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Socialization and Selection Effects in the Association between Weight Conscious Peer Groups and Thin-Ideal Internalization: A Co-Twin Control Study

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Abstract

Affiliation with weight conscious peer groups is theorized to increase thin-ideal internalization through socialization processes. However, selection effects could contribute if genetic and/or environmental predispositions lead to affiliation with weight conscious peers. Co-twin control methodology was used to examine socialization and selection effects in 614 female twins (ages 8–15) from the Michigan State University Twin Registry (MSUTR). Thin-ideal internalization and peer group characteristics were assessed via self-report questionnaires. Results suggested the presence of both socialization and selection effects. In terms of socialization, twins who reported increased exposure to weight conscious peers relative to their co-twins had elevated thin-ideal internalization scores, regardless of zygosity. However, associations between weight conscious peers and thin-ideal internationalization within twin pairs were attenuated, suggesting that genetic

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and shared environmental selection effects also contribute. Findings significantly extend previous work by confirming the presence of socialization processes and highlighting selection processes to be examined in future longitudinal research.

Keywords

Thin-ideal internalization; peer groups; socialization; selection; weight conscious

Thin-ideal internalization (i.e., the extent to which an individual accepts and attempts to attain socially defined ideals of beauty; Thompson & Stice, 2001) has been identified as a risk factor for the development of disordered eating and eating disorders (see reviews, Stice, 2002; Thompson et al., 2001). Interventions aimed at reducing thin-ideal internalization demonstrate promise in preventing the development of disordered eating (e.g., Stice, Becker, & Yokum, 2013). Knowledge of the etiology of thin-ideal internalization could lead to enhanced effectiveness of these prevention efforts, as new information on specific risk factors for thin-ideal internalization could be used to modify and strengthen existing prevention programs.

One potentially important factor is affiliation with weight conscious peer groups (i.e., peer groups that are highly focused on topics such as attractiveness, body weight, body shape, exercise, and dieting). These types of peer groups are included in theoretical models of the development of thin-ideal internalization and subsequent disordered eating (e.g., triparite model; Keery, van den Berg, & Thompson, 2004). Studies suggest significant cross-sectional correlations between weight conscious peer groups and thin-ideal internalization in adolescent girls, with moderate-to-large effect sizes (Clark & Tiggemann, 2006; Jones, Vigfusdottir, & Lee, 2004; Keery et al., 2004; Shroff & Thompson, 2006).

However, the lack of longitudinal or experimental studies to date limits the causal inferences that can be drawn. Specifically, rather than affiliation with weight conscious peer groups directly causing increases in thin-ideal internalization via socialization effects, it is possible that girls who are already more inclined toward thin-ideal internalization are more likely to select into weight conscious peer groups. Such selection effects would occur if pre-existing genetic and/or environmental factors lead an individual to select weight conscious peers (i.e., exposure to weight conscious peer groups is non-random). The possibility of genetic selection is consistent with the theory of gene-environment correlations, in which an individual's exposure to risk environments is influenced by (i.e., correlated with) their genotype (Scarr & McCartney, 1983). Thus, individuals with elevated genetic risk for thin-ideal internalization may also be more likely to select environments that perpetuate this risk. Environmental selection, on the other hand, would be present when environmental circumstances, such as family beliefs and behaviors regarding body image and weight (Rodgers & Chabrol, 2009), lead to selection of weight conscious peers. In either case, observed elevations in thin-ideal internalization in girls affiliated with weight conscious peer groups could be entirely or partially due to pre-existing genetic or shared environmental factors, rather than purely due to exposure to weight conscious peers (i.e., socialization processes).

One way to examine socialization and selection effects is through longitudinal research that examines whether pre-existing genetic and/or environmental factors drive an individual to select weight conscious peer groups (i.e., selection) and, while accounting for the effects of selection, also examine whether thin-ideal internalization increases as a result of exposure to weight conscious peers (i.e., socialization). Although some longitudinal research on weight conscious peer groups and *disordered eating* with these types of designs exists (for a summary of these studies, see O'Connor, Burt, VanHuysse, & Klump, in press), results have been mixed, and no such studies have focused on thin-ideal internalization as an outcome variable. Fortunately, there are methods to examine the role of socialization and selection effects indirectly using cross sectional data; most notably, the co-twin control design (McGue, Osler, & Christensen, 2010). Co-twin control studies compare outcomes in reared-together co-twins discordant on level of exposure to an environmental risk factor (Burt et al., 2010; McGue et al., 2010; Rubin, 2007). In order to infer the role of selection and/or socialization effects, the co-twin control model capitalizes on the common environmental and genetic background within twin pairs. Indeed, reared-together twin pairs are matched on shared environmental experiences (i.e., environmental influences that are common to co-twins such as age, socioeconomic status, and key sociocultural influences such as access to thin-focused media, parental focus on weight, etc.). Additionally, due to their genetic relatedness, twin pairs are entirely (in the case of identical twins) or partially (in the case of fraternal twins) matched on genetic predispositions. Thus, in the co-twin control design, shared environmental and genetic selection effects are controlled for, since twin-pair discordance in an exposure variable such as weight conscious peer groups cannot be explained by differences in genetic or shared environmental predispositions (McGue et al., 2010).

In order to determine whether selection effects are present, the co-twin control design utilizes comparisons of within-person effects and within-twin-pair effects. Within-person effects are analogous to traditional correlational designs because they examine associations between each individual twin's level of exposure to weight conscious peer groups and her own level of thin-ideal internalization. Within-twin-pair effects examine associations between discordance on degree of exposure to weight conscious peer groups and each twin's level of thin-ideal internalization. The within-twin-pair results in DZ twins are interpreted based upon genetic and environmental relatedness, as reared-together DZ twins share 50% of their genes and 100% of their shared environment. The within-twin-pair analyses in MZ twins provide the maximum control for selection effects, as MZ twins share 100% of their genes and shared environmental experiences. Indeed, since genetic and shared environmental selection effects are entirely controlled in MZ twins, a significant association between discordance in weight conscious peer group exposure and thin-ideal internalization in MZ twins cannot be due to genetic or environmental selection effects, and instead are explained by socialization effects (see Figure 1, Scenario A).

Alternatively, when the association between level of exposure to weight conscious peer groups and thin ideal-internalization is small and not significant in discordant MZ twins, either genetic and/or shared environmental selection effects are suggested (see Figure 1, Scenarios B and C), since levels of thin-ideal internalization within the twin pair are similar despite differential exposure to weight conscious peer groups. More specifically, Scenario B in Figure 1 suggests genetic selection effects, since the association is attenuated *only* in MZ twins, where genetic selection effects are controlled for entirely, but remains significant in DZ twins, where genetic selection effects are only partially controlled. Scenario C in Figure 1 suggests genetic and shared environmental selection effects, or shared environmental effects only, since an association is present only at the individual level, and is not present when genetic and environmental selection is partially or entirely controlled for (i.e., in MZ and DZ twins). Notably, when Scenario C is present, it is not possible to disentangle the specific role of shared environmental versus genetic selection effects. More specifically, Scenario C could emerge when *both* genetic and shared environmental selection is occurring, but Scenario C could also occur if only shared environmental selection is at play. For this reason, throughout the remainder of this manuscript, Scenario C is described as suggesting, "genetic and shared environmental selection or shared environmental selection only." However, Scenario C would not occur in the presence of only genetic selection, as this would be consistent with Scenario B. Unfortunately, since all twins within this sample were reared together, there are no comparisons within this model to identify purely shared environmental selection effects. Taken together, by comparing within-person effects (which do not control for selection effects), within twin-pair effects in DZ twins (which control for shared environmental selection and partially control for genetic selection), and within-twin-pair effects in MZ twins (which control for shared environmental and genetic selection), the co-twin control design allows for a test of socialization versus selection effects for thin-ideal internalization and weight conscious peer groups.

The present study aimed to investigate the role of socialization and selection effects in the association between exposure to weight conscious peer groups and thin-ideal internalization in a sample of pre-adolescent and adolescent female twins. Age, body mass index (BMI) and pubertal development were covaried in analyses, given significant associations between thin-ideal internalization and each of these variables (Hermes & Keel, 2003; Suisman et al., 2014), and evidence that BMI clusters among social groups (Fletcher, Bonell, & Sorhaindo, 2011). It is hoped that results will more clearly delineate whether exposure to weight conscious peer groups operates as a purely environmentally mediated risk variable (i.e., socialization) or whether genetic and environmental selection might contribute to the association between weight conscious peer groups and thin-ideal internalization.

Methods

Participants

Participants for the present study included 614 same-sex female twins (332 monozygotic; 282 dizygotic) between the ages of 8 and 15 ($M = 11.60$, $SD = 2.04$) from the ongoing *Twin Study of Mood, Behavior, and Hormones during Puberty* within the Michigan State University Twin Registry (MSUTR). Twins for the current study were recruited from the Michigan Twins Project (MTP), a population-based registry within the MSUTR that recruits all twins born in Michigan between the ages of 3–25 and 30–50 using birth records in collaboration with the Michigan Department of Community Health (Burt & Klump, 2013; Klump & Burt, 2006). All methods described herein were approved by the appropriate institutional review board, and twins under age 18 provided assent for study participation (with parental informed consent), and twins age 18 and over provided informed consent for participation. Although the MTP is on-going, at present, roughly 57% of twins invited to join the MTP database elected to participate, and participating families are similar to non-participating families in terms of family income, parental education, twin emotional and conduct problems, and a range of other variables (Burt & Klump, 2013). Additionally, participants from the MTP appear to be representative of the surrounding population from which they were drawn in terms of racial and ethnic background and income (Burt & Klump, 2013). Twins within the MTP that met current study age criteria (i.e., ages 8–15 years) and lived within driving distance of Michigan State University were invited to participate in the current study using recruitment methods that were identical to those of the MTP (Burt & Klump, 2013; Klump & Burt, 2006). The response rate for the current study is 73%.

The primary aim of the study from which data were drawn is to investigate ovarian hormone influences on disordered eating during puberty. Thus, several exclusion criteria were applied to ensure accurate hormone sampling (e.g., no recent psychotropic, steroid, or other medication use that is known to influence hormone functioning). As expected given the demographic criteria of the MTP overall, participants from the current study were representative of the population from which they were drawn in terms of racial and ethnic background (83% Caucasian, 10% African American, 8% Multiracial, 0.5% Asian). Participant parental income in the current study also represented a range of socioeconomic backgrounds. Specifically, 6% of participants reported family income less than $20,000 anually; 12% reported $20,000–$40,000; 18% reported $40,000–$60,000; 27% reported $60,000–$100,000; and 37% reported family incomes greater than $100,000 anually.

Procedure

As noted above, the current study utilized data collected in a larger study of ovarian hormone influences on disordered eating during puberty. Once recurited for study participation, participants were given the choice to complete the study at home or in the laboratory. Regardless of whether the assessments were conducted home or in the laboratory, the data were collected within a one-day visit that lasted approximately 5 hours. After consent/assent was completed, participant height and weight were collected using a wall-mounted ruler (in-lab assessments) or tape measure (home assessments) and a digital scale, respectively. Thin-ideal internalization, peer group, and pubertal development measures were completed within a battery of several other self-report questionnaires, including measures of personality, depression, anxiety, and disordered eating. During the visit, other data for the larger study were also collected, including biological samples (e.g., saliva for hormone analysis). An undergraduate research assistant was available to assist participants throughout the assessment battery, and participants were allowed as much time as needed to complete the questionnaires.

Measures

Zygosity determination—Twin zygosity was determined using a physical similarity questionnaire that has been shown to be over 95% accurate compared to genotyping (Lykken, Bouchard, McGue, & Tellegen, 1990). During the study, two research assistants independently completed the physical similarity questionnaire for the twin pair. Additionally, the twins' parent (usually the mother) completed the questionnaire on his/her twins. When results across any of the raters (i.e., parent and research assistants) were discrepant, questionnaire responses and pictures of the twins were examined by the principal investigator (KLK) and graduate students to determine final zygosity status.

Weight conscious peer groups—A composite weight conscious peer groups measure was utilized for the current study, which was based upon the four individual peer measures described below. Procedures and the rationale for computing the composite score follow the description of the individual measures.

Peer preoccupation with weight/dieting: The Perceived Friend Preoccupation with Weight and Dieting Scale (Schutz, Paxton, & Wertheim, 2002), is a 9-item self-report scale that assesses the degree to which a participant's friends think and talk about weight and dieting (e.g., "My friends encourage each other to lose weight", "Weight and shape are important to my friends"). Participants rate the extent to which each item is true for their friend group on a 5-point Likert scale ranging from 1 (*never/definitely not*) to 5 (*always/a lot*). Prior research suggests good internal consistency (Cronbach's alpha) in samples of adolescent girls (α = .86–.87; Schutz et al., 2002; Shroff & Thompson, 2006).

Appearance conversations with friends: The Appearance Conversations with Friends Scale (Jones et al., 2004) assesses the frequency in which participants engage in conversations with peers regarding physical appearance (e.g., "My friends and I talk about what we can do to look our best"; "My friends and I talk about how our bodies look in clothes"). The Appearance Conversations with Friends scale is a 5-item questionnaire and is rated on a 5-point Likert scale ranging from 1 (*never*) to 5 (*very often*). Prior investigations using this scale have demonstrated good internal consistency (α = .85–.88; Jones et al., 2004; Shroff & Thompson, 2006).

Friends as a source of influence: The Friends as a Source of Influence Scale (Paxton, Schutz, Wertheim, & Muir, 1999) is a 5-item scale that assesses how important participants think their friends' opinions are in influencing ideas regarding diets, having a "perfect" body, and weight loss techniques (e.g., "How important are your friends in influencing your idea of the perfect body?" and "How important are your friends in influencing the diets you use to lose weight?"). The items are rated on a 5-point Likert scale from 1 (*not at all important*) to 5 (*very important*). Internal consistency reported in prior studies was good (α = .86–87; Jones et al., 2004; Paxton et al., 1999).

Appearance peer attribution: The Appearance Peer Attribution Scale (Lieberman, Gauvin, Bukowski, & White, 2001; Shroff & Thompson, 2006) is a modified version of the full Peer Attribution Scale (Lieberman et al., 2001), which was created using the four appearance related items from the original scale (Shroff & Thompson, 2006). The Appearance Peer Attribution Scale assesses the degree to which a participant believes that her friends would like her more or that she would increase in popularity if she lost weight or were better looking (e.g., "My friends would like me more if I lost weight"). Each of the four items is rated on a 6-point likert scale ranging from 1 (*false*) to 6 (*true*). Internal consistency for this scale has been good in prior studies (α = 0.85; Shroff & Thompson, 2006).

Composite Measure of Weight Conscious Peers: A z-scored composite measure of self-reported exposure to weight conscious peer groups was created using the four measures described above. Although the construct is labeled "weight conscious peer groups" throughout this manuscript, it is important to acknowledge that some of the items do address appearance more generally. The decision to use a composite score was due to moderate-to-large correlations among the four individual scales (r = 0.31–0.56; Mean $r = 0.43$, $SD = 0.10$). Additionally, the use of one predictor composite score (versus four separate predictors) reduced the potential for type-I errors. To compute the composite weight conscious peer measure, scores for each individual peer scale were standardized, and an average composite score was computed. The majority of participants ($n = 555$, 90.4%) had data available for all four peer measures, with most remaining participants ($n = 45$, 7.3%) having data available for three out of the four peer measures. Thus, the average composite scores were calculated for participants with data for at least three of the four scales. Participants who were missing a score for two or more peer measures ($n = 14$, 2.3%) were excluded.

Thin-ideal internalization—Internalization of the thin-ideal was assessed using a modified version (see description of modifications below) of the general internalization subscale of the Sociocultural Attitudes toward Appearance Questionnaire-3 (Thompson, van den Berg, Roehrig, Guarda, & Heinberg, 2004). The general internalization subscale is commonly used to assess thin-ideal internalization in risk factor and intervention studies (Cafri, Yamamiya, Brannick, & Thompson, 2005; Coughlin & Kalodner, 2006; Yamamiya, Cash, Melnyk, Posavac, & Posavac, 2005). This subscale assesses the extent to which participants want to look like individuals from various media sources. Participants are asked to rate each item on a 5-point Likert scale from 1 (*definitely disagree*) to 5 (*definitely agree*). The general internalization subscale differentiates individuals with eating disorders from controls and demonstrates excellent internal consistency in prior samples (α >.90; Calogero, Davis, & Thompson, 2004; Thompson et al., 2004).

Although participants completed the full, 9-item original general internalization subscale as part of the study battery, only the three items that have been shown to have good factor structure in younger adolescents (Suisman et al., 2014) were used to compute the final thin-ideal internalization score. The 3-item scoring algorithm computes the average internalization score score using items 7 ("I would like my body to look like the models who appear in magazines"), 11 ("I would like my body to look like the people who are in movies"), and 15 ("I wish I looked like the models in music videos)" from the full SATAQ-3[1]. In the current sample, the correlation between scores using the 9-item versus 3-item versions of the questionnaire was quite high ($r = .84$, $p < .001$). Cronbach's alpha for

[1]Since many previous studies have used the 9-item version of the general thin-ideal internalization scale, all co-twin control analyses were run with the 9-item variable included as the outcome rather than the 3-item variable. The pattern of results were entirely consistent with those included herein (data not shown).

the modified 3-item scale was excellent in the current sample (α = .85). Rates of missing data were minimal for thin-ideal internalization (*n* = 16, 2.6%).

Age and pubertal development—Research suggests that mean levels of thin-ideal internalization increase across adolescence and puberty (Hermes & Keel, 2003; Suisman et al., 2014), despite relatively consistent genetic and environmental influences on thin-ideal internalization during this developmental period (Suisman et al., 2014). In order to ensure that phenotypic associations between age, pubertal development, and thin-ideal internalization do not unduly influence results of the current study, these variables were controlled for in all analyses. Similar to prior developmental studies of changes in the heritability of disordered eating and thin-ideal internalization (Culbert, Burt, McGue, Iacono, & Klump, 2009; Suisman et al., 2014), the Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988) was completed by each twin to assess pubertal development. The PDS is a self-report measure that assesses the extent to which participants have experienced physical markers of puberty (i.e., body hair growth, growth spurt, breast changes, skin changes, and onset of menarche). The stem of each item lists the physical marker of puberty in question (e.g., "Would you say your growth in height has…"). Participants then indicate whether development for each physical marker (1) *has not yet begun* (2) *has barely started* (3) *is definitely underway* or (4) *seems completed*. Menarche is rated as present (4) or absent (1). A PDS total score, indicating overall pubertal development, was computed by averaging all items. Prior research with this scale has indicated excellent reliability and validity (Culbert et al., 2009; Petersen et al., 1988), and Cronbach's alpha was good in the current sample (α = 0.86). In the current sample, there was no missing data for age and minimal missing data for pubertal development (*n* = 16, 2.6%).

Body mass index (BMI)—Given significant associations between BMI and thin-ideal internalization (Suisman et al., 2012, 2014), as well as evidence for clustering of BMI among friend groups (Fletcher et al., 2011), BMI was used as a covariate in all analyses. BMI was calculated ([weight])/[height]^2) from measures of height and weight made using a wall-mounted ruler or tape measure and digital scale, respectively. BMI data was available for the majority of the sample (missing data *n* = 6, 1%).

Statistical analyses

Data transformation—All descriptive and co-twin control analyses were conducted using SPSS (version 19). Prior to analyses, the composite weight conscious peer group measure was log transformed to account for positive skew and kurtosis. To account for negative values during log transformation, a constant of 1 was added prior to log transformation (the lowest value for the peer measure was −0.81). All outcome and predictor variables were also standardized to facilitate interpretation of unstandardized fixed-effect coefficients that result from multilevel models.

Co-twin control analyses—The co-twin control analyses used regression-based models within a multilevel model (MLM) framework (Burt et al., 2010; McGue et al., 2010). MLM accounts for the non-independence of the twin data within a pair by nesting a level-1 variable (individual twin) within a level-2 variable (the twin pair). The MLMs were used to examine within-person effects (i.e., associations between exposure to weight conscious peer groups and thin-ideal internalization within each twin) versus within-twin-pair effects (i.e., associations between co-twin discordance in exposure to weight conscious peer groups and thin-ideal internalization in each twin). The within-person effects were estimated by regressing thin-ideal internalization onto the exposure variable (weight conscious peer groups) using the equation:

$$y_{ij} = \beta_0 + \beta_1 x_{ij} + \varepsilon_{ij},$$

where y_{ij} is the observed outcome for the jth twin (j = 1,2) in the ith twin pair (i = 1,2,…,N), x_{ij} is exposure to weight conscious peer groups, β_1 is the within-person effect of peer group exposure on thin-ideal internalization, β_0 is the intercept term, and ε_{ij} is the residual (which is correlated across the two members of a twin pair).

Within-twin-pair effects, on the other hand, included a within-twin-pair (β_w) and a within-person (β_b) effect, using the following model:

$$y_{ij} = \beta_0 + \beta_w(x_{ij} - \bar{x_i}) + \beta_b \bar{x_i} + \varepsilon_{ij},$$

where $\bar{x_i}$ is the mean exposure index (peer group exposure) for the ith pair. By subtracting the *mean* exposure index within the twin pair from the level of exposure in the twin with higher exposure, the within-pair effect estimates the difference in exposure for each twin compared to what the exposure would be expected to be simply from being a member of that family.

In order to model all of these effects, the MLMs for the within-twin-pair analyses included the following variables: 1) each families' mean score on the exposure to weight conscious peers measure, which approximates the overall within-person effect; 2) the difference between each co-twin's score on the weight conscious peers measure and the pairs' mean on the scale (i.e., the within-twin-pair effect); 3) a dummy coded zygosity variable (i.e., MZ twins = 1; DZ twins = 2, and vice-versa, see below for further details) that identifies MZ versus DZ twins; 4) pubertal status; 5) BMI; 6) age; 7) an interaction between the zygosity variable and the family mean score on the weight conscious peers measure; and 8) an interaction between the zygosity variable and the within-twin-pair difference score.

The first interaction term (i.e., number 7, above) tested whether the mean score within the family differed by zygosity status, ensuring that there are not baseline differences in family mean exposure to weight conscious peer groups in MZ versus DZ twins. The final interaction term (i.e., number 8, above) tested for significant differences in within-pair effects between MZ and DZ twins (i.e., zygosity x within-twin-pair difference scores). In order to obtain estimates of the magnitude and significance of the main effects for both MZ and DZ twins, the within-twin-pair MLMs were repeated twice. In the first analysis, zygosity was coded with the DZ twins as the control (i.e., MZ twins = 2 and DZ twins = 1), and the second set included MZ twins as the control (i.e., MZ twins = 1, DZ twins = 2). The first model provided estimates of within-pair exposure for the MZ twins, while the second model provided these same estimates for DZ twins. Importantly, the use of this dummy coding strategy meant that differences in the magnitude of effects in MZ versus DZ twins could be directly tested using the interaction terms (i.e., numbers 7 and 8, above) while also allowing us to obtain individual estimates of effects in MZ and DZ twins (i.e., numbers 1–6, above).

In order to determine whether socialization and/or selection explain the association between weight conscious peer groups and thin-ideal internalization, the magnitude and significance of the within-person (i.e., β_b) and within-pair effects (β_w) was compared. As outlined previously (see Introduction) and in Figure 1, pure socialization effects are suggested if all effects were similar in magnitude and significance. Pure selection effects are suggested if β_w in MZ twins is small and non-significant. When MZ twin effects are small and non-significant, but effects in DZ twins are stronger, genetic selection effects are suggested (Figure 1, Scenario B). When effects are small in both MZ and DZ twins, genetic and shared environmental selection effects *or* only shared environmental selection effects are suggested (Figure 1, Scenario C). Importantly, results that do not represent either pure socialization or pure selection may fall intermediately between the scenarios described above. For example, all effects may be statistically significant, but *not* similar in magnitude (e.g., within-person effects > within-twin-pair effects), which would be interpreted to suggest some role of socialization (Scenario A) as well as genetic and shared environmental selection effects *or* only shared environmental selection effects (Scenario C).

Results

Descriptive Statistics

Table 1 includes descriptive statistics for the exposure (i.e., peer group measure) and outcome (i.e., thin-ideal internalization) variables. Included within Table 1 are descriptive statistics for both raw and within-pair difference scores. As shown in Table 1, raw scores on the composite peer measure and thin-ideal internalization did not differ significantly between MZ and DZ twins, providing reassurance that the zygosity groups were similar in terms of mean thin-ideal internalization and involvement with weight conscious peer groups. Similarly, difference scores suggested that co-twin discordance in peer groups did not significantly differ in MZ versus DZ twins.

Pearson correlations demonstrated that, as expected based on prior work (e.g., Keery et al., 2004), within-person correlations showed significant associations between weight conscious peer groups and thin-ideal internalization. Specifically, the association was moderate and statistically significant in the full sample ($r = .48$, $p < .01$), MZ twins only ($r = .49$, $p < .01$) and DZ twins only ($r = .46$, $p < .01$), with no significant differences in associations between MZ and DZ twins ($z = 0.47$, $p = .64$).

Co-Twin Control Analyses

Results of the co-twin control analyses, controlling for age, BMI, and pubertal development, are summarized below and in Figure 2. As a reminder, the MLM analyses resulted in unstandardized fixed-effect estimates. However, all variables were standardized prior to analyses to facilitate interpretation of these unstandardized effects, and thus can be interpreted similarly to standardized beta estimates. Within person-effect estimates were significant for both MZ twins ($b = 0.67$, $SE = 0.07$, $p < .01$) and DZ twins ($b = 0.59$, $SE = 0.07$, $p < .01$), which was expected based on the correlations reported above and prior research. Within-twin-pair effects were also statistically significant in both MZ ($b = 0.27$, $SE = 0.05$, $p < .01$) and DZ twins ($b = 0.15$, $SE = 0.04$, $p < .01$). The interaction between zygosity status and peer group exposure was not significant ($b = 0.12$, $SE = 0.07$, $p = .07$), suggesting minimal differences in effects for MZ versus DZ twins[2].

Graphing these results (see Figure 2) shows a pattern of effects that resembles both Scenarios A and C in Figure 1. Scenario A is suggested because associations between weight conscious peer groups and thin-ideal internalization were statistically significant within-person and within-twin-pairs. However, Scenario C also appears to be present, as the magnitude of estimates was attenuated within-twin-pairs (bs = 0.15–0.27) as compared to estimates within-individuals (bs = 0.59 – 0.67). Indeed, using the methods described by Cumming (2009) for comparing beta estimates, the within-twin-pair betas for both MZ and DZ pairs were significantly smaller ($p < .05$) than their respective within-person betas. If only socialization effects were present, we would expect the association between peer groups and thin-ideal internalization to be similar in magnitude across within-person and within-twin-pair analyses. The substantial attenuation within-twin pairs suggests that controlling for genetic and environmental selection reduces the magnitude of exposure effects, and supports a role for genetic and shared environmental or only shared environmental selection effects (Scenario C) in addition to socialization effects (Scenario A).

Discussion

Using a co-twin control design, this study demonstrated that the association between weight conscious peer groups and thin-ideal internalization appears to be driven by a combination of socialization (Scenario A) and genetic and shared environmental selection effects *or* only shared environmental selection effects (Scenario C). Findings were independent of BMI, age, and pubertal development, as these variables were covaried in all analyses. Results support previously theorized roles of peer groups in the development of thin-ideal internalization (Keery et al., 2004), which suggested that exposure to weight conscious peers likely increases thin-ideal internalization via social processes (i.e., socialization effects). However, results also highlighted the role of selection, such that joining certain peer groups is non-random, and girls at risk for thin-ideal internalization (due to genetic or environmental propensities) may select into like-minded peer groups. The use of the co-twin control method extended prior correlational results by providing support for hypothesized socialization effects, while also introducing the role of selection into this body of research.

The significant socialization effects observed in this study have implications for prevention and intervention work. The most effective and well-studied eating disorder prevention programs, cognitive dissonance programs (Stice et al., 2013), have been shown to reduce thin-ideal internalization and disordered eating in non-clinical and clinical samples of

[2]We also examined a model with no covariates, and findings were nearly identical to the model that included covariates. Specifically, all of the within-person and within-twin-pair effect estimates were significant for both MZ and DZ twins. Additionally, the within-twin-pair effect estimates were substantially smaller than the within-person analyses, also suggesting a mixture of Scenarios A and C (data not shown).

adolescent girls (e.g., Becker, Bull, Schaumberg, Cauble, & Franco, 2008; Becker, Smith, & Ciao, 2006; Coughlin & Kalodner, 2006; Stice et al., 2013; Stice, Rohde, Butryn, Menke, & Marti, 2015; Yamamiya et al., 2005). These prevention programs focus on changing interpretations of beauty ideals by providing psychoeducation on the realities of images presented in the media (e.g., digital editing of body sizes) and asking participants to engage in writing and other activities that actively argue against the thin-ideal. However, the significant peer socialization processes identified in the current study highlight the important role that interventions aimed at changing peer culture may play in reducing thin-ideal internalization. Recent studies have begun to examine these types of interventions, including a series of studies by Becker and colleagues (2006, 2008) that demonstrated reductions in thin-ideal internalization and disordered eating following the administration of peer-led cognitive dissonance intervention programs to entire non-residential college sororities. It is important to consider that the effects of these interventions may be partially driven through changing peer culture and interactions within the sorority, in addition to potential direct effects of the cognitive dissonance intervention. Additionally, prior intervention research in 11–13 year-old girls used many of the cognitive dissonance strategies described above, and also integrated modules that directly addressed weight conscious peer conversations ("fat talk"), including both psychoeducation and skill-building aimed to reduce fat talk (Richardson & Paxton, 2010). Results of this intervention were promising, as girls in the intervention group reported decreases in weight focused peer conversations, thin-ideal internalization, body comparison, body dissatisfaction, and dietary restraint immediately after program completion as well as at three-month follow-up. The socialization results identified in the current study provide further support for interventions to include strategies to reduce weight-focused conversations among peers.

Evidence also emerged for selection effects that reflect *both* genetic and shared environmental selection or shared environmental selection only. These findings suggest that girls who are predisposed toward thin-ideal internalization are more likely to select weight conscious peers. However, future work is needed to identify the specific influences driving selection into weight conscious peer groups, including shared environmental selection effects, and potentially genetic selection effects. One initial step in this regard would be to use multivariate twin models (e.g., Cholesky decomposition models) to disentangle the magnitude of common shared environmental and genetic influences between weight conscious peer groups and thin-ideal internalization. It is expected that common shared environmental factors would be significant in these models, given that findings consistent with Scenario C always suggest the presence of shared environmental selection effects. However, since it is unclear whether genetic selection effects are significant when co-twin control findings are consistent with Scenario C (i.e., genetic selection may or may not be present), it would be especially useful to test for the presence of common genetic factors using multivariate twin models. If there were significant common genetic factors, this would suggest that genetic selection effects are significant, in addition to shared environmental selection.

Once the role of selection effects are characterized (genetic and shared environmental versus shared environmental only), it will be important to identify specific factors that drive selection into weight conscious peer groups. If genetic selection effects play a role, this could be via heritable personality traits, such as perfectionism, which have been hypothesized to contribute to genetic risk for thin-ideal internalization (Suisman et al., 2012). Indeed, these same traits may also contribute to peer group selection (i.e., girls similar in personality may be more likely to form friendships with one another). Thus, genetic selection may be driven by heritable personality traits that increase genetic risk for thin-ideal internalization and also drive peer selection processes. It will also be important to identify the shared environmental factors (i.e., experiences that co-twins share and would make twins more likely to select similar peer groups) that contribute to selection. These experiences could be due to macro-level variables, such as influences within specific communities contributing to increased emphasis on the thin-ideal/disordered eating behaviors (e.g., the clustering of eating disordered behaviors within counties; see Forman-Hoffman & Cunningham, 2008). Micro shared environmental effects, such as family attitudes regarding weight/dieting (Rodgers & Chabrol, 2009), may also contribute.

Given the role of thin-ideal internalization in the development of disordered eating (Thompson et al., 2001), it is also important to consider these findings within the larger context of the etiology of disordered eating. Another recent study from the MSTUR (O'Connor et al., in press) used a co-twin control design to examine the association between weight conscious peer groups and *disordered eating symptoms*. The study by O'Connor et al. (in press) used the same methodology as the current study, it focused on nearly the same sample (92% overlap in participants), and it utilized the same peer measures. However, O'Connor et al. (in press) examined a range of *disordered eating symptoms*, rather than thin-ideal internalization, as outcome variables (i.e., body dissatisfaction, binge eating, weight preoccupation, overall disordered eating, eating in the absence of hunger, and emotional eating). Overall, the O'Connor et al. (in press) results did not demonstrate a strong role of socialization (i.e., Scenario A was generally not supported). Instead, the O'Connor et al. (in press) findings suggested a fairly consistent role of pure selection effects (i.e., Scenario C; genetic and environmental selection or shared environmental selection only). These findings differ from the current study, which suggested a combination of selection (Scenario C) and socialization (Scenario A) effects. The aggregation of results across the current study and the O'Connor et al. (in press) study suggests that complementary, but not identical, etiological processes may be involved in associations between weight conscious peer groups and disordered eating symptoms versus thin-ideal internalization. Effects of selection appeared to be particularly important for disordered eating symptoms (O'Connor et al., in press), while current results suggest that a combination of socialization and selection effects appear to be key in the association between weight conscious peer groups and thin-ideal internalization. Taken together, although selection effects appear to be important for both phenotypes, thin-ideal internalization seems to be more influenced by socialization/exposure factors than disordered eating. Since thin-ideal internalization can be conceptualized as a risk factor for disordered eating (e.g., Thompson et al., 2001), it is interesting to consider the role that socialization could have in increasing thin-ideal internalization, who may then develop disordered eating symptoms, and further self-select into even more "risky" peer groups. It will be important for future longitudinal work to continue to examine the complex but complementary roles of selection and socialization in the development of thin-ideal internalization, disordered eating symptoms, and clinical eating disorders.

Despite the strengths of the current study, there are several limitations to consider when interpreting results. The current data are cross-sectional, limiting the ability to confirm causal associations between peer groups and thin-ideal internalization. Although the co-twin control design is helpful for identifying the presence of socialization and selection effects, it does not allow for determination of the direction of the association between the risk factor (weight conscious peer groups) and outcome (thin-ideal internalization) without longitudinal designs (McGue et al., 2010). Given the robust theory suggesting that exposure to weight conscious peer groups precedes the development of thin-ideal internalization (e.g., the tripartite model of disordered eating; Keery et al., 2004) the association was conceptualized in this way throughout the current study. However, the possibility of a reverse effect cannot be ruled out, such that high levels of thin-ideal internalization in an individual causes her peer group, or her perceptions of her peer group, to become more weight conscious. Regardless of the direction of effects, the current study suggests that a combination of socialization and selection factors account for *associations* between weight conscious peer groups and thin-ideal internalization. Given the absence of longitudinal data at this time, this is an important step in understanding the role of selection and socialization effects.

Analyses in the current study were based entirely on self-report data, which introduces potential concerns with study data in two ways. First, objective data on the degree to which the peer groups were actually focused on weight were not available. Thus, we are unable to differentiate objective levels of weight consciousness in peer groups from participant perceptions of peer group weight consciousness. This means that co-twins might be discordant only in their *perceptions* of their peer group. Adding to this potential problem is that the co-twin with higher thin-ideal internalization may be more likely to describe her peers as weight conscious simply because she is more sensitive to or perceptive of these topics. If this is the case, there may be a bias toward finding socialization rather than selection effects in the current study, as the association between thin-ideal internalization and peer groups would be higher in the co-twin with elevated thin-ideal internalization as a result of her increased sensitivity to these topics, rather than actual differences in peer groups. However, some selection effects were noted in the current study, and the O'Connor et al. (in press) study did identify a stronger role of selection than socialization effects for disordered eating. These results provide reassurance that the use of self-report data did not prevent the identification of selection effects altogether. A second concern related to the use of self-report measures is the possibility that demand characteristics contributed to responses, as participants may have been more likely to respond to thin-ideal internalization items in ways consistent with their responses to the peer group items, especially since the thin-ideal internalization items immediately followed peer group questionnaires in the assessment battery. However, it seems unlikely that participants would identify the specific research questions assessed in the current study, given the number of constructs assessed throughout the assessment (see Procedures). However, future studies that are able to incorporate informant or other types of data (e.g., direct observation, peer self-reports) would be useful for extending the current findings beyond self-report measures and ensuring that demand characteristics do not account for current findings.

An additional limitation with our study design is that peer group measures assessed only the friends that the participants currently spend time with, but did not assess the peer groups that participants may wish to spend time with or were affiliated with in the past. That is to say, friendship is a two-way street that also evolves over time. It is possible that certain participants were previously affiliated with weight conscious peer groups but for various reasons, no longer affiliate with these peers (or vice-versa). It would be interesting to assess characteristics of past peer groups and desired peer groups to understand how these factors contribute to the results presented herein. For example, if a large portion of the sample desired to be friends with a weight conscious peer group due to selection processes, but were not accepted by the weight conscious group, the magnitude of selection effects could be suppressed. Conversely, if participants were previously affiliated with weight conscious peers, but no longer report being involved with weight conscious peer groups, the effects of socialization could be underestimated. Studies that assess changes to peer groups over time, and also consider desired peer groups, are needed to more fully assess these potential effects.

The co-twin control design does not control for nonshared environmental factors, or unique environmental experiences (e.g., experiencing differential levels of media exposure) that make co-twins different from one another (McGue et al., 2010). These nonshared factors could drive selection into peer groups (e.g., one twin selects into an weight conscious sport while the other does not). The presence of nonshared environmental selection would inflate estimates of *socialization* rather than selection effects, as they would cause differential exposure to weight conscious peer groups and differential levels of thin-ideal internalization in both MZ and DZ twins (i.e., Scenario A in Figure 1 would seem to be present, but it would be driven by nonshared environmental selection effects rather than socialization effects). Future co-twin control studies that explicitly examine nonshared experiences between twin pairs (e.g., differential exposure to thin-ideal media) are needed to rule out such effects. However, it is unlikely that nonshared environmental selection effects account entirely for current results, given that there was evidence for Scenario C (genetic and shared environmental selection or genetic selection only) in the current study.

Despite these limitations, this study provides evidence that observed associations between weight conscious peer groups and thin-ideal internalization are likely accounted for by a combination of socialization and selection effects (specifically, genetic and shared environmental selection or shared environmental selection only). The socialization effects support existing etiological models of thin-ideal internalization and disordered eating, which hypothesize that exposure to weight conscious peer groups leads to thin-ideal internalization via environmental effects. However, the significant role of selection effects supports modifications to these etiological models to incorporate shared environmental and genetic variables that may contribute to self-selection into weight conscious peer groups.

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Highlights

- Weight conscious peer involvement correlates with thin-ideal internalization
- Socialization and/or selection effects may account for this relationship
- The co-twin control design can identify socialization and selection effects
- Results suggest roles of both selection and socialization effects

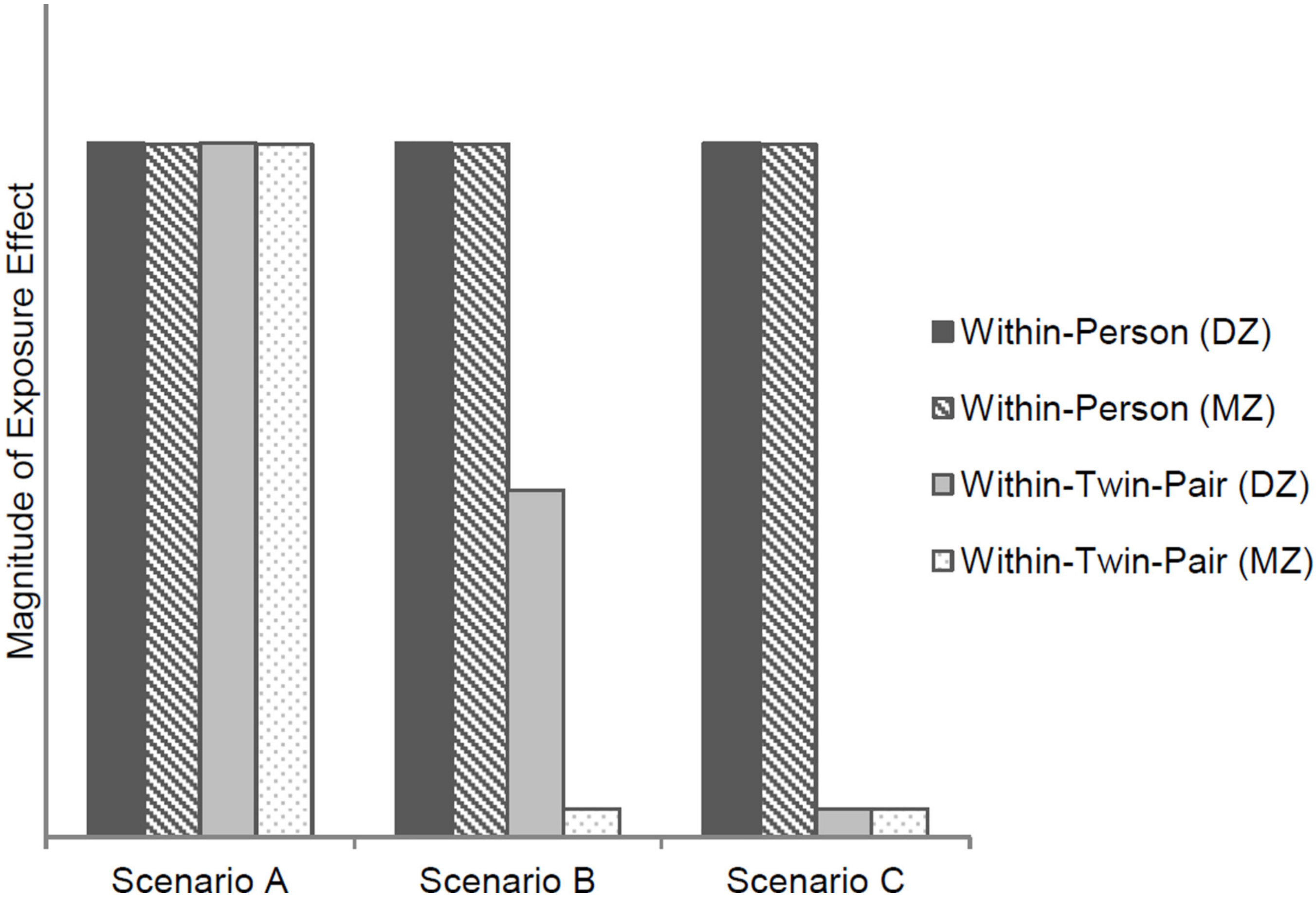

Figure 1.

Interpretation of results within a co-twin control design. Graph depicts hypothetical findings that would support Scenario A (socialization), Scenario B (genetic selection), or Scenario C (shared environmental and genetic selection *or* shared environmental selection only), as discussed in the text. For within-person effects, there are no expected differences between MZ and DZ twins regardless of role of socialization and/or selection, as these results are analogous to correlational results and do not control for any selection processes. For within-twin-pair effects, results in DZ twins control partially for genetic and entirely for shared environmental selection effects, while results in MZ twins control entirely for genetic and shared environmental selection effects.

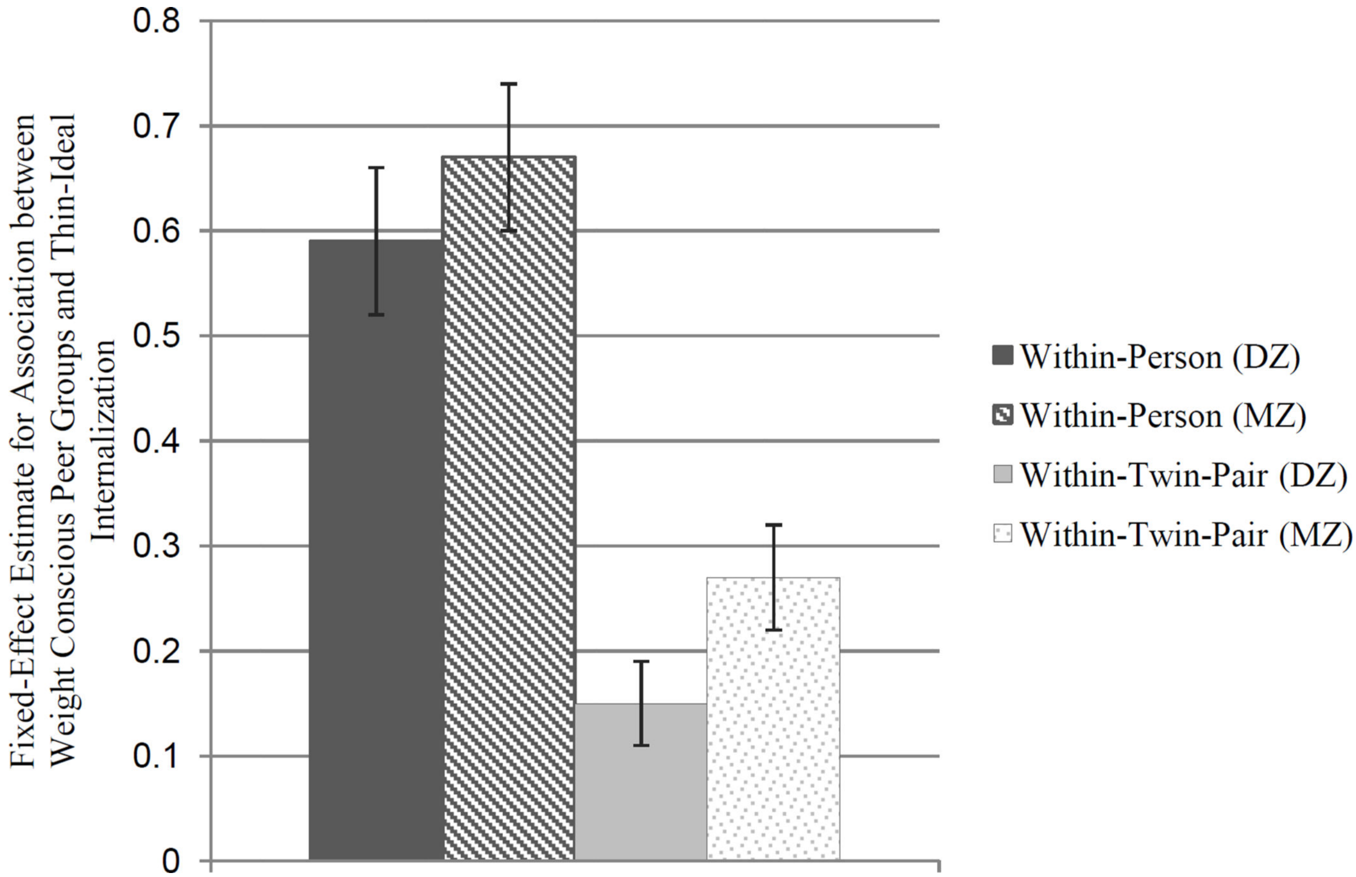

Figure 2.

Graphical Depiction of Co-Twin Control Results. Graphical depictions of fixed-effect estimates for co-twin control results. Results are depicted for the weight conscious peer composite measure predicting thin-ideal internalization. Standard error bars are presented. When compared to hypothetical findings depicted in Figure 1, it can be seen that these findings resemble a combination of Scenario A, since the magnitude of all effects are greater than zero and statistically significant, as well as Scenario C, since the magnitude of within-twin-pair effects in both MZ and DZ twins is reduced as compared to within-person effects. These results suggest that a combination of Scenario A (socialization) and Scenario C (shared environmental and genetic selection effects *or* shared environmental selection effects only) underlies the association between weight conscious peer groups and thin-ideal internalization.

Table 1

Descriptive Statistics for Raw Scores and Difference Scores

	Raw Scores				Difference Scores			
	MZ Twins *M (SD)*	**DZ Twins *M (SD)***	***t (df)***	***p***	**MZ Twins *M (SD)***	**DZ Twins *M (SD)***	***t (df)***	***p***
Weight Conscious Peer Groups (Composite)	−0.04 (0.71)	0.04 (0.78)	−1.25 (601)	.21	0.46 (0.50)	0.54 (0.52)	−1.33 (191)	.19
Thin-Ideal Internalization	2.00 (1.08)	1.99 (1.05)	0.13 (597)	.90	0.96 (0.90)	0.83 (0.77)	1.32 (289)	.38

Note. Raw score MZ Twin n = 323–324, Raw Score DZ Twin n = 276–279, Difference Score MZ Twin n = 157–163, Difference Score DZ Twin n = 137–138. Sample sizes for difference score analyses are approximately half the size of the sample sizes for raw score analyses as difference score analyses were conducted for each pair, while raw score analyses were calculated for each individual. Further, raw scores include all individuals that participated in the study, but difference scores were only able to be calculated for families in which data was available for both twins. Absolute values of sibling difference scores were used for all analyses presented in this table in order to present the range of sibling differences in peer groups and thin-ideal internalization.