# EXAMINATION OF WEIGHT CHANGE AS A SYMPTOM OF DEPRESSION IN CHILDREN AND ADOLESCENTS

By

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Thesis

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

in

Psychology

May, 2007

Nashville, Tennessee

Approved:

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ACKNOWLEDGMENTS

I would like to thank my labmates for their assistance in the development and implementation of this project. Additionally, I would like to thank Dr. Jeffrey Ciesla for his invaluable input and assistance. Finally, I could not have accomplished this without my adviser, Dr. David Cole.

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# CHAPTER I

## INTRODUCTION

Prior to the mid-1970's, psychological researchers questioned the validity of diagnosing major depression in children and adolescents. Since then, the field has largely agreed on the existence of the disorder in these populations, but continues to debate its symptomatology. Currently, the Diagnostic and Statistical Manuel-IV outlines nine core symptoms thought to be related to depression in adults and children, including appetite disturbance, typically measured by significant weight gain or weight loss. Despite considerable research on depressive symptomology in adolescece, results describing the relation between these circumscribed symptoms and depression have been markedly inconsistent, specifically in regard to the symptom of weight change. The primary goal of this paper is to examine the relation between weight change and depression in adolescence.

Depressive symptomology research has largely divided its focus onto two areas. One field of research has looked at the concurrent correlation between symptoms and diagnosis of major depression, while the other examines predictive quality of these symptoms in determining later diagnosis. Examining concurrent symptomology in a population of clinically diagnosed depressed adults, Steer, Ball, Ranieri and Beck (1999) found change in appetite had the second strongest loading onto the somatic-affective factor of the depressive experience. However, in a study of young adults with MDD, Haarasilta and colleagues (2001) rank-ordered DSM symptom prevalence and found

appetite increase as the least prevalent symptom and appetite decrease as the third least prevalent symptom. Using a longitudinal approach, Dryman and Eaton (1991) found diminished sex drive, feelings of guilt or worthlessness, concentration difficulties, and sleep disturbance (for females) or fatigue (for males) were the only symptoms that significantly predicted the development of major depressive disorder (MDD) in adults within one year. Similarly, Eaton and colleagues (1995) found differences in the odds ratios of symptoms in predicting onset of MDD in an adult population. Specifically, weight loss or weight gain was found to be the weakest of the nine symptoms used to predict onset of MDD. Cassidy *et al.*(1997), also looking at adults, examined which DSM criteria correlated with MDD onset and found that weight change had the weakest predictive value of all symptoms.

While these findings cast some doubt on the predictive utility of these core symptoms, particularly weight change, in diagnosing depression in adults, the relation between weight change and depression is even less clear in youth. Some research suggests that depressive symptoms may relate differentially to depression in adolescents versus adults given the typical physical and cognitive development during this period. In particular, weight change is normative in adolescents, especially during puberty.

Looking first at studies that examined the concurrent association between weight change and diagnosis of depression, results of the significance of this relation are decidedly mixed throughout the literature. One of the earliest studies on the symptoms of depression in adolescents found no statistical difference between self-reported weight change in depressed and control adolescents (Inamdar, Siomopoulos, Osborn & Bianchi, 1979). However, using a self-report clinical interview, Sihvola and colleagues (2007)

found that adolescents with major depression were statistically more likely than adolescents with minor depression to experience appetite disturbance. Interestingly, appetite disturbance in those diagnosed with minor depression also differed for boys and girls, with girls significantly more likely to experience appetite-related symptoms (odds ratio, female to males = 2.45). Lewinsohn, Rohde and Seeley (1998), also utilizing self-report interviews, found weight and appetite disturbance occurred significantly more in their depressed than non-depressed subjects. In their meta-analysis, Weiss and Garber (2003) found that the relation of depression to anorexia, appetite problems, hyperexia, and weight loss was highly variable from sample to sample. They also found that the relation of weight gain to depression became more pronounced in older adolescent samples. Collectively, these findings suggest that evidence of a relation between weight change and depression in youth is at best inconsistent.

Fewer studies have examined the prospective relation between weight gain and eventual MDD diagnosis in adolescents. Patton *et al.* (2000) conducted a longitudinal study with an adolescent sample and found self-reported weight change predicted change in severity of depression. They also analyzed symptom frequency across adolescents with mild, moderate and severe depression, finding that appetite disturbance with weight change was a statistically meaningful marker of depression severity, meaning those with more severe depression reported more marked appetite disturbance and weight change.

Several shortcomings present themselves throughout both the concurrent and prospective literature on weight change and depression. Methodologically, most of these studies relied on self-report methods to assess weight and height. In a study of adult dieters and non-dieters, Vartanian, Herman and Polivy (2004) found participants'

estimates of their weight deviated from their true weight by, on average, 9.91 lbs and 8.32 lbs respectively. Furthermore, heavier individuals were found to be worse predictors of their weight than average and underweight participants. A similar pattern was found in adolescents (Abraham, Luscombe, Boyd & Olesen, 2004). Students who were heavier and had higher Body Mass Index (BMI) values were significantly more likely to underestimate their weight. Interestingly, pubertal development also related to the over/under-estimation of weight. The authors found that although students along the entire pubertal developmental trajectory (as measured by the Tanner stages) underestimated their weight, adolescents who had finished puberty were the most accurate, and children in stage 3 (active pubertal development) were the least accurate, underestimating, on average, by 3.5 lbs. In fact, Himes and Faricy (2001) found that the validity of self-reported stature and weight among adolescents was so variable across age groups that they suggested self-reported height and weight were not valid proxies for objective bodily measures in adolescents under 14. Despite this suggestion, most researchers continue to use self-reported measurements in their studies.

Secondly, normative biological development complicates the measurement of depression-related weight gain. For instance, weight gain during puberty accompanying typical growth is not only normative but healthy and adaptive. Simple measures of weight may not distinguish differences between healthy and unhealthy changes. Many researchers address this issue by computing a body-mass index (BMI); however, this method has its shortcomings as well, particularly during adolescence. Weight gain due to the development of muscle is typically seen as normative, particularly in males. BMI does not, however, distinguish between muscle and fat development, the later theorized

to be associated with depression more than the former. The current study addresses this issue by measuring changes in weight, height and body fat to more thoroughly examine how changes in each of these variables relates to depressive symptoms.

Confounding the relation between weight change and depression is the possibility that a third variable explains the correlation between the weight change symptom and depression. A large literature exists on the complicated relation between weight change, depressive affect, and body image. Several studies suggest that body dissatisfaction is highly prevalent in adolescents, especially females (Krahnstoever-Davison, Markey & Birch., 2003; Sinton & Birch, 2006;Vander-Wal and Thelen, 2000). Body dissatisfaction has been shown to play an important role in weight change, as both cause and effect. Swarr and Richards (1996) found that girls reported more body dissatisfaction at the onset of puberty and accompanying weight gain.

Whether the relation between depression, weight change, and negative body image is concurrent or prospective, and, if prospective, which variable comes first, is not clear within the literature. Body dissatisfaction and body image importance have been found to be consistent, significant predictors of extreme weight change over an eight-month period of time (McCabe & Ricciardelli, 2006). Body dissatisfaction has also been found to be associated concurrently with negative affect and depressive disorder in several studies (Stice and Bearman, 2001; Stice and Shaw, 2003). A study by Paxton, Eisenberg and Neumark-Sztainer (2006) found Time 1 depression correlated with Time 2 body dissatisfaction across adolescence, and was a unique significant predictor of Time 2 body dissatisfaction for middle adolescent boys. The same study, however, also found Time 1 body dissatisfaction prospectively predicted Time 2 depression for mid-

adolescent boys and early adolescent girls (Paxton, Neumark-Sztainer, Hannan & Eisenberg, 2006). The authors suggest that the relation between body dissatisfaction and depression may vary across gender and developmental level.

The current study is designed to examine the relation of depression to a variety of weight-related variables and body dissatisfaction in children and adolescents. By assessing changes in depressive symptoms, height, weight, and body fat over a four-month interval, we were able to examine both cross-sectional and longitudinal relations.

Most empirical work in this area use clinical populations rather than community samples, meaning these studies typically only examine children with pre-existing MDD. Due to the association between subthreshold depression and later-onset MDD, mild to moderate forms of this disorder are worthy of examination and frequently missing from studies that utilize clinical populations exclusively (see Georgiades, Lewinsohn, Monroe & Seeley, 2006). Furthermore, studying only those adolescents with a pre-existing disorder do not allow researchers to distinguish the cause and effect nature of weight change to depression. We chose to use a community-based sample to clarify these issues.

Within this population we focused on assessing three important research questions. The first seeks to relate actual weight change, as measured by independent observers, to changes in depressive affect. The second examines the relation between self-reported weight change and change in depression levels. Finally, the third looks at whether body dissatisfaction is a relevant variable in predicting future dysphoria.

# CHAPTER II

# METHOD

## *Participants*

Participants included 215 adolescents, recruited from a middle and high school in a small suburban Southern town. Explanatory letters were sent to the parents of all 6th, 7th, 9th, 10th and 12th graders currently taking a language arts or physical education class. Research assistants also went to each classroom to explain the study and answer students' questions. Signed consent and assent was obtained for 215 students. 112 students were from the middle school and had an average age of 12. The remaining 103 students attended the high school and had an average age of 16. Cumulatively, the sample was 93% Caucasian and 50.1% female. All children participated in two waves of this study and received a $10 gift certificate to a local movie theater. Wave 1 data collection took place at the beginning of the school year. Researchers returned four months later to collect Wave 2 data.

## *Measures*

*Self-Reported Weight and Height.* At both waves, the participants completed a Current Weight Questionnaire (CWQ) which asked for demographic information and the student's best estimate of his or her own weight and height. If students claimed not to know their weight or height they were encouraged to give their best guess. From this,

researchers calculated a Body Mass Index (BMI) based on their self-reported stature. The BMI is calculated by dividing a student's weight (in kilograms) by their height (in meters) squared.

*Depression Meaures.* The participants completed the Childhood Depression Inventory (CDI, Kovacs, 1981), a 27-item self-report questionnaire assessing severity of depressive symptoms, at both waves. Each item reflects a different symptom or correlate of depression, such as "I am sad once in a while," and respondents circle one of three statements reflecting varying degrees of symptom severity. Responses range from 0 (no experience of the symptom) to 2 (frequent experience of the symptom) and are rated for frequency within the last two weeks. The CDI shows strong psychometric properties in both clinic and non-clinic populations, including a high degree of internal consistency, test-retest reliability and construct validity (Cole, Hoffman, Tram, & Maxwell, 2000). Cronbach's alpha for this sample for Wave 1 was .89 and Wave 2 was .88. Additionally, students filled out the Center for Epidemiological Studies-Depression Scale (CES-D, Radloff, 1977) at both time points. The CES-D is a 20-item self-report questionnaire designed to assess depressive symptomology in the last week. Respondents rate items corresponding to depressive affect on a 0 to 3 Likert-type scale where 0 corresponds to rarely or none of the time and 3 means most or all of the time. High levels of convergent and concurrent validity have been shown and prior research has also yielded good internal consistency (alpha > .85, Radloff, 1977). Within our own sample, alphas for Wave 1 and Wave 2 were .89.

*Self-Reported Body Shape*. Students were asked at both waves of data collection to estimate their own body shape from an array of figure drawings designed for a child

and adolescent populations As per Byrne and Hills' (1996) recommendations, figure drawings appropriate for pre-pubescent children were used with students in from the middle school group, while post-pubescent figures were used for those participants from the high school group. A total of seven male or female figures from very skinny to overweight, adapted from Stunkard, Sorensen and Schulsinger (1983), Tiggeman (2005, personal communication), and Collins (1991) were presented to each respondent depending on his or her sex, and a line was drawn underneath marked from 0 to 18. Students were told to make an "x" on the line to indicate which silhouette best represented their body shape. They were informed the "x" did not have to be put on a specific number but could be drawn anywhere along the scale they saw fit. In similar fashion, participants rated their desired body shape using a second set of silhouettes. At Wave 2 only, a third array of silhouettes was also presented, asking students to estimate what their body shape was at the first data collection, four months prior. Figure drawings such as these are used frequently in body-image research and have been found to have good psychometric properties using seven silhouettes in adults (Ambrosi-Randic, Pokrajac-Bulian & Taksic, 2005), adolescents and children (Collins, 1991).

*Objective Physical Measures*. At both time points, we measured height using a Seca portable stadio-meter. Participants stood barefoot with their back to the measuring rod while research assistants recorded their height. Height measurement was taken on two separate identical stadio-meters by two trained individual researchers. Correlations between Time 1 and Time 2 for these measures were $r = .996$. We measured weight on a Tanita Model BF-522, which provided a read-out of both weight in pounds and body-fat using a bioelectrical impedance (BEI) analysis technique. A safe, low-level electrical

current is run through the body, which flows through fat and muscle at different speeds. This allows the device to calculate a ratio of fat to muscle and other body tissue. Although hydration level has some effect on this measurement, the psychometric properties of BEI are found to be adequate (Pateyjohns, Brinkworth, Buckley, Noakes & Clifton, 2006). We measured weight and body fat on two identical Tanita machines by different research assistants. Weight measurements between the machines correlated $r$ = .995, and body fat measurements correlated $r$ = .939. Because of measurement error with the BIA method due to hydration fluctuations, we decided also to measure body fat using the Futrex 6100, which uses a near infrared (NIR) method that does not dependent on water-level. NIR and an average of the BIA measurements of body fat correlate $r$ = .897.

*Depressive Cognitions.* At wave 2, participants completed the Automatic Thoughts Questionnaire (ATQ, Hollon & Kendall, 1980), a 30-item self-report questionnaire that assesses how frequently participants experience negative thoughts, such as "I feel so helpless" and "I wish I could just disappear." Respondents endorse items on a 1 – 5 Likert-type scale with 1 meaning 'not at all' and 5 corresponding to 'all the time.' The ATQ has shown strong internal consistency and convergent validity in both children (Kazdin, 1990) and adults (Dobson & Breiter, 1983). Within our own sample, Cronbach alpha = .97.

*Body Image.* At wave 2, we administered the Multidimensional Body-Self Relations Questionnaire (MBSQR; Cash, 1994, 2000), a self-report assessment of personal body image. The questionnaire was normed on a large, national body-image survey (Cash, Winstead & Janda, 1986) and produces strong reliability coefficients ranging from Cronbach's alpha's of .70 to .91 for males and .73 to .90 for females (Cash,

1994). The current study used one of the ten possible subscales. Appearance Evaluation, taps into the respondent's self-percieved evaluation of her looks (e.g. "I like the way I look without my clothes on."). The subscale had adequate reliability (Cronbach alpha was .82).

The Physical Appearance and Global Self-Worth subscales of the Self-Perception Profile for Adolescents (SPPA; Harter, 1988) were used to tap into the student's self-esteem regarding both her physical appearance and global self. The questionnaire asks students to choose which of two short statements about adolescents is truer for them. The respondents then decide if this statement is "really true" or "sort of true" for them. The Physical Appearance subscale of the SPPA assesses adolescent's perceived self-competence in the area of physical attractiveness (e.g. "Some teenagers are not happy with the way they look" versus "Other teenagers are happy with the way they look."). The Global Self-Worth subscale measures general feelings of self-esteem (e.g. "Some teenagers are very happy being the way they are" versus "Other teenagers wish they were different."). Cronbach alpha's for both subscales were .73.

*Procedure.*

Both waves of data collection was completed in either a large auditorium (at the high school) or in smaller classrooms of about 20 students (at the middle school). At Wave 1, participants were given a brief description of the study and researchers collected assent forms. Participants were again reminded of their assent agreement at Wave 2, re-read the limits on confidentiality and asked again if they would like to participate again. During both waves, students filled out a series of questionnaires as research assistants

circulated throughout the room to answer any questions. After participants completed their packet of questionnaires, they removed their socks and shoes and lined up to have their height, weight and body fat read by specially trained researchers. Results of their measurements were not revealed to the student.

# CHAPTER III

# RESULTS

Means and standard deviations, divided by school and sex of participant are summarized in Table 1. All values are within the expected range. From these variables, several variables were created to reflect change between Time 1 and Time 2 data collections. All change variables were created by subtracting the measured value at Time 1 from Time 2. A body mass index (BMI) was created by dividing the participant's weight (in kilograms) by his height in meters, squared. A composite of the CDI and CES-D scores were calculated by standardizing and averaging their total scores at both Wave 1 and Wave 2 of data collection to create a depression composite score at each time point. Similarly, a composite of the bio-electric impedance (BEI) body fat measurement (averaged between the two observations) and the near-infrared (NIR) body fat measurement was created to form an overall body fat composite score at each wave of data collection. An overview of correlations between key variables and the Time 2 depression composite is presented in Table 2. Again, values are within expected limits and consistent with our initial hypotheses.

## *Confirmatory Factor Analysis of Latent Variables*

I. Correlation of latent body fat change variable to latent depression variable

In order to examine the relation between weight change and depression, controlling for prior depression, we used structural equation modeling (SEM). With this latent variable approach, our estimates of key relations were not attenuated due to the fallibility of our measures. In this model (depicted in Figure 1), we allowed 3 measures to load onto a latent weight change variable: change in BMI score, change in body fat as measured by bio-electric impedance (BEI), and change in body fat as measured by near infra-red (NIR) technology. The CDI and CES-D from Wave 1 loaded onto our Time 1 Depression factor. The CDI, CES-D, and ATQ from Wave 2 loaded onto our Time 2 Depression factor. We allowed error terms for the CDI and CES-D at Time 1 to correlate with the corresponding error terms at Wave 2.

To ensure that the Depressive Symptoms latent variable at Time 1 was invariant with the Time 2 Depressive Symptoms latent variable, we also constrained the loadings of the CES-D and CDI onto their respective Time 1 and Time 2 depression variables to be equal. To enhance the reliability of all parameter estimates, we placed a series of cross-group constraints on a number of model parameters that were not significantly different across groups (middle school boys, middle school girls, high school boys and high school girls). Initially, we selected a reference group (middle school boys) and constrained the variance of the latent variables Weight Change and Time 1 Depression for this group to be one. To identify the models in the other groups we constrained the loadings of one measure from each latent variable across the remaining groups. This created variances for the other groups expressed in units of the reference group (middle school boys). Next, we constrained factor loadings of all manifest variables onto their latent constructs across groups, with the exception of the BEI measure. Further, we

created cross group constraints for the manifest variable error variances, manifest variable residual covariances, and latent variable residual variances. Finally, group differences in the structural model paths were tested using a model comparison approach. The final model fit well ($\chi^2$=121.676, df = 99, p-value = .061, RFI = .817, CFI = .972, RMSEA = .032), and no one set of constraints significantly perturbed the fit of the model from the previous set.

Model parameter estimates appear in Table 3. Factor loadings were all relatively large and highly significant, with the exception of the BEI. The final model suggested the paths between Time 1 Depression and Time 2 Depression was significant across groups. No group, however, showed a significant relation between Weight Change and Time 2 Depression, controlling for Time 1 Depression. Furthermore, no latent variable paths were significantly different across groups.

To test for the effects of individual measures of body fat change to predict our Time 2 Depression Composite measure while controlling for age and sex, three multiple regression models were created, each using one of the body fat variables used to create our latent body fat change variable (see above). None of these variables significantly predicted Time 2 Depression above and beyond sex and age. Next, interaction terms were created between sex and each of these variables, and three new, hierarchical linear models were created. The first step of each of the models included the individual measure, age and sex; the second step of the model added the sex by body fat measure term. To control for family-wise error terms, a .01 significance level was used. No sex by body fat measure interaction terms was significant. Finally, we examined the moderating effects of age by creating age by body fat measure terms. We again created

three hierarchical linear regression models including age, sex and each individual body fat variable in the first step, and adding the age by body fat measure term in the second step. Using the .01 significance level, no interaction terms were found to be significant.

II. Correlation of latent self-reported weight change variable to latent depression variable.

To examine the correlation between self-reported weight change and depression, controlling for prior depression, we again used structural equation modeling to create three latent variables: self-reported weight change, depression at Wave 1 and depression at Wave 2 (depicted in Figure 2). We allowed three measures to load onto the latent self-reported weight change variable: change in self-reported weight, change in BMI calculated from self-reported height and weight estimates, and change in self-perceived shape as measured by silhouette. We used the CDI and CES-D from the Wave 1 data collection to create our latent Wave 1 depression factor. The CDI, CES-D and ATQ collected at Wave 2 loaded significant onto our latent Wave 2 depression factor. We again allowed the CDI and CES-D at Time 1 to correlate with the corresponding error terms at Wave 2. We achieved identification of our models using the same method described above.

Again, we created a series of constraints of our model parameters. Constraints were placed on all factor loadings of manifest variables across groups, manifest variable error variances, manifest variable residual covariances, and latent variable residual variances. The model fit well with these cross-group constraints ($\chi^2$=133.374, df = 97, p-value = .008, RFI = .807, CFI = .959, RMSEA = .041), and no one set of constraints significantly perturbed the fit of the model from the previous set. Again, group

differences in the latent factor loading paths were tested using a model comparison approach. Parameter estimates for this model appear in Table 4. Manifest variable factor loadings were all large and highly significant, with the exception of the self-reported change in silhouette shape. Again, Depression at Time 1 significantly correlated with Depression at Time 2. The latent self-reported weight change variable, however, did not significantly load on Time 2 Depression for any group. Also, no group differences were found between loadings of the latent self-reported weight change variable and either it's loading onto depression at Time 2, or it's correlation with Time 1 depression. However, the loading of Time 1 depression onto Time 2 depression was found to be significantly lower for middle school boys.

To test for individual measure effects on our Time 2 Depression Composite we again ran a series of multiple regression models using age, sex and one self-reported weight change variable per model. Using the .01 significance level no self-reported weight change significantly predicted Time 2 depression over and above sex and age. Once again individual sex by self-reported weight change and age by self-reported weight change interaction terms were created and six hierarchical regression models were created, analogous to those described in the previous section. Again, no interaction terms were significant in predicting Time 2 depression levels.

III. Correlation of latent body dissatisfaction weight change variable to latent depression variable.

We examined the correlation between body dissatisfaction and depression, controlling for prior depression, using SEM to create three latent variables: body dissatisfaction, depression at Wave 1 and depression at Wave 2 (depicted in Figure 3).

We allowed three measures to load onto the latent body dissatisfaction variable: body dissatisfaction as measured by silhouette, the body satisfaction scale of the SPPA, and the appearance evaluation scale of the MBSQR. We used the CDI and CES-D from the Wave 1 data collection to create our latent Wave 1 depression factor. The CDI, CES-D and ATQ collected at Wave 2 loaded significant onto our latent Wave 2 depression factor. We again allowed the CDI and CES-D at Time 1 to correlate with the corresponding error terms at Wave 2. We achieved identification of our models using the same method described above.

As befor, we placed a series of constraints on our model parameters. Constraints were placed on all factor loadings of manifest variables across groups, manifest variable error variances, manifest variable residual covariances, and latent variable residual variances. A model comparison approach was utilized to test for across group differences. The model fit well with these cross-group constraints ($\chi^2$=150.329, df = 111, p-value = .008, RFI = .804, CFI = .959, RMSEA = .043), and no one set of constraints significantly perturbed the fit of the model from the previous set. . Parameter estimates for this model appear in Table 5. Factor loadings were all large and highly significant, with the exception of the self-reported change in silhouette shape. Again, Depression at Time 1 significantly correlated with Depression at Time 2. The latent body dissatisfaction variable also significantly loaded onto Time 2 Depression for all groups. No significant group differences were found between the latent factor loadings of body dissatisfaction onto Time 2 Depression, or Time 1 Depression and Time 2 Depression. Group differences between the correlation of body dissatisfaction and Time 1 depression were found between middle school boys and girls, as well as high school boys and girls.

Interestingly, no differences were found between middle school boys and high school girls, as well as between middle school girls and high school boys.

The relation of individual body-dissatisfaction measures, controlling for age and sex, to the Time 2 depression composite was tested by creating individual linear models, similar to those described above. Time 2 depression was significantly predicted by the SPPA Physical Attractiveness Scale ($B = -.06$, $SE = .02$, $\beta = -.21$, $p<.001$), and the Appearance Evaluation Subscale of the MBSQR ($B = -.04$, $SE = .01$, $\beta = -.24$, $p<.001$), above and beyond sex and age. Sex by body dissatisfaction variables and age by body dissatisfaction variables were created to test for moderational effects. No interaction terms were significant at the .01 significance level.

# CHAPTER IV

# DISCUSSION

We examined three important research questions regarding the symptomology of depression in adolescents in this study. First, we tested literal weight change as a symptom of depression. Findings from this study revealed no significant support for including change in weight as a purported depressive symptom. Second, we examined the possible relation between self-reported weight change and depressive symptoms. Again, no data were found to support this link in our adolescent population. Finally, we examined how body dissatisfaction predicts depressive symptoms over time. Our findings indicate a strong relation between negative body image and depression in our sample, suggesting that body dissatisfaction may be the superior predictor of depressive symptoms in an adolescent population.

Our first finding examined weight change as a symptom of depression, as suggested by the DSM. Our correlational analyses revealed no relation between our measures of depression and change in BMI or change in body-fat as measured by BEI and NIR techniques. Confirmatory factor analyses revealed no significant correlation between weight change and depression, when prior depression was statistically controlled, across both sexes and age ranges included in our sample. These null results pose a possible problem for standard diagnosis of depression in adolescents. Several clinical interviews, including the widely used Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS; Orvaschel, Puig-Antich, Chambers,

Tabrizi, & Johnson, 1982)) and Revised Diagnostic Interview Schedule for Children (DISC-R; Schwab-Stone, Fallon, Briggs & Crowther, 1993), as well as the majority of self-report questionnaires, including the CDI and CES-D, credit weight change as a symptom of depression in children and adolescents. These results suggest that the link between these two variables is not as clear-cut as would be expected from the criteria for Major Depressive Disorder as outlined by the DSM.

Most prior studies, and indeed most clinical diagnoses of depression, do not use physical measures of weight change. In fact, presence or absence of this weight change symptom is often rated entirely on the subject's self-report. But a review of the literature also suggests adolescents are not valid reporters of their own weight (Abraham, Luscombe, Boyd & Olesen, 2004). In our own study we found students' self-reported weight was discrepant from their real weight, on average, by over six pounds (6.3 lbs at Wave 1 and 6.6 lbs at Wave 2). When one considers the average weight of students at both Waves of data collection was only 135 lbs, this discrepancy constitutes approximately 5% of their total weight. Guidelines for K-SADS ratings suggest that any change over 5% of their total weight should be rated as a threshold level symptom, confounding any use of actual and self-reported weight in discerning weight gain or weight loss within one study. To further test the efficacy of utilizing self-reported weight change in predicting change in depression scores, another CFA model was created. This analysis also revealed no significant correlation between self-reported weight change and depression at Time 2, when controlling for prior depression levels. Repeated regression analyses found no instance of self-reported weight change significantly predicting depression at Wave 2 after controlling for Wave 1 depression.

Our third finding suggests that negative body image is associated with depression symptoms above and beyond prior depression levels for both boys and girls, across middle and high school age groups. This finding is not surprising in light of the consistent support that has been found for a significant correlation between body dissatisfaction and depression (Allgood-Merten, Lewinsohn & Hops, 1990; Cash, 2002; Wichstrom, 1999). Negative body image has also been shown to predict depression prospectively in both boys and girls (Paxton, Neumark-Sztainer, Hannan & Eisenberg, 2006). These findings underscore that negative cognitions about one's body feed into the development of depression in adolescents. In fact, this study suggests that findings supporting weight change in diagnosing depression may not be tapping into actual weight change, but rather negative cognitions regarding body image and evaluation.

While our study was limited to middle and high school students, future research should extend this study into earlier and later development. More findings regarding weight change and depression exist in the adult literature, and both clarifying these findings, to account for negative cognitions regarding body satisfaction, as well as linking them developmentally to the current study's findings will create a better understanding of how perceived and actual weight change is related to depressive affect throughout development. Furthermore, more points of data collection would have allowed us to better examine the temporal nature of weight change, body dissatisfaction, and depressive affect as well as look at longer-term weight change. Research into the nature and timing of cognitions regarding one's own weight will help elucidate the complex relationship between perceived bodily change, body image and negative affect. Understanding further the etiology of these beliefs may have implications for interventions and

preventions for both depression and eating pathology. This study was also limited by its reliance on self-reported depression and depressive symptomology. Including parent and teacher report of depressive symptoms would help eliminate some self-report bias. Finally, our study was limited to a non-referred, community sample. Extension into the clinical population will be important to understand how negative body image, distorted belief in weight change and affect interact in clinically depressed individuals.

Overall, these findings suggest a need to revisit DSM criteria for diagnosis of depression. Refinement of our understanding of the symptoms that constitute Major Depressive Disorder will not only bolster our understanding of such pathology, but also inform our attempts at intervention and prevention.

**Table 1.** Means and Standard Deviations for Manifest Variables.

| | Boys | | Girls | |
|---|---|---|---|---|
| Variable | Time 1 | Time 2 | Time 1 | Time 2 |
| | | High School | | |
| Self-Reported Height (inches) | 69.18 (3.22) | 69.38 (2.92) | 64.60 (2.47) | 64.57 (2.49) |
| Self-Reported Weight (pounds) | 169.04 (49.08) | 165.81 (43.95) | 136.65 (25.15) | 139.25 (28.16) |
| Observed Height (inches) | 68.14 (2.78) | 68.02 (2.79) | 63.91 (2.24) | 64.06 (2.25) |
| Observed Weight (inches) | 168.48 (46.06) | 164.12 (37.96) | 141.49 (30.49) | 143.33 (30.96) |
| Observed Body Fat (BEI) | 19.46 (10.88) | 18.58 (11.22) | 28.92 (7.85) | 28.70 (8.19) |
| Observed Body Fat (NIR) | 21.67 (9.20) | 21.79 (10.06) | 32.54 (6.89) | 32.16 (7.04) |
| CDI | 7.34 (5.24) | 6.23 (4.58) | 8.93 (6.99) | 8.51 (7.29) |
| CES-D | 31.23 (7.13) | 30.93 (6.24) | 35.57 (10.15) | 34.95 (9.98) |
| ATQ | | 45.54 (17.99) | | 47.73 (19.65) |
| MBSRQ – App. Evaluation | | 26.74 (4.62) | | 24.17 (5.25) |
| SPPA – Physical Attractiveness | | 14.06 (3.10) | | 12.08 (3.84) |
| | | Middle School | | |
| Self-Reported Height (inches) | 61.75 (4.59) | 62.11 (5.59) | 60.96 (4.43) | 62.05 (4.71) |
| Self-Reported Weight (pounds) | 112.85 (32.14) | 110.70 (27.25) | 105.45 (30.21) | 109.46 (33.27) |
| Observed Height (inches) | 60.81 (3.21) | 61.56 (3.45) | 60.39 (3.07) | 60.77 (3.30) |
| Observed Weight (inches) | 116.29 (32.43) | 118.81 (33.64) | 116.70 (32.69) | 120.31 (32.99) |
| Observed Body Fat (BEI) | 22.06 (10.11) | 19.76 (9.41) | 27.47 (9.16) | 27.85 (9.32) |
| Observed Body Fat (NIR) | 26.95 (6.18) | 26.58 (6.54) | 27.57 (6.80) | 28.18 (6.73) |
| CDI | 9.01 (7.58) | 6.73 (6.75) | 8.69 (8.60) | 6.95 (8.05) |
| CES-D | 34.21 (10.84) | 32.35 (10.04) | 34.40 (10.35) | 34.21 (10.15) |
| ATQ | | 48.15 (19.42) | | 56.21 (21.35) |
| MBSRQ – App. Evaluation | | 25.20 (5.14) | | 21.5 (4.87) |
| SPPA – Physical Attractiveness | | 13.75 (2.88) | | 12.41 (2.96) |

*Note.* BEI = Bioelectric Impedance; NIR = Near Infrared; CDI = Children's Depression Inventory; CES-D = Center for Epidemiologic Studies – Depression; ATQ = Automatic Thoughts Questionnaire; MBSRQ = Multidimensional Body-Self Relations Questionnaire; SPPA = Self-Perception Profile for Adolescents.

**Table 2.** Correlations with Time 2 Depression Composite.

| Manifest Variable | Time 1 | Time 2 | Time 2 – Time 1 |
|---|---|---|---|
| *Physical Measures* | | | |
| Observed Height | .031 | .047 | .010 |
| Observed Weight | .090 | .110 | .006 |
| Observed Body Fat (BEI) | .122 | .173* | .120 |
| Observed Body Fat (NIR) | .161* | .189** | .089 |
| Observed BMI | .100 | .107 | -.026 |
| *Perception Measures* | | | |
| SR Weight | .086 | .096 | .006 |
| SR Height | .094 | .105 | .008 |
| SR BMI | .054 | -.059 | .018 |
| Actual Height – SR Height | .133 | .131 | -.010 |
| Actual Weight – SR Weight | -.064 | -.047 | -.026 |
| SR Silhouette Change | | -.059 | |
| *Psychological Measures* | | | |
| Silhouette Shape Dissatisfaction | -.189** | -.247*** | .032 |
| SPPA Body Satisfaction Scale | | -.429*** | |
| MBSQR Appearance Eval. Scale | | -.414*** | |
| ATQ | | .730*** | |

*Note.* BEI = Bioelectric Impedance Analysis Technique; NIR = Near Infrared Analysis Technique; SR = Self Report; BMI = Body Mass Index; ATQ = Automatic Thoughts Questionnaire

**Table 3.** Relation among Latent Variables: Actual Weight Change, Depression at Time 1 and Depression at Time 2.

| | Middle School | | High School | |
|---|---|---|---|---|
| | Boys | Girls | Boys | Girls |
| | | Structural Model Parameters | | |
| Dep 1 ↔ CBF | -.193 | -.093 | .103 | .101 |
| CBF → Dep 2 | -.145 | .028 | .059 | .136 |
| Dep 1 → Dep 2 | .665*** | .886*** | .859*** | .712*** |
| | | Measurement Model Parameters[a] | | |
| Dep 1 → CDI 1 | .916*** | .924*** | .805*** | .900*** |
| Dep 1 → CES-D 1 | .868*** | .880*** | .721*** | .859*** |
| Dep 2 → CD1 2 | .891*** | .912*** | .788*** | .910*** |
| Dep 2 → CES-D 2 | .832*** | .862*** | .701*** | .859*** |
| Dep 2 → ATQ 2 | .786*** | .821*** | .639*** | .818*** |
| CBF → Δ BMI | .991*** | .993*** | .997*** | .987*** |
| CBF → Δ NIR | .675*** | .656*** | .729*** | .421*** |
| CBF → Δ BEI | .440*** | .027 | .014*** | .736*** |
| e1 ↔ e4 | .038 | .038 | .038 | .038 |
| e2 ↔ e3 | .575*** | .575*** | .575*** | .575*** |

*** $p < .001$, [a] Un-standardized estimates were constrained to be equivalent across groups (except the BEI). These are standardized estimates.

*Note.* Dep 1 = Depression Latent Variable at Time 1; Dep 2 = Depression Latent Variable at Time 2; CBF = Change in Body Fat; CDI = Children's Depression Inventory; CES-D = Center for Epidemiological Studies – Depression; ATQ = Automatic Thoughts Questionnaire; Δ BMI = Change in BMI; Δ NIR = Change in Near-Infrared Measured Body Fat; Δ BEI = Change in Bio-Electric Impedance Measured Body Fat; e1 = Error associated with CES-D 1; e4 = Error associated with CES-D 2; e2 = Error associated with CDI 1; e3 = Error associated with CDI 2.

**Table 4.** Relation among Latent Variables: Self-Reported Weight Change, Depression at Time 1 and Depression at Time 2.

| Parameter estimate | Middle School | | High School | |
|---|---|---|---|---|
| | Boys | Girls | Boys | Girls |
| | Structural Model Parameters | | | |
| Dep 1 ↔ SRWC | -.117 | -.018 | .296 | .145 |
| SRWC → Dep 2 | -.045 | .226 | -.116 | .042 |
| Dep 1 → Dep 2 | .680***a | .892*** | .956*** | .744*** |
| | Measurement Model Parameters[a] | | | |
| Dep 1 → CDI 1 | .882*** | .889*** | .721*** | .863*** |
| Dep 1 → CES-D 1 | .899*** | .906*** | .753*** | .882*** |
| Dep 2 → CD1 2 | .904*** | .930*** | .782*** | .925*** |
| Dep 2 → CES-D 2 | .840*** | .837*** | .685*** | .855*** |
| Dep 2 → ATQ 2 | .772*** | .810*** | .765*** | .812*** |
| SRWC → SR Δ Weight | .978*** | .895*** | .890*** | .822*** |
| SRWC → SR Δ BMI | .835*** | .078*** | .973*** | .978*** |
| SRWC → SR Δ Silhouette Shape | .180 | .078 | .076 | .056 |
| e1 ↔ e4 | -.014 | -.014 | -.014 | -.014 |
| e2 ↔ e3 | .567*** | .567*** | .567*** | .567*** |

*** $p < .001$, [a] Un-standardized estimates were constrained to be equivalent across groups (except the BEI). These are standardized estimates.

*Note.* Dep 1 = Depression Latent Variable at Time 1; Dep 2 = Depression Latent Variable at Time 2; SRWC = Self-Reported Weight Change Latent Variable; CDI = Children's Depression Inventory; CES-D = Center for Epidemiological Studies – Depression; ATQ = Automatic Thoughts Questionnaire; SR Δ Weight = Self-Reported Change in Weight; SR Δ BMI = Self-Reported Change in Body Mass Index; SR Δ Silhouette Shape = Self-Reported Change in Selected Self-Silhouette Shape ; e1 = Error associated with CES-D 1; e4 = Error associated with CES-D 2; e2 = Error associated with CDI 1; e3 = Error associated with CDI 2.

**Table 5.** Relation among Latent Variables: Body Dissatisfaction, Depression at Time 1 and Depression at Time 2.

| Parameter estimate | Middle School | | High School | |
|---|---|---|---|---|
| | Boys | Girls | Boys | Girls |
| | | Structural Model Parameters[a] | | |
| Dep 1 ↔ BD | -.326*b | -.703***c | -.781***c | -.201b |
| BD → Dep 2 | .333*** | .314*** | .397*** | .298*** |
| Dep 1 → Dep 2 | .552*** | .632*** | .550*** | .687*** |
| | | Measurement Model Parameters[d] | | |
| Dep 1 → CDI 1 | .923 | .923 | .923 | .923 |
| Dep 1 → CES-D 1 | .828 | .828 | .828 | .828 |
| Dep 2 → CD1 2 | .910 | .919 | .879 | .926 |
| Dep 2 → CES-D 2 | .804 | .820 | .750 | .833 |
| Dep 2 → ATQ 2 | .779 | .797 | .721 | .811 |
| BD → Silhouette Dissatisfaction | .525 | .525 | .525 | .525 |
| BD → MBSQR Appearance Eval. | .829 | .829 | .829 | .829 |
| BD → SPPA Body Satisfaction | .646 | .646 | .646 | .646 |
| e1 ↔ e4 | .603** | .603** | .603** | .603** |
| e2 ↔ e3 | .097 | .097 | .097 | .097 |

* p < .05, ** p < .01, *** p < .001, [a] Parameters followed by a letter in a given row are significantly different from those parameters followed by a different letter, [d] Un-standardized estimates were constrained to be equivalent across groups (except the BEI). These are standardized estimates.

*Note.* Dep 1 = Depression Latent Variable at Time 1; Dep 2 = Depression Latent Variable at Time 2; SRWC = Self-Reported Weight Change Latent Variable; CDI = Children's Depression Inventory; CES-D = Center for Epidemiological Studies – Depression; ATQ = Automatic Thoughts Questionnaire; e1 = Error associated with CES-D 1; e4 = Error associated with CES-D 2; e2 = Error associated with CDI 1; e3 = Error associated with CDI 2.

Fig. 1

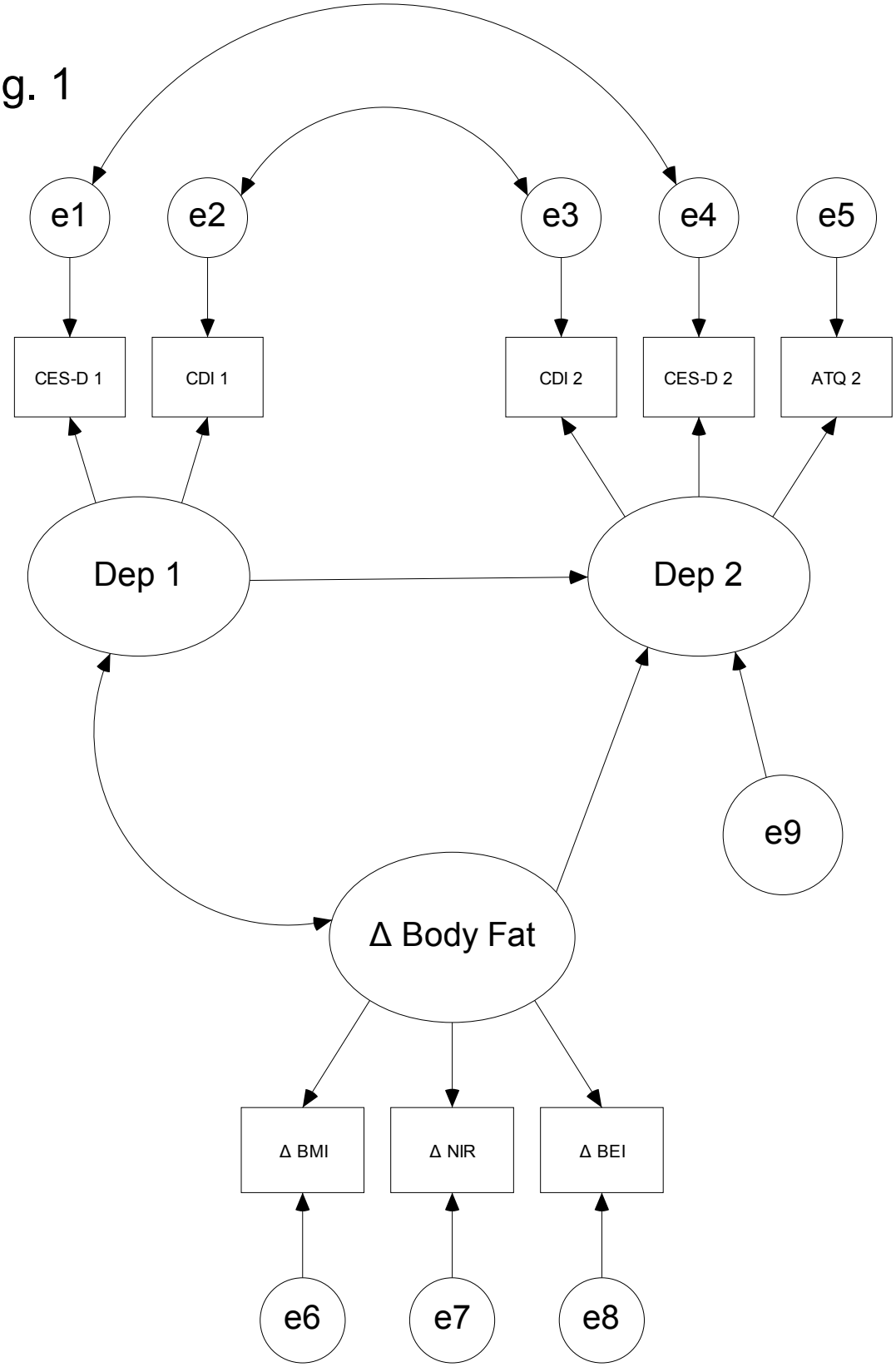

e1
e2
e3
e4
e5
CES-D 1
CDI 1
CDI 2
CES-D 2
ATQ 2
Dep 1
Dep 2
e9
Δ Body Fat
Δ BMI
Δ NIR
Δ BEI
e6
e7
e8

Fig. 2

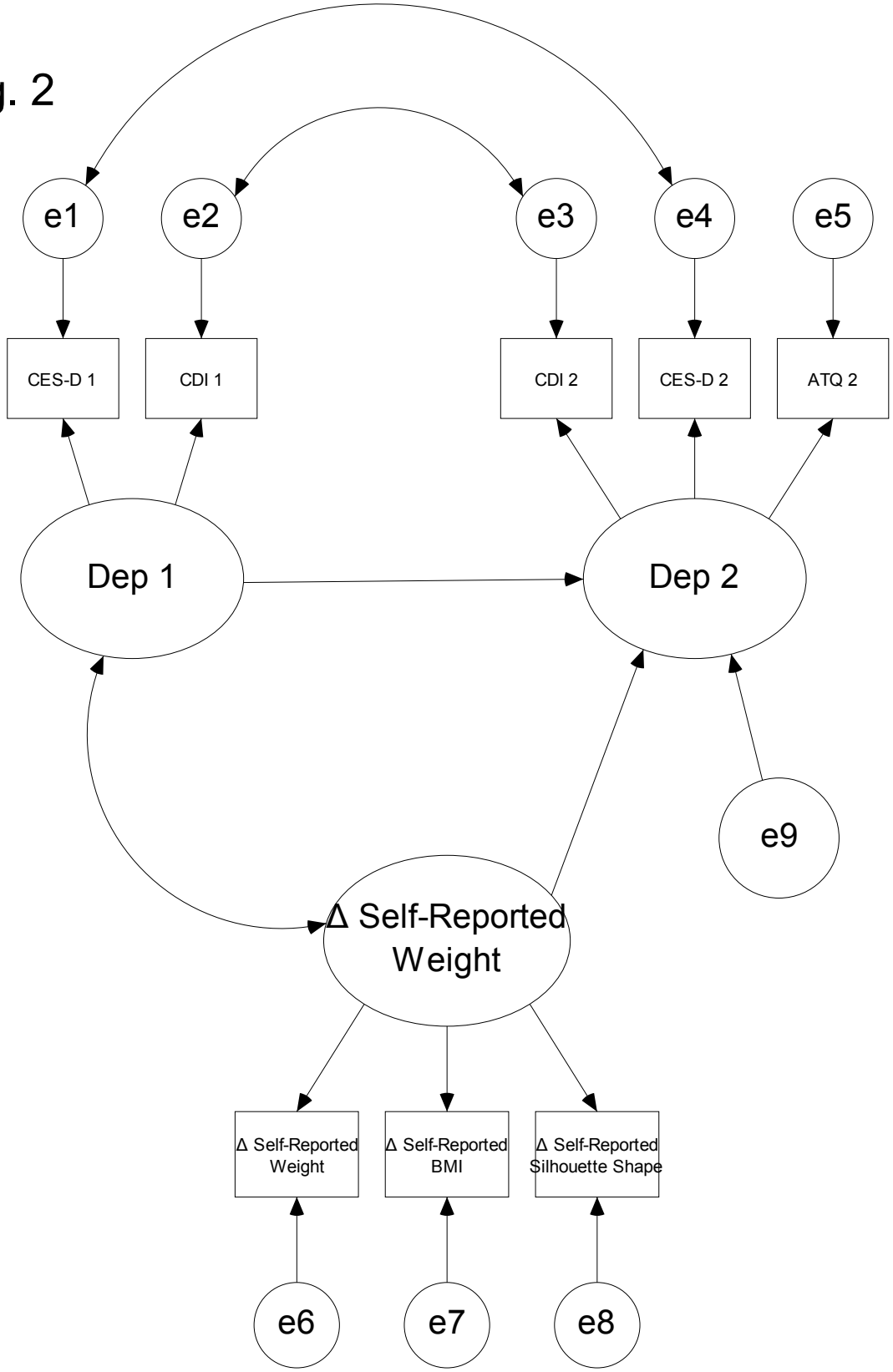
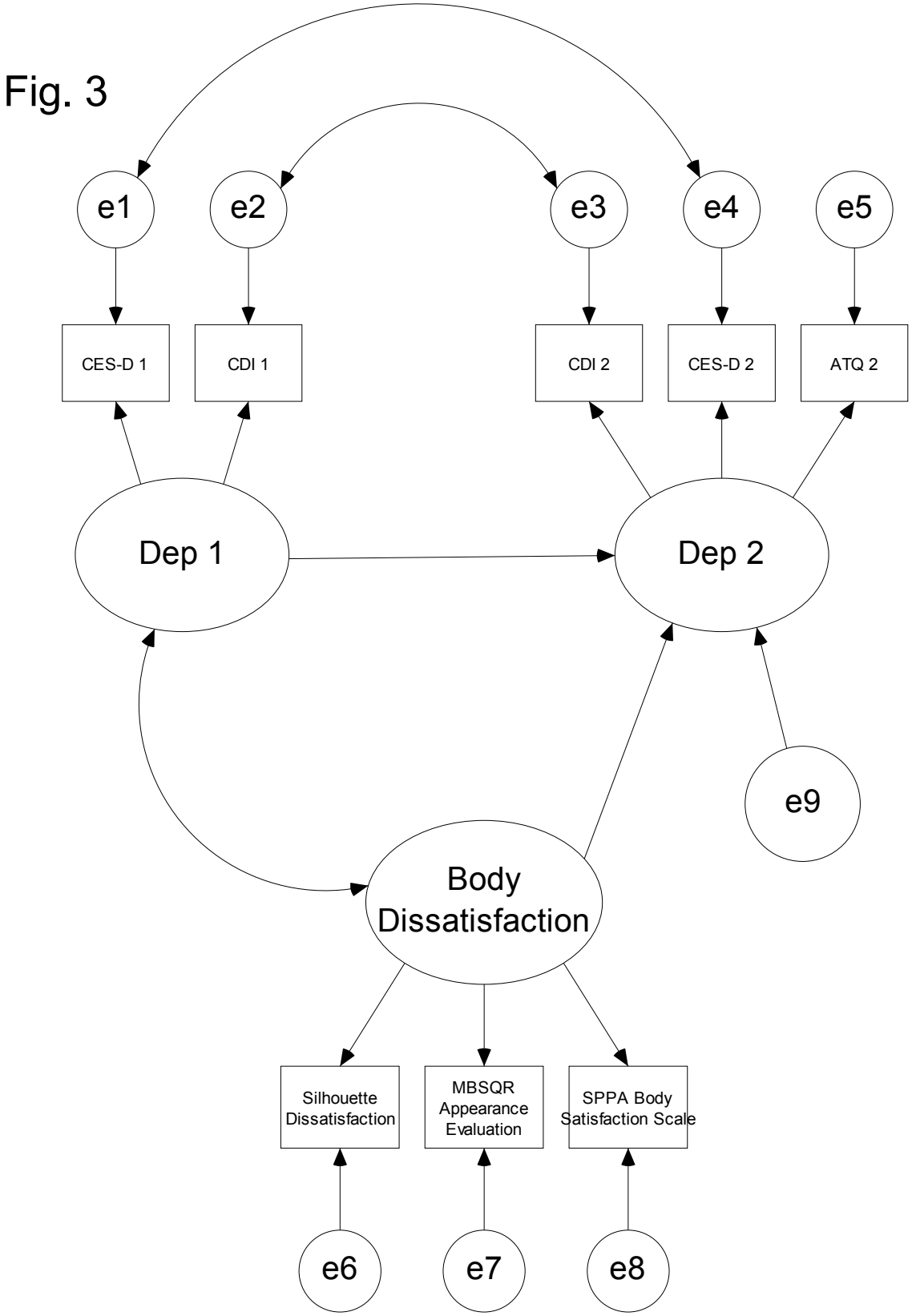

e1
e2
e3
e4
e5
CES-D 1
CDI 1
CDI 2
CES-D 2
ATQ 2
Dep 1
Dep 2
e9
Δ Self-Reported Weight
Δ Self-Reported Weight
Δ Self-Reported BMI
Δ Self-Reported Silhouette Shape
e6
e7
e8

Fig. 3


e1
e2
e3
e4
e5
CES-D 1
CDI 1
CDI 2
CES-D 2
ATQ 2
Dep 1
Dep 2
e9
Body Dissatisfaction
Silhouette Dissatisfaction
MBSQR Appearance Evaluation
SPPA Body Satisfaction Scale
e6
e7
e8

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