)

Director: Dr. Winford Gordon

Previous research suggests that personality differences among individuals with disordered eating may be predictive of symptomatology, treatment response, and prognosis. This study sought to use the MMPI-2-RF to look for personality and psychopathology differences between eating disorder subtypes. The groups examined were participants exhibiting predominantly restricting, bingeing, or purging behaviors as well as low body weight and nutritional deficiency. Results indicated that participants who exhibited restricting behaviors or had significant weight loss and nutritional deficiency had lower scores on the scales measuring emotional and internalizing dysfunction and higher scores on the scales measuring behavioral externalizing dysfunction. Participants who exhibited bingeing and purging behaviors had higher scores on the emotional and internalizing scales and lower scores on the behavioral externalizing scales. The opposite patterns suggest that different treatment methods may best address the specific and different symptoms of each eating disorder group.

CHAPTER 1: INTRODUCTION

There has been a dramatic increase in the last half-century in the prevalence of eating disorders (Hudson, Hiripi, Pope, & Kessler, 2007). Eating disorders have the highest mortality rate of any disorder in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). A review of thousands of cases of adult females with anorexia nervosa revealed an overall mortality rate of 5%. In the surviving patients, less than half made a full recovery, 33% made a partial recovery, and 20% experienced a chronic course of the disorder. A review of thousands of cases of adult females with bulimia nervosa revealed an overall mortality rate of 0.3%. In the surviving patients, 48% made a full recovery, 26% made a partial recovery, and 26% experienced a chronic course of the disorder (Steinhausen, 2009). Among women diagnosed with eating disorders, a considerable number have comorbid personality and anxiety disorders (Godt, 2008; Swinbourne et al., 2012). Therefore, being able to effectively measure personality and psychopathology differences in eating disorder subtypes could lead to more specific and effective treatment methods.

There is also evidence that women diagnosed with eating disorders may have abnormal brainwave functioning (Hatch et al., 2011). A more recent area of research has focused on the relationship between eating disorders and electroencephalography (EEG). The relationship is not yet clear and there have only been suggestions of possible trends. The inconsistent findings may be attributed to the heterogeneous groups studied, different techniques used, and different experimental settings (Jáuregui-Lobera, 2011).

This study will explore the associations between personality and disordered eating and EEGs and disordered eating. This paper includes a review of the literature to chronicle the

history and current conceptualization of eating disorders. The history of the MMPI and its use in studying eating disorders will be discussed. Finally, EEGs and qEEGs will be discussed along with their use within eating disorder populations. The plans for a study using the latest version of the MMPI, the MMPI-2-RF, and quantitative EEG (brain mapping) to differentiate between eating disorder subtypes will be outlined.

CHAPTER 2: LITERATURE REVIEW

History of Eating Disorders

Eating disorders have been evident throughout much of human history. Historically, combinations of economic and social factors have driven or inhibited disordered eating behaviors. Ancient Romans often purged after feasting in order to be able to eat more. Ancient Egyptian hieroglyphics depict monthly purges to avoid illness. African tribes tell stories of adults fasting during famines to save food for their children, and then continuing to fast even when they were dangerously malnourished and the famine was over. Wealthy Roman females, under spiritual guidance, starved themselves to show contempt for their bodies (Egnel, Staats Reiss, & Dombeck, 2007).

The first formal diagnosed and recorded account of anorexia was in London, England in the 1680's by Dr. Richard Morton. Dr. Morton thought his extremely skinny female patient was being eaten away by her sadness. Sir William Gull was the first to characterize anorexia as a disease arising from a mental state. He named the disease anorexia nervosa meaning loss of appetite. Around the same time, psychiatrist Charles Lasegue viewed anorexia from a more psychological and social standpoint. He believed anorexia occurred in homes with an abundance of food where children were expected and pressured to eat all of the food on their plate. He believed this was often stressful for children and some children refused to eat as a way to rebel. Dr. Lasegue also believed that women experiencing emotional turmoil with no outlet protested by not eating (Egnel, Staats Reiss, & Dombeck, 2007).

For a long time anorexia and bulimia were thought to be physical diseases. They were attributed to hormone imbalances, endocrine deficiencies, and even tuberculosis. Then in the

1930's, the medical community began to accept that eating disorders could be caused by psychological and emotional disturbances (Egnel, Staats Reiss, & Dombek, 2007). Binge eating and compensatory purging was first mentioned in the 1930s, but it appeared only in the context of anorexia (Habermas, 1989). Anorexia nervosa was included in the first edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-I) (American Psychiatric Association, 1952). In the 1950's bulimia was recognized as distinct from anorexia. Bulimia was first included in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) (American Psychiatric Association, 1980). Since then, the placement and criteria of eating disorders have changed with each revision of the DSM.

Current Diagnostic Criteria for Eating Disorders

In the DSM-IV-TR, there was anorexia nervosa (AN; a binge/purge subtype and a restrictive subtype), bulimia nervosa (BN; purge and non-purging subtypes), and Eating Disorder Not Otherwise Specified (EDNOS) (American Psychiatric Association, 2000). However, research suggested that the subtypes for AN and BN lacked predictive validity and clinical utility (Peat, Mitchell, Hoek, & Wonderlich, 2009; van Hoeken, Veling, Sinke, Mitchell, & Hoek, 2009). The DSM-5 (2013) has changed several of the diagnostic criteria for eating disorders in response to these criticisms. The DSM-5 (2013) now categorizes anorexia and bulimia in a new category of Feeding and Eating Disorders. Further, the DSM-5 says that only an individual's most recent eating behavior, over the last three months, should be used to characterize a subtype for the disorder (American Psychiatric Association, 2013). The organization of the DSM-5 (2013) reflects changes made in response to criticisms of the DSM-IV-TR's (2000) classification system. The old classification system was thought to be too categorical and therefore did not capture real-life clinical experience. People did not fit exactly into one of the categories and

sometimes had symptoms that spanned multiple categories. Therefore, the DSM-5 (2013) is based on a dimensional approach that organizes diagnoses across developmental and lifespan stages. It begins with diagnoses that typically occur early in life and moves from diagnoses common in adolescence to diagnoses that usually occur in adulthood and later life. Beyond the lifespan considerations, the diagnostic categories were ordered based on the strength of the relationships and similarities between the categories (American Psychiatric Association, 2013). The DSM-5 (2013) was organized in this way because many disorders have overlapping symptoms and there are often co-morbid diagnoses across many of the categories. This may allow clinicians to more readily identify potential co-morbid diagnoses that may need to be considered.

The DSM-5 (2013) defines feeding and eating disorders as a “persistent disturbance of eating or eating-related behavior that results in the altered consumption or absorption of food and that significantly impairs physical health or psychological functioning” (p. 329). According to the DSM-5 (2013), there are three essential features of AN: persistent energy intake restriction; intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain; and a disturbance in self-perceived weight or shape (American Psychiatric Association, 2013). People diagnosed with AN restricting subtype exhibit an intense fear of gaining weight and a disturbance in the way their body weight and shape is perceived. The restrictive subtype is characterized by weight loss due to restricted caloric intake through dieting, fasting, and/or excessive exercise. Further, individuals who are AN restricting subtype will have no recurrent binge-eating episodes within the most recent three months.

The three essential features of BN are: recurrent episodes of binge eating, recurrent inappropriate compensatory behaviors to prevent weight gain, and self-evaluation that is unduly

influenced by body shape and weight. To meet diagnostic criteria for BN, the binge eating and compensatory behaviors must occur, on average, at least once a week for the most recent three months (American Psychiatric Association, 2013). The DSM-5 (2013) defines an episode of binge eating as eating, in a discrete period of time, an amount of food that is definitely larger than most persons would eat in a similar period of time, under similar circumstances.

Personality, Psychopathology, and Eating Disorders

Research has shown that a considerable number of individuals who meet criteria for AN also meet criteria for another psychological disorder. For example, Swinboume et al. (2012) found that 65% of women in an outpatient treatment program for an eating disorder met criteria for at least one comorbid anxiety disorder. Among the women with a comorbid anxiety disorder, 42% were diagnosed with social phobia, 26% with generalized anxiety disorder, 5% with obsessive-compulsive disorder, 3% with agoraphobia, and 2% with a specific phobia. They also found that in a group of women seeking treatment for an anxiety disorder, 13.5% met the criteria for a comorbid eating disorder. Individuals with BN have also been found to have high rates of comorbid personality disorders, with borderline personality disorder being the most prevalent (Godt, 2008). Evidence suggests that personality differences among individuals with eating disorders may even be predictive of symptomatology, treatment response, and prognosis. Patients diagnosed with BN and borderline personality disorder were found to have longer durations of clinically significant eating disorder symptoms when compared to patients diagnosed with BN but no comorbid diagnoses (Cassin & Von Ranson, 2005; Johnson, Tobin, & Dennis, 1990). Internalizing and externalizing factors of personality have been found to play a role in the presentation and maintenance of symptoms in individuals with comorbid eating and personality disorders. Global (social, occupational, or school) functioning was found to be

significantly impaired by the presence of comorbid internalizing or externalizing personality pathology in people diagnosed with AN and BN (De Bolle et al., 2011).

Perfectionism, obsessive-compulsiveness, impulsivity, and sensation-seeking are associated with eating disorder pathology (Cassin & Von Ranson, 2005). Individuals with AN and BN both tend to have perfectionistic and obsessive-compulsive traits, while individuals with BN exhibit more impulsivity and sensation seeking behaviors. The rates of comorbid obsessive-compulsive disorder and obsessive-compulsive personality disorder were found to be 20% and 13% in a mixed sample eating disorder population (Halmi et al., 2005). These characteristics are seen in individuals with AN as a need for control, rigid thinking, experiential avoidance, perfectionistic tendencies, affective restraint, feelings of low self-efficacy, and a lack of social spontaneity (Forbush, Heatherton, & Keel, 2007; Peck & Lightsey, 2008; Rawal, Park, Williams, & Mark, 2010). Depression and anxiety are common in individuals with AN and often grow worse because of malnutrition (Mattar, Thiebaud, Huas, Cebula, & Godart, 2012). Some characteristics of individuals with BN include: low self-esteem, depressive symptoms, impulsivity, sensation seeking, and substance abuse (Abbate-Daga, Gramaglia, Malfi, Piero, & Fassino, 2007; Ahren-Moonga, Holmgren, von Knorring, & Klinteberg, 2008; Guerrieri, Nederkoom, & Jansen, 2008; Root, 2010).

An emphasis on the relationship between identifiable personality traits and disordered eating is both theoretically and practically significant. First, disordered eating is theoretically an expression of psychological attributes that are connected to the form of the disorder. There should be a clear attribute to action relationship. Second, if there are systematic personality differences within the eating disorder subtypes then personality assessment may be another way

to identify and differentiate between individuals with eating disorders. Earlier identification followed by more thorough diagnoses may allow for more effective intervention.

Personality Assessment and Development of the MMPI

In order to assess personality differences between eating disorders, one must have a valid, reliable tool for measuring personality. The Minnesota Multiphasic Personality Inventory (MMPI) has been the most widely used instrument for studying personality for decades. There have been countless demonstrations of its ability to measure clinically relevant personality and psychopathology characteristics in a variety of settings and populations.

The MMPI was originally developed in 1943 by Stark Hathaway and Charnley McKinley of the University of Minnesota Hospital. The idea was to develop an efficient and reliable way to arrive at psychodiagnostic labels for patients. Hathaway and McKinley constructed the basic Clinical scales of the MMPI by putting together 504 personality-type statements. They then administered the 504 items to two sample groups. The first group was 724 visitors and relatives of patients at the University of Minnesota Hospital with no known psychopathology. The second group was a sample of 221 University of Minnesota Hospital patients who represented all of the major psychiatric categories of that era. The scales were derived through empirical keying. Item analysis was used to identify significant differences between the items endorsed by each psychiatric group versus the non-psychiatric group. The items that were identified as significantly different between the specific psychiatric groups and the non-psychiatric group were combined to make the different MMPI Clinical scales. In 1946, Drake created the final Clinical scale, a measure of social introversion, by contrasting items endorsed by groups of college women who had scored in the high or low range of the introversion-extroversion scale of

the Minnesota T-S-E Inventory. Scores on each of the scales were converted to T-scores. A *T*-score above a 70 on the MMPI is considered to be clinically significant (Graham, 2011).

The following is a description of each Clinical scale of the MMPI. Scale 1, Hypochondriasis (Hs), is a measure of symptoms associated with a diagnosis of hypochondriasis. Characteristics of high scores on scale 1 are excessive bodily concern, preoccupation with health problems, and the development of physical symptoms in response to stress. Scale 2, Depression, is a measure of symptomatic depression. The characteristics of people high on Scale 2 are sadness, lack of hope, pessimism, and dissatisfaction with life. Scale 3, Hysteria, is used to identify patients having hysterical reactions to situations. High scores on Scale 3 indicate feeling overwhelmed and the development of physical symptoms as a reaction to stress. Scale 4, Psychopathic Deviate, was developed to identify people with psychopathic personalities. High scores on Scale 4 are indicative of problems incorporating the values and standards of society, impulsivity, rebelliousness, hostility, and aggression. Scale 5, Masculinity-Femininity, was originally developed to identify homosexuality in men. Homosexuality was considered a mental disorder during the development of the original MMPI. Items on Scale 5 indicate broad interest patterns of males and females. Scale 6, Paranoia, was developed to identify patients with paranoid symptoms. Moderate elevations on this scale are typically seen in people who have a paranoid orientation and are sensitive and overly responsive to other people's opinions. They are often suspicious and hostile. Extremely elevated scores on Scale 6 are indicative of people who exhibit psychotic behaviors. People with extreme scores may have delusions, ideas of reference, and disturbed thinking. Scale 7, Psychasthenia, is characterized by people who have excessive thoughts and doubts, compulsions, and unreasonable fears. This scale is often referred to as the "Anxiety Scale." People with high Scale 7 scores tend to be experiencing psychological

discomfort, feel anxious, and are worried. Scale 8, Schizophrenia, was developed to identify people with the diagnosis of schizophrenia. This is a very heterogeneous scale that is often elevated for many people with a variety of symptoms. It is characterized by disturbances of thinking, mood and behavior. Scale 9, Hypomania, is characterized by elevated mood and energy levels, accelerated motor activity, impulsivity, and flight of ideas. Scale 0, Social Introversion, measures a person's social interactions and responsibilities. High scores on Scale 0 indicate a person who is socially withdrawn and introverted. Low scores on Scale 0 indicate a person who is very sociable and extroverted (Graham, 2011).

MMPI and Eating Disorders

The MMPI has been widely used to compare the profiles of women diagnosed with anorexia nervosa and bulimia nervosa. Efforts have been made to compare the profiles of women diagnosed with anorexia nervosa restricting subtype (ANR) and anorexia nervosa non-restricting/bulimic subtype (ANB). Researchers began to use the MMPI to try to find defining characteristics that would differentiate the subtypes of anorexia nervosa as well as bulimia nervosa. They were looking for a specific profile that would characterize patients with each type of eating disorder.

Casper et al. (1980) compared the MMPI profiles of women with ANR and ANB. They found that overall the women diagnosed with ANB scored significantly higher on Clinical scales 2, 4, 7, and 8 than the women diagnosed with ANR. The women with ANB reported more problems with depression, impulse control, and anxiety. The ANR women were characterized as being more socially withdrawn, timid, and perfectionistic. Pyle et al. (1981) looked at the MMPI profiles of 30 women diagnosed with BN. They found significant elevation on the same four scales as Casper et al. (1980); 2, 4, 7, and 8. Norman and Herzog (1983) compared the MMPI

profiles of patients diagnosed with ANR, ANB and BN. Scale 2 was the only scale to reach clinical elevation for the ANR group, indicating elevated levels of depressive symptoms. The ANB group had clinical elevations on scales 1, 2, 3, 4, 6, 7, and 8. The women in the ANB group reported problems associated with hypochondriasis, depression, hysteria, impulse control, paranoia, and schizophrenia. The BN group had clinical elevations on Scales 2, 4 and 8. The BN group reported problems associated with depression, impulse control, and schizophrenia. Scale 4 was the only scale to show significant differences between groups. Scale 4 was significantly higher in the BN and ANB groups than in the ANR. There was no significant difference between scores on the psychopathic deviate scale between the ANB and BN. Scale 4 is often taken as an indicator of impulsivity and sensation seeking. These group differences are consistent with the impulsivity control problems associated with bulimics while restrictive anorexics typically show high constraint, persistence, and low novelty seeking (Guerrieri, Nederkoom, & Jansen 2008; Cassin & Von Ranson, 2005). Norman and Herzog (1983) also looked at two-point and three-point profile codes for each group. The BN group's elevated scale 24 code is often interpreted as people exhibiting impulsivity, hostility, depression, and anxiousness. The ANR group's elevated scale 28 code is interpreted as people who are depressed, withdrawn, agitated, and anxious. The ANB group's elevated scale 248 is interpreted as people who are depressed, withdrawn, distrustful, impulsive, and irritable (Graham, 2011). Shisslak, Pazda, and Crago (1990) compared the profiles of women diagnosed with BN and ANR. The women with BN had elevated scores on the Clinical scales 3, 4, 5, 7 and 8 while the ANR group had significantly lower scores on all five of these scales.

These studies using the MMPI began to suggest a consistent profile for women with eating disorders. Patients with ANR consistently showed few to no elevations on the Clinical

scales associated with depression, anxiety, and social introversion. Women with ANB typically had more elevated Clinical scales indicating problems with depression, anxiety, impulsivity and hostility. Women diagnosed with BN showed less consistent patterns of Clinical scale elevations but typically had a greater number of elevations compared to the ANR groups and profiles closer to those of the ANB groups. Depression was typically the most elevated Clinical scale across all eating disorder groups.

Some studies found more elevated Clinical scales for women with anorexia nervosa. Small et al. (1981) compared the MMPI profiles of female patients diagnosed with schizophrenia and a group of patients diagnosed with anorexia nervosa. They found significant elevations on scales 2, 6, 7, and 8 for the anorexic patients. Hendren (1983) found elevated scores on the Clinical scales 2, 7 and 8 in women diagnosed with anorexia nervosa. Scott and Baroffio (1986) compared the MMPI profiles of patients diagnosed with anorexia nervosa, bulimia nervosa, morbid obesity, and a normal control group. The study found that the patients with disordered eating or obesity had similar overall profiles. The anorexic patients scored significantly higher than the bulimic patients on Scale 0. In these studies, the more elevated profiles of the AN groups could be due to the fact that they were using a mixed group (both ANR and AB) so the average profile was higher because of the elevated profiles typically seen in women with AB. As described above, when the AN group is split into ANR and ANB sub-groups you see more specific group pathology and differences between the sub-groups.

To summarize these many studies and their findings, studies using the MMPI generally found that women with ANR scored predominantly in the subclinical range on all scales while women with ANB and BN scored on average in the clinical range on three to six scales. Depression was the most common factor across all profiles. These early studies suggested that

women with ANB more closely resembled women with BN than ANR. Women with ANB and BN tended to have expressive and dramatic profiles while women with AN were more depressive, anxious, and withdrawn (Vitousek & Manke, 1994). These profiles matched other personality measures that found women with ANB and BN to be more impulsive and sensation and novelty seeking, while women with AN are higher in constraint and persistence (Cassin & Von Ranson, 2005). The aforementioned research suggests that the MMPI was able to reveal profile differences between AN and BN diagnoses, specifically when the AN groups were divided into ANR and ANB and ANR was compared to BN.

Development of the MMPI-2

The MMPI was revised and published in 1989 as the MMPI-2 (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989). The new MMPI-2 was standardized on a more representative normative sample population. The new normative population consisted of 2,600 adults from across the country that better matched the census data. Questions from the old MMPI that contained sexist language, Christian religious beliefs, and inappropriate content for the contemporary test takers were removed. The MMPI-2 consists of 567 items and is comprised of the same Clinical scales as the original MMPI. Hathaway and McKinley developed Validity scales to detect falsified or distorted responses. The “Cannot Say” scale score was the total number of items that were either omitted or responded to as both true and false. The L scale, originally known as the Lie scale, was developed to detect when people tried to present themselves in an overly positive or favorable way. This is a measure of the tendency to underreport pathology. The F Scale, known as the Infrequency scale, was developed to detect when a person was endorsing items in a direction different than 90% of the normal sample population. People who did not comply with directions or who were confused often scored high

on the F scale. The F scale is also a measure of the tendency to overreport pathology. The K scale was developed as a correction scale to adjust to someone underreporting pathology. A t-score above a 65 on any scale in the MMPI-2 is considered to be clinically significant (Graham, 2011).

MMPI-2 and Eating Disorders

The MMPI-2 has been widely used to assess personality and psychopathology among patients with eating disorders. Approximately 50% of inpatient eating disorder treatment centers in the U.S. administer the MMPI-2 to patients to look for psychopathology beyond disordered eating that may be causing distress (Anderson & Paulosky, 2004). After studies using the MMPI suggested profile differences between the different eating disorder subtypes, researchers began using the updated MMPI-2 to look for similar patterns. The MMPI-2 was normed using a more representative sample population and researchers aimed to assess more homogeneous eating disorder subtype groups.

Pryor and Wiederman (1996) compared the MMPI-2 profiles of women diagnosed with ANR, ANB, Bulimia Nervosa Purging (BNP), and Bulimia Nervosa Nonpurging (BNN). They found no significant differences in scores on the Clinical scales between any of the eating disorder groups. Elevations of scales 2 and 7 were the most common. This is indicative of depression, anxiety, and emotional distress. Pryor and Wiederman (1996) noted that elevations on scales 4 and 6 were most common among the women who engaged in purging. This is consistent with the impulsivity and lack of constraint often associated with bulimic patients (Cassin & Von Ranson, 2005; Guerrieri, Nederkoom, & Jansen 2008). Cumella, Wall, and Kerr-Almeida (2000) examined the MMPI-2 profiles of women diagnosed with ANR, ANB, a mixed group of BN, and Eating Disorder Not Otherwise Specified (EDNOS). Patients in all four groups

had clinically elevated scores on the same six scales: 1, 2, 3, 4, 7, and 8. The highest 3 point code for all of the groups was a 273. A 273 code type is indicative of someone who is likely to report feelings of anxiety and depression as well as physical complaints. They are often distrustful of other people (Graham, 2011). The most common two point codes were a 27 and 23. A 27 code is indicative of someone who is anxious, tense, depressed, worried, and high strung. A 23 code is indicative of someone who is depressed, agitated, dependent, and feels helpless (Graham, 2011). The findings from this study were consistent with Pryor and Wideman's (1996) findings that showed a common profile pattern across the different eating disorder groups. The women in all groups showed common symptoms of depression, anxiety, dependency, obsessive-compulsive behaviors, and emotional inhibition. These studies also showed more psychopathology in the mean profiles of all the groups, especially the ANR group. Compared to the older MMPI profiles, patients in the ANB and BN groups showed more elevation on scale 7 of the MMPI-2 and all groups had more elevation on Scale 3 on the MMPI-2 (Cumella et al., 2000). Exterkate, Bakker-Brehm, and Jong (2007) examined the MMPI-2 profiles of women diagnosed with ANR, ANB, BNP, BNN, and EDNOS. They found that the overall profiles of all the eating disorder groups showed elevation on the same 6 Clinical scales: 2, 3, 4, 6, 7, and 8. Similarly to Cumella et al. (2000), the most common two point code across all groups was a 27 (Exterkate et al., 2007). Because the MMPI-2 is considered to be a more accurate measure of psychopathology and personality, the similar profiles of the women on the MMPI-2 are thought to better characterize the eating disorder groups than the old MMPI profiles. The MMPI-2 may not be useful in making accurate differential diagnoses between the different types of eating disorders.

Development of the RC Scales and MMPI-2-RF

In 2003, Tellegen et al. (2003) developed the Restructured Clinical (RC) scales to more effectively measure the core constructs of the Clinical Scales. These were developed because there had been high interscale correlations, item overlap, and over-inclusive item content on the Clinical scales. Demoralization had been known to be a characteristic shared by most patients, regardless of diagnosis, and was a shared component of all the Clinical scales. As a result, demoralization was impairing the discriminant validity of the Clinical scales (Marek, Ben-Porath, Sellbom, McNulty, & Heinberg, 2014). The RC scales were developed by removing the common factor of demoralization from all of the Clinical scales and identifying the remaining mutually distinctive core constructs of each Clinical scale (Ben-Porath, 2012). The 9 RC Scales are as follows: RCd (demoralization), RC1 (somatic complaints), RC2 (low positive emotion), RC3 (cynicism), RC 4 (antisocial behavior), RC6 (ideas of persecution), RC7 (dysfunctional negative emotions), RC8 (aberrant experiences), and RC9 (hypomanic activation) (Tellegen et al., 2003). T-scores above a 65 are considered to be clinically significant. Elevations on RCd are indicative of significant emotional turmoil, unhappiness, hopelessness, and general dissatisfaction. Elevations on RC1 are indicative of neurological, gastro-intestinal, and pain-related complaints. Elevations on RC2 are indicative of a lack of positive emotional experiences and vulnerability for depression. Elevations on RC3 are indicative of cynical beliefs, distrustfulness, and beliefs that others look out only for their own interests. Elevations on RC4 are indicative of antisocial behavior including juvenile misconduct, family issues, substance misuse, and aggressiveness. Elevations on RC6 are indicative of significant persecutory ideation and paranoid delusions. Elevations on RC7 are indicative of negative emotional experiences such as anxiety, anger, and fear. Elevations on RC8 are indicative of unusual thoughts and

perceptions. Elevations on RC9 are indicative of impulsivity, grandiosity, aggression, and generalized activation (Ben-Porath, 2012). Research on the RC scales has found support for increased internal consistency over the old Clinical scales, decreased interscale correlations among the RC Scales, and equal to improved convergent and discriminant validity when compared to their old Clinical scale counterparts (Tellegen et al., 2003).

Using a similar rationale, Ben-Porath and Tellegen developed the Minnesota Multiphasic Personality Inventory-2 Restructured Form (MMPI-2-RF) using the full MMPI-2 item pool. The MMPI-2-RF utilizes a more dimensional approach to personality and psychopathology. Personality and psychopathology are examined using broad domains consisting of relatively narrower, more focused, more unidimensional scales measuring varying levels of specific personality and psychopathology components. Notably, the MMPI-2-RF is constructed in a hierarchical fashion similar to contemporary models of psychopathology (Kotov et al., 2011; Krueger & Markon, 2005; Sellbom, Ben-Porath, & Bagby, 2008). The MMPI-2-RF is comprised of 338 items scored on 51 scales: 9 validity scales and 42 substantive scales. The 42 substantive scales are comprised of the 9 RC scales, 3 higher-order scales, 23 specific problem scales, 2 interest scales, and the PSY-5 scales (Ben-Porath & Tellegen, 2008/2011a; Harkness & McNulty, 2006). T-scores above a 65 are considered to be clinically significant. The validity scales are the seven revised validity measures from the MMPI-2 (variable response inconsistency, true response inconsistency, infrequent responses, infrequent psychopathology responses, and uncommon virtues) as well as new measures of infrequent somatic complaints and a response bias scale (exaggerated memory complaints). The 3 higher-order scales are measures of emotional/internalizing dysfunction (problems associated with mood and affect), thought dysfunction (problems associated with disordered thinking), and

behavioral/externalizing dysfunction (problems associated with under-controlled behavior). The 23 specific problem scales are divided into 4 somatic scales, 10 internalizing scales, 4 externalizing scales, and 5 interpersonal scales. The 2 interest scales are measures of aesthetic-literary interests (literature, music, and theater) and mechanical interests (fixing things, building things, the outdoors, and sports). The PSY-5 scales are modeled similarly to the emerging model of personality disorders outlined in Section III of the DSM-5 (Anderson et al., 2013). Specifically, the scales consist of: aggressiveness (instrumental, goal-directed aggression), psychoticism (disconnection from reality), disinhibition (under-controlled behavior), negative emotionality/neuroticism (anxiety, insecurity, worry, and fear), and introversion/low positive emotionality (social disengagement and anhedonia) (Ben-Porath & Tellegen, 2008/2011a). The MMPI-2-RF was designed to improve efficiency and enhance construct validity. The authors aimed to preserve the most clinically relevant items from the MMPI-2 while creating reliable and meaningful scales (Ben-Porath, 2012).

MMPI-2-RF and Eating Disorders

There have been no published studies using the MMPI-2-RF to distinguish between people with different types of eating disorders. However, there have been a few unpublished dissertations examining transformed archived MMPI and MMPI-2 scores into MMPI-2-RF scores for women with different eating disorders. The women in all of the studies have been diagnosed with eating disorders based on criteria from the DSM-IV-TR (American Psychiatric Association, 2000). Erreca (2010) examined the MMPI-2-RF scores, derived from old MMPI-2 scores, of women diagnosed with either AN or BN. She found that the overall scores of patients with AN and BN were very similar, with women with AN elevating slightly more scales. The results indicated that the derived MMPI-2-RF was not able to distinguish between the two

groups. The AN and BN groups had similar elevations on scales measuring emotional/internalizing dysfunction, demoralization, cognitive complaints, somatic complaints, malaise, self-doubt, and anxiety. The only two elevated scales showing significant differences were the scales measuring gastrointestinal complaints and introversion, with the AN group scoring higher on both. Brackman (2013), the only study in which participants completed the MMPI-2-RF, examined the scores of women with ANR, ANB, BN, and EDNOS. Similar to Erreca's (2010) findings, the overall scores of women in all of the groups were very similar. There were some scales that discriminated between the groups: low positive emotions (highest for the ANR group), social avoidance (highest for the ANR group), aggressiveness (highest for the ANB and BN groups), psychoticism (highest for the ANB and BN groups), and introversion (highest for the ANR group). However, low positive emotion was the only clinically elevated scale and it was only clinically elevated for the ANR group. Both Erreca (2010) and Brackman (2013) found clinically significant elevations of low positive emotion for the ANR groups which may indicate that the MMPI-2-RF is sensitive to some group differences. Stone (2013) looked at the MMPI-2-RF scores of women diagnosed with AN or BN. Similar to Erreca (2010) and Brackman (2013), the MMPI-2-RF was not able to discriminate between different eating disorder groups. Women in the AN group scored higher on scales measuring ideas of persecution, neurological complaints, psychoticism, and hypomanic activation. However, the scale measuring neurological complaints was the only one to reach clinical significance. This was the only elevated scale for the AN group that was different from the BN group and the BN group had no clinical elevations different from the AN group. The AN group's higher scores on the thought disorder scales are likely reflective of body checking and comparing to other women and the belief that others are evaluating their weight and shape. Sherry (2013), examined MMPI

scores transformed into MMPI-2-RF scores of women diagnosed with AN or BN. She found no significant differences between groups on any of the scales. Both groups had the highest elevations on scales related to somatic complaints as well as elevations indicating emotional and internalizing distress.

Thus far the MMPI-2-RF has not been able to differentiate between eating disorder groups. However, the dissertations previously mentioned had some limitations that may have compromised the results. One study (Sherry, 2013) transformed MMPI profiles into MMPI-2-RF scores. These derived scores may misrepresent the profiles because of the substantial changes to the test questions across the revisions. There was a 25% item-level change from the MMPI to the MMPI-2, so transforming MMPI scores into MMPI-2-RF scores would produce estimated, less accurate scores. Only one of the studies (Brackman, 2013) used the actual MMPI-2-RF and that study differentiated between the subtypes of ANB and ANR. Thus, more work needs to be done using the actual MMPI-2-RF rather than scores derived from the older forms of the MMPI.

Electroencephalography and quantitative Electroencephalography

Electroencephalography (EEG) is an electrophysiological technique that measures electrical activity in the cortex through one or more electrodes attached to the scalp. Historically, this electrical activity was recorded as continuously shifting voltages. These ongoing shifts were recorded via an analog device, such as a pen on a moving strip of paper, and the overall pattern at one point in time was then compared to the pattern at other points in time. Sometimes the analog record was analyzed for key components such as amplitude, measured as microvolts (μV), and frequency, measured in cycles per second or hertz (Hz). The amplitude of EEGs recorded from the scalp are 10 to 100 μV . The frequency range is 0.5 to more than 13 Hz.

The early approach to analyzing the patterns of electrical activity by measuring frequency led to a very specific characterization of the brain's electrical activity. Counting the frequency of the wave cycles led physiologists to identify four basic brain waves: delta (<4 Hz), theta (4–8 Hz), alpha (8–13 Hz) and beta (>13 Hz) (Jáuregui-Lobera, 2011). It has been well established that someone's level of arousal or psychological state is highly correlated with certain frequencies. For example, when an individual is alert and active beta waves (>13 Hz) are most frequent in an EEG. Conversely, when an individual is asleep, delta waves (<4 Hz) are more common.

An EEG actually measures the relative activity across the brain's surface. In order to measure voltage change the electrical state at one point must be compared to some other point. Thus an EEG signal is a measure of the difference in voltage between two recording locations. For example, the electrical state at electrode 1 may be 10 μ V positive relative to the electrical state at electrode 2. Different EEG recording techniques use various reference points to define the wave for each recording electrode. The voltage contrasts between every electrode and one or more comparison electrodes produces a "montage." Among the various ways of creating a montage, the Laplacian montage compares the voltage signal at each electrode with a weighted average of the voltage signals from all the electrodes which surround that electrode.

A transition to digitized outputs and the general availability of high speed computing radically changed the way that EEGs are recorded and analyzed. First, the voltage differences can be converted from continuous analog signals to a specific value that is represented digitally. The frequency with which these converted values are calculated is an important procedural variable. Then, with a stream of digital values coming from each electrode in the entire montage, the overall pattern of voltage differences can be monitored by a computer with a very

fast sampling rate. The result of digitized values and very frequent sampling of those values is a quantitative EEG (qEEG). The qEEG provides more options that monitor discrete analog changes.

For example, the results of a qEEG can be used for “brain mapping” (Teplan, 2002). If electrode A is showing higher voltage than its comparison electrodes, you can superimpose an activity signal on the location of electrode A. A common way to represent such activity is with a color. The region beneath electrodes showing high amplitude changes would be colored red and regions showing only low amplitude changes would be colored blue. Obviously a qEEG can also provide actual values and those measures of amplitude and frequency can define a person’s dominant brainwave frequency or a response to stimulation.

Brainwave frequency abnormality, or atypical patterns of electrical interaction between different areas of the brain, may be related to some pathology. For example, the qEEG can identify abnormal levels of theta and beta waves related to ADHD (Duric, Assmus, Gundersen, & Elgen, 2012). A global decrease in alpha synchronization has been found in patients with bipolar disorder (Kim et al., 2013). Decreased theta, alpha, and beta activity has been associated with generalized anxiety disorder (Demerdzieva, 2011).

Electroencephalography and Eating Disorders

Research looking for EEG indicators or correlates of eating disorders has been limited. Most of this work has focused on patients with AN (Jáuregui-Lobera, 2011). It is believed that altered sleeping EEG patterns in AN patients may be related to body mass index and changes in nutritional status (Crisp, Stonehill, & Fenton, 1971; Marca et al., 2004). However, researchers continue to debate whether brain activity abnormalities, seen in EEGs, contribute to AN or whether the EEG abnormalities are an effect of starvation. Research has demonstrated that

underweight patients with AN have reduced alpha and increased beta activity in the frontal lobe (Hatch et al., 2011). Research based on qEEG has found a reduced amplitude of alpha-1 and alpha-2 waves in parietal, occipital, and limbic areas in people with AN and BN compared to a control group. Reduced alpha-1 waves in the temporal area were also found in people with AN and BN compared to a control group, with patients with AN have the lowest amplitude. (Rodriguez et al., 2007)

In general, the relationship between EEG and eating disorders is poorly described and difficult to understand. There are inconsistent findings that may be attributed to variability in the eating disorder groups, differences between EEG techniques used, and differences in experimental settings (Jáuregui-Lobera, 2011). There has been no research conducted that attempts to use qEEG brain mapping to differentiate between eating disorder groups.

Statement of the Problem

As previously stated, evidence suggests that personality differences among individuals with disordered eating may be predictive of symptomatology, treatment response, and prognosis (Cassin & Von Ranson, 2005; Johnson et al., 1990). The MMPI-2-RF is a reliable and valid measure of personality and psychopathology (Ben-Porath & Tellegen, 2008b). Very few studies have utilized the MMPI-2-RF to distinguish among eating disorder groups. Most of these studies have used old MMPI and MMPI-2 scores transformed into MMPI-2-RF scores. Further, previous studies relating eating disorders to MMPI profiles have mainly used mixed eating disorder groups without looking at the differences between the specific subtypes (Brackman, 2013; Erreca, 2010; Sherry, 2013; Stone, 2013). Therefore, the current study aimed to use actual, rather than derived, MMPI-2-RF scores to look for personality and psychopathology differences between eating disorder subtypes. The groups examined were participants exhibiting

predominantly restricting, bingeing, or purging behaviors as well as low body weight and nutritional deficiency. Categorizing participants by symptoms and behaviors emphasizes the shift towards examining the different constructs of personality and psychopathology and not just the broad, heterogeneous categories.

Secondly, little has been done with EEG and eating disorders and the work done has not produced consistent findings (Jáuregui-Lobera, 2011). One clinical practice has used qEEG to classify individual global brainwave function as rigid, flexible, or disorganized. The clinician then offers clients a specific treatment plan based on the classification of their brainwave pattern. Clinical interpretations of the results of this differentiated therapy suggest that people with a flexible pattern are easiest to treat because flexible activity more easily adapts to different situations. People who show a rigid pattern are the hardest to treat since they seem to be stuck in one dominant mode of activity. People with a disorganized pattern may lack self-regulation and benefit from treatment because their brain activity responds well to rules. Therefore, a continuation of this study will also use qEEG to look for these patterns in the eating disorder groups' global brainwave activity.

As previously mentioned with the DSM-5 and the MMPI-2-RF, using a dimensional approach to assess and organize diagnoses may lead to more clinically relevant diagnoses and treatment methods for eating disorder groups. Similarly, the goals of this study were consistent with the National Institute of Mental Health's (NIMH) Research Domain Criteria (RDoC) project that focuses on the shift from the old categorical diagnostic classification system to classifying mental disorders based on behavioral dimensions and neurobiological measures ("Research Domain Criteria," n.d., para. 1).

Hypotheses

Hypothesis 1: It was hypothesized that women who exhibit restricting behaviors or have low weight and nutritional deficiencies will have statistically significant higher scores on the scales measuring constructs related to internalizing dysfunction.

1a: It was hypothesized that women in these groups will have statistically significant higher scores on the scale EID.

1b: It was hypothesized that women in these groups will have statistically significant higher scores on the scale RCd.

1c: It was hypothesized that women in these groups will have statistically significant higher scores on the scale RC2.

1d: It was hypothesized that women in these groups will have statistically significant higher scores on the scale RC7.

1e: For exploratory purposes, it was hypothesized that the women in these groups will have statistically significant higher scores on the 11 others scales in the emotional dysfunction domain.

Hypothesis 2: It was hypothesized that women who exhibit bingeing or purging behaviors will have statistically significant higher scores on the scales measuring constructs related to behavioral dysfunction.

2a: It was hypothesized that women in these groups will have statistically significant higher scores on the scale BXD.

2b: It was hypothesized that women in these groups will have statistically significant higher scores on the scale RC4.

2c: It was hypothesized that women in these groups will have statistically significant higher scores on the scale RC9.

2d: For exploratory purposes, it was hypothesized that the women in these groups will have statistically significant higher scores on the 6 other scales in the behavioral dysfunction domain.

Hypothesis 3: As the study continues, it is hypothesized that women in the restricting group will be more likely to be classified as having “rigid” brain activity.

Hypothesis 4: As the study continues, it is hypothesized that women in the purging group will be more likely to be classified as having “disorganized” brain activity.

CHAPTER 3: METHODOLOGY

Participants

Participants were seven adult females at the Avalon Hills Eating Disorder Treatment Center in Logan, Utah. This is a residential treatment facility that treats both adolescents and adults seeking treatment for eating disorders. Participant ages ranged from 18 years old to 29 years old with an average age of 22.11 years. As the study is continued in the future, we expect to gather data on a total of 100 adult female patients.

Measures

Personality and psychopathology were measured using the MMPI-2-RF. The MMPI-2-RF consists of 338 true/false items grouped into 51 scales: 9 validity scales and 42 substantive scales. The MMPI-2-RF is completed on a computer. Reliability and validity information was obtained from the MMPI-2-RF Technical Manual (Ben-Porath & Tellegen, 2008b). There is moderate to strong test-retest coefficients for the validity. The internal consistency coefficients for females on the validity, higher order, and RC scales were found to be moderate to strong. Studies have demonstrated good reliability, validity, and generalizability of scale scores across various sample groups (Marek, Ben-Porath, Ashton, & Heinberg, 2014; Marek et al., 2014).

Eating disorder symptoms were assessed using a 15-item eating disorder criteria checklist developed for this study (Figure 1). Items on the checklist are related to restricting behaviors, bingeing behaviors, purging behaviors, and weight loss and nutritional deficiency. Item severity and frequency were scored using a 3 point Likert scale ranging from “never” to “daily” and “mild” to “severe.”

As the project continues, a qEEG will be conducted on each participant. A qEEG produces approximately 2,100 different measurements defining activity across the brain. The observed levels of delta, theta, alpha, and beta frequencies can be compared to a normative sample to identify atypical activity. This study will conduct the qEEGs using a 19 channel Daymed system. The measurements will be processed using the Neuroguide and SKIL systems. Neuroguide produces images of the brainwaves at different locations in the brain and SKIL produces the spectral plots, maps of the dominant frequency of the brain, and the alpha response with eyes open and eyes closed. Participants will be classified as rigid if their spectral chart's highest point is the delta wave frequency, flexible if their spectral chart's highest point is the alpha wave frequency, or disorganized if their spectral chart has more than one different peak in their wave frequency.

Procedure

Participants completed the MMPI-2-RF on a computer at the facility in Logan, Utah. Technicians at the facility filled out the eating symptom checklist for each participant. The technicians have been trained to conduct a full qEEG for each participant. As the project continues, each participant will undergo 4 recordings in 1 session: 1 eyes-closed recording for 3 minutes, 2 eyes-open recordings for 3 minutes each, and 1 eyes-closed recording for 20 minutes. During the recording, participants will face away from any visual stimuli and the room will be kept as quiet as possible to deter an auditory distractions.

CHAPTER 4: RESULTS

Bivariate correlations were examined between selected MMPI-2-RF scales and each item on the eating disorder symptom criteria checklist. Results of the bivariate correlations are presented in Tables 1 and 2.

Contrary to hypothesis 1, the restricting symptoms were negatively correlated with the scales measuring emotional and internalizing dysfunction while positively correlated with the scales measuring behavioral and externalizing dysfunction. Fasting was negatively correlated with helplessness ($r = -.893$, $p < .01$). Excessive exercise was positively correlated with the scales measuring behavioral/externalizing dysfunction ($r = .874$, $p < .05$), antisocial behavior ($r = .773$, $p < .05$), substance abuse ($r = .769$, $p < .05$), and disconstraint ($r = .757$, $p < .05$).

The weight loss and nutritional deficiency symptoms were negatively correlated with the scales measuring emotional and internalizing dysfunction while positively correlated with the scales measuring behavioral and externalizing dysfunction. Food avoidance was negatively correlated with the scale measuring negative emotionality/neuroticism ($r = -.846$, $p < .01$). Significant weight loss was negatively correlated with the scales measuring emotional/internalizing dysfunction ($r = -.883$, $p < .01$), low positive emotions ($r = -.798$, $p < .05$), and helplessness/hopelessness ($r = -.914$, $p < .01$). Nutritional deficiency was negatively correlated with the scales measuring emotional/internalizing dysfunction ($r = -.944$, $p < .01$), demoralization ($r = -.788$, $p < .05$), low positive emotions ($r = -.817$, $p < .05$), helplessness/hopelessness ($r = -.805$, $p < .05$), and introversion ($r = -.916$, $p < .01$). Nutritional deficiency was positively correlated with the scales measuring antisocial behavior ($r = .887$, $p < .01$) and disconstraint ($r = .758$, $p < .05$). Fear

of weight gain was negatively correlated with the scale measuring multiple specific fears ($r = -.757, p < .05$).

Contrary to hypothesis 2, the binge eating symptoms were positively correlated with the scales measuring emotional and internalizing dysfunction while negatively correlated with the scales measuring behavioral and externalizing dysfunction. Binge-eating was positively correlated with the scale measuring emotional/internalizing dysfunction ($r = .780, p < .05$). Binge-eating was negatively correlated with the scales measuring behavioral/externalizing dysfunction ($r = -.798, p < .05$), antisocial behavior ($r = -.937, p < .01$), substance abuse ($r = -.875, p < .01$), activation ($r = -.834, p < .05$), and disconstraint ($r = -.873, p < .05$). A sense of lack of control was positively correlated with the scales measuring emotional/internalizing dysfunction ($r = .882, p < .01$), demoralization ($r = .847, p < .05$), low positive emotions ($r = .774, p < .05$), and introversion ($r = .861, p < .05$). A sense of lack of control was negatively correlated with the scales measuring behavioral/externalizing dysfunction ($r = -.811, p < .05$), antisocial behavior ($r = -.975, p < .01$), juvenile conduct problems ($r = -.799, p < .05$), activation ($r = -.796, p < .05$), and disconstraint ($r = -.873, p < .05$).

Purging symptoms were positively correlated with a scale measuring emotional and internalizing dysfunction. The use of laxatives was positively correlated with the scale measuring behavior restricting fears ($r = .860, p < .05$).

No qEEG data was available at this time. A continuation of this study will explore the full qEEGs of each participant.

CHAPTER 5: DISCUSSION

While the data are preliminary, some clear patterns have emerged. Participants who exhibited restricting behaviors or had significant weight loss and nutritional deficiency had lower scores on the scales measuring emotional and internalizing dysfunction and higher scores on the scales measuring behavioral externalizing dysfunction. An opposite pattern was found for participants who exhibited bingeing and purging behaviors, with higher scores on the emotional and internalizing scales and lower scores on the behavioral externalizing scales.

Further data will need to be analyzed, but the opposite patterns among eating behaviors suggests that different treatment methods for eating disorder subtypes may best address their specific and different symptoms. It may be best to focus on internalizing dysfunction when working with clients who exhibit predominantly bingeing and purging behaviors. Clients should be evaluated for comorbid internalizing disorders such as depression or anxiety. Tailoring treatment to focus on problems related to their emotional dysfunction may lead to the best treatment outcomes. This dysfunction may inhibit a client's ability to change eating-related behaviors since they may feel too distressed or helpless to make any changes. Additionally, low positive emotionality may interfere with the client's treatment engagement so it may be best to target these symptoms from the start (Ben-Porath, 2012).

When working with clients who exhibit predominantly restricting behaviors and significant weight loss and nutritional deficiency, it may be best to target symptoms related to behavioral externalizing dysfunction during treatment. Clients should be evaluated for comorbid externalizing disorders such as personality disorders or substance use disorders. These clients may be at a higher risk for treatment noncompliance and inadequate self-control. Acting-out

behaviors may interfere with the development of a therapeutic relationship and subsequently slow or hinder treatment progress (Ben-Porath, 2012). It may be important to address a client's externalizing dysfunction during the early stages of treatment in order to have the most successful treatment outcomes. It is unlikely that eating-related behaviors and problems can be successfully treated if the client does not have enough self-control to be engaged in treatment and a strong therapeutic relationship has not been established.

This study had some limitations that may have affected the results. The small sample size of seven participants is not enough to generalize to the larger eating disorder population. The participants were all from a residential treatment center in Logan, Utah. It is expected that data collection will continue there as well as an out-patient clinic in Long Island, NY. Gathering data from both an in- and out-patient facility will be more representative of the general eating disorder population and encompass women with varying severities and symptoms. With the continuation of this study, we aim to gather data on at least 100 participants. Additionally, comorbid diagnoses were not accounted for in the participants. Additional psychopathology may be exacerbating eating disorder symptoms as well as general personality and psychopathological dysfunction measured by the MMPI-2-RF. The next round of data collection will include information about additional diagnoses to account for other psychopathology.

While this study only examined a small set of women with eating disorders, the results are promising. Continuing to collect data on a larger sample size may lead to more clear personality and psychopathological differences among eating disorder subtypes. Having the additional qEEG data will provide a useful psychophysiological measure that may be driving or exacerbating eating disorder symptomology. Taking a dimensional approach to assess and

organize psychological diagnoses may lead to more accurate and relevant diagnoses and subsequent treatment methods for eating disorder groups.

REFERENCES

- Abbate-Daga, G., Gramaglia, C., Malfi, G., Piero, A., & Fassino, S. (2007). Eating problems and personality traits. An Italian pilot study among 992 high school students. *European Eating Disorders Review*, 15, 471-478.
- Ahren-Moonga, J., Holmgren, S., von Knorring, L., & Klinteberg, B. (2008). Personality traits and self-injurious behaviour in patients with eating disorders. *European Eating Disorders Review*, 16, 268-275.
- American Psychiatric Association. (1952). *Diagnostic and Statistical Manual of Mental Disorders*, (1st ed.) Washington, DC: American Psychiatric Press.
- American Psychiatric Association. (1980). *Diagnostic and Statistical Manual of Mental Disorders*, (3rd ed.) Washington, DC: American Psychiatric Press.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (4th ed., text rev.)*. Washington, DC: American Psychiatric Press.
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders*, (5th ed.). Washington, DC: American Psychiatric Press.
- Anderson, J., Sellbom, M., Bagby, R., Quilty, L., Veltri, C., Markon, K., & Kreuger, R. (2013). On the convergence between PSY-5 domains and PID-5 domains and facets: implications for assessment of DSM-5 personality traits. *Assessment*, 20(3), 286-294.
- Anderson, D., & Paulosky, C. (2004). A survey of the use of assessment instruments by eating disorder professionals in clinical practice. *Eating and Weight Disorders*, 9(3), 238-241.
- Ben-Porath, Y., & Tellegen, A. (2008/2011a). *MMPI-2-RF: Manual for administration, scoring and interpretation*. University of Minnesota Press.

- Ben-Porath, Y. & Tellegen, A. (2008/2011b). *MMPI-2-RF: Technical Manual*. University of Minnesota Press.
- Ben-Porath, Y. (2012). *Interpreting the MMPI-2-RF*. Minneapolis, MN: University of Minnesota Press.
- Brackman, L. (2013). MMPI-2-RF profiles of women with an eating disorder: The impact of trauma and hopelessness. Unpublished doctoral dissertation, Alliant International University, San Diego, CA.
- Butcher, J. N., Dahlstrom, W. G., Graham, J. R., Tellegen, A., & Kaemmer, B. (1989). *MMPI-2: Minnesota Multiphasic Personality Inventory-2: Manual for administration and scoring*. Minneapolis: University of Minnesota Press.
- Casper, R., Eckert, E., Halmi, K., Goldberg, S., & Davis, J. (1980). Bulimia: its incidence and clinical importance in patients with anorexia nervosa. *Archives of General Psychiatry*, 37(9), 1030-1035.
- Cassin, S., & Von Ranson, K. (2005). Personality and eating disorders: a decade in review. *Clinical Psychology Review*, 25, 895-916.
- Crisp, A., Stonehill, E., & Fenton, G. (1971). The relationship between sleep, nutrition and mood: a study of patients with anorexia nervosa. *Postgraduate Medical Journal*, 207-213.
- Cumella, E. J., Wall, A. D., & Kerr-Almeida, N. (2000). MMPI-2 in the inpatient assessment of women with eating disorders. *Journal Of Personality Assessment*, 75(3), 387-403.
- De Bolle, M., De Clercq, B., Pham-Scottez, A., Mels, S., Rolland, J., Guelfi, J., De Fruyt, F. (2011). Personality pathology comorbidity in adult females with eating disorders. *Journal of Health Psychology*, 16, 303-313.

- Demerdzieva, A. (2011). EEG characteristics of generalized anxiety disorder in childhood. *Acta Informatica Medica*, 19(1), 9.
- Duric, N. S., Assmus, J., Gundersen, D., & Elgen, I. B. (2012). Neurofeedback for the treatment of children and adolescents with ADHD: a randomized and controlled clinical trial using parental reports. *BMC Psychiatry*, 12, 107.
- Egnel, B., Staats Reiss, N., & Dombeck, M., (2007). Eating disorders: Historical understandings. Retrieved March 4, 2015, from http://www.mentalhelp.net/poc/view_doc.php?type=doc&id=11747&cn=46.
- Erreca, K. (2010). MMPI-2-RF profiles of women with eating disorders in an inpatient setting. Unpublished doctoral dissertation, Alliant International University, San Diego, CA.
- Exterkate, C., Bakker-Brehm, D., & Jong, C. (2007). MMPI-2 profiles of women with eating disorders in a dutch day treatment sample. *Journal of Personality Assessment*, 178-186.
- Forbush, K., Heatherton, T., & Keel, P. (2007). Relationships between perfectionism and specific disordered eating behaviors. *International Journal of Eating Disorders*, 40, 37-41.
- Godt, K. (2008). Personality disorders in 545 patients with eating disorders. *European Eating Disorders Review*, 16, 94-99.
- Graham, J. (2011). *MMPI-2: Assessing personality and psychopathology* (5th ed.). New York: Oxford University Press.
- Guerrieri, R., Nederkoom, C., & Jansen, A. (2008). The effect of an impulsive personality on overeating and obesity: Current state of affairs. *Psychological Topics*, 17, 265-286.

- Habermas, T. (1989). The psychiatric history of anorexia nervosa and bulimia nervosa: weight concerns and bulimic symptoms in early case reports. *International Journal Of Eating Disorders*, 8(3), 259-273.
- Halmi, K., Tozzi, F., Thornton, L., Crow, S., Fichter, M., Kaplan, A., ... Bulik, C. (2005). The relation among perfectionism, obsessive-compulsive personality disorder and compulsive disorder in individuals with eating disorders. *International Journal of Eating Disorders*, 38, 371-374.
- Harkness, A., & McNulty, J. (2006). *An Overview of Personality: The MMPI-2 Personality Psychopathology Five (PSY-5) Scales. MMPI-2: A practitioner's guide*. Washington, DC US: American Psychological Association.
- Hatch, A., Madden, S., Kohn, M., Clarke, S., Touyz, S., Gordon, E., & Williams, L. (2011). Eeg in adolescent anorexia nervosa: Impact of refeeding and weight gain. *International Journal of Eating Disorders*, 65-75.
- Hendren, R. L. (1983). Depression in anorexia nervosa. *Journal of the American Academy Of Child Psychiatry*, 22(1), 59-62.
- Hudson, J., Hiripi, E., Pope, H., & Kessler, R. (2007). The prevalence and correlates of eating disorders in the national comorbidity survey replication. *Biological Psychiatry*, (61), 348-358.
- Jáuregui-Lobera, I. (2011). Electroencephalography in eating disorders. *Neuropsychiatric Disease and Treatment*, 8, 1-11.
- Johnson, C., Tobin, D., & Dennis, A. (1990). Differences in treatment outcome between borderline and non-borderline bulimics at one year follow-up. *International Journal Of Eating Disorders*, 9, 617-627.

- Kim, D., Bolbecker, A., Howell, J., Rass, O., Sporns, O., Hetrick, W., . . . O'Donnell, B. (2013). Disturbed resting state EEG synchronization in bipolar disorder: A graph-theoretic analysis. *NeuroImage Clinical*, 2, 414-423.
- Kotov, R., Ruggero, C., Krueger, R., Watson, D., Yuan, Q., Zimmerman, M. (2011). New dimensions in the quantitative classification of mental illness. *Archives of General Psychiatry*. 68(10), 1003-1011.
- Krueger, R., & Markon, K. (2006). Reinterpreting comorbidity: a model-based approach to understanding and classifying psychopathology. *Clinical Psychology*, 2, 111-133.
- Marca, G., Farina, B., Mennuni, G., Mazza, S., Giannantonio, M., Spadini, V., . . . Mazza, M. (2004). Microstructure of sleep in eating disorders: Preliminary results. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity*, 77-80.
- Marek, R., Ben-Porath, Y., Ashton, K., Heinberg, L. (2014). Minnesota multiphasic personality inventory-2 restructured form (MMPI-2-RF) scale score differences in bariatric surgery candidates diagnosed with binge eating disorder versus BMI-matched controls. *International Journal of Eating Disorders*, 47, 315–319.
- Marek, R., Ben-Porath, Y., Sellbom, M., McNulty, J., Heinberg, L. (2014). Validity of Minnesota Multiphasic Personality Inventory – 2 – Restructured Form (MMPI-2-RF) scores as a function of gender, ethnicity, and age of bariatric surgery candidates. *Surgery for Obesity and Related Disease*. 1-8.
- Mattar, L., Thiebaud, M., Huas, C., Cebula, C., & Godart, N. (2012). Depression, anxiety and obsessive-compulsive symptoms in relation to nutritional status and outcome in severe anorexia nervosa. *Psychiatry Research*, 200, 513-517.

- Norman, D. K., & Herzog, D. B. (1983). Bulimia, anorexia nervosa, and anorexia nervosa with bulimia a comparative analysis of MMPI profiles. *International Journal of Eating Disorders*, 2(2), 43-52.
- Peat, C., Mitchell, J. E., Hoek, J. W., & Wonderlich, S. A. (2009). Validity and utility of subtyping Anorexia Nervosa. *International Journal of Eating Disorders*, 42, 590- 594.
- Peck, L., & Lightsey, O. (2008). The eating disorders continuum, self-esteem and perfectionism. *Journal of Counseling and Development*, 86, 184-192.
- Pyle, R. L., Mitchell, J. E., & Eckert, E. D. (1981). Bulimia: A report of 34 cases. *Journal Of Clinical Psychiatry*, 42(2), 60-64.
- Pryor, T., & Wiederman, M. (1996). Use of the MMPI-2 in the Outpatient Assessment of Women with Anorexia Nervosa or Bulmia Nervosa. *Journal of Personality Assessment*, 66(2), 363-373.
- Rawal, A., Park, R., Williams, J., & Mark, G. (2010). Rumination, experiential avoidance, and dysfunctional thinking in eating disorders. *Behaviour Research and Therapy*, 48, 851-859.
- Research Domain Criteria. (n.d.). In *National Institute of Mental Health*. Retrieved from <http://www.nimh.nih.gov/research-priorities/rdoc/index.shtml>
- Rodriguez, G., Babiloni, C., Brugnolo, A., Percio, C., Cerro, F., Gabrielli, F., . . . Ferro, A. (2007). Cortical sources of awake scalp EEG in eating disorders. *Clinical Neurophysiology*, 1213-1222.
- Root, T. (2010). Substance abuse is increased in patients with AN and BN. *Eating Disorders Review*, 21, 9-9.

- Scott, R. L., & Baroffio, J. R. (1986). An MMPI analysis of similarities and differences in three classifications of eating disorders: anorexia nervosa, bulimia, and morbid obesity. *Journal of Clinical Psychology, 42*(5), 708-713.
- Sellbom, M., Ben-Porath, Y., & Bagby, R. (2008). Personality and psychopathology: mapping the MMPI-2 restructured clinical (RC) scales onto the five factor model of personality. *Journal of Personality Disorders, 22*(3), 291-312.
- Sherry, H. (2013). Estimated MMPI-2-RF profiles of women with disordered eating behavior. Unpublished doctoral dissertation, Sam Houston State University, Huntsville, TX.
- Small, A. C., Madero, J., Gross, H., Teagno, L., Leib, J., & Ebert, M. (1981). A comparative analysis of primary anorexics and schizophrenics on the MMPI. *Journal of Clinical Psychology, 37*(4), 733-736.
- Shisslak, C. M., Pazda, S. L., & Crago, M. (1990). Body weight and bulimia as discriminators of psychological characteristics among anorexic, bulimic, and obese women. *Journal of Abnormal Psychology, 99*(4), 380-384.
- Steinhausen, H. (2009). Outcome of eating disorders. *Child and Adolescent Psychiatric Clinics of North America, 18*(1), 225-242.
- Stone, H. (2013). MMPI-2-RF profiles of women with eating disorders in an inpatient setting: anorexia nervosa, bulimia nervosa, and eating disorders – not otherwise specified. Unpublished doctoral dissertation, Alliant International University, San Diego, CA.
- Swinboume, J., Hunt, C., Abbott, M., Russell, J., St Clare, T., & Touyz, S. (2012). The comorbidity between eating disorders and anxiety disorders: Prevalence in an eating disorder sample and anxiety disorder sample. *Australian and New Zealand Journal of Psychiatry, 46*, 118-131.

- Tellegan, A., Ben-Porath, Y., McNulty, J., Arbisi, P., Graham, J., & Kaemmer, B. (2003). *MMPI-2 Restructured Clinical (RC) scales: Development, Validation, and Interpretation*. Minneapolis, MN: University of Minnesota Press.
- Teplan, M. (2002). Fundamentals of EEG measurement. *Measurement Science Review*, 2(2).
- van Hoeken, D., Veling, W., Sinke, S., Mitchell, J. E., & Hoek H. W. (2009). The validity and utility of subtyping Bulimia Nervosa. *International Journal of Eating Disorders*, 42, 595-602.
- Vitousek, K., & Manke, F. (1994). Personality variables and disorders in anorexia nervosa and bulimia nervosa. *Journal of Abnormal Psychology*, 103(1), 137-147.

APPENDICES

Table 1

Bivariate correlations between the emotional and internalizing dysfunction MMPI-2-RF scales and the eating disorder symptom checklist

	EID	RCd	RC2	RC7	SUI	HLP	NFC
Restricting: Dieting	-.471	-.220	-.348	-.298	-.316	-.662	-.105
Restricting: Fasting	-.694	-.393	-.724	-.469	-.479	-.893**	-.180
Restricting: Exercise	-.559	-.470	-.448	.245	-.306	-.162	.543
Binge-eating	.780*	.751	.721	.141	.435	.422	-.248
Binge-eating: Loss of Control	.882**	.847*	.774*	.270	.491	.557	-.162
Purging: Vomitting	.142	.226	-.216	-.579	-.349	-.396	-.443
Purging: Laxatives	-.070	.228	-.281	.381	-.426	.099	.030
Purging: Diuretics	-.283	-.218	-.063	.534	.144	.162	.506
Food Avoidance	-.648	-.728	-.551	-.743	-.354	-.648	-.456
Consequences Concern	-.171	-.155	-.025	-.385	-.093	-.349	-.326
Weight Loss	-.883**	-.597	-.798*	-.395	-.561	-.914**	0.000
Nutritional Deficiency	-.944**	-.788*	-.817*	-.406	-.558	-.805*	.034
Psychosocial Functioning	-.266	-.050	-.457	-.546	-.418	-.568	-.693
Fear of Weight Gain	.119	-.129	.344	-.265	.379	-.021	-.023

	STW	AXY	ANP	BRF	MSF	NEGEr	INTRr
Restricting: Dieting	.289	-.395	.129	-.507	-.393	-.094	-.511
Restricting: Fasting	.320	-.673	-.342	-.477	.071	-.367	-.493
Restricting: Exercise	-.645	.341	-.276	.743	.211	-.241	-.675
Binge-eating	.683	-.134	.676	-.461	-.139	.665	.736
Binge-eating: Loss of Control	.674	-.086	.664	-.288	.081	.755*	.861*
Purging: Vomitting	.382	-.523	-.012	-.369	.052	.217	.206
Purging: Laxatives	-.311	.441	.008	.860*	.709	.158	-.070
Purging: Diuretics	-.258	.278	-.128	.476	.342	-.162	-.252
Food Avoidance	-.258	-.223	-.551	-.574	-.641	-.846*	-.553
Consequences Concern	.167	-.179	.176	-.649	-.737	-.155	-.256
Weight Loss	0.000	-.431	-.338	-.258	-.120	-.465	-.814*
Nutritional Deficiency	-.354	-.184	-.504	-.072	-.232	-.674	-.916**
Psychosocial Functioning	.354	-.461	-.246	-.558	.036	-.313	-.015
Fear of Weight Gain	.240	-.258	.164	-.721	-.757*	-.042	.033

Note. Significant correlations bold and marked with asterisk(s): p<.01=**, p<.05=*

Table 2

Bivariate correlations between the behavioral externalizing dysfunction MMPI-2-RF scales and the eating disorder symptom checklist

	BXD	RC4	RC9	JCP	SUB
Restricting: Dieting	.202	.232	.268	.153	-.373
Restricting: Fasting	.247	.490	.393	.170	.152
Restricting: Exercise	.874*	.773*	.620	.617	.769*
Binge-eating	-.798*	-.937**	-.572	-.726	-.875**
Binge-eating: Loss of Control	-.811*	-.975**	-.577	-.799*	-.716
Purging: Vomiting	-.410	-.204	-.455	-.588	-.247
Purging: Laxatives	.387	.295	.307	.105	.724
Purging: Diuretics	.519	.376	.591	.487	.566
Food Avoidance	.153	.487	.075	.503	-.080
Consequences Concern	-.117	-.067	-.099	.089	-.689
Weight Loss	.577	.738	.574	.469	.234
Nutritional Deficiency	.710	.887**	.579	.689	.395
Psychosocial Functioning	-.248	.065	-.057	-.097	-.080
Fear of Weight Gain	-.325	-.322	-.289	-.081	-.786*

	AGG	ACT	AGGRr	DISCr
Restricting: Dieting	.216	.015	-.087	.137
Restricting: Fasting	.180	.447	.314	.409
Restricting: Exercise	.484	.631	.662	.757*
Binge-eating	-.256	-.834*	-.721	-.873*
Binge-eating: Loss of Control	-.233	-.796*	-.625	-.873*
Purging: Vomiting	0.000	-.446	.230	-.578
Purging: Laxatives	-.082	.476	.625	.186
Purging: Diuretics	.193	.637	.156	.696
Food Avoidance	-.258	.301	-.026	.326
Consequences Concern	-.125	-.290	-.452	-.173
Weight Loss	.330	.550	.399	.626
Nutritional Deficiency	.265	.658	.462	.758*
Psychosocial Functioning	-.444	.188	.036	-.095
Fear of Weight Gain	.063	-.535	-.652	-.250

Note. Significant correlations bold and marked with asterisk(s): $p < .01 = **$, $p < .05 = *$.

Figure 1. *Eating Disorder Symptom Checklist*

Based on interviews and background information, please select the choice that best describes the symptoms over the last 90 days prior to the initiation of treatment.

	Never	Sometimes	Often	Daily
Restricting of intake relative to dieting	0	1	2	3
Restricting of intake relative to fasting	0	1	2	3
Restricting of intake relative to excessive exercise	0	1	2	3
Binge-eating: eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than what most individuals would eat in a similar period of time under similar circumstances.	0	1	2	3
Binge-eating: a sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating).	0	1	2	3
Purging: Vomiting	0	1	2	3
Purging: Laxatives	0	1	2	3
Purging: Diuretics	0	1	2	3
Purging: Enemas	0	1	2	3
	N/A	Mild	Moderate	Severe
Food avoidance based on sensory characteristics of food	0	1	2	3
Concern about aversive consequences of eating (such as choking or vomiting)	0	1	2	3
Significant weight loss (or failure to achieve normal weight) related to feeding/eating behavior	0	1	2	3
Significant nutritional deficiency related to feeding/eating behavior	0	1	2	3
Eating-related marked interference with psychosocial functioning	0	1	2	3
Intense fear of gaining weight or becoming fat	0	1	2	3