Running Head: VICTIMIZATION, FRIENDS, ANXIETY

This is an Accepted Manuscript of an article published by Taylor & Francis Group in Journal of Clinical Child & Adolescent Psychology on 2015, available online: https://www.tandfonline.com/doi/abs/10.1080/15374416.2013.873984?journalCode=hcap20.

The Dark Side of Friends: A Genetically Informed Study of Victimization Within Early Adolescents' Friendships

Mara Brendgen[1,2]

Alain Girard [2]

Frank Vitaro [2,3]

Ginette Dionne [4]

Michel Boivin [4]

[1]Department of Psychology, University of Quebec at Montreal, Montréal, Canada; [2]Ste-Justine Hospital Research Center, Montreal, Quebec, Canada; [3]School of Psycho-Education, University of Montreal, Montreal, Canada; [5]Department of Psychology, Laval University, Quebec City, Canada;

Corresponding Author: Mara Brendgen, Ph.D., Department of Psychology, University of Quebec at Montreal, C.P. 8888 succursale Centre-ville, Montreal, Quebec, Canada, H3C 3P8, email: Brendgen.Mara@uqam.ca.

Funding for this study was provided by the Social Sciences and Humanities Research Council of Canada, the Canadian Institutes of Health Research, and the Fonds de Recherche en Santé du Québec. We thank Jocelyn Malo and Marie-Elyse Bertrand for coordinating the data collection and Hélène Paradis for data management and preparation. We also thank the twins and their families as well as their classmates for participating in this study.

Abstract

Objective. Using a genetically informed twin design, this study examined 1) whether, in line with gene-environment correlation (rGE), a genetic disposition for anxiety puts children at risk of being victimized by a close friend or by other peers, and 2) whether, in line with gene-environment interaction (GxE), victimization by a close friend or by other peers moderates the expression of a genetic disposition for anxiety.

Method. Participants were 268 monozygotic and dizygotic twin pairs (MZ males = 71, MZ females = 80, DZ males = 56, DZ females = 61; 87% of European descent) assessed via questionnaires in grade eight (mean age = 14.06 years, SD = 3.60). Participants reported about their victimization by a close friend and by other peers and their anxiety level.

Results. Victimization by a close friend and victimization by other peers were uncorrelated. In line with rGE, genetic factors related to anxiety predicted victimization by other peers whereas victimization by a close friend was not predicted by heritable characteristics. Moreover, in line with a suppression process of GxE, victimization by other peers reduced the role of genetic factors in explaining inter-individual differences in anxiety. In contrast, in line with a diathesis-stress process of GxE, victimization by a close friend fostered the expression of a genetic disposition for anxiety.

Conclusions. Victimization by a close friend seems to happen to adolescents regardless of their personal, heritable characteristics. If it does occur, however, it is a source of distress mostly for youth with a genetic vulnerability for anxiety.

Keywords: Peer victimization, friendship, anxiety, gene-environment correlation, gene-environment interaction

The Dark Side of Friends: A Genetically Informed Study of Victimization Within Early Adolescents' Friendships

Victimization among children and adolescents is a major problem in many countries around the world (Smith et al., 1999). Canadian data show that 30% of boys and 24% of girls are being beaten up, threatened, taunted, or humiliated by their peers (Craig, Wang, Goldbaum, Peters, & Silverman, 2000). Peer victimization carries severe risks for the victims. In addition to conduct problems and school-related difficulties, victimized youth often develop serious internalizing problems such as anxiety and depressed affect (Juvonen, Wang, & Espinoza, 2011; Reijntjes et al., 2011; Reijntjes, Kamphuis, Prinzie, & Telch, 2010). Most research on peer victimization has focused on victimization perpetrated by classmates or relatively unfamiliar peers. There is increasing evidence, however, that youth may also experience relational or even physical abuse in close relationships that hold specific significance to them, such as their dyadic friendships (Crick & Nelson, 2002; Daniels, Quigley, Menard, & Spence, 2010; Kawabata, Crick, & Hamaguchi, 2010; Mishna, Wiener, & Pepler, 2008). Experiences of abuse in this dyadic relationship context may not only pose a threat for victims' emotional well-being but also serve as a social learning environment that reinforces the submissive or hostile-reactive behavior characteristic of many victimized children. Several scholars have therefore emphasized that maltreatment within the friendship context warrants urgent attention (Crick & Nelson, 2002; Mishna et al., 2008). Little is known, however, about the risk factors and consequences of victimization within close dyadic friendships. The present study addressed these issues using a genetically informed design.

Victimization by a Close Friend

Friendships have typically been considered as an important positive force in youngsters' lives, especially for victimized youth. Numerous studies suggest that both the risks and the consequences of peer victimization may be attenuated for youth who have one or more good friends (Hodges, Boivin,

Vitaro, & Bukowski, 1999; Kendrick, Jutengren, & Stattin, 2012; Lamarche et al., 2007; Lamarche et al., 2006; Schwartz, McFadyen-Ketchum, Dodge, Pettit, & Bates, 1999). Friends may not always be a source of support, however. Although studies on this topic are scarce, between 5% and 30% of youth report experiencing abuse from their close friends (Crick & Nelson, 2002; Daniels et al., 2010; Mishna et al., 2008; Waasdorp, Bagdi, & Bradshaw, 2010). Whereas in girls' friendships this abuse mainly takes the form of relational victimization (e.g., having secrets revealed, being ridiculed, conspired against, or purposely neglected), boys often experience both relational and physical maltreatment from their friends (Crick & Nelson, 2002; Daniels et al., 2010). Importantly, both physical and relational forms of victimization occur even in relationships that are considered by both friends as their best friendship. Indeed, youth in reciprocated friendships do not report less victimization perpetrated by their friend than youngsters in unilateral friendships (Daniels et al., 2010).

In light of the salience of close dyadic friendships for children and adolescents, it is not surprising that victimization by a close friend is associated with serious internalizing problems such as low self-esteem, anxiety, or depressed affect (Crick & Nelson, 2002). However, the only study - to our knowledge - that has examined the links between victimization within dyadic friendships and youngsters' internalizing problems was based on cross-sectional data (Crick & Nelson, 2002). As noted by Reijntjes and colleagues (2010), many theorists view peer victimization primarily as a cause of future adjustment problems. Given that experiences of social rejection and humiliation trigger the same neurological responses as physical pain (Eisenberger, 2012), it is indeed conceivable that peer victimization may cause worry, fear and avoidance of potentially stressful social interactions through submissive behavior. In line with this notion, research shows that victimization by the larger peer group is associated with a significant increase in internalizing problems, including anxiety (for a meta-analysis, see Reijntjes et al., 2010). Such reactions might be even more intense when the abuse is perpetrated by someone who is or has been considered a friend. Inversely, anxious behavior may also

lead to victimization by peers. Advocates of this view maintain that youth who show fearfulness and submissiveness signal an inability to effectively defend themselves against attacks, which may lead aggressors to expect impunity for their behavior (Hodges & Perry, 1999; Perry, Williard, & Perry, 1990; Storch, Masia-Warner, Crisp, & Klein, 2005). Moreover, a propensity for manifesting outward signs of fear and submissiveness has been shown to further reinforce peers' aggressive behavior (Schwartz, Dodge, & Coie, 1993). A meta-analysis of existing research also supports this view, showing that pre-existing internalizing problems, including anxiety, are a significant risk factor of victimization experienced in the larger peer group context (Reijntjes et al., 2010). Youth with these characteristics may thus also be at greater risk of being victimized by their close friends. Indeed, it has been suggested that especially anxious-submissive behavior may increase the risk of being victimized by a close friend as it may reinforce aggressive dominance in the interaction partner (Mishna et al., 2008). Moreover, given that anxiety symptoms such as worry and fear are considered proximal stress responses that are more frequent than - and often precede - depressive symptoms in children and adolescents (Zahn-Waxler, Klimes-Dougan, & Slattery, 2000), examining anxiety as a potential outcome of victimization by a close friend may be of particular relevance.

The Usefulness of a Genetically Informed Design for Examining the Association Between Anxiety and Victimization By a Close Friend

Because ethical concerns preclude the use of experimental designs, studies examining the association between mental health problems such as anxiety and peer victimization are typically based on a correlational design using standard singleton samples (i.e., one child per family). However, even longitudinal correlational designs with singletons cannot provide a completely valid test of whether, for example, anxious behavior puts youth at risk of victimization by a close friend or whether, in turn, such experiences foster anxiety. An alternative and complimentary solution is the use of a genetically informed design, such as a behavioral genetic study based on twins (Moffitt,

2005; Pearson, 2007). By disentangling genetic from environmental sources of inter-individual variance, behavioral genetics can help examine to what extent inter-individual differences in victimization by a close friend are explained a) by genetic factors that are inherent to individuals themselves and b) by environmental factors. An extension of such an analysis would allow assessing to what extent genetic factors or environmental factors associated with anxiety also contribute to the risk of victimization by a close friend. A finding of correlated genetic factors that simultaneously influence anxiety and victimization would be consistent with a gene-environment correlation (rGE) process whereby a child's genetic vulnerability for anxiety (G) leads to – and thus becomes correlated with – maltreatment by peers in general or by a close friend (E). This is a) because genetic vulnerability factors are assumed to impact a social experience such as victimization through their effect on outwardly observable manifestations such as anxious behavior and b) because environmental factors that may simultaneously influence anxiety and victimization are controlled in the analyses. Findings from behavioral genetic studies indeed suggest that anxiety in children and adolescents is to a significant extent influenced by genetic factors (Frani, Middeldorp, Dolan, Ligthart, & Boomsma, 2010; Gregory & Eley, 2007). Genetic influences have also been found for generalized peer victimization, without specifying the source of victimization (Ball et al., 2008; Brendgen et al., 2011). It is unclear, however, whether a genetic propensity for anxious behavior is associated with an increased risk of being victimized by a close friend.

Controlling for such a potential rGE, behavioral genetic studies can also examine whether victimization by a close friend can contribute to explaining inter-individual differences in anxiety. Of particular interest in this context is the question whether and how victimization by a close friend interacts with genetic factors to predict anxiety. Such a gene-environment interaction (GxE) may be in line with a diathesis-stress process, such that victimization by a close friend triggers or exacerbates the expression of a genetic predisposition for anxiety. This pattern would also be consistent with the

idea that victimization by a close friend leads to anxiety symptoms most strongly in those youth with a genetic vulnerability for such problems. Conversely, it is possible that a potential stressor such as victimization by a close friend reduces the role of genetic factors in explaining anxiety symptoms. Such a suppression process of GxE would indicate that victimized youngsters show increased anxiety even when they do not possess an inherent vulnerability for developing anxiety symptoms. The few existing studies so far provide evidence for both types of GxE in the link between peer-related stressors and internalizing problems. Thus, in line with a diathesis-stress process of GxE, findings from two molecular genetic studies show that internalizing problems are especially pronounced in victimized children and adolescents who carry two 5-HTTLPR short alleles, a genotype that increases vulnerability to developing internalizing problems (Benjet, Thompson, & Gotlib, 2010; Sugden et al., 2010). In contrast, and more in line with a suppression process of GxE, findings from a quantitative genetic study with six-year old twins revealed that rejection by the peer group reduces the role of genetic factors in explaining teacher-rated internalizing symptoms (Brendgen et al., 2009). Again, however, none of these studies identified the specific source of stress (i.e., close friends versus other peers). It thus still remains to be seen whether victimization by a close friend interacts with genetic vulnerabilities in explaining inter-individual differences in internalizing problems, notably anxiety.

The Present Study

To address the previously mentioned issues, the present study used a genetically informed design based on early adolescent twins raised together to test 1) whether, in line with a gene-environment correlation (rGE), a genetic disposition for anxiety puts youth at risk of being victimized by close friends, and 2) whether, in line with a gene-environment interaction (GxE), victimization by a close friend moderates the expression of a genetic disposition for anxiety. The same rGE and GxE were also examined in the link between anxiety and victimization by other peers. These comparative analyses were important to examine whether the observed results are specific to victimization by a

close friend or whether they generalize to all victimization experiences at the hand of peers, irrespective of the specific source. If necessary, any overlap between victimization by a close friend and victimization by other peers was controlled in the analyses. These issues were addresses during early adolescence, when youngsters are believed to be particularly vulnerable to anxiety reactions due to increased importance of peer relationships compared to younger children (Storch et al., 2005).

Methods

Sample

The 268 twin pairs (MZ males = 71, MZ females = 80, DZ males = 56, DZ females = 61) participating in this study were part of a population-based sample of 448 MZ and same-sex DZ twin pairs from the greater Montreal area who were recruited at birth between November 1995 and July 1998. Zygosity was assessed by genetic marker analysis of 8-10 highly polymorphous genetic markers and twins were diagnosed as MZ when concordant for every genetic marker. When genetic material was insufficient or unavailable due to parental refusal (43% of cases), zygosity was determined based on physical resemblance questionnaires at 18 months and again at age 9 (Goldsmith, 1991; Spitz et al., 1996). The comparison of zygosity based on genotyping with zygosity based on physical resemblance in a subsample of 237 same-sex pairs revealed a 94% correspondence rate, which is extremely similar to rates obtained in other studies (Magnusson et al., 2013; Spitz et al., 1996). Eighty-seven percent of the families were of European descent, 3% were of African descent, 3% were of Asian descent, and 1% were Native North Americans. The remaining families did not provide ethnicity information. Demographic characteristics of the twin families were comparable to those of a sample of single births representative of urban centers in the province of Quebec. At the time of their child(ren)'s birth, 95% of parents lived together; 66% of mothers and 60% of fathers were between 25 and 34 years old; 17% of mothers and 14% of fathers had not finished high school; 28% of mothers and 27% of fathers held a

university degree; 83% of the parents held an employment; 10% of the families received social welfare or unemployment insurance; 30% of the families had an annual income of less than $30,000.

The sample was followed longitudinally during early childhood focusing on child and family characteristics as well as in kindergarten and over the course of elementary school until grade 6 (the end of elementary school in Quebec), focusing on children's social and academic development. New data collections were started with transition to high school in grades 7 and 8 and the present study utilizes data from the latter phase (mean age = 14.06 years, SD = 3.60 months). Overall average attrition in the sample was a little more than 3% per year, such that 268 twin pairs participated in grade 8. These twin pairs did not differ from those who were lost through attrition in regard to mother-rated anxiety or aggression at ages 18 to 48 months, parental education, parents' age, or family revenue, but there were fewer single parent families in the remaining study sample. Data collections took place via personal interviews in the twins' homes. Active written consent from the twins and their parents was obtained. All instruments were approved by the Institutional Review Boards of the University of Quebec in Montreal and the Ste-Justine Hospital Research Center.

Measures

Victimization by a close friend and victimization by other peers were assessed using the twins' self-reports on nine items inspired by the Social Experiences Questionnaire (Crick & Grotpeter, 1996) (e.g., "During this school year, how many times has another kid called you names or said mean things to you?,… said mean things about you to other kids? …., stopped you from being in his or her group although you wanted to be?, …. pushed, hit or kicked you?, …. threatened you or said mean things about you via e-mail, chat room, or cell phone?", … Deliberately ignored you or pretended not to know you? "). For each item, participants indicated whether the behavior was done a) by a close friend (indicating *victimization by a close friend*) and/or b) by other peers the participant was never friends with (indicating *victimization by other peers*). Responses were given on a three-point scale ranging

from 0 (never), 1(once or twice) to 2 (often). Prior to responding to the items, participants were reminded that close friends pertained to friends of the same sex with whom they did not have any romantic affiliations. Item scores for victimization by a close friend were summed to yield a global *Victimization by a close friend* score (Cronbach's alpha = .70 *Mean* = 0.34, *SD* = 1.06, Min = 0.0, Max =11.0; Skew = 4.97, Kurtosis = 32.84). Similarly, item scores for victimization by other peers were summed to yield a global *Victimization by other peers* score (Cronbach's alpha = .76 *Mean* = 1.83, *SD* = 2.26, Min = 0.0, Max = 11.0, Skew = 1.66, Kurtosis = 2.61). In contrast to victimization by other peers, victimization by a close friend was a much less frequent experience, with 83% of youth reporting that they had never been victimized by a close friend (compared to 36% who had never been victimized by other peers). To reduce skewness and kurtosis, victimization by a close friend and victimization by other peers were subjected to square root transformations and outliers with values of 3SDs or higher (1.6% of data points) were winsorized (Post-transformation Skew = 2.50, Kurtosis = 6.20, for *Victimization by a close friend;* Skew = 0.40, Kurtosis = -0.77, for *Victimization by other peers*).

Anxiety was assessed via the twins' self-reports using an abbreviated version (10 items) of the *Children's Manifest Anxiety Scale (CMA*S) (Reynolds & Richmond, 1978, 1997). The CMAS is a widely used instrument that evaluates physiological, emotional, and cognitive symptoms of anxiety in youth from 6 to 19 years of age and has shown good reliability and validity in previous studies (Kendall & Suveg, 2006). In the present study, participants indicated, for example, whether in the past month they "were nervous", "were worried", "were afraid of many things", 'had trouble falling asleep", "were worried about what other people said or would say about them", "had stomach-aches". Response options ranged from 0 (never), 1 (once or twice), 2 (several times), to 3 (very often). Item scores were summed to compute a total Anxiety score (Cronbach's alpha = .87, *Mean* = 7.05, *SD* = 5.12, Min = 0.0, Max = 30.0, Skew = 0.96, Kurtosis = 0.98).

Analyses

Preliminary Analyses

Using the Mplus software package (Muthén & Muthén, 1998-2010), preliminary Means Structure analyses, which were run as a four-group model with equality constraints of the means across sex groups but with freely estimated parameters across MZ and DZ pairs, revealed that girls were more anxious (χ^2 (2) = 35.3, $p < .001$) but less victimized by other peers (χ^2 (2) = 7.18, $p = .03$) than boys. No sex differences emerged in regard to victimization by a close friend (χ^2 (2) = 1.61, $p = .44$). To account for the sex differences in anxiety and victimization by other peers, these two variables were z-standardized within sex groups for subsequent analyses. Further analyses were performed to test potential sex moderation of the within-pair variance-covariance structure of the study variables. These analyses, which were again run as a four-group model with equality constraints across sex groups but with freely estimated parameters across MZ and DZ pairs, revealed no significant difference between boys and girls ($\chi^2(16) = 12.31$, $p = .72$ for victimization by other peers and $\chi^2(16) = 10.31$, $p = .85$ for victimization by a close friend). Data were therefore pooled combining male and female MZ pairs and combining male and female DZ pairs, respectively, to maximize statistical power). Additional Means Structure analyses, which were run as a two-group model with equality constraints of the means across zygosity groups, revealed no mean differences in regard to the study variables between MZ twins and DZ twins (χ^2 (1) = .51, $p = .47$, for anxiety, χ^2 (1) = .49, $p = .49$, for victimization by other peers; χ^2 (1) = .17, $p = .67$, for victimization by a close friend). Within-twin-pair correlations in regard to victimization by a close friend were $r = .09$, $p = .25$ for MZ twins and $r = .06$, $p = .55$ for DZ twins, in regard to victimization by other peers they were $r = .40$, $p < .001$ for MZ twins and $r = .29$, $p < .001$ for DZ twins, and in regard to anxiety they were $r = .44$, $p < .001$ for MZ twins and $r = .13$, $p = .16$ for DZ twins. Bivariate correlations using robust Hubert-White Sandwich estimations of standard errors to account for data dependency due to twinning revealed that victimization by other peers and victimization by a close friend were uncorrelated experiences ($r = -.02$, $p = .65$). However, both

victimization by other peers and victimization by a close friend were positively correlated with anxiety (r = .30, p < .001, and r = .15, p < .01, respectively).

Main Analyses: Rationale of Genetic Models

Through structural equation modeling, the classical twin design makes it possible to estimate the extent to which the observed variance of a measured variable (e.g., anxiety) is explained by three latent (i.e., nonmeasured) sources of variance: 1) latent additive genetic factors (A), 2) latent shared environmental factors (C), which equally influence the two twins of a pair, and 3) latent non shared environmental factors (E), which differentially influence the two twins of a pair (Neale & Cardon, 1992). To this end, a two-group model is fixed to the data for MZ-twins and DZ twins, where the within-twin pair correlations of the latent additive genetic factors (A) are fixed to 1.0 for MZ twins (who are genetically identical) and to 0.5 for DZ twins (who on average share only half of their genes). The within-twin pair correlations of the latent shared environmental factors (C) are fixed to 1.0 for both MZ and DZ twins. Within-twin pair correlations of the latent nonshared environmental factors (E) are fixed to 0.0 for both MZ and DZ twins. The estimated coefficients a, c, and e, which are fixed to be equal across the two twins in a pair and across MZ and DZ twins, are the factor loadings that provide information about the relative contribution of the latent factors A, C, and E to the total variance of the measured variable. Any measurement error is included in the latent E effect.

Testing rGE. The basic ACE model can be extended to include two measured variables in a bivariate model. If one of these variables is a putative environmental experience, such as victimization, it is also possible to examine potential rGE in the link between victimization experiences and anxiety. Because the preliminary analyses had shown that victimization by a close friend and victimization by other peers were uncorrelated, separate but identical bivariate models were specified for these two victimization experiences. Specifically, a bivariate Cholesky model was specified where the covariance structure of victimization and anxiety was partitioned into (1) “common” latent factors A_C, C_C and E_C

that influence both victimization and anxiety and (2) "unique" latent factors A_U, C_U and E_U that influence only anxiety (Figure 1). All model paths were fixed to be equal for the two twins in a pair and for MZ and DZ twins**.** Coefficients a_{CV}, c_{CV} and e_{CV} represent the factor loadings of victimization on the "common" latent factors A_C, C_C and E_C. These coefficients indicate the effects of genetic, shared, and nonshared environmental factors on victimization. A significant coefficient a_{CV} would indicate that victimization is to a significant extent influenced by genetic factors, which is a necessary precondition for testing rGE with anxiety. Coefficients $a_{CA,}$ c_{CA} and e_{CA} represent the factor loadings of anxiety on the "common" latent factors A_C, C_C and E_C. A significant coefficient a_{CA} – assuming a significant coefficient a_{CV} – would indicate that both anxiety and victimization are influenced by the same genetic factors (i.e., rGE). Significant coefficients $c_{CA,}$ or e_{CA} would indicate that anxiety and victimization are influenced by the same shared or nonshared environmental factors. Finally, coefficients $a_{UA,}$ c_{UA} and e_{UA} represent the factor loadings of anxiety (A) on the "unique" latent factors A_U, C_U and E_U. These coefficients indicate to what extent anxiety is influenced by genetic, shared, and nonshared environmental factors that are unrelated to victimization. All models were estimated using a robust maximum likelihood fit function (MLR) to account for nonnormality of the data. Model fit was assessed with the Root Mean Squared Error Approximation (RMSEA), the Standardized Root Mean Residual (SRMR), the Comparative Fit Index (CFI) and robust S-B χ^2 statistics. Low and nonsignificant χ^2 values, values of RMSEA below .08 and of SRMR below .05 and values of CFI above .90 indicate good fit (Hu & Bentler, 1999). To maximize model parsimony and statistical power, parameter estimates that did not at least reach a statistical trend ($p \leq .10$) were fixed to zero and the fit of the trimmed model was compared to that of the complete model depicted in Figure 1 via a nested χ^2-difference test for S-B χ^2 values. The best fitting trimmed model was then used for tests of GxE.

Testing GxE. To test whether victimization by other peers interacts with genetic effects on anxiety, the bivariate Cholesky model was further expanded by adding (1) an interaction term between

victimization and the "common" genetic factor A_C predicting to anxiety, represented by the term βa_{CA} and (2) another interaction term between victimization and the "unique" genetic factor A_U predicting to anxiety, represented by the term βa_{UA} (see again Figure 1). If significant, any of these two interaction terms would indicate the presence of GxE. To examine whether any moderating effect of victimization is truly specific to the latent genetic effects on anxiety, it was also important to estimate potential interactions between victimization and the environmental effects on anxiety (Purcell, 2002; Van Der Sluis, Posthuma, & Dolan, 2012). To this end, interaction effects between victimization and the "common" and "unique" nonshared environmental factors E_C and E_U predicting to anxiety were added, represented by the terms βe_{CA} and βe_{UA}. Moreover, in case the bivariate model without interaction terms revealed significant "common" and "unique" shared environmental effects C_C and C_U on anxiety, interaction terms between these two factors and victimization also needed to be added, represented by the terms βc_{CA} and βc_{UA}. Of note, because classical fit indices such as χ^2 and RMSEA are not available for a model that includes interaction terms, the bivariate model with interaction terms was compared to the previous bivariate model without interaction terms using the –2LL difference test, which is equivalent to a nested χ^2-difference test (Purcell, 2002).

Results

Victimization by a Close Friend and Anxiety

As can be seen in Table 1, the results from the trimmed bivariate model without interaction terms revealed significant shared and nonshared environmental influences on victimization by a close friend (c_{CV} = .24, p = .04, and e_{CV} = .87, p < .001). There were no genetic effects on victimization by a close friend, suggesting absence of rGE. The significant genetic effects found for anxiety (a_{UA} = .62, p < .001) were thus necessarily unrelated to victimization by a close friend. There were also no shared environmental effects on anxiety. Instead, the covariance between victimization by a close friend and anxiety was entirely explained by "common" nonshared environmental effects (e_{CA} = .13, p < .01). The

remaining variance of anxiety was explained by nonshared environmental effects that were unrelated to victimization by a close friend (e_{UA} = .75, p < .001).

Expressed as relative influences, these results indicate that shared environmental factors explained $c_{CV}^2/(c_{CV}^2 + e_{CV}^2)$ = 7% of the total variance of victimization by a close friend and nonshared environmental factors explained the remaining 93% of the total variance. In regard to anxiety, genetic influences explained $(a_{UA}^2)/(a_{UA}^2 + e_{CA}^2 + e_{UA}^2)$ = 40% of the total variance, with nonshared environmental factors explaining the remaining 60% of the total variance. There was also an environment-environment correlation (rEE) of $e_{CV}e_{CA}/\sqrt{e_{CV}^2(e_{CA}^2 + e_{UA}^2)}$ = .18, indicating that a small but significant portion of the environmental factors influencing anxiety, i.e., = 3%, are those associated with victimization by a close friend.

The trimmed bivariate model with interaction terms (Table 1 and Figure 2) showed an improved model fit compared to the previous trimmed model without interaction terms, ΔLogLikelihood = $\chi^2(3)$ = 21.26, p < .001. There were significant interactions of victimization by a close friend with the latent genetic influences on anxiety (βa_{UA} = 0.19, p < .001) and with the latent nonshared environmental influences on anxiety (βe_{CA} = -0.11, p = .01, and βe_{UA} = -0.26, p < .001). These findings indicate that the relative influence of genetic and nonshared environmental factors on anxiety varies depending on the extent of victimization by a close friend. As can be seen in Figure 4a, the effect of genetic factors on anxiety was much stronger (explaining almost 100% of the variance) in youth who were more frequently victimized by a close friend than in youth who were very little or not victimized by a close friend (explaining about 30% of the variance). These findings are in line with a diathesis-stress process of GxE, where a stressor enhances the expression of genetic vulnerability for a mental health problem.

Victimization by Other Peers and Anxiety

As can be seen in Table 2, a first model trim where all parameters that did not at least reach a statistical trend were constrained to be zero, led to a significant drop in fit compared to the complete

bivariate model without interactions terms, $\Delta\chi^2(3) = 7.93$, $p < .01$. Inspection of residuals revealed that there was a non-negligible parameter (a_{CA}) that, albeit being nonsignificant in the complete model, needed to be included in the trimmed model to avoid a significant loss in fit. Moreover, this parameter became significant in the modified trimmed model with interaction terms (see below). The modified trimmed bivariate model without interaction terms that included this parameter did not differ in fit from the complete bivariate model without interaction terms, $\Delta\chi^2(2) = .22$, $p = .90$. The results showed significant genetic effects on victimization by other peers ($a_{CV} = .54$, $p < .01$). Most of the variance of victimization by other peers was explained by environmental factors, however. Some, albeit nonsignificant portion came from environmental influences shared by the two twins in a pair ($c_{CV} = .32$, $p = .11$) and the largest part was explained by nonshared environmental influences ($e_{CV} = .74$, $p < .001$). Genetic influences were also found for anxiety and some of these genetic influences also explained victimization by other peers ($a_{CA} = .25$, $p = .13$). These findings indicate the presence of rGE in the association between anxiety and victimization by other peers. There were also genetic influences on anxiety that were unrelated to victimization by other peers ($a_{UA} = .58$, $p < .01$). The remaining variance in anxiety was explained by nonshared environmental factors and some of these nonshared environmental influences also explained victimization by other peers ($e_{CA} = .20$, $p < .01$). These findings indicate the presence of an environment-environment correlation (rEE) in the association between anxiety and victimization by other peers. However, most of the nonshared environmental influences on anxiety were unrelated to victimization by other peers ($e_{UA} = .73$, $p < .001$).

Expressed as relative influences, these results indicate that genetic factors explained $a_{CV}^2/(a_{CV}^2 + c_{CV}^2 + e_{CV}^2) = 31\%$ of the variance of victimization by other peers and nonshared environmental factors explained $e_{CV}^2/(a_{CV}^2 + c_{CV}^2 + e_{CV}^2) = 58\%$ of the variance. Shared environmental factors explained the remaining 11% of the variance of victimization by other peers, although the parameter was not significant. In regard to anxiety, genetic influences explained a total of $(a_{CA}^2 + a_{UA}^2)/(a_{CA}^2 +$

$a_{UA}^2 + e_{CA}^2 + e_{UA}^2$) = 41% of the variance, with a gene-environment correlation (rGE) of $a_{CV}a_{CA}/\sqrt{a_{CV}^2(a_{CA}^a + a_{UA}^2)}$= .40 between anxiety and victimization by other peers. In other words, 16% (i.e., $.40^2$) of the genetic influence on victimization by other peers is explained by genetic factors associated with anxiety. There was also an environment-environment correlation (rEE) of $e_{CV}e_{CA}/\sqrt{e_{CV}^2(e_{CA}^2 + e_{UA}^2)}$= .27, indicating that a small but significant portion of the environmental factors influencing anxiety, i.e., = 7%, are those associated with victimization by other peers.

Adding the interaction terms (Table 2 and Figure 3) significantly improved model fit compared to the previous trimmed model without interaction terms, ΔLogLikelihood = $\chi^2(4) = 16.38$, $p < .01$. There were significant interactions of victimization by other peers with latent genetic influences on anxiety ($\beta a_{UA} = -0.17$, $p = .05$) and with latent nonshared environmental influences on anxiety ($\beta e_{UA} = 0.16$, $p < .001$). This finding indicates that genetic and nonshared environmental influences on anxiety vary significantly depending on the extent of victimization by other peers. As can be seen in Figure 4b, for youth who were rarely victimized by other peers, inter-individual differences in anxiety were explained more by genetic factors (explaining more than 60% of the variance) and less by environmental factors (explaining less than 40% of the variance). In contrast, for youth who were highly victimized by other peers, inter-individual differences in anxiety were explained mostly by environmental factors (explaining around 90% of the variance) and only to a very small extent by genetic factors (explaining around 10% of the variance). These findings are in line with a suppression process of GxE, where exposure to a stressor reduces the role of genetic influences in explaining inter-individual differences in mental health problems.

Discussion

Using a genetically informed design based on early adolescent twins, the goal of this study was to examine 1) whether, in line with a gene-environment correlation (rGE), a genetic disposition for anxiety puts youth at risk of being victimized by close friends, and 2) whether, in line with a gene-

environment interaction (GxE), victimization by a close friend moderates the expression of a genetic disposition for anxiety. To test whether the observed results are specific to victimization by a close friend or whether they generalize to all victimization experiences at the hand of peers, we also examined whether similar rGE and GxE processes can be found in the link between anxiety and victimization by other peers that are (or were) not friends with the victimized youth. Although it occurs considerably less frequently than victimization by other peers, a non-negligible portion of our study participants indicated that they have suffered victimization at the hand of a close friend. Our findings thus concur with those from other studies that even close friendships can sometimes be a source of harm (Crick & Nelson, 2002; Daniels et al., 2010; Kawabata et al., 2010; Mishna et al., 2008). Despite the similarity of behaviors used to inflict harm, however, victimization by close friends and victimization by other peers seem to be distinct experiences. As suggested by our data, victims suffering maltreatment from a close friend are not necessarily at risk of being victimized by other peers. There also seem to be important differences in the specific mechanisms of gene-environment interplay that link the two victimization experiences with anxiety.

Is Genetic Propensity for Anxiety a Risk Factor of Victimization by a Friend or by Other Peers?

Genetic factors explained a significant portion of victimization by peers outside of the friendship context. This is similar to the findings reported in other studies on generalized peer victimization (Ball et al., 2008; Brendgen et al., 2011). The present study suggests that genetic factors that are associated with anxious behavior play an important role in this regard. Because individuals probably try to avoid rather than actively seek out exposure to maltreating peers that they are not and never were friends with, this rGE likely reflects an "evocative" rGE process whereby anxious characteristics inherent in the child elicit peer victimization. It has been proposed that youngsters who are manifestly anxious, prone to crying and submissive may become targets of victimization because their behavior signals an inability to defend themselves against attacks (Hodges & Perry, 1999; Perry et

al., 1990). Moreover, because bullies value displays of suffering such as crying and submissiveness in their victims, these behavioral responses further reinforce peers' aggressive behavior (Perry & Perry, 1974; Schwartz et al., 1993). In line with these propositions, the present results lend further support to findings from non-genetically informed research that anxious-submissive behavior can put youth at risk of becoming the target of maltreatment by peers (Reijntjes et al., 2010; Schwartz et al., 1993). Still, like in all correlational studies, it cannot be ruled out that the same genetic factors that link anxiety and victimization by other peers through rGE also influence other, nonmeasured behavioral variables that are related to both and that may thus also mediate genetic influences in victimization by other peers.

The significant genetic effects found for victimization by other peers stand in stark contrast to the findings observed for victimization by a close friend. Indeed, victimization in the friendship context was not explained by heritable characteristics of the victim. Moreover, bivariate correlations revealed that victimization by a close friend and victimization by other peers are uncorrelated experiences. The absence of genetic influences and the strong nonshared environmental influences on victimization by a close friend along with the lack of correlation with victimization by other peers suggest that victimization by a close friend is more of a "random" event that may also befall youth who do not have the risk profile that is typical of many victims. In contrast to victimization by other peers, victimization suffered at the hands of a close friend may be more a function of relationship quality and the characteristics of the abusive friend. Thus, youth who are victimized by a close friend report poorer conflict resolution within the friendship and a higher desire for an exclusive relationship especially on the part of the victimizing friend (Daniels et al., 2010; Grotpeter & Crick, 1996). There is also evidence that relationally aggressive children in particular tend to elicit the revelation of personal secrets from their friends, without necessarily sharing their own secrets in return (Grotpeter & Crick, 1996). In addition to possible physical threats, the aggressive friend may then use the personal knowledge

obtained as leverage to gain or maintain control over the relationship. More research is needed to uncover the environmental conditions that put youth at risk of being bullied by a close friend.

Does Victimization by a Close Friend or by Other Peers Moderate Genetic Effects on Anxiety?

Although they may be rooted in different risk factors, our findings suggest that victimization by a close friend and victimization by other peers contribute to anxiety in youth either by enhancing or suppressing (i.e., overriding) genetic effects on anxiety. Specifically, in line with a suppression process of GxE, victimization by other peers reduced the role of genetic influences in explaining inter-individual differences in anxiety. This finding suggests that victimization by other peers may promote anxiety even in youth without a genetic predisposition. It is noteworthy that a similar suppression process of GxE was found in kindergarten, where genetic influences played a lesser role in explaining individual differences in depressive symptoms in children who were rejected by their peers than in accepted children (Brendgen et al., 2009). Like peer rejection, victimization by the larger peer group is a rather stable phenomenon that often affects the same individuals even when the peer context changes (Brendgen, Vitaro, Bukowski, Doyle, & Markiewicz, 2001; Paul & Cillessen, 2003). Moreover, research shows that victimization by the larger peer group usually happens in plain view of others, with peers not directly involved as either bullies or victims present in 85% of cases (Craig, Pepler, & Atlas, 2000; Fekkes, Pijpers, & Verloove-Vanhorick, 2005). Most of these bystanders do not intervene to support the victim (Goossens, Olthof, & Dekker, 2006) and as many as 20–30% even encourage the bullies (Salmivalli, 2001). Indeed, victims are often chosen because they are rejected by the peer group and bystanders often perceive victimized youth as being at least partly responsible for their own plight, justifying the maltreatment based on victims' deviant characteristics or behaviors (Teräsahjo & Salmivalli, 2003). As a consequence, victimized youth become more and more rejected over time, thus further solidifying their status as easy targets of peer aggression (Hodges & Perry, 1999). This vicious

cycle may be difficult to break and can thus explain why such experiences may trigger anxiety even in youth who are not normally prone to worries and fear.

In contrast to the suppression process of GxE observed for victimization by other peers, victimization by a close friend exacerbated the effect of genetic influences on anxiety. This diathesis-stress process of GxE suggests that victimization in the friendship context fosters worries and fears especially in those youth with a genetic predisposition for anxiety. What may explain these divergent patterns of GxE? Although adolescents with a genetic propensity for anxiety are not necessarily more at risk than others of being victimized by a close friend, they seem to react more strongly when they experience abusive behavior from a friend. In support of this notion, experimental research has revealed that anxious children show greater physiological reactivity, feelings of rejection, and helplessness than their non-anxious counterparts when faced with social rejection by a friend (Gazelle & Druhen, 2009). Compared to individuals without a genetic propensity for anxiety, highly anxious youth may thus be less likely to assert themselves against attacks from their friend. They may also have a smaller number of other friendships to draw upon as a source of comfort. Anxious youth have indeed been found to possess fewer reciprocal friends and to obtain less companionship and support from the friendships they do have than non-anxious youth (La Greca & Lopez, 1998). The lack of alternatives, along with the fact that even abusive friendships often offer some measure of intimacy and companionship (Daniels et al., 2010; Grotpeter & Crick, 1996; Mishna et al., 2008), may make it especially difficult for victims who are prone to anxiety to end the relationship. Thus, as suggested by Crick and Nelson (2002), abusive friendships may in many ways resemble abusive romantic relationships. More research is needed to examine links between victimization within close friendships and within later romantic relationships and the role of victims' disposition for anxiety in this context.

Strengths, Limitations, Conclusions

This is the first study to investigate gene-environment interplay in the association between victimization by a close friend and anxiety symptoms in youth. A major asset of this study is that the same mechanisms of gene-environment interplay were also examined in the link between anxiety and victimization by other peers outside the friendship context. These comparative analyses were important to assess whether the observed results generalize to all victimization experiences at the hand of peers. Several limitations also need to be considered. One limitation concerns the cross-sectional nature of the data due to budgetary restrictions. Because empirical evidence about the stability of victimization experiences within close friendships is still lacking, a short-term longitudinal design of less than a few months should be ideally used to examine gene-environment interplay linking victimization by a close friend and anxiety. However, because even cross-sectional genetically-informed data allow disentangling rGE from GxE, they can provide clues about the directionality of the link between victimization by a close friend and anxiety (Moffitt, 2005; Pearson, 2007). Another limitation concerns the relatively small sample size. Although statistical power was sufficient to detect significant rGE and GxE, future studies need to replicate the present findings with larger samples. Much larger samples are also necessary to examine whether the findings indeed apply equally to girls and boys. Like in other studies, we found no sex differences in the overall frequency of victimization by a friend (Crick & Nelson, 2002; Daniels et al., 2010). Previous studies have also shown little evidence of sex differences in the genetic-environmental architecture of anxiety in children and adolescents (Frani et al., 2010) and our preliminary analyses suggested no sex differences in the covariance pattern of the study variables. Moreover, the scarce empirical evidence so far suggests that victimization by a close friend is associated with self-reported anxiety and emotional distress in both girls and boys (Crick & Nelson, 2002). More research is also needed to examine whether the present results generalize to other age groups. As mentioned, our findings of a suppression process of GxE involving victimization by the larger peer group and of a diathesis-stress process of GxE involving victimization by a close friend

resemble findings obtained in other studies on conceptually related peer experiences using younger children (Brendgen et al., 2009; Gazelle & Druhen, 2009). Although these similarities suggest that our findings might generalize to younger children, it remains to be seen whether the same holds for older adolescents. Finally, while our victimization scale reflected a variety of victimization behaviors (e.g., physical, verbal, overt and covert relational as well as cyber-victimization), each of these was only represented with one or two items. Examinations of different forms of victimization were thus unfeasible. Future research should investigate whether differential processes of rGE and GxE can be observed for physical versus relational victimization within as well as outside the friendship context.

Despite these limitations, our study adds to the sparse research on victimization within friendships and provides important information on how such experiences may differ from victimization by the larger peer group. The findings indicate that youngsters with a genetic vulnerability for anxiety are more at risk than others of being victimized by peers outside the friendship context. Nevertheless, even adolescents without a genetic propensity for anxiety experience increased worry and fear if they are harassed by peers outside the friendship context. In contrast, victimization by a close friend seems to happen to adolescents regardless of their personal, heritable characteristics. If it does occur, however, victimization by a close friend seems to be a source of distress mostly for those youth with a genetic vulnerability for anxiety. Adults need to recognize that some friendships may hide a darker side that is comparable to the bully-victim interactions occurring outside the friendship context.

Table 1

Bivariate Genetic Model Results for Victimization by a Close Friend and Anxiety

	Full Model without Interaction Terms		Trimmed Model without Interaction Terms		Trimmed Model with Interaction Terms	
Parameters	Estimate	*p*	Estimate	*p*	Estimate	*p*
a_{CV}	.16 [-.07; .38]	.17	-	-	-	-
a_{CA}	.60 [.27; .92]	< .001	-	-	-	-

βa_{CA}	-	-	-	-	-	-
a_{UA}	.00 [-.41; .41]	.99	.62 [.49; .75]	< .001	.61 [.51; .72]	< .001
βa_{UA}	-	-	-	-	.19 (.12; .27]	< .001
c_{CV}	.23 [.43; .04]	.02	.24 [.01; .48]	.04	.26 [.08; .45]	.01
c_{CA}	.20 [-.07; .47]	.15	-	-	-	-
βc_{CA}	-	-	-	-	-	-
c_{UA}	.00 [-.10; .10]	1.00	-	-	-	-
βc_{UA}	-	-	-	-	-	-
e_{CV}	.86 [.75; .97]	< .001	.87 [.77; .97]	< .001	.87 [.94; .79]	< .001
e_{CA}	.09 [.00; .19]	.04	.13 [.04; .22]	< .01	.07 [-.12; .26]	.46
βe_{CA}	-	-	-	-	-.11 [-.20; -.01]	.01
e_{UA}	.75 [.66; .84]	< .001	.75 [.66; .84]	< .001	.69 [.62; .75]	< .001
βe_{UA}	-	-	-	-	-.26 [-.28; .23]	< .001
LogLikelihood	-1 434.17		-1434.93		-1424.3	
N. of parameters	11		7		10	
AIC	2890.35		2883.86		2868.60	
BIC	2929.86		2908.99		2904.51	
RMSEA	.00		.00			
CFI	1.00		1.00			
TLI	1.00		1.03			
SRMR	.09		.09			

Note. 95% Confidence intervals in brackets.

Table 2

Bivariate Genetic Model Results for Victimization by Other Peers and Anxiety

	Full Model without Interaction Terms		Trimmed Model without Interaction Terms		Trimmed Model with Interaction Terms	
Parameters	Estimate	*p*	Estimate	*p*	Estimate	*p*
a_{CV}	.50 [.13; .87)	.01	.54 [.20; .87]	< .01	.51 [.85; .16]	< .01
a_{CA}	.18 [-.58; .71)	.51	.25 [-.08; .58]	.13	.35 [.66; .04]	.03
βa_{CA}	-	-	-	-	.07 [-.12; .27]	.48
a_{UA}	.59 [.16; 1.03)	.01	.58 [.18; .97]	< .01	.52 [.31; .73]	< .001
βa_{UA}	-	-	-	-	-.17 [-.35; -.01]	.05
c_{CV}	.37 [.01; .74)	.04	.32 [-.07; .72]	.11	.37 [.00; .75]	.06
c_{CA}	.11 [-.23; .45)	.52	-	-	-	-
βc_{CA}	-	-	-	-	-	-
c_{UA}	.00 [-.19; .19)	.99	-	-	-	-
βc_{UA}	-	-	-	-	-	-
e_{CV}	.74 [.64; .84)	< .001	.74 [.63; .84]	< .001	.74 [.66; .82]	< .001
e_{CA}	.21 [.07; .35)	.07	.20 [.07; .32]	< .01	.23 [.09; .37]	< .001
βe_{CA}	-	-	-	-	-.02 [-.15; .11]	.77
e_{UA}	.73 [.64; .81)	< .001	.73 [64; .80]	< .001	.71 [.64; .78]	< .001
βe_{UA}	-	-	-	-	.16 [.09; .23]	< .001
LogLikelihood	-1 434.67		-1434.78		-1426.59	
N. of parameters	11		9		13	
AIC	2891.35		2887.57		2879.18	
BIC	2930.85		2919.89		2925.87	
RMSEA	.03		.01			
CFI	.98		1.00			
TLI	.99		1.00			
SRMR	.07		.07			

Note. 95% Confidence intervals in brackets.

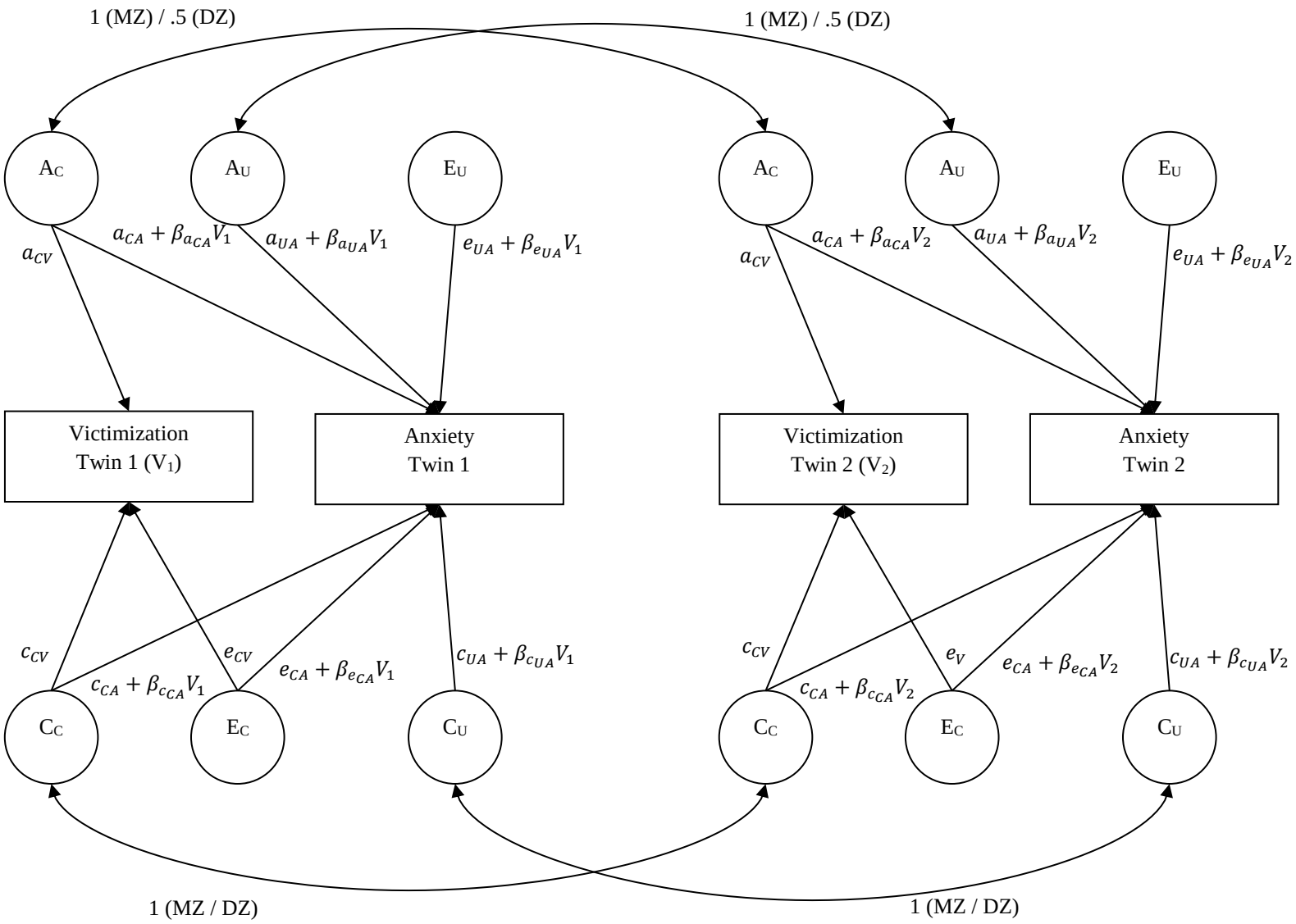


Figure 1. Complete (i.e., untrimmed) bivariate Cholesky model.

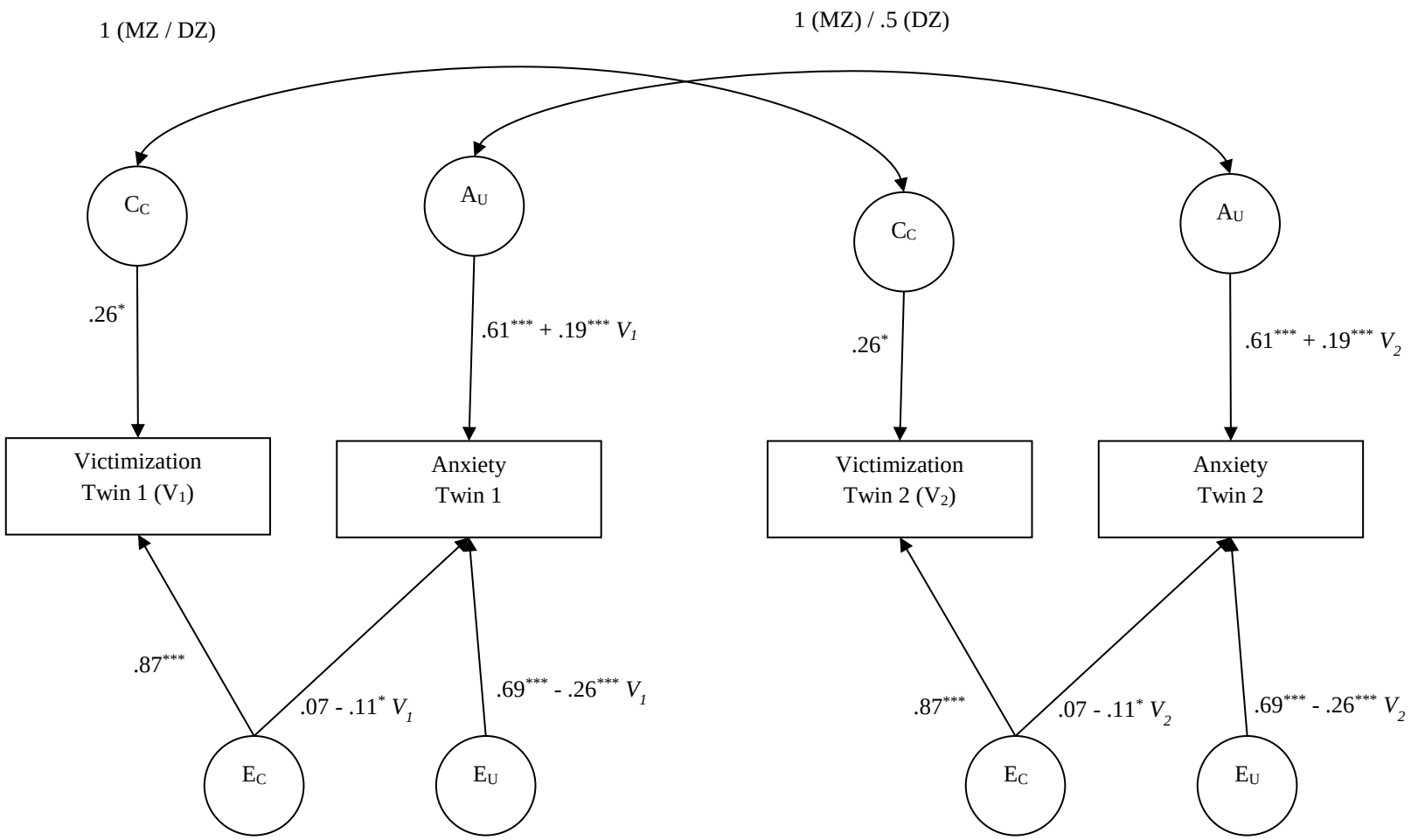


Figure 2. Final (i.e., trimmed) bivariate Cholesky model for victimization by a close friend and anxiety. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

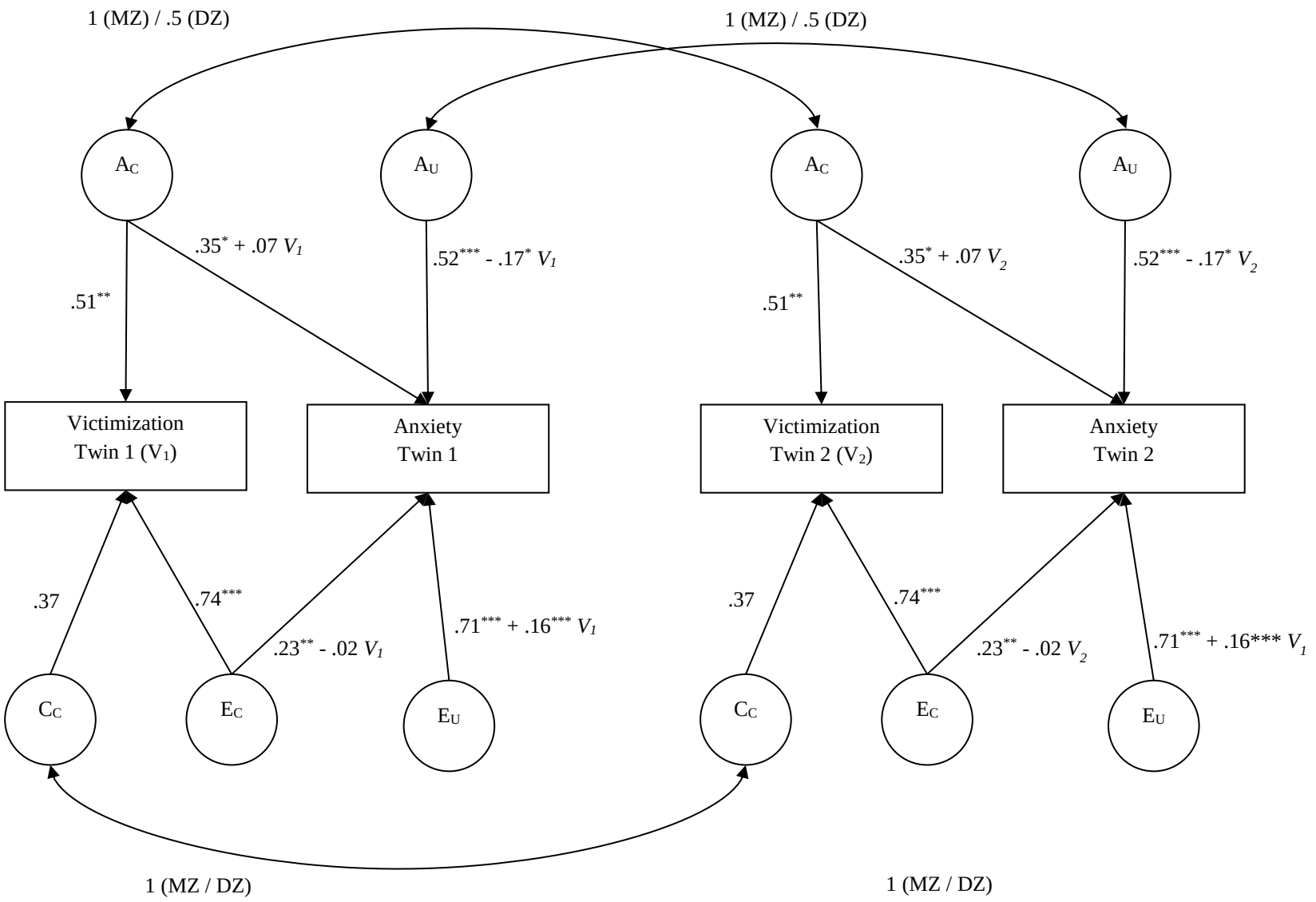


Figure 3. Final (i.e., trimmed) bivariate Cholesky model for victimization by other peers and anxiety. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

*Figure 4a***.** Plot of total variance and of additive genetic (A^2), and nonshared environmental (E^2) variance components of anxiety as a function of victimization by a close friend (z-standardized scores).

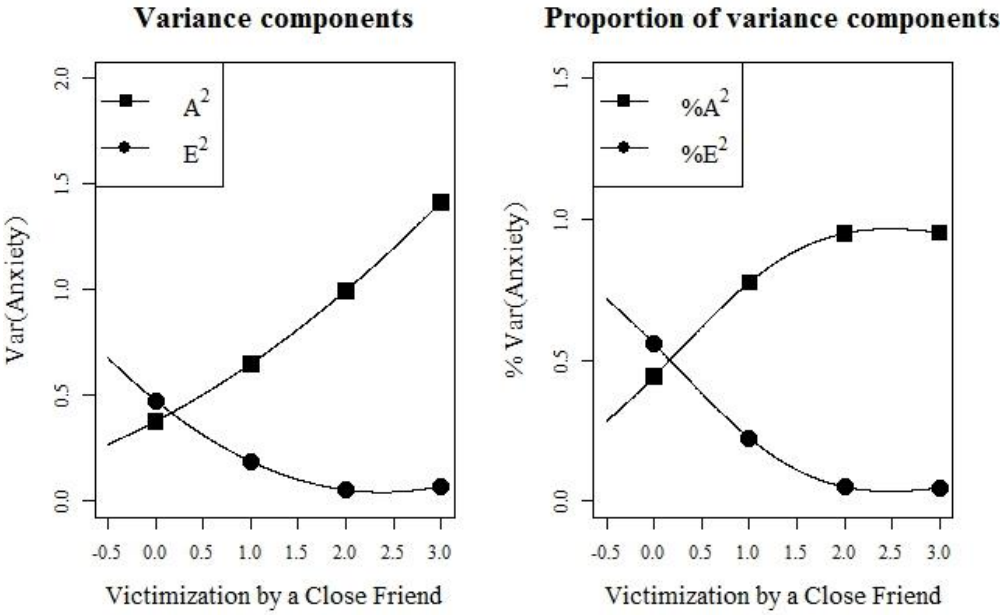
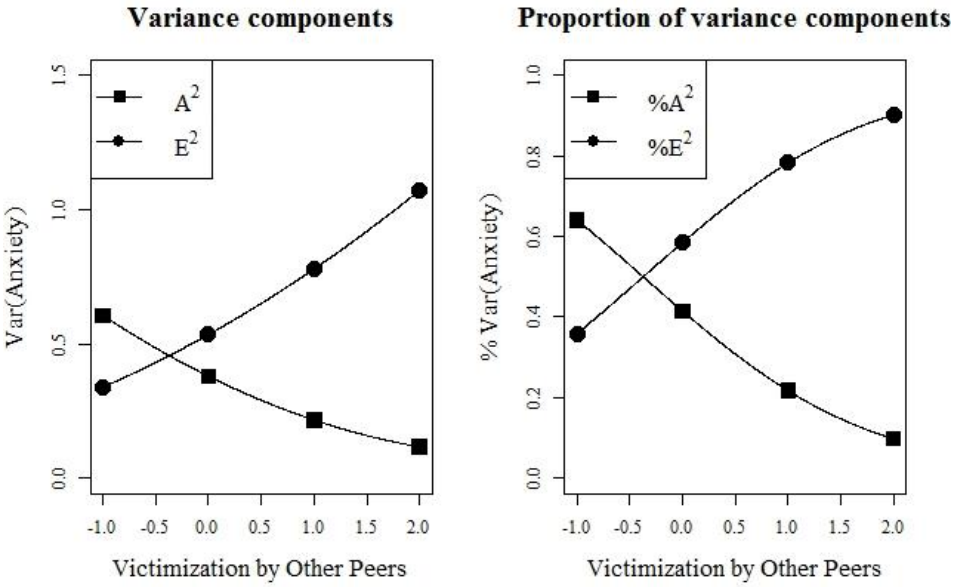


*Figure 4b***.** Plot of total variance and of additive genetic (A^2), and nonshared environmental (E^2) variance components of anxiety as a function of victimization by other peers (z-standardized scores).



References

Ball, H. A., Arseneault, L., Taylor, A., Maughan, B., Caspi, A., & Moffitt, T. E. (2008). Genetic and environmental influences on victims, bullies and bully-victims in childhood. *Journal of Child Psychology and Psychiatry, 49*, 104-112. doi: 10.1111/j.1469-7610.2007.01821.x

Benjet, C., Thompson, R. J., & Gotlib, I. H. (2010). 5-HTTLPR moderates the effect of relational peer victimization on depressive symptoms in adolescent girls. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 51*, 173-179. doi: 10.1111/j.1469-7610.2009.02149.x

Brendgen, M., Boivin, M., Dionne, G., Barker, E. D., Vitaro, F., Girard, A., . . . Pérusse, D. (2011). Gene-environment processes linking aggression, peer victimization, and the teacher-child relationship. *Child Development, 82*, 2021-2036. doi: DOI: 10.1111/j.1467-8624.2011.01644.x

Brendgen, M., Vitaro, F., Boivin, M., Girard, A., Bukowski, W. M., Dionne, G., . . . Pérusse, D. (2009). Gene-environment interplay between peer rejection and depressive behavior in children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 50*, 1009-1017. doi: 10.1111/j.1469-7610.2009.02052.x

Brendgen, M., Vitaro, F., Bukowski, W. M., Doyle, A. B., & Markiewicz, D. (2001). Developmental profiles of peer social preference over the course of elementary school: associations with trajectories of externalizing and internalizing behavior. *Developmental Psychology, 37*, 308-320. doi: 10.1037/0012-1649.37.3.308

Craig, W. M., Pepler, D., & Atlas, R. (2000). Observations of bullying in the playground and in the classroom. *School Psychology International, 21*, 22–36. doi: 10.1177/0143034300211002

Craig, W., Wang, T., Goldbaum, S., Peters, R., & Silverman, R. (2000). Understanding risk and protective factors in bullying and victimization among Canadian children and adolescents: Applied Research Branch Strategic Policy, Human Resources Development Canada.

Crick, N. R., & Grotpeter, J. K. (1996). Children's treatment by peers: victims of relational and overt aggression. *Development and Psychopathology, 8,* 367–380. doi: 10.1017/S0954579400007148

Crick, N. R., & Nelson, D. A. (2002). Relational and physical victimization within friendships: nobody told me there'd be friends like these. *Journal of Abnormal Child Psychology, 30,* 599-607. doi: 10.1023/A:1020811714064

Daniels, T., Quigley, D., Menard, L., & Spence, L. (2010). "My best friend always did and still does betray me constantly": examining relational and physical victimization within a dyadic friendship context. *Canadian Journal of School Psychology, 25,* 70-83. doi: 10.1177/0829573509357531

Eisenberger, N. I. (2012). Broken hearts and broken bones: A neural perspective on the similarities between social and physical Pain. *Current Directions in Psychological Science, 21,* 42-47. doi: 10.1177/0963721411429455

Fekkes, M., Pijpers, F. I. M., & Verloove-Vanhorick, S. P. (2005). Bullying: who does what, when and where? Involvement of children, teachers and parents in bullying behavior. *Health Education Research, 20,* 81-91. doi: 10.1093/her/cyg100

Frani, S., Middeldorp, C. M., Dolan, C. V., Ligthart, L., & Boomsma, D. I. (2010). Childhood and adolescent anxiety and depression: beyond heritability. *Journal of the American Academy of Child and Adolescent Psychiatry, 49,* 820-829. doi: 10.1016/j.jaac.2010.05.013.

Gazelle, H., & Druhen, M. J. (2009). Anxious solitude and peer exclusion predict social helplessness, upset affect, and vagal regulation in response to behavioral rejection by a friend. *Developmental Psychology, 45,* 1077-1096. doi: 10.1037/a0016165

Goldsmith, H. H. (1991). A zygosity questionnaire for young twins: a research note. *Behavior Genetics, 21,* 257-269. doi: 10.1007/BF01065819

Goossens, F. A., Olthof, T., & Dekker, P. H. (2006). New participant role scales: comparison between various criteria for assigning roles and indications for their validity. *Aggressive Behavior, 32*, 343-357. doi: 10.1002/ab.20133

Gregory, A. M., & Eley, T. C. (2007). Genetic influences on anxiety in children: what we've learned and where we're heading. *Clinical Child and Family Psychology Review, 10*, 199-212. doi: 10.1007/s10567-007-0022-8

Grotpeter, J.K., & Crick, N. R. (1996). Relational aggression, overt aggression, and friendship. *Child Development, 67*, 2328-2338. doi: 10.1111/1467-8624.ep9706060170

Hodges, E. V. E., & Perry, D. G. (1999). Personal and interpersonal antecedents and consequences of victimization by peers. *Journal of Personality and Social Psychology, 76*, 677-685. doi: 10.1037/0022-3514.76.4.677

Hodges, E. V. E., Boivin, M., Vitaro, F., & Bukowski, W. M. (1999). The power of friendship: protection against an escalating cycle of peer victimization. *Developmental Psychology, 35*, 94-101. doi: 10.1037/0012-1649.35.1.94

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1-55. doi: 10.1080/10705519909540118

Juvonen, J., Wang, Y., & Espinoza, G. (2011). Bullying experiences and compromised academic performance across middle school grades. *Journal of Early Adolescence, 31*, 152-173. doi: 10.1177/0272431610379415

Kawabata, Y., Crick, N. R., & Hamaguchi, Y. (2010). Forms of aggression, social-psychological adjustment, and peer victimization in a japanese sample: the moderating role of positive and negative friendship quality. *Journal of Abnormal Child Psychology, 38*, 471-484. doi: 10.1007/s10802-010-9386-1

Kendall, P. C., & Suveg, C. (2006). Treating anxiety disorders in youth. In P. C. Kendall (Ed.), *Child and Adolescent Therapy: Cognitive-Behavioral Procedure* (3 ed., pp. 243-294). New-York: Guilford Press.

Kendrick, K., Jutengren, G., & Stattin, H. (2012). The protective role of supportive friends against bullying perpetration and victimization. *Journal of Adolescence, 35,* 1069-1080. doi: 10.1016/j.adolescence.2012.02.014

La Greca, A. M., & Lopez, N. (1998). Social anxiety among adolescents: linkages with peer relations and friendships. *Journal of Abnormal Child Psychology, 26,* 83-94. doi: 10.1023/A:1022684520514

Lamarche, V., Brendgen, M., Boivin, M., Vitaro, F., Dionne, G., & Pérusse, D. (2007). Do friends' characteristics moderate the prospective links between peer victimization and reactive and proactive aggression? *Journal of Abnormal Child Psychology, 35*, 665-680. doi: 10.1007/s10802-007-9122-7

Lamarche, V., Brendgen, M., Boivin, M., Vitaro, F., Pérusse, D., & Dionne, G. (2006). Do friendships and sibling relationships provide protection against peer victimization in a similar way? *Social Development, 15*, 373-393. doi: 10.1111/j.1467-9507.2006.00347.x

Magnusson, P. K. E., Almqvist, C., Rahman, I., Ganna, A., Viktorin, A., Walum, H., . . . Lichtenstein, P. (2013). The swedish twin registry: establishment of a biobank and other recent developments. *Twin Research and Human Genetics, 16,* 317-329. doi: 10.1017/thg.2012.104

Mishna, F., Wiener, J., & Pepler, D. (2008). Some of my best friends——experiences of bullying within friendships. *School Psychology International, 29*, 549-573. doi: 10.1177/0143034308099201

Moffitt, T. E. (2005). The new look of behavioral genetics in developmental psychopathology: gene-environment interplay in antisocial behaviors. *Psychological Bulletin, 131,* 533-554. doi: 10.1037/0033-2909.131.4.533

Muthén, L. K., & Muthén, B.O. (1998-2010). *Mplus User's Guide. Sixth Edition*

Neale, M. C., & Cardon, L. R. (1992). *Methodology for genetic studies of twins and families*. Dortrecht, Netherlands: Kluwer Academic.

Paul, J., & Cillessen, A. H. (2003). Dynamics of peer victimization in early adolescence: results from a four-year longitudinal study. *Journal of Applied School Psychology, 19*, 25-43. doi: 10.1300/J008v19n02_03

Pearson, C. H. (2007). Is heritability explanatorily useful? *Studies in History and Philosophy of Science Part C :Studies in History and Philosophy of Biological and Biomedical Sciences, 38,* 270-288. doi: 10.1016/j.shpsc.2006.12.012

Perry, D. G., Williard, J. C., & Perry, L. C. (1990). Peers' perceptions of the consequences that victimized children provide aggressors. *Child Development, 61,* 1310-1325. doi: 10.1111/j.1467-8624.1990.tb02863.x

Perry, D. G., & Perry, L. C. (1974). Denial of suffering in the victim as a stimulus to violence in aggressive boys. *Child Development, 45,* 55-62. doi: 10.2307/1127749

Purcell, S. (2002). Variance components models for gene-environment interaction in twin analysis *Twin Research, 5*, 554-571. doi: 10.1375/136905202762342026

Reijntjes, A., Kamphuis, J. H., Prinzie, P., Boelen, P. A., Van Der Schoot, M., & Telch, M. J. (2011). Prospective linkages between peer victimization and externalizing problems in children: a meta-analysis. *Aggressive Behavior, 37,* 215-222. doi: 10.1002/ab.20374

Reijntjes, A., Kamphuis, J. H., Prinzie, P., & Telch, M. J. (2010). Peer victimization and internalizing problems in children: a meta-analysis of longitudinal studies. *Child Abuse and Neglect, 34,* 244-252. doi: 10.1016/j.chiabu.2009.07.009

Reynolds, C. R., & Richmond, B. O. (1978). What I think and feel: A revised measure of children's manifest anxiety. *Journal of Abnormal Child Psychology, 6,* 271-280. doi: 10.1007/bf00919131

Reynolds, C. R., & Richmond, B. O. (1997). What I think and feel: a revised measure of children's manifest anxiety. *Journal of Abnormal Child Psychology, 25,* 15-20. doi: 10.1023/a:1025751206600

Salmivalli, C. (2001). Group view on victimization—empirical findings and their implications. In J. Juvonen & S. Graham (Eds.), *Peer harassment in school: the plight of the vulnerable and victimized* (pp. 398–419). New York: Guilford Press.

Schwartz, D., McFadyen-Ketchum, S., Dodge, K. A., Pettit, G. S., & Bates, J. E. (1999). Early behavior problems as a predictor of later peer group victimization: moderators and mediators in the pathways of social risk. *Journal of Abnormal Child Psychology, 27,* 191-201. doi: 10.1023/A:1021948206165

Schwartz, D., Dodge, K. A., & Coie, J. D. (1993). The emergence of chronic peer victimization in boys' play groups. *Child Development, 64,* 1755-1772. doi: 10.1111/j.1467-8624.1993.tb04211.x

Smith, P. K., Morita, Y., Junger-Tas, J., Olweus, D., Catalano, R., & Slee, P. (1999). *The nature of school bullying: a cross-national perspective*. New York: Routledge.

Spitz, E., Moutier, R., Reed, T., Busnel, M. C., Marchaland, C., Roubertoux, P. L., & Carlier, M. (1996). Comparative diagnoses of twin zygosity by SSLP variant analysis, questionnaire, and dermatoglyphic analysis. *Behavior Genetics, 26,* 55-63. doi: 10.1007/BF02361159

Storch, E. A., Masia-Warner, C., Crisp, H., & Klein, R. G. (2005). Peer victimization and social anxiety in adolescence: a prospective study. *Aggressive Behavior, 31*, 437-452. doi: 10.1002/ab.20093

Sugden, K., Arseneault, L., Harrington, H., Moffitt, T. E., Williams, B., & Caspi, A. (2010). Serotonin transporter gene moderates the development of emotional problems among children following bullying victimization. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*, 830-840. doi: 10.1016/j.jaac.2010.01.024

Teräsahjo, T., & Salmivalli, C. (2003). "She is not actually bullied." The discourse of harassment in student groups. *Aggressive Behavior, 29*, 134-154. doi: 10.1002/ab.10045

Van Der Sluis, S., Posthuma, D., & Dolan, C. V. (2012). A note on false positives and power in G × E modelling of twin data. *Behavior Genetics, 42*, 170-186. doi: 10.1007/s10519-011-9480-3

Waasdorp, T. E., Bagdi, A., & Bradshaw, C. P. (2010). Peer victimization among urban, predominantly african american youth: coping with relational aggression between friends. *Journal of School Violence, 9*, 98-116. doi: 10.1080/15388220903341372

Zahn-Waxler, C., Klimes-Dougan, B., & Slattery, M. J. (2000). Internalizing problems of childhood and adolescence: prospects, pitfalls, and progress in understanding the development of anxiety and depression. *Development and Psychopathology, 12*, 443-466. doi: 10.1017/S0954579400003102