

NETWORK ANALYSIS OF RISK FACTORS TARGETED IN EATING DISORDERS  
PREVENTION

By

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## ABSTRACT OF THE THESIS

### Network Analysis of Risk Factors Targeted in Eating Disorders Prevention

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Although research has employed traditional statistical approaches to identify risk factors that may be targeted in eating disorders prevention, the current paper seeks to analyze such risk factors through the use of network analysis in a sample of women who underwent *the Body Project*. It was hypothesized that targeted risk factors (e.g., thin-ideal internalization) would be connected to more proximal risk factors (e.g., body satisfaction) which would be connected to observable bulimic symptomology (e.g., episodes of binge-eating and purging). Additionally, it was hypothesized that weight and shape concern would share edges with bulimic symptomatology and to risk factors, as over-evaluation of shape and weight is a transdiagnostic mechanism that maintains eating disorders. The second aim of this research was to test whether this network significantly changed as a result of the intervention through the use of network comparison analysis. Finally, analyses sought to evaluate whether network structures differed between those who endorsed binge eating at baseline and those who did not. Network analyses revealed no edge between thin-ideal internalization and other risk factors at an edge threshold of 0.2. Additionally, no risk factors shared edges with bulimic symptomatology although they shared edges with shape and weight concern. Finally, network comparison revealed no

difference between network structures derived from those who endorsed binge eating at baseline versus those who did not. Results suggest that a theoretical target of thin-ideal internalization may be less central to a network of eating disorder risk factors. Instead, the success of *the Body Project* may be attributed to its effect on other factors.

*Keywords:* prevention, eating disorders, body dissatisfaction, thin-ideal internalization, network analysis

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## Table of Contents

Abstract.....	ii
Acknowledgements.....	iv
List of Tables.....	vi
List of Illustrations.....	vii
Introduction.....	1
Method.....	9
Participants.....	9
Procedure of Intervention.....	9
Measures.....	11
Analyses.....	13
Results.....	15
Descriptive Statistics.....	15
Network Analysis.....	16
Network Comparisons.....	16
Discussion.....	18
Acknowledgment of Previous Publications.....	33
References.....	34
Appendix A.....	38

## **List of Tables**

Table 1: Demographics .....	22
Table 2: Descriptive Statistics .....	23
Table 3: Correlation Matrix .....	24
Table 4: Network Abbreviations .....	25
Table 5: Centrality of Network Nodes across Time-points .....	26

## **List of Illustrations**

Figure 1: Network Structure Across Time- points.....	27
Figure 2: Measure of Centrality.....	28
Figure 3: Network Structure for Baseline Data.....	29
Figure 4: Network Structure for Follow-up Data.....	30
Figure 5: Network Structure of Risk Factors (No Objective Overeating Episodes).....	31
Figure 6: Network Structure of Risk Factors (Objective Overeating Episodes) .....	32

## Introduction

Eating disorders (EDs) usually have a chronic and destructive course. Current treatments remain effective for only a portion of individuals with bulimia nervosa (BN), binge eating disorder (BED), and subthreshold levels of disordered eating pathology (Wilson, Grilo, & Vitousek, 2007). Treatment is even less effective for anorexia nervosa (AN), which has the highest mortality rate out of any psychiatric disorder (Arcelus, Mitchell, Wales, & Nielsen, 2011).

In addition to the limited efficacy of current treatments, EDs are associated with a host of negative consequences. These include medical complications, comorbid depression, and anxiety disorders (e.g., Ulfvebrand, Birgegård, Norring, Högdahl, & von Hausswolff-Juhlin, 2015). Further, large numbers of individuals with EDs do not receive treatment (Fairburn, Welch, Norman, O'Connor, & Doll, 1996). Given the limited efficacy of current interventions for these chronic disorders (Wilson et al., 2007), researchers have begun to develop and test ED prevention programs that target groups at higher risk.

Prevention of EDs follows public health models of intervention and, to date, often focuses on certain populations known to have a higher risk of developing an ED (i.e., the interventions are *selective* or *indicated*). Risk factors, or variables known to precede a certain condition, provide researchers with a way to identify groups for which the intervention would be beneficial and may additionally serve as targets of intervention. Thus, the reduction of these risk factors, in turn, decreases an individual's odds of developing the condition of interest. Empirically, risk factors should be those factors that prospectively predict, rather than retrospectively correlate with a diagnosis.



Several risk factors have been identified to prospectively predict ED pathology (described below) through the use of traditional statistical approaches (e.g., regression and analysis of variance). From this literature, one could assume that individuals endorse risk factors prior to diagnosis. However, the field has yet to analyze the connectivity of these risk factors to each other and to symptoms themselves by way of network analysis. Network analysis is based in mathematical graph theory, in which nodes (e.g., variables, constructs, observable symptoms) are connected to other nodes by way of edges (a directed or undirected relationship between nodes that controls for the effects of all other variables; see Epskamp, Waldorp, Mottus, & Borboom, 2016 for review). In contrast to latent approaches, which assume a symptom is independently representative of an underlying disorder, network analysis holds that observable symptoms both incite and perpetuate a network (McNally et al., 2015) which may be viewed as a prototype and thus a disorder. The goal of the current paper is to evaluate the network of risk factors in relation to each other and to facets of ED pathology (e.g., weight and shape concern, binge episodes, and purge episodes) in order to understand if these risk factors are effective targets of intervention, and how likely they are to influence more proximal risk factors to ED symptomatology.

### **Risk Factors for ED Pathology**

Risk factors for EDs include but are not limited to negative affect, lower body satisfaction, thin-ideal internalization, self-objectification, gender, earlier pubertal timing, higher body mass index (BMI), and genetic polymorphisms (e.g., Jacobi & Fittig, 2010). Prevention of EDs selects modifiable (e.g., body satisfaction) versus unmodifiable (e.g., genetics) risk factors in efforts to reduce risk for the development of an ED, subthreshold

ED symptomatology, or a more proximal risk factor for the development of an ED. Prevention, thus, does not intend to treat existing psychopathology. The following are both modifiable risk factors addressed by *the Body Project* and observed symptoms within ED pathology that serve as outcome variables in various prevention trials.

**Body satisfaction.** Research demonstrates that lower body satisfaction predicts maladaptive eating behaviors (e.g., dietary restriction and restraint, emotional eating, binge eating, etc.) prospectively (e.g., Killen et al., 1996). In girls with overweight status, higher body satisfaction protects against increases in weight in the future (i.e., up to a 5-year follow-up; van den Berg & Neumark-Sztainer, 2007). According to Stice's dual pathway model of bulimia nervosa, increased internalization of the thin-ideal standard of beauty (i.e., the notion that beauty is equated with a thin body; Thompson & Stice, 2001) promoted in western culture leads to decreased body satisfaction (Stice, Nemeroff, & Shaw, 1996). Indeed, research by Stice & Whitenton (2002) showed that increased weight and pressure to be thin accounted for two distinct pathways to lower body satisfaction. Finally, body satisfaction is linked to comorbid depression. Noles and Cash (1985) demonstrated that body satisfaction was significantly lower in individuals with depression. This correlation is noteworthy, given that negative affect has been demonstrated to prospectively predict episodes of binge-eating and purging (e.g., Stice et al., 1996). Given that body dissatisfaction predicts a host of negative consequences apart from ED pathology (e.g., Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2010), reduction of this risk factor serves as an outcome of *the Body Project* in prevention trials.

**Thin-ideal internalization.** Thin-ideal internalization refers to the extent to which an individual subscribes to the thin-ideal standard of beauty. Thin-ideal internalization is

thought to result from societal pressure to be thin. Indeed, research demonstrates that societal pressure to be thin leads to body dissatisfaction (see Stice 2002 for review). Research additionally suggests that more acute pressures to be thin (i.e., presentations of images of the thin-ideal) has more deleterious effects on women who are already body dissatisfied (e.g., Groez, Levine, & Murnen, 2002). Research additionally indicates that this risk factor may lead to greater body dissatisfaction given increased self-surveillance (e.g., monitoring, checking) of one's body (Fitsimmons-Craft et al., 2012).

**Negative affect.** With respect to affect regulation, theories of BN suggest that individuals binge in order to reduce negative affect and may purge in order to reduce anxiety about a binge episode (Polivy & Herman, 1993). Other compensatory behaviors, such as compulsive exercise, may serve the same purpose of reducing negative affect (Polivy & Hermann, 1993). Research demonstrates that negative affect prospectively predicts ED symptomatology and is a causal risk factor for body dissatisfaction in laboratory models utilizing negative mood induction (e.g., Haedt-Matt, Zalta, Forbush, & Keel, 2012). Meta-analyses indicate that this risk factor may play a greater role in the development of BN and BED as compared to more general maladaptive eating behaviors, such as dieting (e.g., Stice 2002).

**Self-Objectification** Research has implicated the role of self-objectification in risk for the development of disordered eating pathology. Self-objectification refers to the process of viewing the self as an object to be evaluated by others (e.g., Frederickson & Roberts, 1996). Theoretical models suggest that individuals who put a greater emphasis on observable, physical attributes in their self-evaluation have a greater risk for experiencing body shame that results from not conforming to the thin-ideal. Thus, body

shame is usually experienced via objectification from individuals who hold higher levels of thin-ideal ideal internalization (Calogero, Davis, & Thompson, 2005) and for individuals who survey their bodies more often (Fitsimmons-Craft et al., 2012). Such body shame further places individuals at risk for engaging in maladaptive weight control behaviors. The measure of self-objectification in the current trial included three subscales which measured how often individuals surveyed their bodies, levels of body shame, and perceived control over how one's body looks (Lindberg, Hyde, & McKinley, 2006).

**Disordered eating pathology as outcome.** Weight and shape concern regard the extent to which individuals are preoccupied with their weight and shape (e.g., fear of gaining weight) and how much value they place on weight and shape in determining self-worth (Fairburn, 2008). Under the cognitive behavioral model of eating disorders, over-evaluation of weight and shape is the transdiagnostic mechanism through which EDs are developed and maintained (Fairburn et al., 2003). According to Fairburn (2003), this leads to dieting, which leads to binge eating and potentially purging as in the case of BN. Objective binge eating refers to eating a large amount of food in one sitting given the circumstances and feeling a loss of control during the binge. In BN, purging occurs as well and may include vomiting, compulsive exercise, or use of laxatives. Thus, weight and shape concern and bulimic symptoms are often measured as outcome variables in prevention trials.

### **Reduction of Risk: *The Body Project***

To date the, *the Body Project*, an ED prevention intervention, has received the most empirical support for the prevention of EDs when delivered selectively (Stice, Marti, Spoor, Presnell, Shaw, 2008; Stice, Mazotti, Weibel, Agras, 2000; Stice, Rohde,

Gau, & Shaw, 2009; Stice, Trost, & Chase, 2003, Stice, Shaw, Burton, & Wade, 2006).

*The Body Project* is a cognitive-dissonance-based intervention that aims to prevent the onset of EDs through the reduction the above mentioned risk factors (i.e., thin-ideal internalization, body dissatisfaction, negative affect, self-objectification; Stice, Chase, Stormer, & Appel, 2001). Evidence supports the use of this intervention in college-age women, and it has been shown to prevent the occurrence of eating disorders out to a 14-month follow-up (Becker et al., 2010).

*The Body Project* is based on Stice and colleagues' dual pathway model of bulimic pathology, which suggests that societal pressure to be thin may lead to an internalization of the thin-ideal standard of beauty (Stice, Ziemba, Margolis, & Flick, 1996). This then leads to body dissatisfaction, which results in maladaptive efforts to control weight (i.e., dietary restraint) as well as negative affect arising from failure to conform to the thin-ideal. This model suggests that negative affect and dietary restraint are the most proximal risk factors for bulimic pathology. A core component of *the Body Project* is anti-thin-ideal content (Stice & Presnell, 2007), which is thought to have a cascading effect on more proximal risk factors such as dietary restraint and negative affect.

*The Body Project* consists of two, 2-hour groups sessions in which participants define the thin-ideal standard of beauty promoted in western-culture, discuss the costs associated with pursuing this ideal, and complete numerous behavioral tasks that challenge the thin-ideal (Stice & Presnell, 2007). These activities are thought to produce cognitive dissonance, a phenomenon in which individuals experience discomfort that arises from holding contradicting beliefs (Festinger, 1957). It is believed that individuals

likely shift their attitudes towards the new belief in order to reduce such discomfort.

Regarding *the Body Project*, such activities include speaking and acting out against the thin-ideal standard of beauty that is prevalent in mainstream media.

Beyond its efficacy in randomized clinical trials (Stice et al., 2001), *the Body Project* has been shown to be effective when delivered by undergraduate peer-leaders to a group of fellow sorority members (i.e., members of the intervention group) trained by doctoral level providers (e.g., Becker, Smith, & Ciao, 2005) as well as peer-leaders trained by undergraduate students who had previously served as peer-leaders (Kilpela et al., 2014). Thus, in addition to being an efficacious program, *the Body Project* has been demonstrated to be highly scalable, utilizing less expensive providers to disseminate the program. Specifically, Kilpela et al. (2014) found that undergraduate trainers produced peer leaders who yielded the same reductions in risk factors as peer leaders trained by doctoral-level clinicians.

Although *the Body Project* has been shown to reduce risk factors and prevent the incidence of EDs, little research examines whether a reduction in the target of thin-ideal internalization via the intervention is responsible for changes observed at follow-up. The primary aim in the use of network analysis was to test the dual-pathway model of BN and replicate the relationship between thin-ideal internalization and ED symptomatology. Additionally, the current study sought to explore whether this risk factor is truly a more distal risk factor than the more proximal risk factors of body dissatisfaction and negative affect. Analyses sought to examine the data in three different ways: the network of factors across all time points for all participants, the network of factors between baseline and follow up data, and the network of factors between individuals who endorsed

objective overeating versus those who did not. Network analyses included all risk factors measured in the trial (e.g., body satisfaction, body mass index [BMI], body shame, control beliefs, negative affect, self-surveillance, and thin-ideal internalization).

It was hypothesized that thin-ideal internalization would have a more distal connection to ED pathology than does body dissatisfaction, and that the relationship between body dissatisfaction and thin-ideal internalization would become fractured after the intervention. Although thin-ideal internalization is a potential mechanism through which prevention yields its effects, the current study sought to test whether other aspects of the sample are more important targets of intervention. This would be demonstrated if another risk factor had a more proximal connection to ED pathology or body satisfaction itself. Additionally, given that weight and shape concern is a transdiagnostic maintenance factor (Fairburn et al., 2003), it was hypothesized that this measure would demonstrate the highest connectivity to all other risk factors and to ED pathology. Finally, it was hypothesized that risk factors would be more highly connected in the population of individuals who endorsed objective overeating episodes at baseline versus those who do not.

## Method

### Participants

Participants were recruited via sorority membership at a small liberal arts school located in southern United States. A total of 354 women who had joined a sorority over a three-year period (2009-2011) were eligible to attend sessions for *the Body Project*, which was made mandatory by the sororities themselves. From this pool of new members, a total of 297 women were randomized to receive the intervention from a peer leader (PL) trained by a doctoral-level clinician (i.e., very expensive provider; VEP) plus an undergraduate trainer (UT) or from a PL trained by an undergraduate trainer alone (UTA). Individuals who were not randomized to a condition in the study either had a documented and excused conflict intervening with the program as determined by their sorority or decided to drop out of their sorority altogether. Of these women, 285 individuals voluntarily agreed to participate in the study itself, which consisted of providing data via self-report questionnaires in addition to attending sessions. Thus, in terms of individuals who provided data, the VEP + UT condition of the study consisted of 144 women and the UTA condition consisted of 141 women. Women with a diagnosable ED at baseline ( $n = 7$ ) were excluded from analyses.

Participant ages ranged from 18 to 21 years ( $M = 18.71$ ,  $SD = 0.74$ ). Individuals reported an average BMI of 22.32 ( $SD = 3.19$ ). The sample was predominantly Caucasian (76.3%) in addition to consisting of women who were Hispanic or Latino (12.6%), Asian (4%), African American (1.8%), and multiple races (6.8%). Approximately 6% of the sample did not report an ethnicity (see Table 1 for demographics).

### Procedure



**Initial clinical trial.** Although participation in *the Body Project* was semi-mandatory, participation in the study (i.e., providing data via self-report questionnaires) was voluntary. Both the program and the study were approved by the Institutional Review Board on the university's campus, student affairs, the individual sororities themselves, and the university's Greek Council. After meeting to discuss both the mandatory meetings and semi-mandatory completion of the study, the researchers stratified each member to intervention groups by sorority in order to get a fair representation of all sororities across groups. All groups were studied during the same month and were led by PLs. Participants were blind to which PLs were trained by a UTA or UT + VEP. Data were collected before the intervention, immediately after the intervention, at an 8-week follow-up, an 8-month follow-up, and a 14-month follow-up.

***The Body Project protocol.*** *The Body Project* consisted of two, 2-hour sessions. These sessions were led by 2-3 PLs and consisted of identical material. At the beginning of Session 1, PL's acquired voluntary commitment from participants to engage with the program from session to session. In Session 1, participants worked as a group to define the thin-ideal, discussed its origins as a standard for beauty, discussed the costs associated with pursuit of this ideal, and completed an exercise that required they a.) identify a pressure to conform to the thin-ideal and b.) subsequently challenge that pressure. Session 1 ended with the review of a homework assignment that asked the participants to complete a mirror exposure, which consisted of standing in front of a mirror and identifying aspects they liked about themselves that were physical, emotional, and social in aspect.

The second session started with reviewing the homework from session 1 and sharing identified qualities from the mirror exposure with the group. Participants then completed a role-play in which their goal was to convince a PL to not engage in their hypothetical pursuit of the thin-ideal. Additionally, they completed smaller role plays in which their goal was to challenge “fat talk.” “Fat talk” refers to statements that endorse the thin-ideal implicitly or explicitly (e.g., “This dress makes me look so fat” or “You look amazing! Have you lost weight?”). The next module in this session had participants brainstorm ways in which their sororities could engage in social activism targeted at combating the thin-ideal after the program ended. Next, members selected a self-affirmation or activity that challenged conforming to the thin-ideal that they would carry out after the program ended. Finally, the session ended with commentary from all members on their experience with the program (Becker & Stice, 2008).

## Measures

The following measures were used to assess levels of risk factors among the sample as well as identify any occurrence of ED pathology during the study period (see Appendix A for questionnaires).

**Thin-ideal internalization.** Thin-ideal internalization was assessed using the Ideal Body Stereotype Scale-revised (IBSS-R; Stice, Ziemba, Margolis, & Flick, 1996). The IBSSR has individuals rate the extent to which they agree or disagree (1 = *strongly disagree*, 5 = *strongly agree*) with 10 statements that measure thin-ideal internalization (e.g., “Slim women are more attractive.”). A recent study identified that two items are unreliable measures of thin-ideal internalization (Green, 2013). Analyses were conducted with these two items dropped from the average.

**Body satisfaction.** In order to evaluate body satisfaction, this study included the Satisfaction with Body Parts Scale (SBPS; Berscheid, Walster, & Bohrnstedt, 1973). This measure asks participants to rate their satisfaction (1 = *extremely dissatisfied*, 6 = *extremely satisfied*) with 9 aspects of their body (e.g., weight, figure, thighs, etc.). Body satisfaction is measured as an average across the 9 items.

**Self-objectification.** Self-objectification was measured using the Objectified Body Consciousness-Youth scale (OBC-Y; Lindberg et al., 2006). This scale measures three facets of self objectification: self-surveillance (4 items; e.g., “I often worry about whether the clothes I am wearing make me look good”), body shame (5 items; e.g., “I would be ashamed for people to know what I really weigh”), and body control beliefs (5 items; e.g., “I can weigh what I’m supposed to if I try hard enough”).

**Negative affect.** Three subscales (sadness, guilt, fear/anxiety) from the Positive and Negative Affect Scale (PANAS; Watson & Clark, 1988) were used to assess negative affect. Participants rated to what extent they felt each emotion (1 = *very slightly*, 5 = *extremely*) over the two weeks prior to each rating.

**Eating disorder symptomatology.** In order to assess disordered eating pathology, participants answered questions on a condensed, 10-item version of the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn, 1994). The EDE-Q asks participants to rate often they have engaged in a range of eating behaviors (e.g., “Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food [given the circumstances]?”) as well as to what extent they have held attitudes toward their weight and shape (e.g., “Over the past 28 days, has your weight influenced how you think about [judge] yourself as a person?”). Without

validation from a clinician, self-reported objective binge episodes are referred to objective overeating episodes and are labeled in this manner throughout this paper. This measure provides information on ED symptoms as well as maintaining mechanisms (e.g., weight and shape concern).

## **Analyses**

All participants with a prior diagnosis of an eating disorder ( $n = 7$ ) were removed from analyses, given that *the Body Project* is intended to reduce risk factors among individuals who do not have an ED diagnosis. Demographic and descriptive statistics of all variables were computed using SPSS (IBM Corporation, 2016; see Table 1). Before conducting network analyses, Pearson's correlations were computed on all continuous variables. The Network App developed by Kossakowski, Epskamp and van Borkulo (2017) was utilized to calculate the centrality of each variable to the network. Within this application, the GLASSO estimation model was utilized in order to control for spurious correlations (Kossakowski et al., 2015). This model sets spurious correlations to 0, and thus only non-zero correlations may generate edges between nodes (Kossakowski et al., 2015). Edges control for the effects of all other nodes in the network. In generating the network, the edge threshold was set to 0.2, as per methods employed by a number of studies (e.g., Stone, DuBois, DeJesus, Rodgers, & Rizzo, 2017). All edges below this threshold were thus suppressed, given that they should not be expected to be predictive of other nodes in the network. Nodes included both risk factors and ED pathology (e.g., weight and shape concern, binge episodes, episodes of purging) in initial network analyses.

The network analyses derived three facets of centrality of each node in the network: betweenness, closeness, and strength. Betweenness is a measure of the number of shortest paths between one node and another. In other words, higher scores of betweenness indicate that these nodes are traversed more often in order for information to travel from one node to the other (Borgatti, 2005). Closeness is calculated by obtaining the inverse of the total distances or paths between nodes (Borgatti, 2005). Distance refers to how many edges are between one node and all others. Therefore, higher scores on this index would indicate shorter distance from this node to another node. Finally, the strength of each node was computed which was computed following methods employed by other studies utilizing network analysis (e.g., Forbush et al. 2016, McNally, 2015). This is a measure of the weight of ties it has to other nodes in the network.

## Results

At baseline, participants reported an average score of 2.28 ( $SD = 1.64$ ) on weight and shape concern, which was generated by taking an average of the shape and weight concern subscales of the EDE-Q. Participants reported a mean score of 2.97 ( $SD = .86$ ) on body satisfaction and a mean score of 3.51 ( $SD = 0.57$ ) on thin-ideal internalization (see Table 2 for descriptive statistics on all network analysis variables). Pearson's correlations on baseline variables indicated significant correlations between all continuous variables except for BMI with thin-ideal internalization and negative affect. Additionally, the control beliefs subscale was not significantly correlated with any variables except for weight and shape concern ( $r = 0.14, p < .01$ ; see Table 3).

### Network Analysis

A network analysis of all risk factors and ED symptomatology generated a small world index of 2.38, indicating that a small world network was not generated. A small world network is one in which nodes appear to be randomly distributed but demonstrate higher connectivity to other nodes by surrounding "neighbors" (Watts & Strogatz, 1998). A small world network would require a value of 3 or greater.

Figure 1 depicts the network of risk factors and ED symptoms across all time points (refer to Table 4 for node abbreviations). Network analysis revealed that weight and shape concern had the highest degree of strength. Nodes by descending strength were weight and shape concern, body shame, self-surveillance, body satisfaction, purge episode, binge episode, negative affect, control beliefs, thin ideal-internalization, and BMI (see Figure 2 for graph depicting strength centrality for each variable).

Table 5 demonstrates numeric measures specific centrality measures of betweenness and closeness. Weight and shape concern had the highest degree of betweenness centrality (2.35), indicating that this node appeared most frequently in the shortest path between one node and another. The order of the rest of the nodes was as follows: control beliefs, self-surveillance, body shame, objective overeating episode; purge episode; thin ideal internalization, BMI; body satisfaction; negative affect.

Finally, weight and shape concern demonstrated the highest degree of closeness centrality (1.47), indicating that information travels most quickly from this node to others. Closeness centrality for the remaining nodes emerged in the following order: body shame, self-surveillance, body satisfaction, negative affect, control beliefs, thin-ideal internalization, purge episode, objective overeating episode, BMI.

Regarding the valence of connections, weight and shape concern, the most central node, was negatively connected with self-surveillance, body satisfaction, and body shame, given that higher scores on these indices indicated reduced self-surveillance, body shame, and body dissatisfaction. Body shame produced a triangle with body satisfaction and weight and shape concern and was positively associated with body satisfaction and negatively associated with weight and shape concern. Negative affect was associated with weight and shape concern and thus connected to all other nodes in this sub-network. Thin-ideal internalization, BMI, and control beliefs were not associated with other nodes in the network at a threshold of 0.2, but were connected to other nodes below this threshold. Objective overeating and purge episodes formed positive edges with each other but not with risk factors or with weight and shape concern.

### **Network Comparisons**

**Baseline versus follow-up data.** After yielding an overall network structure, analyses compared the networks of data collected at baseline with data collected at follow-up. In this network comparison analysis, the AND-rule was utilized, which allows edges to only be drawn if there is a non-zero correlation to and from two nodes (Kossakowski, 2017). After setting gamma to 0.5 and running 1000 iterations, the analysis revealed no significant difference between networks derived from baseline and follow-up data,  $p = 0.26$  indicating that the intervention did not affect the connectivity among risk factors and ED symptomatology (see Figure 3 and 4 for network structures of baseline and follow-up data).

**Objective overeating versus non-objective overeating population.** At baseline, 39.9% ( $n = 111$ ) of individuals reported objective overeating episodes (e.g., eating a large amount of food in one sitting and experiencing a loss of control), and 37.1% ( $n = 103$ ) endorsed a facet of purging which included vomiting, use of laxatives, or exercising in a compulsive or driven way. Reporting of objective overeating episodes at baseline was used to split the dataset into two files, whose risk factors structure was analyzed with the removal of ED pathology outcome variables (binge-eating and purging). Analyses thus incorporated BMI, body satisfaction, self-surveillance, control beliefs, body shame, thin-ideal internalization, and negative affect into the model. Analyses employed the AND-rule for edges, set gamma to 0.5, and ran 1000 iterations of the data. This comparison indicated that risk factor structures were not differentially connected ( $p = .10$ ) when examined by group (see Figures 5 and 6 for network structures of individuals who reported objective overeating episodes versus individuals who did not).



## Discussion

The aim of the current study was to test the relationship between thin-ideal internalization to other risk factors, given that activities in *the Body Project* are believed to produce cognitive dissonance with internalization of the thin-ideal standard of beauty. Additionally, analyses sought to explore which risk factors were central in a network of risk factors and facets of ED pathology (e.g., weight and shape concern, subs-threshold levels of objective overeating and purge episodes). Given that research has supported the use of the *Body Project*, the identification of targets that may be more central may improve implementation of the protocol and potentially streamline delivery of the intervention. This model suggests that certain risk factors (e.g., body satisfaction, negative affect, body shame, and self-surveillance) may be more predictive of weight and shape concern than current measurements for thin-ideal internalization. However, even these risk factors are not predictive of observable ED behaviors, such as objective overeating and purge episodes, in a selective population. This finding held when data was analyzed across all time points and when baseline network structure was compared with the network structure of follow-up data.

Weight and shape concern emerged as the most central node, in line with previous research on over-evaluation of shape and weight in clinical populations (e.g., DuBois, Rodgers, Franko, Eddy, & Thomas, 2017). This indicates that apart from being a transdiagnostic maintenance factor in EDs, it appears in women who are at risk for the development of ED symptomatology and demonstrates a high degree of betweenness through which other risk factors communicate information. Given a lack of connection to binge-eating and purging, weight and shape concern in this “at risk” population may be

different from clinical populations. Future research should seek to understand what differentiates those who begin to demonstrate symptomatology with those who present with a combination of risk factors. Overall, this research demonstrates that *the Body Project* is, indeed, targeting many risk factors connected to a core maintaining mechanism for EDs.

Finally, this study provides the first analysis of the network structure of risk factors of those who endorsed objective overeating episodes at baseline versus those who did not. Analyses indicated risk factors were not distinctly connected between these two populations. Although this behavioral symptom of EDs may be thought to indicate higher risk, the current findings suggest that risk factors are more indicative of a maintaining mechanism of ED pathology. Given that meeting for a binge episode barring criteria for frequency is common in the general population (e.g., Bruce & Agras, 1992), research may need to compare the network structures of this population with individuals who report clinical levels of binge-eating or binge-eating *and* purging.

### **Limitations and Future Directions**

Given that the prevention intervention was delivered selectively in the current trial, future research should compare this network structure to an indicated population and to a clinical population. This may shed light on which nodes remain most central throughout different levels of severity for risk factors and ED pathology. One limitation of this study was a lack of a dietary restraint subscale on the EDE-Q, which would provide more accurate information regarding the potential dual pathway model of bulimic pathology.

Given that thin-ideal internalization did not emerge, in any model, as reliably connected to other nodes in the network, this network does not support the dual pathway model of bulimic pathology. Although research demonstrates that body dissatisfaction may be more prevalent in college age women, individuals were not screened for body dissatisfaction or thin-ideal internalization in order to enter the current trial. Thus, this model may be at odds with research that screens for women who demonstrate higher levels of body dissatisfaction in order to deliver the intervention in a more indicated fashion. Those populations may demonstrate greater links between nodes in the network.

These analyses suggest that the power of *the Body Project* intervention may lie in its targeting of body dissatisfaction, self-surveillance, body shame, and negative affect rather than dissonance-based exercises focused on the thin-ideal standard of beauty. For example, *the Body Project* includes a mirror exposure for individuals to complete at home. It is possible that this component is responsible for the intervention's prevention of ED diagnoses. Additionally, activities aimed at producing cognitive dissonance with thin-ideal internalization potentially produce cognitive dissonance with distinct risk factors that are more modifiable than internalization of the thin-ideal standard of beauty.

Body shame emerged as the node with the second highest closeness centrality and may implicate a difference between what one deems to be attractive versus what implicates value and self-worth (i.e., finding the thin-ideal attractive versus feeling as though one is a bad person if they do not conform to the ideal). Additionally, the connection of body shame and negative affect to shape and weight concern may implicate that individuals who go on to binge and purge do so in order to regulate affect (e.g., Stice

et al., 1996). Thus, these findings have implications for the manner in which populations should be selected for the intervention (e.g., higher rates of body dissatisfaction), and how the intervention could potentially be adapted (e.g., potentially focusing on exposures over cognitive dissonance aimed at thin-ideal internalization).

Apart from comparing the network structures of individuals at different levels or risk to clinical populations, it would be useful to understand which items within each questionnaire are most central to each construct in order to quickly identify individuals who may benefit from *the Body Project*. In a similar vein, dismantling *the Body Project* by cognitive dissonance aimed at thin-ideal internalization versus a mirror exposure may determine which segment of the intervention yields the greatest changes in risk factors. Such research could help increase the “dosage” of truly necessary components and strengthen both prevention effects and reduction of risk.

Table 1

*Demographics*

<u>Characteristics</u>	<u>N (%)</u>
Age	
18	122 (43.9%)
19	117 (42.1 %)
20	31 (11.2%)
21	5 (1.8%)
Race	
Hispanic or Latino	35 (12.6%)
Not Hispanic or Latino	203 (73.0%)
No response	35 (12.6%)
Ethnicity	
White	212 (76.3%)
Black or African American	5 (1.8%)
Native Hawaiian or Other Pacific Islander	1 (.4%)
Asian	11 (4.0%)
More than one race	19 (6.8%)
American Indian/ Alaska Native	1 (.4%)
No Response	16 (5.8%)

*Note.* Demographic information for participants.

Table 2

*Variable Descriptives*

<u>Characteristics</u>	<u>M</u>	<u>SD</u>
Body Mass Index	22.32	3.19
Body Satisfaction	2.97	0.86
Body Shame	5.13	1.24
Control Beliefs	3.05	0.88
Self-Surveillance	3.03	1.21
Weight and Shape Concern	2.28	1.64
Thin-Ideal Internalization	3.51	0.57
Negative Affect	28.70	9.52

*Note.* Means and standard deviations for variables at baseline. All variables were entered into network analysis.

Table 3

*Correlation Matrix*

	1.	2.	3.	4.	5.	6.	7.	8.
1. WSC	1							
2. NA	-.43**	1						
3. IBSSR	.17**	.13*	1					
4. BMI	.20**	.04	-.06	1				
5. SWBP	-.59**	-.29**	-.17**	-.40**	1			
6. CB	-.14**	-.03	-.05	-.03	.11	1		
7. BS	-.67**	-.43**	-.24**	-.20**	.56**	.06	1	
8. SS	-.48**	-.39**	-.25**	-.04	.37**	-.04	.46**	1

*Note.* Correlations for continuous variables in the sample. One asterisk indicates  $p < .05$ .

Two asterisks indicate  $p < .01$ . WSC = Weight and Shape Concern; NA = Negative

Affect; IBSSR = Thin Ideal Internalization; BMI = Body Mass Index; SWBP = Body

Satisfaction; CB = Control Beliefs; BS = Body Shame; SS = Self-Surveillance

Table 4

*Abbreviations*

<u>Abbreviations</u>	<u>Construct</u>
SWB	Body Satisfaction
ssr	Self-Surveillance
prg	Purge Episode
PAN	Negative Affect
OBE	Objective Overeating Episode
IBS	Thin-ideal Internalization
edg	Weight and Shape Concern
cnt	Control Beliefs
BMI	Body Mass Index
bdy	Body Shame

*Note.* Abbreviations for constructs entered in network analyses.

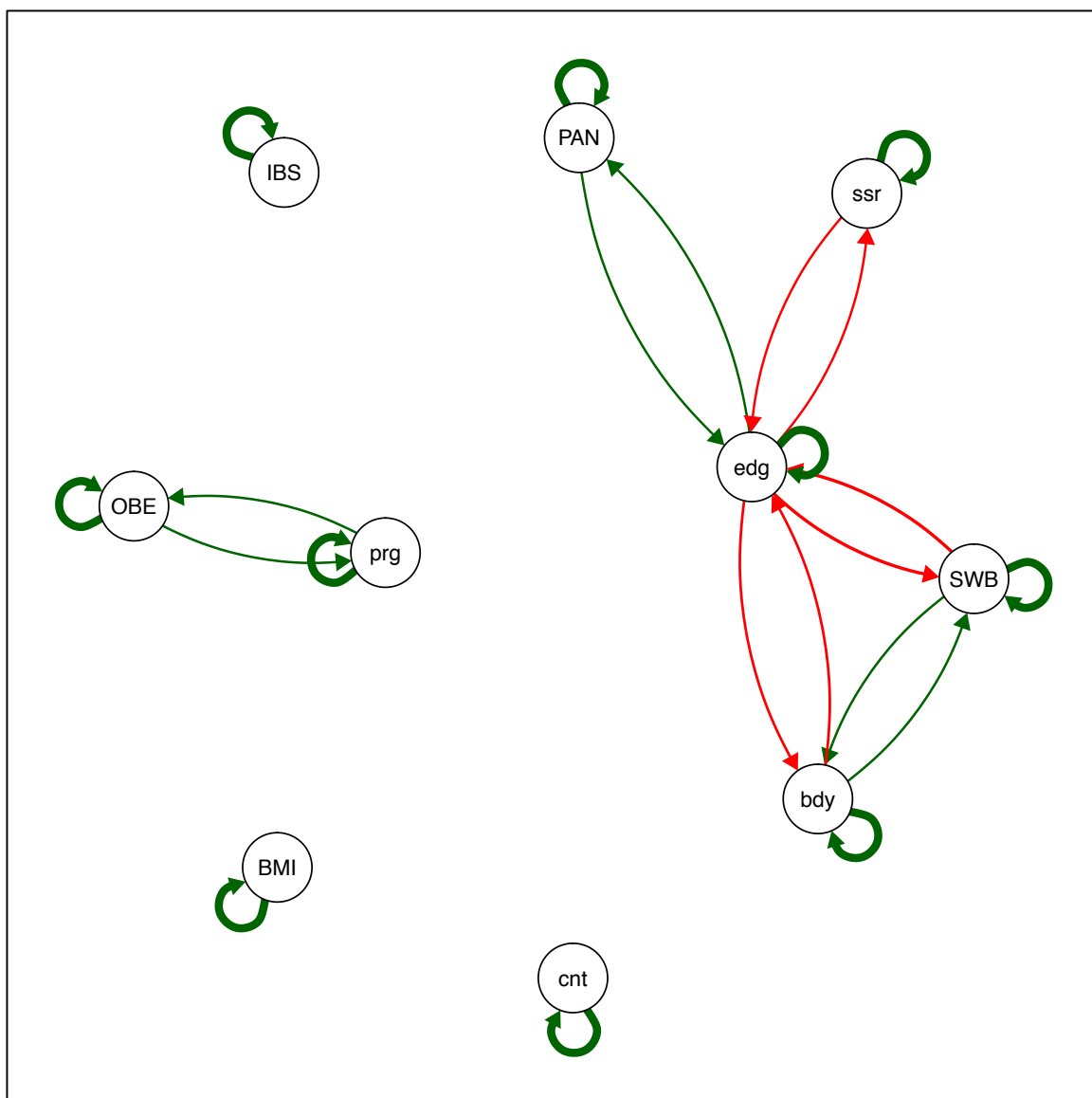


Table 5

*Centrality of Network Nodes across all Time-points*

<u>Variable</u>	<u>Betweenness</u>	<u>Closeness</u>
Body Mass Index*	-0.77	-2.05
Body Satisfaction	-0.77	0.58
Body Shame	0.09	1.08
Control Beliefs*	0.94	-0.24
Self-Surveillance	0.37	0.62
Weight and Shape Concern	2.35	1.47
Objective Overeating Episodes	-0.48	-0.55
Purging	-0.48	-0.48
Thin-Ideal Internalization*	-0.48	-0.43
Negative Affect	-0.77	0.002

*Note.* Asterisk indicates node was not connected to other nodes within the network at a threshold of 0.2



*Figure 1.* Network structure of risk factors and ED pathology across all time points. Red arrows indicate a negative relationship.

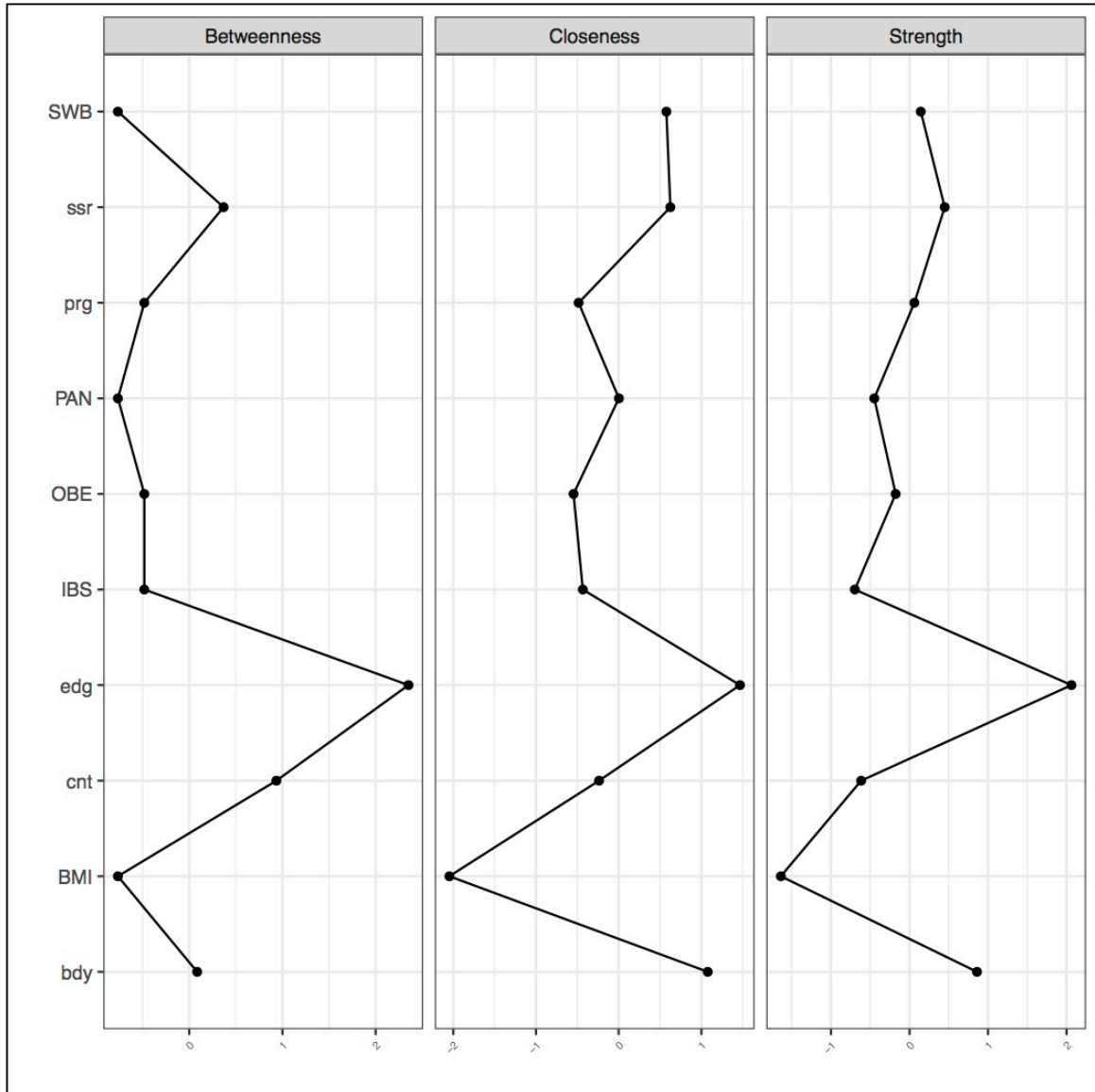
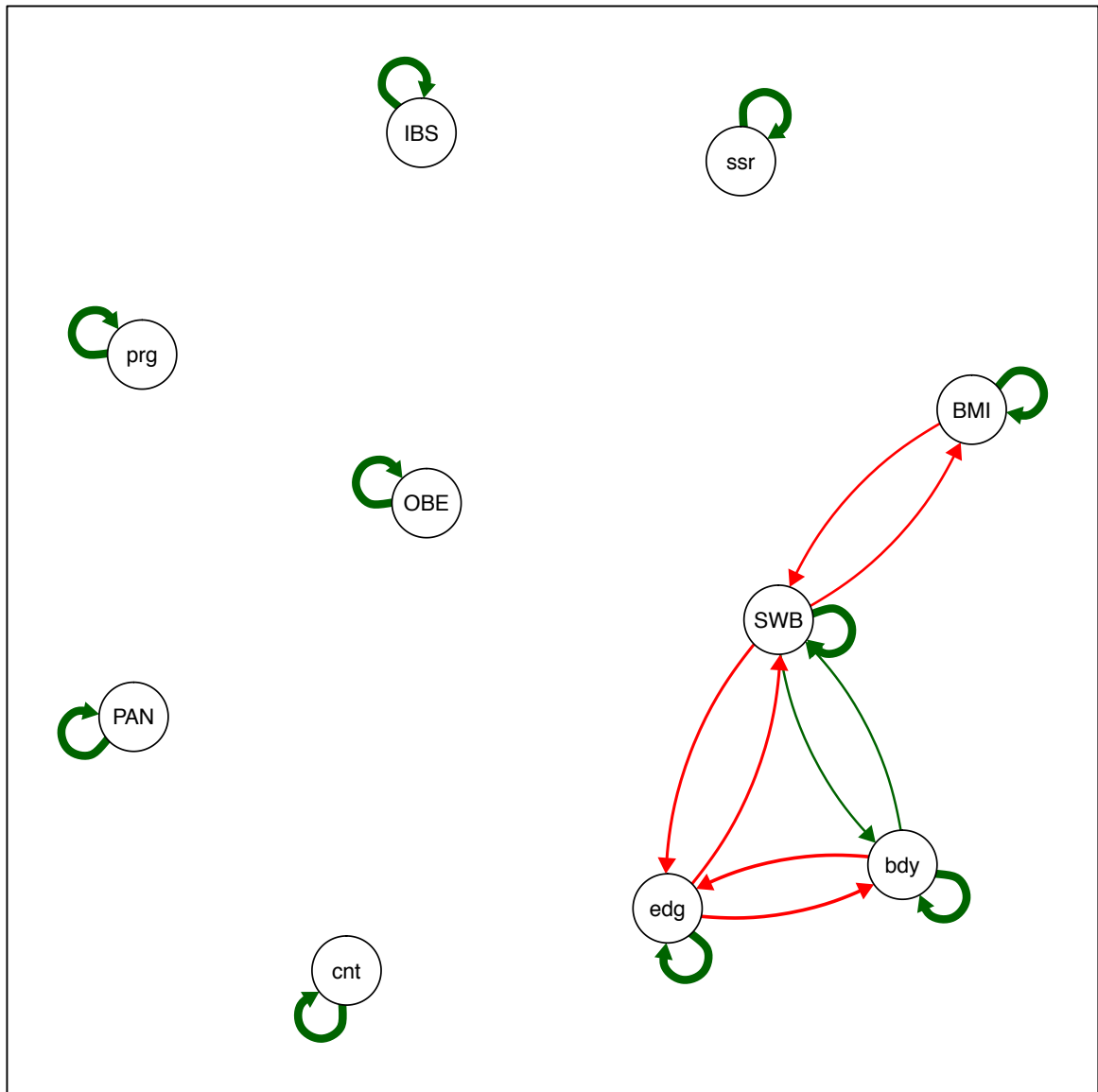
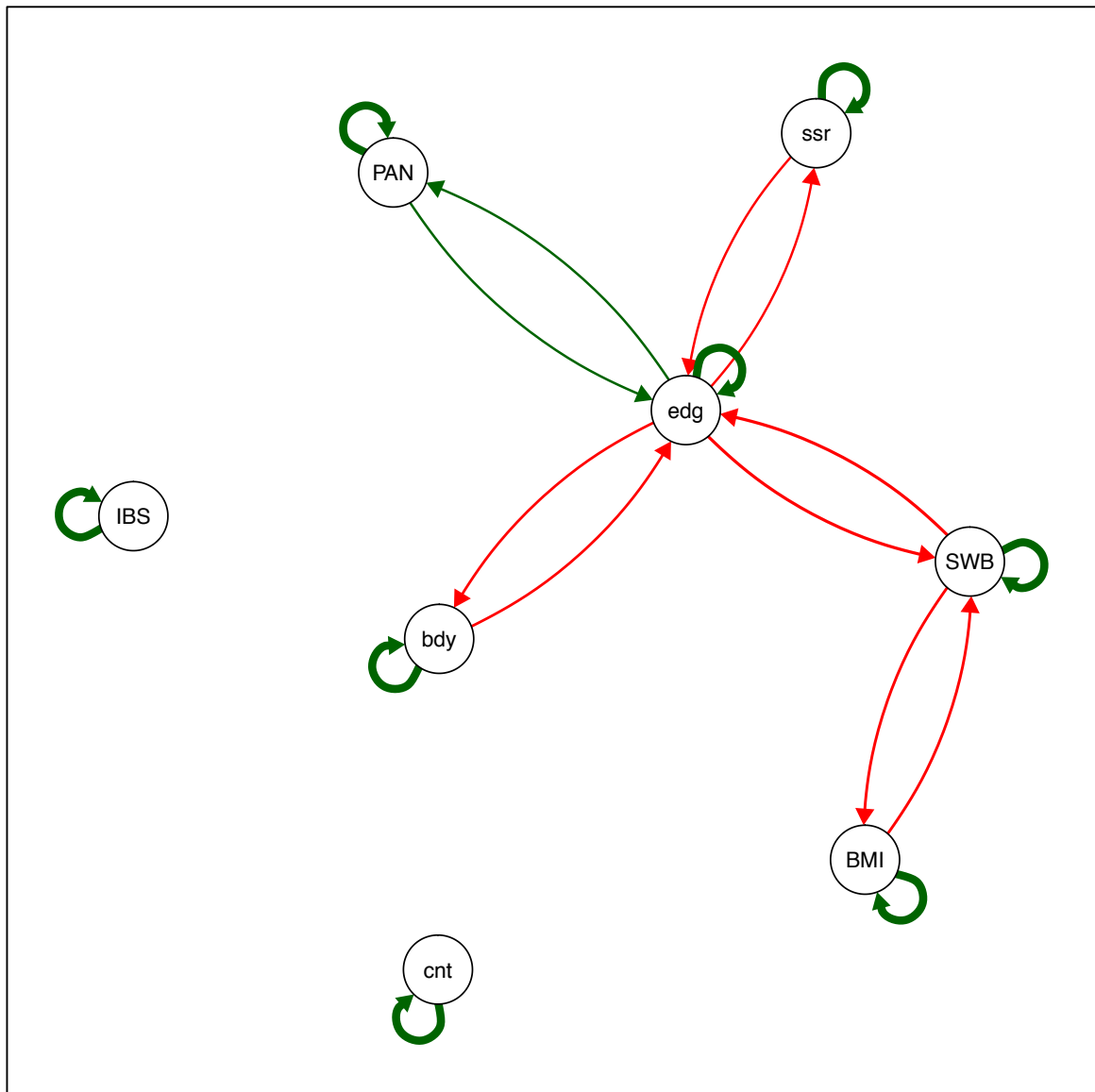


Figure 2. Betweenness, Closeness, and Strength of each variable.

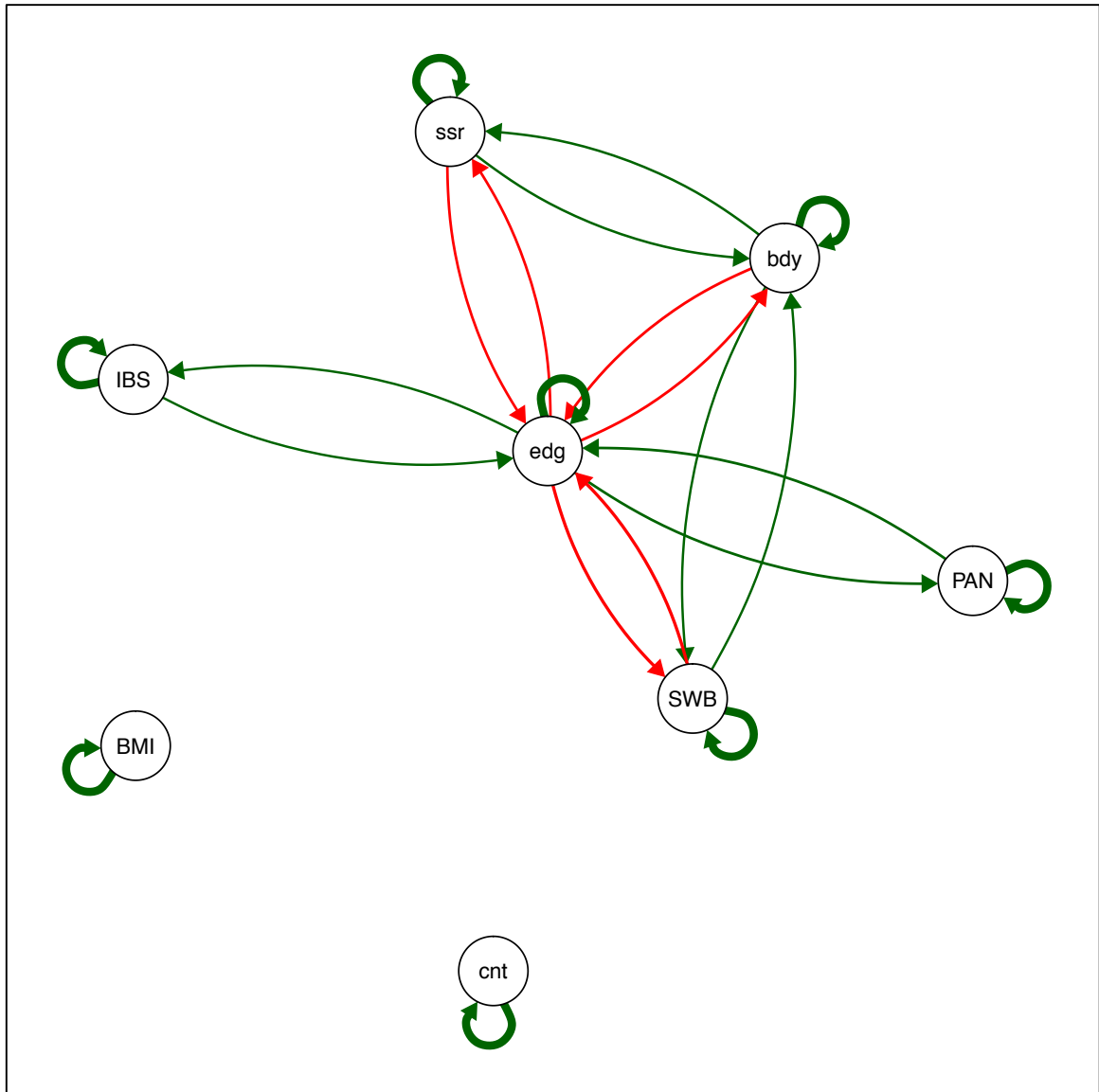


*Figure 3.* Network structure of baseline data. Red arrows indicate a negative relationship.

Figure 4. Network structure of follow-up data. Red arrows indicate a negative relationship.



*Figure 5.* Network structure for individuals who did not endorse objective overeating episodes at baseline. Network structure represent data across all time points. Red arrows indicate a negative relationship.



*Figure 6.* Network structures for individuals who endorsed objective overeating episodes at baseline. Network structure represent data across all time points. Red arrows indicate a negative relationship.

## Acknowledgement of Previous Publications

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## Appendix A

## Ideal Body Stereotype Scale-Revised

We want to know what you think attractive women look like. How much do you agree with these statements?

- | Strongly<br>disagree (1) | Somewhat<br>disagree (2) | Neither agree<br>nor disagree (3) | Somewhat<br>agree (4) | Strongly<br>agree (5) |
|--------------------------|--------------------------|-----------------------------------|-----------------------|-----------------------|
|--------------------------|--------------------------|-----------------------------------|-----------------------|-----------------------|
1. Thin women are more attractive.
  2. Tall women are more attractive.
  3. Women with toned bodies are more attractive.
  4. Slim women are more attractive.
  5. Women who are in shape are more attractive.
  6. Slender women are more attractive.
  7. Women with long legs are more attractive.
  8. Curvy women are more attractive.
  9. Shapely women are more attractive.
  10. Women who are taller are more attractive.

## PANAS-X

We would like to know how you have been feeling over the past few weeks. Please mark the appropriate number, which best reflects your agreement with each statement.

1	2	3	4	5
Very Slightly or Not at all	A little	Moderately	Quite a Bit	Extremely

1. Nervous
2. Disgusted with self
3. Guilty
4. Angry with self
5. Afraid
6. Dissatisfied with self
7. Alone
8. Blameworthy
9. Frightened
10. Sad
11. Jittery
12. Blue
13. Downhearted
14. Scared
15. Lonely
16. Shaky
17. Ashamed

## EATING QUESTIONNAIRE

Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all the questions. Thank you.

Questions 1 and 2: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days) only.

How many of the past 28 days...	No	1-5	6-12	13-15	16-22	23-27	Every
	days	days	days	days	days	days	day
	(0)	(1)	(2)	(3)	(4)	(5)	(6)

1. Have you had a definite fear of that 0      1      2      3      4      5      6  
you might gain weight?

2. Have you felt fat?                      0      1      2      3      4      5      6

3. Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?

4. ...On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)?

5. Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e., you have eating an unusually large amount of food and have had a sense of loss of control at the time)?

6. Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight?

7. Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight?

8. Over the past 28 days, how many times have you exercised in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat, or to burn off calories?

Questions 9-10: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days).

Over the past 28 days...	Not at All (0)	(1)	Slightly (2)	(3)	Moderately (4)	Markedly (5)	(6)
9. Has your weight influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
10. Has your shape influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6

What is your weight at present? (Please give your best estimate.)

What is your height? (Please give your best estimate.)

If female: Over the past three-to-four months have you missed any menstrual periods?

If so, how many?

Have you been taking the “pill”?



## Satisfaction with Body Parts Scale

Extremely dissatisfied (1)	Moderately dissatisfied (2)	Neutral (3)	Moderately satisfied (4)	Extremely satisfied (5)
-------------------------------	--------------------------------	----------------	-----------------------------	----------------------------

Over the past week, how satisfied were you with your:

1. Weight
2. Figure
3. Appearance of stomach
4. Body Build
5. Waist
6. Thighs
7. Buttocks
8. Hips
9. Legs

### Body Objectification

Please circle the response that indicates your attitude towards your body.

Strongly agree	agree	somewhat agree	neutral	somewhat disagree	disagree	strongly disagree
1	2	3	4	5	6	7

1. I often compare how I look with how other people look.
2. During the day I think about how I look many times.
3. I often worry about whether the clothes I am wearing make me look good.
4. I often worry about how I look to other people.
5. I feel ashamed of myself when I haven't made an effort to look my best.
6. I feel like I must be a bad person when I don't look as good as I could.
7. I would be ashamed for people to know what I really weigh.
8. When I am not exercising enough, I question whether I am a good person.
9. When I am not the size I think I should be, I feel ashamed.
10. I think I am pretty much stuck with the looks I was born with.
11. I think I could look as good as I wanted to if I worked at it.
12. I really don't think I have much control over how my body looks.
13. I think my weight is mostly determined by the genes I was born with.
14. I can weigh what I'm supposed to if I try hard enough.