Published in final edited form as:

Int J Eat Disord. 2016 February ; 49(2): 188–192. doi:10.1002/eat.22457.

Does Parental Divorce Moderate the Heritability of Body Dissatisfaction? An Extension of Previous Gene-Environment Interaction Effects

Shannon M. O'Connor, M.A.¹, Kelly L. Klump, Ph.D.¹, Jessica L. VanHuyse, Ph.D.², Matt McGue, Ph.D.³, and William Iacono, Ph.D.³

¹Department of Psychology, Michigan State University

²Department of Behavioral Medicine, Genesys Regional Medical Center, Consortium for Advanced Psychology Training, Michigan State University Flint Area Medical Education

³Department of Psychology, University of Minnesota

Abstract

Objective—Previous research suggests that parental divorce moderates genetic influences on body dissatisfaction. Specifically, the heritability of body dissatisfaction is higher in children of divorced versus intact families, suggesting possible gene-environment interaction effects. However, prior research is limited to a single, self-report measure of body dissatisfaction. The primary aim of the present study was to examine whether these findings extend to a different dimension of body dissatisfaction, body image perceptions.

Method—Participants were 1,534 female twins from the Minnesota Twin Family Study, ages 16–20 years. The Body Rating Scale (BRS) was used to assess body image perceptions.

Results—Although BRS scores were heritable in twins from divorced and intact families, the heritability estimates in the divorced group were not significantly greater than estimates in the intact group. However, there were differences in nonshared environmental effects, where the magnitude of these environmental influences was larger in the divorced as compared to the intact families.

Discussion—Different dimensions of body dissatisfaction (i.e., negative self-evaluation versus body image perceptions) may interact with environmental risk, such as parental divorce, in discrete ways. Future research should examine this possibility and explore differential gene x environment interactions using diverse measures.

Keywords

Body Dissatisfaction; Parental Divorce; Gene-Environment Interaction; Eating Disorders; Twins

---

Corresponding Author: Kelly L. Klump, PhD, MSU Foundation Professor, Department of Psychology, Michigan State University, 316 Physics Road- Room107B, East Lansing, MI 48824-1116, PH: 517-432-7281, Fax: 517-432-2476, klump@msu.edu.

Parts of this manuscript were presented at the Twenty Sixth Annual Meeting of the Society for Research in Psychopathology, Ann Arbor, MI October 4–7, 2012.

None of the authors have financial conflicts of interest.

Parental divorce has been implicated as a potential risk factor for the development of eating pathology (1–4.). However, little is known about the etiologic factors that might drive this association. While most research has focused on parental divorce as a purely environmental factor (5.), one study found that parental divorce may act as an environmental “trigger” that enhances genetic predispositions for disordered eating through gene-environment interactions (GxE). Suisman et al. (2011) found significantly higher heritability of body dissatisfaction in twins from divorced versus intact families. Interestingly, these GxE effects were specific to body dissatisfaction and were not found for other types of disordered eating (3.).

Additional studies are needed to confirm GxE effects and extend them to other dimensions of body dissatisfaction. Body image is a multidimensional construct that typically focuses on evaluations (e.g., dissatisfaction with the size or shape of the stomach, arms, etc.) or body image perceptions (i.e., believing that one’s body is larger or smaller than one’s perceived ideal) (6.). Although these two dimensions are correlated, they can also be distinct, as an individual could rate his/her ideal shape as thinner than his/her current shape, but not be distressed about this discrepancy. The body dissatisfaction questionnaire used by Suisman et al. (2011) focused on the evaluative component of body image (e.g., whether the participant believes specific body parts, such as the stomach, are too big), so little is known about whether body image perceptions also demonstrate GxE effects. Exploration of potentially distinct etiologic pathways for different dimensions of body dissatisfaction may allow for development of more targeted interventions (e.g., interventions that target negative evaluations but not an individual’s judgment of their body shape). The current study represents a first step in this process by examining whether previously demonstrated GxE effects for parental divorce and body dissatisfaction extend to body image perceptions.

METHODS

Participants

Participants included 1,534 adolescent female twins (MZ = 980 (63.9%), DZ = 554 (36.1%)) (see Table 1) from the Minnesota Twin Family Study (MTFS; 7–8.). The twins were drawn from two MTFS cohorts – one initially assessed at age 11 (and then re-assessed at age 17), and another initially assessed at age 17. Similar to Suisman et al. (2011), we used data from the 17-year-old assessment for both cohorts to avoid pubertal effects on genetic risk (9–11.). Notably, our sample partially overlapped (63%) with Suisman et al. (2011), who used data from the MTFS and the Michigan State University Twin Registry (MSUTR; 12–13.).

Measures

Zygosity Determination—Zygosity was determined using multiple measures (see 14.) that have been shown to be ~95% accurate (15–16.).

Parental Divorce—Parental divorce was measured via twin self report.

Body Image Perceptions—The Body Rating Scale (BRS; 17.) displays nine figures ranging from underweight to overweight and asks participants to select the figures that best

represent their current and their ideal figure. Body image perceptions were calculated by subtracting the current from the ideal figure (18.). While test-retest reliability has not been assessed in the BRS, the BRS correlates highly ($r=.85$) (17.) with the Figure Rating Scale (19.) that demonstrates excellent two-week test-retest reliability (i.e., .89–.92.:20). Within the present study, correlations between measured BMI and ratings of current figure on the BRS were large ($r=.70$), suggesting that self-ratings of body size on the BRS are in line with actual body size.

Data Analysis

Twin correlations were used to provide initial indications of differences in genetic and environmental influences in twins from divorced versus intact families. Cross-sectional, univariate structural equation models were then fit to the raw data using Mx (21.). These modeling procedures are discussed in detail elsewhere (22.), and therefore are only briefly characterized here. Two initial models were fit to the data: one constraining all of the parameters (i.e., additive genetic (A), shared environmental (C), and nonshared environmental (E) effects) to be equal across divorce and intact groups (Constrained model) and another allowing the parameters to vary (Unconstrained model). Several submodels that differentially constrained A, C, and E to be equal across groups were then compared to identify the best fitting model. Model fit was compared by subtracting the $-2\ln L$ of each model from that of a baseline model (i.e., a model that only estimated BRS variances, means, and covariances) to produce a likelihood-ratio chi-square test of goodness of fit. This chi-square was then used to calculate Akaike's Information Criterion (AIC; χ^2-2df), a measure of model fit versus model parsimony. In order to examine *differences* between nested biometric models, AIC values were compared (i.e., the smallest AIC indicated the best fitting model) and an additional likelihood-ratio chi-square test of goodness of fit was computed by subtracting the $-2\ln L$ value of the nested model from the Unconstrained model.

RESULTS

Independent sample t-tests revealed no statistically significant differences in mean levels of BRS body dissatisfaction between twins from divorced versus intact families. Interestingly, mean level differences also did not emerge in Suisman et al. (2011). Notably, a lack of strong phenotypic associations does not eliminate the possibility of GxE, as GxE may attenuate phenotypic associations.

Genetic influences appeared to be important in both groups, as the MZ twin correlations were larger than the DZ twin correlations. However, unlike Suisman et al. (2011), MZ/DZ differences were somewhat smaller (and not statistically significant) in the divorced group, suggesting the possible presence of shared environmental influences in this group only. The lower MZ twin correlations in the divorced group also hinted at more substantial nonshared environmental influences in divorced as compared to intact families.

The best-fitting model constrained additive genetic and shared environmental estimates to be equal across divorced and intact groups while allowing nonshared environmental estimates to vary (i.e., "Constrain AC") (Table 2) ¹. Standardized parameter estimates from this model

showed no significant contribution of the shared environment (estimated at 0%), but significant additive genetic (34–45%) and nonshared environmental (55–65%) influences in both groups. Unstandardized parameter estimates further showed that it was the nonshared environment that differed between groups, with larger nonshared environmental influences in divorced as compared to intact families (Table 2).

DISCUSSION

Our results extend prior findings by examining the effects of GxE on associations between parental divorce and body image perceptions, a different dimension of body dissatisfaction than previously examined. While the negative self-evaluation component of body dissatisfaction has demonstrated GxE effects (3.), we found no evidence that parental divorce enhances the heritability of body image perceptions. Indeed, the best-fitting model suggested no differences in genetic effects across divorced versus intact families.

Importantly, sample overlap (i.e., 68.3%) between the previous (3.) and current study make it unlikely that discrepant findings are due to sample characteristics. Moreover, post-hoc analyses using only the subgroup of MTFS twins who were in both studies showed identical results to those reported herein (i.e., the “Constrain AC” model was best fitting and parameter estimates were highly similar). Differences in results likely reflect unique etiologic mechanisms underlying the relationship between parental divorce and each dimension of body dissatisfaction. Specifically, parental divorce may act as a trigger of genetic predispositions for the negative self-evaluation component of body dissatisfaction, but not the perceived deviation of current body shape from ideal. Conceptually, it is possible that parental divorce may enhance genetic risk for negative affect more broadly, with the negative self-evaluation component of body dissatisfaction demonstrating GxE effects due to its relation to negative affect. Future studies should explore this possibility by replicating the differential effects of divorce on body dissatisfaction dimensions and modeling GxE effects on negative affect more broadly.

The current study also revealed that parental divorce may serve as a trigger for increased nonshared environmental influences on body image perceptions. This suggests that individual differences in how co-twins *experience* parental divorce (e.g., one twin having closer relations to the non-custodial parent) are important in whether a co-twin views her current body as deviating from her ideal. Moving forward, it will be important to identify the particular genetic and nonshared environmental factors that differentially contribute to each dimension of body dissatisfaction in divorced versus intact families.

While the current study had a number of strengths (e.g., large sample size), it was not without limitations. We observed a lower rate of parental divorce (20.4%) than the U.S. population average (e.g., 43–46%; 28.). Lower rates may have resulted in decreased power to detect significant differences between groups, particularly shared environmental effects

---

¹We also examined whether BMI or age at the time of the divorce significantly influenced results. To examine BMI, we regressed each twin's BMI from her BRS score prior to analyses. For age at the time of divorce, we followed the analyses of Suisman et al. (2011) and fit a 3-group constraint model (i.e., divorce before age 12, divorce after age 12, and intact families) to test for significant differences across groups. In all cases, the “Constrain AC” model continued to be the best fitting, and parameter estimates were nearly identical to those reported in Table 2.

that are difficult to detect with smaller samples (23.). Parental divorce was explored as a dichotomous variable (i.e., yes/no), and we did not examine the multitude of factors that may contribute to a child's experience of parental divorce (e.g., parental conflict prior to, during, and after the divorce; 24). The impact of a more nuanced view of parental divorce on GxE effects should be explored in future research. Finally, parental divorce is only one of many factors (e.g., trauma, parent-child conflict) that might activate genetic risk for body dissatisfaction. Future studies should examine whether GxE effects are specific to parental divorce or occur more broadly with exposure to other negative life events and experiences.

Acknowledgments

Funding/Support This research was supported by grants from the National Institute of Alcohol Abuse and Alcoholism (R01 AA 09367) awarded to Drs. McGue and Iacono and the National Institute on Drug Abuse (R01 DA 013240) awarded to Drs. McGue and Iacono. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Health, Michigan State University, or the University of Minnesota.

References

1. Martinez-Gonzalez MA, Gual P, Lahortiga F, Alonso Y, de Irala-Estevez J, Cervera S. Parental factors, mass media influences, and the onset of eating disorders in a prospective population-based cohort. *Pediatrics*. 2003; 111(2):315–20. [PubMed: 12563057]
2. Billingham RE, Abrahams T. Parental divorce, body dissatisfaction and physical attractiveness ratings of self and others among college women. *College Student Journal*. 1998; 32(1):148–52.
3. Suisman JL, Burt SA, McGue M, Iacono WG, Klump KL. Parental divorce and disordered eating: An investigation of a gene-environment interaction. *Int J Eat Disord*. 2011; 44(2):169–77. [PubMed: 21312202]
4. Shisslak CM, Crago M, McKnight KM, Estes LS, Gray N, Parnaby OG. Potential risk factors associated with weight control behaviors in elementary and middle school girls. *J Psychosom Res*. 1998; 44(3/4):301–13. [PubMed: 9587875]
5. Amato PR. Children's adjustment to divorce: Theories, hypotheses, and empirical support. *Journal of Marriage and the Family*. 1993; 55(1):23–38.
6. Hrabosky JJ, Cash TF, Veale D, Neziroglu F, Soll EA, Garner DM, Strachan-Kinser M, Bakke B, Clauss LJ, Phillips KA. Multidimensional body image comparisons among patients with eating disorders, body dysmorphic disorder, and clinical controls: A multisite study. *Body Image*. 2009; 6(3):155–63. [PubMed: 19410528]
7. Iacono WG, McGue M. Minnesota Twin Family Study. *Twin Res*. 2002; 5(5):482–7. [PubMed: 12537881]
8. Iacono WG, McGue M, Krueger RF. Minnesota Center for Twin and Family Research. *Twin Res*. 2006; 9(8):978–84.
9. Culbert KM, Burt SA, McGue M, Iacono WG, Klump KL. Puberty and the genetic diathesis of disordered eating attitudes and behaviors. *J Abnorm Psychol*. 2009; 118(4):788–96. [PubMed: 19899848]
10. Klump KL, McGue M, Iacono WG. Age differences in genetic and environmental influences on eating attitudes and behaviors in preadolescent and adolescent female twins. *J Abnorm Psychol*. 2000; 109(2):239–51. [PubMed: 10895562]
11. Klump KL, Burt SA, McGue M, Iacono WG. Changes in genetic and environmental influences on disordered eating across adolescence: A longitudinal twin study. *Arch Gen Psychiatry*. 2007; 64(12):1409–15. [PubMed: 18056549]
12. Klump KL, Burt SA. The Michigan State University Twin Registry (MSUTR): Genetic, environmental and neurobiological influences on behavior across development. *Twin Res*. 2006; 9(6):971–7.

13. Burt SA, Klump KL. The Michigan State University Twin Registry (MSUTR): An update. *Twin Res.* 2013; 16(1):344–50.
14. Iacono WG, Carlson SR, Taylor J, Elkins IJ, McGue M. Behavioral disinhibition and the development of substance-use disorders: Findings from the Minnesota Twin Family Study. *Dev Psychopathol.* 1999; 11:869–900. [PubMed: 10624730]
15. Lykken DT, Bouchard TJ Jr, McGue M, Tellegen A. The Minnesota Twin Family Registry: some initial findings. *Acta genet med gemellol.* 1989; 39(1):35–70. [PubMed: 2392892]
16. Peeters H, Gestel SV, Vlietinck R, Derom C, Derom R. Validation of a telephone zygosity questionnaire in twin of known zygosity. *Behav Genet.* 1998; 28(3):159–63. [PubMed: 9670591]
17. Sherman DK, Iacono WG, Donnelly JM. Development and validation of body rating scales for adolescent females. *Int J Eat Disord.* 1995; 18(4):327–33. [PubMed: 8580918]
18. Thompson, JK. *Body image disturbance: Assessment and treatment.* Elmsford, NY: Pergamon Press; 1990.
19. Stunkard, AJ.; Sorenson, T.; Schlusinger, F. Use of the Danish adoption register for the study of obesity and thinness. In: Kety, S.; Rowland, LP.; Sidman, RL.; Matthysse, SW., editors. *The Genetics of Neurological and Psychiatric Disorders.* New York: Raven Press; 1983. p. 115-120.
20. Thompson JK, Altabe MN. Psychometric qualities of the figure rating scale. *Int J Eat Disord.* 1991; 10(5):615–9.
21. Neale, MC. *Mx: Statistical modeling.* 3. Richmond, VA: Department of Psychology; 1995.
22. Neale, MC.; Cardon, LR. *Univariate Analysis. Methodology for Genetic Studies of Twins and Families.* Netherlands: Springer; 1992. p. 149-87.
23. Martin NG, Eaves LJ, Kearsy MJ, Davies P. The power of the classical twin study. *Heredity.* 1978; 40:97–116. [PubMed: 272366]
24. Amato PR, Loomis LS, Booth A. Parental divorce, marital conflict, and offspring well-being during early adulthood. *Social Forces.* 73(3):895–915.

Sample Characteristics.

Table 1

			Intact vs. Divorce Mean Comparisons			
	Full Sample	Intact Families	Divorced Families	<i>t</i> (<i>df</i>)	<i>p</i>	<i>d</i>
<i>N</i>	1,534	1,222	312	--	--	--
MZ Pairs	980	774	206	--	--	--
DZ Pairs	554	448	106	--	--	--
Mean Age (SD) [Age Range]	17.75 (0.59) [16.55 to 19.70]	17.73 (0.58) [16.55 to 19.70]	17.82 (0.63) [16.58 to 19.50]	2.09 (1324)	.04	.15
Mean BMI (SD) [BMI Range]	23.46 (4.69) [16.08 to 52.02]	23.35 (4.43) [16.08 to 52.02]	23.88 (5.62) [16.40 to 51.57]	1.43 (358.43)	.15	.10
BRS Difference Score [BRS Range]	0.96 (1.04) [-3.00 to 6.00]	0.95 (1.01) [-3.00 to 6.00]	1.00 (1.17) [-2.00 to 6.00]	0.67 (435.79)	.50	.05
Body Rating Scale Difference Score^a						
Ideal thinner (%)	1,004 (65.5%)	806 (66.0%)	198 (63.5%)	<i>z^b</i>	<i>p</i>	
Ideal same (%)	475 (31.0%)	375 (30.7%)	100 (32.1%)	-0.85	.40	
Ideal larger (%)	54 (3.5%)	40 (3.3%)	14 (4.5%)	0.46	.65	
				1.04	.30	
Twin Correlations						
MZ Pairs	0.41 ***	0.43 ***	0.38 ***	--	--	
DZ Pairs	0.24 ***	0.21 ***	0.27 ***	--	--	
<i>Z^c</i>	3.58 **	4.14 **	1.02	--	--	

Note. BRS = body rating scale; MZ = monozygotic. DZ = dizygotic

^aNegative BRS difference scores indicate that the ideal body type was rated as larger than the current body type, while positive BRS difference scores indicate that the ideal body type was rated as smaller than the current body type. A BRS difference score of 0 indicates that the ideal and current body types were the same.

^bThe *z*-test examines differences in proportions between the intact and divorced group.

^cThe *z*-test examines differences between the MZ and DZ twin correlations.

* *p* < .05;

** *p* < .01;

*** *p* < .001.

The twin correlation is significantly different from 0.

Table 2

Model fitting results in intact versus divorced families

Models	Intact Families (<i>n</i> =1,221)				Divorced Families (<i>n</i> =312)				Fit Statistics			
	<i>a</i> ²	<i>c</i> ²	<i>e</i> ²	<i>a</i> ²	<i>c</i> ²	<i>e</i> ²	-2lnL (df)	-2lnL (df)	-2lnL (df) ^a	-2lnL (df) ^b	<i>p</i>	AIC
Baseline	--	--	--	--	--	--	4342.93 (1513)	--	--	--	--	--
Fully Unconstrained												
<i>Std. Estimates</i>	.44 (.17-.51)	.00 (.00-.23)	.56 (.49-.64)	.29 (.00-.55)	.11 (.00-.46)	.60 (.45-.78)						
<i>Unstd. Estimates</i>	.45 (.18-.55)	.00 (.00-.24)	0.57 (.50-.66)	.40 (.00-.84)	.15 (.00-.68)	.82 (.63-1.10)	4356.45 (1525)	13.52 (12)	--	--	--	-10.48
Fully Constrained												
<i>Std. Estimates</i>	.41 (.16-.50)	.02 (.00-.24)	.57 (.50-.65)	--	--	--						
<i>Unstd. Estimates</i>	.44 (.17-.57)	.02 (.00-.26)	.62 (.55-.70)	--	--	--	4369.30 (1528)	26.37 (15)	12.85 (3)	--	<0.01	-3.63
Constrain A only												
<i>Std. Estimates</i>	.44 (.19-.51)	.00 (.00-.22)	.56 (.49-.64)	.32 (.14-.42)	.08 (.00-.29)	.59 (.47-.74)						
<i>Unstd. Estimates</i>	.45 (.19-.55)	.00 (.00-.23)	.57 (.50-.66)	.45 (.19-.55)	.11 (.00-.43)	.82 (.65-1.05)	4356.47 (1526)	13.54 (13)	.02 (1)	0.89	0.89	-12.46
Constrain C only												
<i>Std. Estimates</i>	.44 (.17-.51)	.00 (.00-.23)	.56 (.49-.65)	.41 (.15-.55)	.00 (.00-.18)	.59 (.45-.76)						
<i>Unstd. Estimates</i>	.44 (.17-.55)	.00 (.00-.24)	.57 (.50-.66)	.56 (.20-.85)	.00 (.00-.24)	.81 (.63-1.06)	4356.65 (1526)	13.72 (13)	.20 (1)	0.65	0.65	-12.28
Constrain E only												
<i>Std. Estimates</i>	.37 (.09-.47)	.03 (.00-.28)	.60 (.53-.68)	.53 (.14-.62)	.00 (.00-.37)	.47 (.38-.57)						
<i>Unstd. Estimates</i>	.38 (.09-.51)	.03 (.00-.29)	.62 (.55-.70)	.69 (.18-.96)	.00 (.00-.49)	.62 (.55-.70)	4362.27 (1526)	19.34 (13)	5.82 (1)	0.02	0.02	-6.66
Constrain AC only												
<i>Std. Estimates</i>	.44 (.18-.52)	.01 (.00-.24)	.55 (.48-.63)	.34 (.14-.43)	.01 (.00-.19)	.65 (.57-.73)						
<i>Unstd. Estimates</i>	.45 (.19-.56)	.01 (.00-.24)	.57 (.50-.65)	.45 (.19-.56)	.01 (.00-.24)	.86 (.69-1.08)	4357.39 (1527)	14.46 (14)	0.94 (2)	0.63	0.63	-13.54
Constrain AE only												
<i>Std. Estimates</i>	.40 (.17-.47)	.00 (.00-.20)	.60 (.53-.68)	.33 (.14-.43)	.18 (.04-.37)	.49 (.40-.59)						
<i>Unstd. Estimates</i>	.42 (.18-.52)	.00 (.00-.21)	.62 (.56-.71)	.41 (.18-.52)	.23 (.04-.53)	.62 (.56-.71)	4363.47 (1527)	20.54 (14)	7.02 (2)	0.03	0.03	-7.46
Constrain CE only												
<i>Std. Estimates</i>	.38 (.12-.47)	.02 (.00-.25)	.60 (.53-.68)	.52 (.28-.62)	.01 (.00-.20)	.47 (.38-.57)						
<i>Unstd. Estimates</i>	.40 (.12-.51)	.02 (.00-.26)	.62 (.55-.70)	.68 (.34-.96)	.02 (.00-.26)	.62 (.55-.70)	4362.30 (1527)	19.37 (14)	5.85 (2)	0.05	0.05	-8.63

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Note. a^2 = additive genetic effects, c^2 = shared environmental effects, e^2 = nonshared environmental effects; AIC = Akaike's Information Criterion. Columns for a^2 , c^2 and e^2 show standardized (labeled "Std. Estimates") and unstandardized (labeled "Unstd. Estimates") parameter estimates with 95% confidence intervals in parenthesis. The best fitting model (bolded and outlined) is that which constrains the additive genetic and shared environmental factors to be equal across twins from intact and divorced families.

p Difference in $-2\ln L$ from the baseline model; used to calculate AIC.

q Difference in $-2\ln L$ from the Unconstrained model; p values compare the fit of the model relative to the fully unconstrained model.