NEUROPSYCHOLOGICAL CORRELATES OF BODY IMAGE DISTURBANCE

A thesis submitted

to Kent State University in partial
fulfillment of the requirements for the
degree of Master of Arts

by

Kelly Marie Stanek

May, 2009
TABLE OF CONTENTS

LIST OF TABLES ........................................................................................................iv
INTRODUCTION ........................................................................................................1
METHODS .................................................................................................................12
RESULTS .................................................................................................................24
DISCUSSION .............................................................................................................27
REFERENCES ..........................................................................................................36
LIST OF TABLES

1. Descriptive Statistics for Body Image, Demographic, Medical, Psychological, and Neuropsychological Variables………………………………………………………………………………………………46
2. Correlations between Body Image Disturbance Components and Neuropsychological Test Performance………………………………………………………………………………………………48
3. Hierarchical Regression Analysis Predicting Body Checking from Demographic, Psychological, and Neuropsychological Variables…………………………………………………………50
Introduction

Body image disturbance (BID) has become increasingly prevalent in the last several decades (Cash & Henry, 1995; Cash, Morrow, Hrabosky, & Perry, 2004). Studies have shown that over 80% of American females are dissatisfied with their appearance and that body dissatisfaction occurs in 78% of American females by age 17 (Brumberg, 1997; Smolak, 1996). BID is both a risk factor and a defining characteristic of the eating disorders and a significant problem in obesity (American Psychiatric Association, 2000; Friedman, Reichmann, Costanzo, & Musante, 2002; Schwartz & Brownell, 2004). BID occurs on a continuum, however, so that healthy women and men of all ages and weights are affected to various degrees by these appearance-related concerns (Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999).

The term *body image* most generally refers to the internal representation of one’s appearance (Thompson et al., 1999). Body image disturbance then, represents a maladaptive experience of body, including misperception, cognitive distortion and disturbed emotional experience regarding the body. While the phrase *body image* has been employed with increasing frequency in mainstream vocabulary, literature surrounding the *construct* of BID is broad, blanketing a correspondingly broad lexicon and conceptualization. The aim of the present study was to clarify the nature of BID by
investigating the neuropsychological correlates of a multidimensional conceptualization of BID in a non-eating-disordered sample.

**A Multi-Dimensional Definition of Body Image Disturbance**

Early discussion of the internal representation of one’s body incorporated the neurologically rooted concept of *body schema* (Head & Holmes, 1911), as well as the concept of a *body image* that could be influenced by psychosocial factors (Schilder, 1950). As interest in anorexia grew, however, *body image* was conceptually limited to body size-estimation by many researchers and clinicians. For example, Bruch (1962, 1973) proposed that the tendency to overestimate one’s body size was a defining feature of anorexia and due to a general perceptual disturbance that distorted internal bodily sensations. More recent research on BID has expanded the conceptualization of body image to include cognitive, affective and behavioral components, in addition to the perceptual component of body size estimation (Slade, 1988; Cash, 2000; Thompson et al., 1999; Thompson, 2004; Reas & Grilo, 2004). The expansion of BID to include these multiple facets has led not only to a broader symptomatology and vocabulary (i.e. *body satisfaction*, *body esteem*, *body schemas*; Thompson et al., 1999; Thompson, 2004), but also to the appreciation of the dimensional nature of the BID construct. While BID is still a diagnostic component of anorexia and bulimia, it is now generally recognized that disturbances in body image occur on a continuum in eating-disordered and healthy individuals of all weights. For the purpose of the present study, BID is defined as a multi-dimensional construct comprised of three interrelated, but not necessarily interdependent,
facets: perceptual, attitudinal, and behavioral disturbance. These three components of BID are elaborated upon below.

*Behavioral Body Image Disturbance*

The behavioral component of BID encompasses the behavioral correlates of body-related affective and cognitive disturbances. Maladaptive behavioral body image disturbances include compulsive mirror-checking, pinching of body areas to monitor fat, and avoiding certain clothing or situations that allow scrutiny of appearance by others (Reas, Whisenhunt, Netemeyer, & Williamson, 2002; Thompson et al., 1999). While body-related behaviors represent an important dimension of body experience, this behavioral component has only recently received due empirical investigation in the body image literature (Cash, 2002; Reas, White, & Grilo, 2006; Grilo et al., 2005; Shafran, Fairburn, Robinson, & Lask, 2004; Reas & Grilo, 2004).

*Attitudinal Body Image Disturbance*

Attitudinal body image entails subjective satisfaction with one’s body and appearance (Thompson et al., 1999). The attitudinal component of BID is characterized by affective and cognitive disturbances related to the body. Examples of attitudinal BID include unrealistic appearance expectations and negative emotional and cognitive evaluation of appearance (Thompson et al., 1999; Keel, 2005). This attitudinal disturbance is often summarized by the term *body dissatisfaction*.

*Perceptual Body Image Disturbance*
As originally highlighted in description of anorexic symptomatology, body size misperception has historically referred to over-estimation of one’s actual body size, or seeing oneself as larger than others do (Bruch, 1962). This perceptual component of BID is often depicted and quantified through the discrepancy across measurement of body size and the individual’s tangible or visual estimate of the same measurement. Research has demonstrated that perceptual disturbances in body image occur in individuals of all weights and that both over and under-estimation of size in multiple body areas occur in individuals with BID (Thompson & Thompson, 1986; Fallon & Rozin, 1985; Valtolina, 1998).

*The Neuropsychology of Body Image Disturbance*

A great deal of research has focused on psychosocial correlates and risk factors for the attitudinal component of BID. Longitudinal data has identified body weight, perceived sociocultural pressure, and internalization of the thin ideal as the best predictors of body dissatisfaction (Stice & Whitenton, 2002). Although weight status and psychosocial factors may account for much of the variance in body dissatisfaction observed in American women, it is likely that these biopsychosocial factors interact with neuropsychological factors and that the multidimensional construct of BID may be better predicted when taking neurocognitive differences into account.

There has been a seemingly intuitive drive to investigate the role of cognitive deficits in anorexic individuals who over-estimate body size. This body of literature provides evidence for general neuropsychological dysfunction in anorexia, but clarity of these findings is obscured by multiple confounds in a psychopathological population.
Another large body of research has focused on the nature and etiology of body dissatisfaction in non-clinical samples, but these studies have rarely examined cognitive function. Given the lack of integration of these lines of research, it remains unclear whether body size misperception represents a neuropsychological dysfunction in either population or whether the behavioral and attitudinal symptoms of BID are related to dysfunction in any cognitive domain. Thus, while evidence suggests strong psychosocial influences for BID, it remains to be seen whether neuropsychological mechanisms are also involved.

**Cognitive Dysfunction and Body Image Disturbance: A Conceptual Basis**

The symptomatology of BID provides numerous opportunities for links between body-related cognitive, perceptual, and behavioral disturbances and neuropsychological function. For instance, the ability to provide an accurate concrete estimate of one’s body shape and size can be intuitively linked to spatial ability, as well as attention and memory for visual input. Repetitive body checking behaviors can be intuitively linked to difficulties in self-monitoring and behavioral control. Consistently dysfunctional thought patterns common in BID, such as evaluative biases and distortions, may be related to above-mentioned deficits as well as higher reasoning abilities and perseverative thinking. The conceptual framework for exploring the neuropsychology of BID, however, consists of more than intuitive connection. Previous research supports the conceptual basis for further exploration of cognitive dysfunction within each main component of BID.

*Perceptual disturbances.*
Few studies have directly examined neuropsychological correlates of body misperception, but there is some evidence for a direct association between body size over-estimation and visuospatial deficits and more extensive evidence for generalized visuospatial dysfunction in anorexia (Thompson & Spana, 1991; Duchesne et al., 2004). It seems likely that the mental representation of one’s body size and shape may be neurologically based and that the translation of that image into a tangible estimation of one’s external image may require visuospatial ability. However, it also seems probable that one’s ability to accurately estimate body size and shape may be influenced to various degrees by less obvious cognitive abilities, such as visual memory and attention, as well as executive functions such as planning, abstract thinking, and cognitive flexibility.

*Attitudinal disturbances.*

Although existing evidence points strongly toward sociocultural mechanisms for the development of attitudinal BID, it is possible that neuropsychological mechanisms modify or contribute to body dissatisfaction. The frequent comorbidity of depression and body dissatisfaction (Stice & Whitenton, 2002; Kaur, Singh, & Javed, 2003; Noles, Cash, & Winstead, 1985; Friedman et al., 2002) suggests the possibility that cognitive deficits similar to those found in depressed individuals, particularly frontal lobe dysfunction, may also be present in individuals suffering from body dissatisfaction. Related research confirms that frontal deficits are present in individuals with anorexia, and that these deficits are directly related to measures of body dissatisfaction, but no studies to date have directly examined the possibility that attention and executive function may be related to body dissatisfaction in a non-clinical sample (Fassino et al., 2002). Likewise,
increased body mass is a robust linear predictor of body dissatisfaction (Stice and Whitenton, 2002) that has also been associated with cognitive deficits in adults free from medical and psychiatric disorders, including deficits in working memory and executive function (Gunstad, Paul, Cohen, Tate, & Gordon, 2006). Together, these findings are suggestive of a shared frontal mechanism that merits further exploration.

*Behavioral disturbances.*

Although no studies to date have directly examined the relationship between behavioral symptoms of BID and cognitive function, similarities in symptomatology among behavioral correlates of BID and obsessive compulsive disorder (OCD) and body dysmorphic disorder (BDD) suggest the potential involvement of similar neuropsychological mechanisms. In a comparison of individuals with OCD and BDD, both patient groups exhibited executive dysfunction, including deficits in response inhibition and planning, when compared to normal controls (Hanes, 1998). Other studies have provided evidence for deficits in multiple cognitive domains, particularly nonverbal memory, executive function (including set-shifting, organization, and cognitive inhibition), and slowed performance on speeded tasks (Olley, Malhi & Sachdev, 2007; Penadés, Catalán, Andrés, Salamero, & Gastó, 2005; Roth, Baribeau, Milovan, & O'Connor, 2004; Segalàs et al., 2008). Given similarities in symptomatology, particularly regarding checking behaviors, the emphasis on frontal dysfunction throughout the OCD literature further supports the possibility that frontal dysfunction may play an important role in BID.
Evidence for Cognitive Dysfunction in Anorexia and Obesity

As mentioned, additional evidence for associations between BID and cognitive function may already be found in the eating disorder and obesity literature. However, existing research tends to investigate cognitive dysfunction more generally within clinical populations rather than explicitly focusing on BID. For instance, individuals with anorexia have been shown to perform worse than control subjects on cognitive tasks. Deficits in multiple cognitive domains, including psychomotor speed, information processing, attention, working memory, executive function (particularly abstraction, flexibility, set-shifting, and decision making), and visuospatial and visual-constructional ability have been documented (Duchesne et al., 2004; Fassino et al., 2001; Green et al., 1996). Brain imaging studies in individuals with anorexia suggest right parietal lobe dysfunction, which is associated with visuospatial ability, and lend support to findings of reduced visuospatial test performance in this population (Duchesne et al., 2004). Furthermore, evidence suggests that some cognitive deficits in anorexia may be irreversible, even with successful treatment and weight restoration (Duchesne et al., 2004). Despite a lack of longitudinal data, the possibility that certain cognitive deficits may represent etiological mechanisms for disordered eating is salient and lends relevance to the investigation of neuropsychological correlates of BID, a risk factor for the eating disorders.

Fassino and colleagues (2002) examined the relationship between executive function and BID more directly in a sample of women with anorexia and a healthy comparison group. BID was assessed using the Body Shape Questionnaire (BSQ;
Cooper, Taylor, Cooper, & Fairburn, 1987) a self-report questionnaire of attitudinal and behavioral aspects of BID. They found that the BSQ was significantly associated with errors on the Wisconsin Card Sorting Test, a measure of cognitive flexibility, in the anorexic group, but not in the healthy control group. While these findings suggest some frontal deficit in anorexia, the lack of a significant association in the control group warrants replication. Further studies designed to examine BID more specifically among non-eating-disordered individuals of a range of body weights are needed to determine whether attitudinal BID is also related to executive dysfunction in a non-clinical population.

Although these studies provide evidence that deficits in multiple cognitive domains occur in individuals with anorexia, it is difficult to fully determine underlying mechanisms for these deficits and it remains unclear how BID may be involved. Observed cognitive deficits in this clinical population may be attributable to a number of confounding factors related to disordered eating and underweight, including effects of semi-starvation and malnutrition on the brain.

Likewise, obese individuals perform worse than normal-weight controls on certain cognitive tasks. A recent study of body composition and cognitive function in healthy individuals demonstrated that body mass was associated with reduced performance on cognitive tasks that assess working memory and executive function (Gunstad et al., 2006). As in anorexia, however, mechanisms underlying these deficits may be difficult to determine, given the multiple medical complications associated with obesity. More specifically, comorbidity, including cardiovascular disease, diabetes, and
reduced physical activity, may influence the degree of cognitive dysfunction in obese individuals (Cicconetti, Riolo, Priami, Tafaro, & Ettore, 2004).

In summary, evidence for neuropsychological dysfunction in individuals prone to BID can be found in the literature on anorexia and obesity. While this evidence supports the conceptual basis for further investigation of cognitive dysfunction in BID, findings from these studies cannot generalize to BID in non-clinical populations due to multiple confounding medical and methodological factors. Given the continuous nature of BID, investigation in a non-clinical sample is necessary to elucidate the construct of BID, particularly its neuropsychological substrates (Cash, 2002).

Evidence for Cognitive Dysfunction in Body Image Disturbance

Few studies to date have examined cognitive function and BID in healthy individuals. Thompson and Spana (1991) examined body size misperception and visuospatial ability in a non-clinical sample. They administered a size estimation task in which participants were asked to estimate the width of several body areas using an adjustable light beam projected onto a wall. Their sample included 69 undergraduate women who did not meet diagnostic criteria for an eating disorder. They also administered the Space Relations Scale of the Differential Aptitude Test, which tests the ability to mentally rearrange figures, and the Benton Visual Retention Test (BVRT), a test of visual attention and memory. They found an association ($r = .33, p < .05$) between errors on the BVRT and over-estimation of the thigh area. Thompson and Spana (1991) concluded that their findings provided mild support for a relationship between body size over-estimation and visuospatial ability. However, this study was limited by the number
and breadth of neuropsychological tests administered and by the exclusion of other relevant cognitive domains and components of the multidimensional BID construct.

The Current Study

No study to date has examined the association between cognitive function and each of the major components of BID in a non-clinical sample. Previous research has revealed cognitive deficits in individuals with eating pathology. However, few studies have directly examined the relationship of BID to cognitive test performance and even fewer studies have explored the possibility that the relationship between BID and cognitive function may exist outside of eating pathology. While there is reason to believe that body misperception, body dissatisfaction, and body-checking and avoidant behaviors are related to deficits in attention, memory, executive function, and visuospatial abilities, these hypothetical relationships have not yet been empirically examined. The current study examined these possibilities by measuring body composition, body size misperception, body dissatisfaction, body-related behavioral disturbances, and cognitive test performance across multiple cognitive domains in non-eating-disordered female undergraduates. It was expected that deficits in memory, attention, visuospatial ability, and executive function would be related to perceptual, attitudinal, and behavioral components of BID after controlling for the effects of body weight and other theoretically relevant control variables.
Methods

Participants

Study participants were recruited from the Kent State University Department of Psychology undergraduate subject pool. Women between the ages of 18 and 26 who were proficient in the English language were eligible to participate. Men were excluded due to lower rates of body dissatisfaction relative to women and to greater amounts of applicable research conducted with women (Fallon & Rozin, 1985; Feingold & Mazzella, 1998; Cash et al., 2004). Pregnant women and those with a history of significant neurological injury or illness (e.g., seizure disorder) and/or severe psychiatric illness (e.g., schizophrenia) were excluded. Women who met DSM-IV-TR diagnostic criteria for an eating disorder (anorexia, bulimia, binge-eating disorder) were excluded.

A total of 141 individuals were recruited for the current study. Of that group, 126 were eligible for study participation. Listwise deletion excluded 26 of those individuals from analyses due to incomplete self-report data. A total of 100 eligible individuals with complete data were included in the current analyses.

The study sample was composed of 72.8% Caucasian women, 17.5% African-American women, 6.8% Asian women, 1% Hispanic women, and 1.9% women of other racial/ethnic minority groups. Participants’ average age was 19 ± 1.4 years and average education was 13 ± 0.8 years. Although no participant met criteria currently, 6% of the
sample reported a past history of disordered eating. Given the low frequency of reported eating pathology in the current sample, comparisons between groups with and without history of eating pathology were not conducted. Additional sample characteristics are presented in Table 1.

Procedure

The local Institutional Review Board approved all methods and all individuals provided written informed consent before participating in this study. Participants scheduled an assessment session using an online scheduling system and received credit towards a general psychology class requirement following participation, according to regulations put forward by the Kent State University Undergraduate Psychology Research Pool. The two-hour assessment session included four components: body size estimation, body measurement, neuropsychological assessment, and assessment of psychological and medical characteristics through self-report. Participants were instructed to remove shoes and any bulky outerwear (e.g. coats and heavy sweaters) to facilitate accurate measurement and body size estimation. Trained female research assistants conducted all tests, following standardized administration and scoring procedures. A licensed clinical neuropsychologist supervised all neuropsychological assessments.

Measures

Assessment of Body Image Disturbance
Behavioral body image disturbance.

The Body Checking Questionnaire (BCQ; Reas et al., 2002) was used to quantify behavioral manifestations of BID. This self-report questionnaire includes 23 items that address various body-related dysfunctional behaviors, including ritualistic and compulsive mirror checking and weighing, pinching of body areas to monitor fat, and appearance-related avoidant behaviors. Participants were asked to indicate frequency of these behaviors using a 5-point Likert scale, ranging from “never” to “very often,” with a high score indicating greater disturbance. The BCQ has demonstrated good stability (.94) and internal consistency (> .80) and has been used in eating disordered and obese populations (Reas et al., 2006; Calugi, Dalle Grave, Ghisi, & Sanavio, 2006; Grilo et al., 2005). Cronbach’s alpha in the current sample was .92.

Attitudinal body image disturbance.

The Body Areas Satisfaction Scale (BASS), a subscale of the Multidimensional Body-Self Relations Questionnaire (MBSRQ; Brown, Cash, & Mikulka, 1990; Cash, 2000) was used to quantify body dissatisfaction. Participants were asked to rate their level of satisfaction with nine body areas using a 5-point Likert scale, ranging from 1 (very dissatisfied) to 5 (very satisfied). A low BASS score is indicative of less satisfaction with several body areas, whereas a high score indicates satisfaction with most body areas. The BASS has good reported stability (.74) and internal consistency (.73) and is widely used in college populations (Cash, 2000). Cronbach’s alpha in the current sample was .80.
Perceptual body image disturbance.

Body size misperception was assessed using a novel procedure that measured the discrepancy between individual perception of body size and the perception of that individual’s body size by independent raters. First, the Body Image Assessment for Obesity (BIA-O; Williamson et al., 2000) was employed to measure individual perception of body size. The BIA-O is a figural rating scale that is widely used as a measure of body dissatisfaction in women and men of varying weights. In the current study, participants were asked to examine a randomly arranged array of 18 female BAI-O silhouettes, which vary in size from very thin to very overweight, and to select the silhouette that most accurately depicts her own body size and shape. Each silhouette choice corresponds to a ranking of 1-18, with 18 indicating the largest body size. During the assessment session, a digital photograph was taken of each participant in front of a white background, mimicking the position and composition of the BIA-O silhouettes. Participant faces were covered to preserve anonymity. These photographs were printed onto photographic paper that closely matched the BIA-O stimulus in size and shape. On a separate occasion, four independent raters (two women and two men) were asked to examine each participant’s photograph in comparison to a random arrangement of the 18 BIA-O figures and to choose the silhouette that best depicted the size and shape of each photographed participant. Inter-rater correlations ranged from .76-.91. The intra-class correlation coefficient was .86. Rater silhouette choice for each participant was subtracted from the participant’s own silhouette choice to create an index of body size misperception (BSMP). Using this system, negative index scores indicated participant
underestimation of body size and positive index scores indicated participant overestimation of body size. Previous research using multiple methods of body size estimation has resulted in conflicting evidence for directionality in estimation by weight. While most researchers concur that individuals with anorexia tend to over-estimate body size and several studies have demonstrated the opposite trend in obesity, findings have been equivocal and it is unclear whether the relationship between misperception and weight is linear in normal to overweight individuals (Smeets et al., 1997; Hennighausen, Enkelmann, Wewetzer, & Remschmidt, 1999; Valtolina, 1998; Thompson & Thompson, 1986). Thus, in order to create a more general indication of body misperception in either direction, the absolute value of each misperception score was used in the current analyses.

Assessment of Psychological and Medical Characteristics

Body Mass Index (BMI) was used to quantify body composition. Participants’ body weight and height were measured using standard protocols. BMI was calculated using the following formula: (body mass (lbs)/ height$^2$ (in$^2$)) x 703. Participants’ BMI ranged from 14.8 lbs/ in$^2$ to 45.4 lbs/ in$^2$ and averaged 23.8 ± 5.7 lbs/ in$^2$. According to the classification system used by the National Institutes of Health, 8.7% of participants were classified as underweight (BMI < 18.5), 61.2% were within the normal weight range (BMI 18.5-24.9), 17.5% were classified as overweight (BMI 25-29.9), 10.7% were classified as obese (BMI 30-40), and 1.9% were classified as extremely obese (BMI < 40).
Body fat percentage was assessed as a secondary measure of body composition, given recent research to suggest that central adiposity might be more closely related to cognitive function than BMI (Cereda, Sansone, Meola, & Malavazos, 2007). A female research assistant took circumference measurements of the hips, thigh, and forearm in duplicate, using a weighted non-stretch fabric tape over clothes. Estimated percent body fat was calculated from these measurements using a standard formula (American College of Sports Medicine, 2005). However, as estimated body fat percentage correlated highly with BMI in the present sample ($r = .86$, $p < .001$), BMI alone was considered an adequate representation of body composition in the current analyses.

The American Version of the National Adult Reading Test (AMNART; Grober & Sliwinski, 1991) was used to provide an estimate of intellectual ability. This test is a measure of reading ability in which participants are asked to pronounce 45 phonetically irregular words, which vary in frequency of use. Performance on this test, and similar versions, produces high reliability estimates ($> .90$) and correlates moderately to highly ($0.40-.80$) with concurrent testing of intellectual ability (Strauss, Sherman, & Spreen, 2006).

The Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) was used to assess depressive symptomatology. This 20-item self-report inventory asks participants to indicate frequency of depressive symptoms using a 4-point Likert scale, ranging from “rarely” to “most of the time,” with a higher score indicating greater depression. The CES-D has demonstrated adequate internal consistency ($> .80$) and adequate sensitivity and specificity in college and psychiatric populations (Radloff, 1977,
Cronbach’s alpha in the current sample was .92.

The Maudsley Obsessional Compulsive Inventory (MOCI; Hodgson & Rachman, 1977) was used to assess obsessive and compulsive symptoms and behaviors. This self-report questionnaire has demonstrated adequate internal consistency (> .70 across subscales) and good temporal stability (.80). Obsessive-compulsive symptomatology is measured with 30 true or false items, with a greater total score indicating more severe symptomatology. Cronbach’s alpha in the current sample was .83.

The Eating Disorder Diagnostic Scale (EDDS; Stice, Telch, & Rizvi, 2000) was used to discriminate between eating-disordered and non-eating-disordered participants in the present study. This 22-item self-report instrument addresses each of the DSM-IV-TR criteria for anorexia nervosa, bulimia nervosa, and binge eating disorder. EDDS diagnoses have been shown to be stable (.80) and good support for criterion validity has been established with longer assessments of eating pathology and structured interview diagnoses (mean r of .83 with EDE and SCID diagnoses). Use of this diagnostic instrument resulted in the exclusion of one participant who met criteria for bulimia nervosa and one participant who met criteria for binge eating disorder.

A brief checklist was used to evaluate medical and psychological history and reported current status. This instrument specifically asked participants to report history of psychological disorders, including eating pathology, and medical conditions with the potential to impact cognitive function, such as uncorrected vision problems, seizure disorders, or heart disease.
Neuropsychological Assessment

Visuospatial ability.

The short form of the Judgment of Line Orientation (JLO; Benton, Sivan, Hamsher, Varney, & Spreen, 1994) was used to assess visual acuity and visuospatial ability. This test specifically examines the ability to perceive and match angulations (Lezak, Howieson, & Loring, 2004). Participants are shown a page with two lines at the top and an array of 12 lines at the bottom. They are asked to identify which lines at the bottom of the page match the orientation of the lines at the top of the page. The short form, which consists of 15 items, correlates highly with the full 30-item version (.94) and has demonstrated good internal consistency (.90; Qualls, Bliwise, & Stringer, 2000). The JLO total score is the number of items correctly completed, with a short form score < 10 indicating some deficit. (Lezak et al., 2004).

The Complex Figure Test (CFT; Rey, 1941) was used to assess visuospatial ability and visual memory. In this test, participants are asked to copy a complex 2-dimensional geometric figure. The figure is then removed and the participant is asked to draw the figure from memory. Thirty minutes later, the participant is asked to draw it again from memory, resulting in a delayed recall score (CFT-DR) Drawings are scored for accuracy and placement of main figure elements with higher scores indicating better visual memory. This test has high test-retest reliability, ranging from .60-.76, and has been shown to be sensitive to mild impairments in visual memory in a range of clinical populations (Loring, Martin, Meador, & Lee, 1990; Lezak et al., 2004).
**Attention and working memory.**

Spatial Span (SS; Wechsler, 1997a) was used to assess visual attention. In this test, the examiner taps a series of blocks on a stimulus board and then asks the participant to tap the same series. Tapping sequences are presented in increasing span. The forward trial score (SS-F) is a sum of the number of these sequences correctly completed. This test has excellent psychometric properties.

Letter Number Sequencing (LNS; Wechsler, 1997b) was used to assess complex attention and working memory. In this test, participants are read a string of numbers and letters and asked to order the numbers and letters in a specific manner: the numbers in ascending order followed by the letters in alphabetical order. For example, if the string was 1-J-A-7, participants would be asked to generate 1-7-A-J. Strings increase in length for each trial, and the total score is the number of trials correctly completed. Strong test-retest reliability (.75) has been demonstrated for this test (Wechsler, 1997b).

The Adaptive Rate Continuous Performance Test (ARCPT; Buchsbaum & Sostek, 1980) was used to assess sustained, focused attention and reaction time. In this computerized assessment, letters of the alphabet briefly appear in the center of the screen in random order. Participants are asked to respond to X only if it followed A, by pressing the space bar. The rate of presentation is adapted to the participant’s response pattern, over the course of several blocks of stimuli presentation. A vigilance decrement index (ARCPT-VD), based on the change in performance between the first and last blocks of stimuli, and an information processing speed index (ARCPT-ISI) were generated for this
test, with higher vigilance decrement values indicating poorer sustained attention and higher ISI values indicating slower information processing.

**Executive functions.**

The Frontal Assessment Battery (FAB; Dubois, Slachevsky, Litvan, & Pillon, 2000) was used to assess executive function. This brief test employs several short tasks to assess executive abilities, including concept formation, response inhibition, and verbal fluency. For example, participants are asked to identify similarities among two words (e.g. automobile and boat), name as many words as they can that begin with a target letter (e.g. words that begin with ‘M’), and tap patterns with their hands. Dubois and colleagues (2000) reported good interrater reliability and internal consistency for the FAB and reported an accuracy rate of 89% in differentiating patients with frontal lobe disorders from normal controls using the FAB total score.

The Stroop Test (Golden, 1978) was used to assess selective attention and response inhibition. This test consists of three sheets of color names (such as “green” or “red”). In the first trial, participants are asked to read as many color names, printed in black ink, as they can in 45 seconds. The second trial is similar, but they are presented with a sheet containing rows of XXX’s printed in various colors and asked to name the color in which each set is printed. In the final color-word interference trial, the participant is asked to read color names that are printed in other colors as quickly as possible. The color-word score (Stroop-CW) is based on the number of correctly read color names in 45 seconds. Performance on this test is linked to frontal lobe function,
particularly concentration and executive function and has demonstrated satisfactory
reliability (Lezak et al., 2004; Strauss et al, 2006).

Overview of Analysis

Preliminary Analyses

In order to meet assumptions of univariate normality, outlying values were taken
in, $BMI$ was log-transformed, and $CES-D$ and $ISI$ were square root-transformed.
Participant age was included as a control variable, given the theoretical and statistical
significance of its association with BID and performance on several cognitive tests.
Likewise, participant BMI and measures of depression ($CES-D$) and obsessive-
compulsive symptomatology ($MOCI$) were included in order to control for potentially
confounding explanations of cognitive dysfunction. Estimated intellectual ability was not
significantly associated with any BID variable, and was therefore not included as a
control variable. Control variables and independent variables were consistent across
regression analyses.

Bivariate correlation analyses were conducted among the three BID variables, to
determine the strength of the relationships among BID components and estimate the
cohesiveness of the BID construct, as defined in the current study. Bivariate correlation
analyses were then conducted among cognitive tests and each component of BID, to
determine the strength of the zero-order correlations among study variables.

Primary Analyses
Three hierarchical multiple regression analyses were conducted to determine whether cognitive test performance was associated with body-checking and avoidance behaviors, body size misperception, and/or body dissatisfaction after controlling for relevant demographic and psychological characteristics.
Results

Correlation Analyses

Components of Body Image Disturbance

Bivariate correlation analyses revealed a significant correlation between BCQ and BASS scores ($r = -.48, p < .001$), but no association between BSMP and BCQ scores ($r = .02, p = .89$) or BSMP and BASS scores ($r = .00, p = .99$). See Table 2.

Body Checking and Cognitive Test Performance

Bivariate correlation analyses indicated significant associations between BCQ total score and SS-F ($r = -.27, p = .01$), LNS ($r = -.26, p = .01$), FAB ($r = -.24, p = .02$), Stroop-CW ($r = -.26, p = .01$), ARCPT-VD ($r = .26, p = .01$), and ARCPT-ISI ($r = .34, p < .001$), with higher levels of body checking corresponding to poorer performance on SS-F, LNS, and FAB, greater vigilance decrement, and slower information processing. See Table 2 for correlations between behavioral BID and cognitive test performance.

Body Dissatisfaction and Cognitive Test Performance

Bivariate correlation analyses indicated significant associations between BASS score and ARCPT-VD ($r = -.24, p = .02$) and FAB ($r = .25, p = .01$), with less body satisfaction corresponding to greater vigilance decrement and poorer FAB performance. See Table 2 for correlations between attitudinal BID and cognitive test performance.
Body Size Misperception and Cognitive Test Performance

Bivariate correlation analyses indicated a statistically significant association between BSMP and CFT-DR performance \((r = -.24, p = .02)\), with greater misperception corresponding to worse delayed recall on the CFT. See Table 2 for correlations between perceptual BID and cognitive test performance.

Regression Analyses

Body Checking and Cognitive Test Performance

After controlling for BMI (log transformed), CES-D (square root transformed), age, and MOCI, results of a hierarchical multiple regression analysis predicting Body Checking (BCQ) from JLO, CFT-DR, SS- F, LNS, ARCPT-ISI (square root transformed), ARCPT-VD, FAB, and Stroop-CW performance indicated a good fit to the data \([\text{adjusted } R^2 = .47, F(12,87) = 8.37, p < .001, \Delta F = 2.08, p = .04]\). ARCPT-ISI (square root transformed) \([\beta = .22, p = .02]\) was a significant predictor of BCQ score, with slower processing speed predicting increased checking behaviors. No other cognitive variables were statistically significant predictors of BCQ score. See Table 3.

Body Dissatisfaction and Cognitive Test Performance

Results of a hierarchical multiple regression analysis predicting Body Dissatisfaction (BASS) from BMI (log transformed), CES-D (square root transformed), age, and MOCI, indicated good overall model fit \([\text{adjusted } R^2 = .46, F(4,95) = 22.04, p < .001]\); however, the addition of JLO, CFT-DR, SS- F, LNS, ARCPT-ISI (square root transformed)
transformed), ARCPT-VD, FAB, and Stroop-CW performance to the model did not significantly improve model fit ($\Delta F = 1.07, p = .39$).

**Body Size Misperception and Cognitive Test Performance**

After controlling for BMI (log transformed), CES-D (square root transformed), age, and MOCI, results of a hierarchical multiple regression analysis predicting Body Size Misperception (BSMP) from JLO, CFT-DR, SS-F, LNS, ARCPT-ISI (square root transformed), ARCPT-VD, FAB, and Stroop-CW performance indicated an inadequate fit to the data [adjusted $R^2 = -.05$, $F(12,87) = .61$, $p = .83$].
Discussion

Results of the current study indicated that the behavioral component of BID was significantly associated with slower information processing speed after accounting for relevant control variables in a sample of college women with no eating pathology. Neither the attitudinal nor perceptual components of BID were significantly associated with neuropsychological test performance after accounting for relevant control variables. Notably, although attitudinal and behavioral components of BID were strongly related, perceptual BID was not associated with either behavioral or attitudinal BID in the current sample, suggesting that the perceptual disturbances of BID may function independently of cognitive, affective and behavioral disturbances. These primary findings of the present study add to current understanding of the nature of the multidimensional BID construct and warrant further discussion.

*The Neuropsychology of Body Image Disturbance in Individuals without Eating Pathology*

The primary study findings indicate that the behavioral component of BID is associated with poorer neuropsychological function, particularly slower information processing speed. This finding makes intuitive sense, as many behavioral manifestations of BID, including repetitive body checking, appear to involve slowed thought processes. Slower information processing may lead to the faulty or more frequent self-monitoring and doubt that yields various checking behaviors.
Notably, slowed information processing speed has also been identified as a specific cognitive deficit in younger adults with depression and cognitive slowing has been demonstrated in OCD (Gualtieri, Johnson, & Benedict, 2006; Tsourtos, Thompson, & Stough, 2002; Roth, Baribeau, Milovan, & O’Conner, 2004). Yet in the current study, the association between information processing speed and behavioral BID remained significant even after controlling for the effects of depression and OCD, indicating an independent association between BID and information processing speed.

This finding, combined with previous findings in OCD and depression, suggests that BID, OCD, and depression may each represent behaviorally distinct phenotypes for a higher form of frontal dysfunction. Evidence for regional white matter abnormalities in both OCD and depression (Li et al., 2007; Menzies et al., 2008), supports the notion of a central, and likely frontal, neuropathological mechanism resulting in any of these symptomatologies or their comorbidity, as well as similar neuropsychological profiles. White matter abnormalities, which impact neuronal connectivity, can result in reduced neural transmission speed and thus, observations of slower cognitive processing (Gunning-Dixon & Raz, 2000). Li and colleagues (2007) used diffusion tensor imaging (DTI) to compare white matter integrity in 19 young adults with Major Depressive Disorder to matched healthy controls. Results indicated the presence of prefrontal white matter abnormalities early in the course of depression. Menzies and colleagues (2008) conducted a similar study in 30 OCD patients, 30 unaffected first-degree relatives, and 30 healthy matched controls. Using DTI, they were able to provide evidence for white matter abnormalities of frontal and parietal regions in OCD, as well as similar
abnormalities in first-degree relatives without clinical signs of OCD, suggesting a possible endophenotype for the disorder (Menzies et al., 2008). In conjunction, these findings support the idea of a shared frontal mechanism and present an intriguing possibility for future study of the underlying neuropathology of BID. Although white matter abnormalities cannot be assumed from neuropsychological test performance, the possibility that BID shares this frontal neuropathology could be addressed in similar DTI studies.

The lack of a significant association between behavioral BID and neuropsychological performance on other tasks involving fronto-subcortical function is unexpected, but meaningful. While zero-order correlations indicated that higher levels of body checking were associated with decreased working memory, visual attention, sustained attention, and executive functioning, only the relationship between body checking and slower information processing retained statistical significance after accounting for the effects of age, weight status, and depressive and obsessive-compulsive symptomatology. These findings suggest that effects of BID on attention and executive function are not independent or specific, and are likely obscured by affective symptomatology for most individuals.

Similarly, although higher levels of body dissatisfaction were associated with decreased executive functioning and sustained attention in zero-order correlation analyses, attitudinal BID was not significantly related to any neuropsychological variable after accounting for weight status, age, and other psychological variables. Given the relatively strong associations between body satisfaction and depression \((r = -.54)\) and
BMI ($r = -0.41$), it is not surprising that attitudinal BID is not independently related to frontal dysfunction. It is also likely that this finding was influenced by the operational definition of attitudinal BID, as subjective ratings of body area satisfaction tend to be strongly associated with psychological disorders such as depression (Wiederman & Pryor, 2000; Denniston, Roth, & Gilroy, 1992; Noles, Cash, & Winstead, 1985; Friedman et al., 2002).

Although the current sample demonstrated a range of inaccurate estimations of body size, perceptual BID was unrelated to neuropsychological test performance in any domain after accounting for control variables. Notably, zero-order correlation analyses indicated a significant association between greater body misperception and poorer visual recall ($r = -0.24$), which is somewhat consistent with Thompson and Spana’s (1991) finding that over-estimation of a specific body area was associated with worse performance on a test of visual attention and memory ($r = 0.33$) in a sample of 69 college women without eating pathology. However, the current study demonstrated that with greater control of potential confounding variables, inaccurate estimation of body size is not independently associated with neuropsychological function.

Although this finding was unexpected, it is at least partly consistent with the argument that the perceptual component of BID does not involve pure visuospatial deficit, but rather, may be inseparable from the cognitive and affective aspects of BID (Skrzypek, Wehmeier & Remschmidt, 2001; Thompson et al., 1999; Keel, 2005). In the current study, however, body misperception was not only unrelated to visuospatial and
other cognitive functions, but was unrelated to the attitudinal and behavioral components of BID.

*The Multidimensional Construct of Body Image Disturbance*

Although not primary to the current study, the finding that perceptual BID was not associated with either behavioral or attitudinal BID in the current sample merits brief discussion, given that BID was operationally defined as a multifaceted construct with interrelated behavioral, attitudinal, and perceptual components. This lack of association suggests that the perceptual disturbances of BID may function independently of cognitive, affective and behavioral disturbances in individuals without eating disorders. There are several possible theoretical explanations and study limitations that may help to explain this unexpected finding.

While early researchers have argued that perceptual and attitudinal components of BID may function and be measurable independently, others have cited evidence suggesting that the concept of body size misperception and its measurement may be inseparable from the cognitive and affective aspects of BID (Garner & Garfinkel, 1981; Gardner, 1996; Skrzypek et al, 2001; Thompson et al., 1999; Keel, 2005). Current findings, however, provided evidence that misperception of body size is not an interrelated component of BID as measured in predominantly normal to overweight women with no diagnosis of eating disorder. It is possible that overestimation of body size may be interlinked with cognitive and affective aspects of BID in individuals with anorexia or bulimia, but that no truly systematic relationship exists between body size estimation and body-related cognitive, affective, and behavioral experience in women.
free from eating pathology. This notion is supported by conflicting evidence regarding the accuracy and directionality of body size estimation in healthy samples (Penner, Thompson, & Coover, 1991; Williamson, Cubic, & Gleaves, 1993; Gustavson et al., 1990; Valtolina, 1998). In order to clarify whether the construct of BID is truly dimensional and continuous, future studies should compare the associations between BID components across individuals with eating disorders and healthy individuals with no eating pathology.

It is also possible that the lack of association between perceptual and cognitive-behavioral aspects of BID is due to issues of measurement and construct definition. Body size misperception was measured using a novel technique in the current study. A silhouette scale was used to estimate body size and shape and compared to independent ratings of each participant’s body size and shape using the same scale. Thus, body misperception was quantified by the novel method as the absolute difference between self and others’ ratings of body size and shape, as opposed to the more common methods of providing some indication of actual versus estimated body size. This novel method was intended to operationalize the construct of body misperception more effectively than previously used methods, which carry a wide range of criticism (Gardner, 1996; Smeets et al., 1997; Thompson & Dolce, 1989). However, the use of this measure may limit comparison of results with similar studies using different methods, as the extent to which different operationalizations of perceptual BID involve the same cognitive and psychological correlates is unknown. Additional studies are needed to evaluate psychometric properties of this scale, including construct validity. Similarly, it is possible
that cognitive and affective aspects comprising the construct of attitudinal BID were not fully represented by a single measure of body satisfaction.

Limitations

Although results of the present study add to current knowledge regarding the nature of BID, several aspects of the current methodology may limit generalizability. As mentioned earlier, issues related to operationalizing and measuring each of the BID components highlighted in this study may have influenced resulting associations with psychological and neuropsychological variables.

Although the goal of the present study was to explore these relationships in healthy young individuals, the current sample may have lacked the variability in weight range, cognitive abilities, and body image disturbances necessary to fully appreciate subtle relationships that may exist. Similarly, while restriction of age and gender was also relevant to the research question, it may be prudent to note that findings related to the nature of BID and its neuropsychological correlates may not generalize to BID in other populations. Future studies might investigate whether the nature of BID is similar in women of varying age, obese women, and women with eating disorders.

Finally, interpretation of findings is limited by the cross-sectional nature of the research design. While this study was able to provide important evidence for an association between processing speed and behavioral manifestations of BID, discussion of these results cannot speak to underlying mechanisms for cognitive impairment or the directionality of this relationship. Longitudinal studies may help elucidate whether these
subtle cognitive deficits are associated with any underlying endophenotypic neuropathology and whether they play any role in the development of eating pathology.

**Conclusions**

Results of the current study provide evidence for an association between slower information processing speed and the behavioral manifestations of BID in young women without disordered eating. A lack of association between body size misperception, as measured by the discrepancy between an individual’s estimation of size and shape and independent raters’ estimation of that individual’s size and shape, and the attitudinal and behavioral manifestations of BID was also revealed. As illustrated above, these findings add to current understanding of the nature of BID as a multidimensional and continuously occurring psychological disturbance outside of eating disordered and obese populations. These findings also provide important clinical implications for assessment and treatment of BID in young women without eating pathology.

Young women suffering from behavioral symptoms of BID in the absence of eating disorder may also present with cognitive difficulties related to slowed information processing. While these difficulties are not likely to appear universally or require substantial modification of existing treatments for BID, clinicians should be aware of the potential for mental slowing and adjust clinical strategy and expectations accordingly. Clinicians should also be aware of the potential for mild executive and attentional dysfunction in clients with behavioral and attitudinal symptoms of BID, depending on the severity of likely comorbid conditions, including depression and OCD. While etiology and directionality of the association between behavioral BID and mental slowing is yet
unclear, future studies might examine the effects of BID treatment on information processing speed in individuals without eating pathology seeking treatment for BID. As suggested earlier, it is possible that behavioral and, to a lesser degree, attitudinal manifestations of BID, may be linked to subtle alterations of normal brain structure in frontal regions. As such, longitudinal studies involving brain imaging in addition to BID treatment might be valuable. Finally, the lack of association between the perceptual and the cognitive, behavioral, and affective dimensions of BID in a non-clinical sample leads to the hypothesis that BID assessment and treatment focusing on perceptual aspects of the disturbance might be ineffective for a client desiring alleviation of cognitive, behavioral, and affective symptomatology, although further study is needed to address this issue.
References


Table 1.

*Descriptive Statistics for Body Image, Demographic, Medical, Psychological, and Neuropsychological Variables (n = 100)*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Image Disturbance Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSMP</td>
<td>1.33</td>
<td>1.05</td>
</tr>
<tr>
<td>BCQ</td>
<td>51.09</td>
<td>14.91</td>
</tr>
<tr>
<td>BASS</td>
<td>3.23</td>
<td>.70</td>
</tr>
<tr>
<td><strong>Demographic Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>18.92</td>
<td>1.36</td>
</tr>
<tr>
<td>Education (yrs)</td>
<td>13.01</td>
<td>.85</td>
</tr>
<tr>
<td><strong>Medical and Psychological Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>23.75</td>
<td>5.76</td>
</tr>
<tr>
<td>CES-D</td>
<td>14.92</td>
<td>11.02</td>
</tr>
<tr>
<td>MOCI</td>
<td>9.55</td>
<td>5.52</td>
</tr>
<tr>
<td>AMNART</td>
<td>27.04</td>
<td>6.76</td>
</tr>
<tr>
<td><strong>Neuropsychological Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JLO</td>
<td>11.31</td>
<td>2.13</td>
</tr>
<tr>
<td>CFT-DR</td>
<td>23.06</td>
<td>5.37</td>
</tr>
<tr>
<td>Measure</td>
<td>Mean 1</td>
<td>Mean 2</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>SS-F</td>
<td>9.81</td>
<td>1.98</td>
</tr>
<tr>
<td>LNS</td>
<td>12.13</td>
<td>2.53</td>
</tr>
<tr>
<td>ARCPT-VD</td>
<td>.04</td>
<td>.05</td>
</tr>
<tr>
<td>ARCPT-ISI</td>
<td>62.07</td>
<td>33.15</td>
</tr>
<tr>
<td>FAB</td>
<td>16.51</td>
<td>1.31</td>
</tr>
<tr>
<td>Stroop-CW</td>
<td>48.55</td>
<td>10.12</td>
</tr>
</tbody>
</table>

*Note.* BMI was log transformed, but is presented untransformed to aid interpretation. CES-D and ARCPT-ISI were square root transformed, but are presented untransformed to aid interpretation. BSMP = Body Size Misperception Index; BCQ = Body Checking Questionnaire; BASS = Body Areas Satisfaction Scale; BMI = body mass index; CES-D = Center for Epidemiological Studies Depression Scale; MOCI = Maudsley Obsessional Compulsive Inventory; AMNART = American version of the National Adult Reading Test; JLO = Judgment of Line Orientation; CFT-DR = Complex Figure Test-Delayed Recall; SS-F = Spatial Span-Forward Trial; LNS = Letter-Number Sequencing; ARCPT-VD = Adaptive Rate Continuous Performance Test-Vigilance Decrement; ARCPT-ISI = Adaptive Rate Continuous Performance Test-Information Processing Speed Index; FAB = Frontal Assessment Battery; Stroop-CW = Stroop Test-Color-Word Trial.
Table 2.

*Correlations between Body Image Disturbance Components and Neuropsychological Test Performance (n = 100)*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSMP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCQ</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASS</td>
<td>.00</td>
<td>-.48***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JLO</td>
<td>-.03</td>
<td>-.10</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFT-DR</td>
<td>-.24*</td>
<td>-.05</td>
<td>.06</td>
<td>.22*</td>
<td></td>
</tr>
<tr>
<td>SS-F</td>
<td>.00</td>
<td>-.27**</td>
<td>.15</td>
<td>.13</td>
<td>.20*</td>
</tr>
<tr>
<td>LNS</td>
<td>.05</td>
<td>-.25*</td>
<td>.06</td>
<td>.26**</td>
<td>.04</td>
</tr>
<tr>
<td>ARCPT-VD</td>
<td>.03</td>
<td>.26**</td>
<td>-.24*</td>
<td>-.01</td>
<td>-.18</td>
</tr>
<tr>
<td>ARCPT-ISI</td>
<td>-.02</td>
<td>.34***</td>
<td>-.12</td>
<td>-.20*</td>
<td>-.28**</td>
</tr>
<tr>
<td>FAB</td>
<td>-.01</td>
<td>-.24*</td>
<td>.25*</td>
<td>-.14</td>
<td>-.02</td>
</tr>
<tr>
<td>Stroop-CW</td>
<td>.06</td>
<td>-.26**</td>
<td>.08</td>
<td>.10</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>---</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>1. BSMP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. BCQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. BASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. JLO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. CFT-DR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. SS-F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. LNS</td>
<td>.42***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. ARCPT-VD</td>
<td>-.20*</td>
<td>-.21*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. ARCPT-ISI</td>
<td>-.30**</td>
<td>-.36***</td>
<td>.42***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. FAB</td>
<td>.33**</td>
<td>.01</td>
<td>-.03</td>
<td>-.15</td>
<td></td>
</tr>
<tr>
<td>11. Stroop-CW</td>
<td>.18</td>
<td>.25*</td>
<td>.02</td>
<td>-.19</td>
<td>.11</td>
</tr>
</tbody>
</table>

*Note. ARCPT-ISI was square root transformed. BSMP = Body Size Misperception Index; BCQ = Body Checking Questionnaire; BASS = Body Areas Satisfaction Scale; JLO = Judgment of Line Orientation; CFT-DR = Complex Figure Test-Delayed Recall; SS-F = Spatial Span-Forward Trial; LNS = Letter-Number Sequencing; ARCPT-VD = Adaptive Rate Continuous Performance Test-Vigilance Decrement; ARCPT-ISI = Adaptive Rate Continuous Performance Test-Information Processing Speed Index; FAB = Frontal Assessment Battery; Stroop-CW = Stroop Test-Color-Word Trial.*

*p < .05. **p < .01. ***p < .001.
Table 3.

*Hierarchical Regression Analysis Predicting Body Checking from Demographic, Psychological, and Neuropsychological Variables (n=100)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE)</td>
<td>β</td>
</tr>
<tr>
<td>Age</td>
<td>-3.17 (.89)</td>
<td>-.29**</td>
</tr>
<tr>
<td>BMI</td>
<td>65.33 (12.44)</td>
<td>.41***</td>
</tr>
<tr>
<td>CES-D</td>
<td>5.25 (.85)</td>
<td>.50***</td>
</tr>
<tr>
<td>MOCI</td>
<td>.42 (.22)</td>
<td>.16</td>
</tr>
<tr>
<td>JLO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFT-DR</td>
<td>.22 (.22)</td>
<td>.08</td>
</tr>
<tr>
<td>SS-F</td>
<td>-.68 (.68)</td>
<td>-.09</td>
</tr>
<tr>
<td>LNS</td>
<td>.82 (.55)</td>
<td>.14</td>
</tr>
<tr>
<td>ARCPT-VD</td>
<td>28.68 (24.21)</td>
<td>.10</td>
</tr>
<tr>
<td>ARCPT-ISI</td>
<td>1.73 (.72)</td>
<td>.22*</td>
</tr>
<tr>
<td>FAB</td>
<td>-.23 (.96)</td>
<td>-.02</td>
</tr>
<tr>
<td>Stroop-CW</td>
<td>-.09 (.12)</td>
<td>-.06</td>
</tr>
<tr>
<td>R²</td>
<td>F</td>
<td>R²</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>.45</td>
<td>19.20***</td>
<td>.54</td>
</tr>
</tbody>
</table>

\( \Delta R^2 \) for \( R^2 \)

\| .09 \| 2.08* 

**Note.** BMI was log transformed. CES-D and ARCPT-ISI were square root transformed.

BSMP = Body Size Misperception Index; BCQ = Body Checking Questionnaire; BASS = Body Areas Satisfaction Scale; BMI = body mass index; CES-D = Center for Epidemiological Studies Depression Scale; MOCI = Maudsley Obsessional Compulsive Inventory; AMNART = American version of the National Adult Reading Test; JLO = Judgment of Line Orientation; CFT-DR = Complex Figure Test-Delayed Recall; SS-F = Spatial Span-Forward Trial; LNS = Letter-Number Sequencing; ARCPT-VD = Adaptive Rate Continuous Performance Test-Vigilance Decrement; ARCPT-ISI = Adaptive Rate Continuous Performance Test-Information Processing Speed Index; FAB = Frontal Assessment Battery; Stroop-CW = Stroop Test-Color-Word Trial.

*\( p < .05 \). **\( p < .01 \). ***\( p < .001 \).