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ASSESSING COMMON GENETIC AND ENVIRONMENTAL EFFECTS ON THE ASSOCIATION BETWEEN PARENT-CHILD RELATIONS AND INTIMATE PARTNER RELATIONSHIP QUALITY

The current study examined the genetic and environmental architecture of early life parent-child relations and intimate partner relationship quality later in life. A series of univariate ACE and bivariate Cholesky decomposition models were fitted to a sample of monozygotic and same-sex dizygotic twins drawn from the Midlife in the United States Study (MIDUS) in order to explore the extent to which genetic factors explain individual differences in mother- and father-child relationship quality and self-reports of intimate partner relationship quality. Results revealed that genetic factors explained variation in reports of parent-child relationship quality (41% to 65%), adult intimate partner relationship quality (34%) and the covariance between the two (81% to 83%). Nonshared environmental factors accounted for the remaining covariance. Findings from the present study suggest that similar genetically influenced characteristics that account for variation in early life parent-child relations are also implicating in explaining variation in healthy intimate partner formation later in life. The implications of these findings for future research on intimate partner relationship quality and family formation are discussing.

Key words: parent-child relations, intimate partner relationship quality, behavioral genetics, adult relationships.

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Ата-ана мен бала арасындағы қарым-қатынас пен жақын серіктеспен қарым-қатынас сапасына жалпы генетикалық және қоршаған орта әсерін бағалау

Бұл зерттеуде ата-аналар мен жас балалар арасындағы қарым-қатынастың және кейінгі өмірдегі жақын серіктік қатынас сапасының генетикалық және экологиялық архитектурасы қарастырылды. Генетикалық факторлар ана-баланың, әке-баланың жеке айырмашылықтарын және жақын серікпен қарым-қатынастың сапасы туралы өзіндік есеп беруін түсіндіру дәрежесін зерттеу үшін, АҚШ-тағы Midlife зерттеуінен (MIDUS) алынған, монозиготалық және бір жынысты егіздердің үлгісін сұрыптау мақсатында бір өлшемді ACE жіктеуінің және екі өлшемді Холецкий жіктеуінің модельдерінің сериясы таңдалды. Алынған нәтижелерге орай, генетикалық факторлар ата-аналар мен балалардың қарым-қатынасының сапасы туралы (41%-ден 65%-ға дейін), ересектер арасындағы жақын серікпен қарым-қатынас туралы (34%) және олардың арасында ковариация туралы (81%-ден 83%-ға дейін) есептің айырмашылығын түсіндіреді. Қоршаған ортадағы ортақ емес факторлар қалған ковариацияны құрады. Аталмыш зерттеу көрсеткендей, ерте кезеңдегі ата-аналар мен балалар арасындағы қарым-қатынас ерекшеліктерін түсіндіретін ұқсас генетикалық әсер ететін сипаттамалар, сонымен бірге есейген уақытта салауатты жақын серікті қалыптастыру кезіндегі өзгерістерді түсіндіру кезінде де қатысады. Бұл нәтижелердің келешектегі серіктестік қатынастар мен отбасылық қарым-қатынастардың сапасын зерттеу нәтижелері талқыланады.

Түйін сөздер: ата-ана мен бала арасындағы қарым-қатынас, жақын серікпен қарым-қатынас сапасы, мінез-құлық генетикасы, ересектермен қарым-қатынас.

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Оценка общего генетического и экологического воздействия на связь между родителями и детьми и качеством отношений с близким партнером

В текущем исследовании изучалась генетическая и экологическая архитектура взаимоотношений между родителями и детьми раннего возраста и качество близких партнерских отношений в дальнейшей жизни. Серия одномерных моделей разложения АПФ и двумерного разложения Холецкого была подобрана для выборки монозиготных и однополых близнецов, взятых из исследования Мидлайф (Midlife) в США (MIDUS), чтобы исследовать степень, в которой генетические факторы объясняют индивидуальные различия у матери-ребенка и отца-ребенка и самоотчеты о качестве тесных партнерских отношений. Результаты показали, что генетические факторы объясняют различия в отчетах о качестве отношений между родителями и детьми (от 41% до 65%), качестве взаимоотношений между близкими партнерами среди взрослых (34%) и ковариации между ними (от 81% до 83%). Факторы окружающей среды составили оставшуюся ковариацию. Результаты настоящего исследования показывают, что сходные генетически значимые характеристики, которые объясняют различия в ранних отношениях между родителями и детьми, также участвуют в объяснении изменений в формировании здорового интимного партнера в более позднем возрасте. Использование данных результатов для будущих исследований по качеству отношений партнера и формирования семьи важны для общественных отношений.

Ключевые слова: детско-родительские отношения, качество отношений с близким партнером, поведенческая генетика, отношения взрослых.

Marriage, or some variant of a committed relationship, is a central feature of virtually all human societies. To date, no culture has been discovered in which marriage—whether polygamous, monogamous, permanent or temporary—is not the norm (Wright, 1994). This initial pairing is the foundation on which society and the family is built upon. Across societies, polygamous and monogamous mating systems are dominant, with some evidence suggesting that most modern industrialized nations practice monogamy (Gray & Anderson, 2010). In the United States, most adults will marry at least once during their lifetime despite the increasingly popular choices of cohabitation and the delaying of marriage altogether (Diamond, 1997; Spotts et al., 2004).

Given the importance and prevalence of these relationships, understanding the mechanisms that influence how bonds are initially formed and maintained is of great importance to scholars across a range of disciplines. For instance, sociologists typically use measures of early parent-child relationships to predict later-life outcomes. Under the sociological framework, the process by which these early bonds affect later relationships is seen as direct and due to social/environmental influences. On the other hand, behavioral geneticists consider the influence of both environmental and genetic effects

on individual differences in relationship quality. To illustrate, the intergenerational transmission of divorce or risk for unhealthy intimate partner relations can be assessed from a genetically informed approach by using sibling pair data to estimate the genetic and environmental effects on the association between parent-child relationships and later-life intimate partner relationships. The current study aimed to assess this intergenerational transmission hypothesis by using quantitative behavior genetic methods to disentangle the genetic from environmental influences that account for the common association between early parent-child relations and later-life adult intimate partner relationship quality.

The Social Science Approach to Parent-Child Relationships

Within the social sciences, the development and maintenance of interpersonal relationships and bonds are of central importance. The parent-child relationship is believed to have considerable explanatory power in predicting later-life child outcomes (Towers, Spotts, & Neiderhiser, 2001). Parenting is often viewed as a unidirectional (and sometimes bidirectional) process from parent

to child and one that is uniform across different children within the same household. The guiding framework is as follows: if parents are warm and caring to their children, then their children will develop prosocial behavioral tendencies and turn out to be healthy, cooperative, and successful in their later-life pursuits and relationships. In essence, the early parent-child relationship serves as a template for future relationships and interactions with others.

Within the field of developmental psychology, attachment theorists place the utmost importance on early parent-child relationships. With the publication of *Attachment* in 1969, Bowlby put forth his theory in which children are said to form “internal working models” from the early parent-child relationship. Crucial to Bowlby’s theory is the concept of responsiveness, which refers to the degree to which parents are warm, supportive, and attuned to their child’s physical and emotional needs. To test Bowlby’s attachment theory, Ainsworth developed the Strange Situation Test (Ainsworth, Blehar, Waters, & Wall, 1978), a twenty minute laboratory-based observation test. For the Strange Situation Test, infants were briefly separated from their mothers and then reunited. Upon reuniting, the infant’s behavior was observed and classified. For example, if a child was securely attached to his/her mother then once reunited, the child would seek contact initially with the parent and then resume play. On the other hand, if a child was insecurely attached to the parent, then the child (upon reunion) would either avoid or move away from the parent.

Using the Strange Situation Test (Ainsworth & Bell, 1970), four types of infant-parent attachment have been identified: secure, insecure-avoidant, insecure-anxious, and disorganized (Bowlby, 1969; Main & Solomon, 1990). The four classifications of infant-parent relationships can be used to examine both the child and mother individually and as a pair. For instance, insecurely attached children, as compared to securely attached children, are proposed to be at increased risk for aggression, maladaptive interpretation of social cues, poorer social and mental health, and overall negative life outcomes. Relatedly, mothers of insecurely attached infants have been found to be less facially expressive, attentive, and angrier in comparison to securely attached infants (Main, Tomasini & Tolan, 1979).

In another well-known theory, the cycle of violence proposes abused children (or children who witness violence) learn maladaptive interaction styles

at a young age that they continue to use throughout their lives (Widom, 1989). For example, a child may imitate their parents’ hostile communication style with peers of the child’s own age and in turn, increase the likelihood of negative peer relationships and possible social rejection. Children who witness home violence or are themselves maltreated have been found to be more likely to form intimate relationships characterized by dysfunction, abuse, and have general deficits in social processing skills than children who do not experience such harsh home environments (Cochran, Sellers, Wiesbrock, & Palacios, 2011; Dodge, Bates, & Pettit, 1990; Margolin & Gordis, 2004; Widom, 1989). Given this evidence, many states have established harsher penalties for domestic violence offenders whose actions are witnessed by a child suggesting that this can be considered a form of child maltreatment (U.S. Dept. of Health and Human Services, 2013).

The theoretical approach illustrated by Bowlby’s attachment theory (1969, 1973) and the cycle of violence hypothesis continues to be the dominant approach among social scientists in explaining why family members tend to be similar to one another. The relationship between early parent-child bonds and later-life outcomes is viewed as social and direct. According to this framework, kids tend to be similar to their parents in behavior and personality due to the intergenerational transmission of expectations, values, and morals. Hence, when a child grows up in an abusive home or has a negative relationship with their parents, these experiences lay the foundation for which all other social interactions are built upon. Indeed, a considerable amount of literature has shown support for the direct influence of early parent-child relationships on later-life outcomes including levels of self-control, general delinquency, academic performance, and substance abuse (Astone & McLanahan, 1991; Barnes & Farrell, 1992; Perrone, Sullivan, Pratt & Margaryan, 2004; Simons et al., 2004). For example, a recent review of empirical findings from several studies using different samples and different measures of parent-child attachment found that insecure attachment was associated with developing internalizing behavioral problems such as depression and anxiety issues in childhood and adolescence (Brumariu & Kerns, 2010). Taken together, although the theoretical approach of the early parent-child bond seems to be supported by contemporary research, the potential role of genetic/biological factors has largely been ignored (O’Connor, Croft, & Steele, 2000).

Methodological Considerations of the Standard Social Science Approach

While links between various aspects of the parent-child relationship and later-life outcomes are consistently found in several studies cutting across multiple social science fields, one important feature of such studies should temper the strength of any conclusions drawn. In standard social science studies, environmental and genetic influences cannot be separated due to the use of standard social science methodologies (SSSMs; Harris, 1998). SSSMs usually include one child and are only capable of measuring between-family differences. By employing this research design, it is not possible to separate environmental influences from genetic influences on the outcome of interest. Given that the majority of parental socialization research employs SSSMs, the possibility of model misspecification is a serious concern with many studies actually capturing the effect of shared genetic influences rather than shared social influences (Harris, 1998; Rowe, 1994).

The theoretical implications of model misspecification can be seen in the theories of early harsh parenting styles. While early harsh parenting styles have been shown to have negative later-life outcomes, most studies do not control for genetic effects leaving open the possibility of genetic confounding (Beaver, Ferguson & Lynn-Whaley, 2010; D'Onofrio & Lahey, 2010; Wright, Schnupp, Beaver, DeLisi, & Vaughn, 2012; Wright & Beaver, 2005). Depending on the research design, different conclusions regarding the association between harsh parenting and later-life outcomes may be reached. For instance, under the standard social science approach, authoritarian parents who employ a punitive parenting style are proposed to be more likely to have children who mirror these techniques later in life by way of imitation and reinforcement.

While this type of explanation is certainly possible, alternative explanations have been advanced that consider the role of shared genetic and unique environmental influences on parent-child relationships (Harris, 1998; Rowe, 1994). Within this framework, the child is likely to mirror the parenting style they experienced due to (1) learned and established expectations of how a parent and child should interact with one another as well as (2) shared genetic material between the child who initially received the specific parenting style and the parent who endorsed the behavior. Thus, the intergenerational transmission of parenting styles is interpreted as the combination of genetic and environmental/social factors interacting to produce a behavioral outcome.

Behavioral Genetics

The field of behavior genetics applies genetic research strategies to the study of human personality, behavior, and characteristics (Plomin et al., 2008). By using genetically informed methods, the extent to which genetic and the environmental factors account for variation in a wide range of traits and behaviors (also known as phenotypes) can be identified. Heritability, or the extent to which variation in a phenotype is under genetic influence, is central to human behavioral genetics (Walsh & Beaver, 2009). To examine the heritability of different traits and behaviors, behavioral genetic studies examine two siblings with varying degrees of genetic relatedness. Commonly, monozygotic (MZ) and dizygotic (DZ) twin pairs are used because they vary in the amount of additive genetic material (DNA) they share. While MZ twins share 100 percent of their additive genetic material, DZ twins only share, on average, 50 percent of their additive genetic material. By comparing the strength of the correlation between twin 1 and twin 2 across MZ and DZ twin status (also known as intraclass [cross-twin] correlations), researchers can examine whether a measurable trait or behavior is under genetic influence. Evidence of a genetic effect would be conferred if a cross-twin correlation for a measured behavior were higher for MZ twins compared to DZ twins. Building upon this step, researchers can employ a wide range of genetically informed methods including biometric modeling, discordant twin designs, and MZ difference scores analysis.

Findings from Behavior Genetic Research on Parent-Child Relationships

A key advantage of using a genetically informed research design over SSSMs is the ability to separate and estimate the environmental and genetic factors that work together to produce an outcome. Environmental factors can be further divided into shared and nonshared influences. While the shared environment component captures shared (or common) experiences between siblings that make them more similar to each other, the nonshared environment component captures unique experiences for each sibling that creates differences in behavior between-siblings. Genetic research designs clarify the extent to which environmental and genetic factors influence behaviors and traits over time and across different environments.

Findings from recent studies that employ genetically sensitive research designs have produced competing findings to those generated from studies using SSSMs in two important ways (Beaver et

al., 2009; Pederson, Spotts & Kato, 2005; Wright et al., 2008). First, the role of genetic factors has now been well-supported within the parent-child relationship calling into question the uniformity of the parent-child relationship. For instance, in Kendler and Baker's (2007) meta-analysis many components of parental socialization were found to be under consistent genetic influence across child- and parent-based designs and ranging from 12 to 37 percent. Thus, the standard practice of only drawing one child per household is incapable of examining differences in parent-child relations within households. Second, child and parent-based studies (depending on whose genetic material is included), supports the idea of a bidirectional relationship between parents and children in which children do influence how parents act towards them (Pederson, Spotts & Kato, 2005; Rowe, 1981, 1983). For instance, a sensitive and attentive child will likely be easier to discipline than a hyperactive aggressive child. Additionally, a child's genetic material will also influence how they perceive (and later report) their childhood experiences. For example, genetic factors are usually found to account for close to 50% of individual differences in parental warmth or affection measures (Lichtenstein et al., 2003; Pederson, Spotts, Kato, 2005; Rowe, 1981, 1983), while the remaining is accounted for by the nonshared environment (Braungart, 1994; Pederson, Spotts, & Kato, 2005; Plomin et al., 1989). These findings suggest that variation in parent-child relations may be partially accounted for by passive and evocative gene-environment correlational processes (*r*GE) (Scarr & McCartney, 1988). Specifically, passive *r*GE would occur if parents' genetically influenced characteristics impact their parenting practices toward their child which, in turn, are correlated with their children's' genetically influenced personality traits. On the other hand, evocative *r*GE, in the context of parenting, would occur if parents alter their childrearing practices based on a child's genetically influenced personality. For example, parents may respond to one child's negative emotionality with harsh punishment and another child's positive emotionality with love and affection. Indeed, recent family-focused behavioral genetic research has found support for these types of genotype-environment associations (Neiderhiser, Reiss, Lichtenstein, Spotts, & Ganiban, 2007; Neiderhiser et al., 2004).

Behavioral genetic studies have also been used to examine the environmental and genetic factors that interact in the prediction of getting married, divorced, and the quality of these relationships—

outcomes that are typically viewed as being partially the result of early life environmental factors found within the family (e.g., being reared in a divorced family). Early behavioral genetic research focused primarily on marital status (i.e., divorce or married) and determining a person's level of risk for getting divorced based on another family member's marital status (Ulbricht & Neiderhiser, 2009). For instance, McGue and Lykken (1992) found that having a divorced co-twin (MZ or DZ) substantially increased the odds of becoming divorced regardless of sex and age. The odds of getting divorced also increased if either the parent of the respondent or his/her spouse was already divorced. In Jockin, McGue and Lykken (1996), the same sample was used to estimate the probability of getting divorced and the possible role of personality factors within relationships. Genetic factors were found to explain between 46% and 52% of the variance in personality traits (for men and women) as well as between 31% and 41% of the variance in divorce. More importantly, genetic influences have been found to partially account for the covariance between personality traits and divorce, suggesting that common genetic effects may influence both personality development and risk for divorce. Other contemporary research has also reported that variation in marital quality is largely accounted for by genetic and nonshared environmental influences (Spotts et al., 2004).

Despite mounting evidence revealing that individual differences in parent-child relationships and later life intimate partner relationship quality are the result biosocial influences, relatively less is known about the extent to which common genetic and environmental factors explain the well established association between both outcomes. With this in mind, the present study aimed to fill this gap in the literature and shed new light on the mechanisms that explain the link between early life parent-child relations and later life intimate partner relationship quality.

Current Study

The purpose of the current study is threefold. First, we use univariate ACE decomposition models to estimate the proportion of variance in mother-child relationship quality, father-child relationship quality, and adult intimate partner relationship quality that can be attributed to additive genetic factors, shared environmental factors, and nonshared environmental factors. Second, we examine the factors that account for the underlying shared etiology between early parent-child relationships and adult intimate partner

relationship quality by decomposing the covariance into genetic and environmental components. Third, we use an MZ twin difference score approach to examine whether or not nonshared environmental effects from early parent-child relationship quality predict variation in later life adult intimate partner relationship quality.

Methods

Data

Data for the current study came from the Survey of Midlife Development in the United States (MIDUS). The MIDUS study is a national longitudinal study designed to study the effects of midlife development on health and well-being. Beyond the national probability sample ($N = 3,487$), oversamples of select metropolitan areas ($N = 757$) and a sample of siblings ($N = 950$) and twins ($N = 1,914$) were also included. Data have been collected in two waves thus far. The first wave of MIDUS data collection began in 1995-1996 with roughly 7,000 adults ranging from 25 to 74 years old. Respondents reported on their social and physical health including social networks, community involvement, personality traits, occupational history, childhood and background factors, and health status via phone and self-administered questionnaires (Brim, Ryff & Kessler, 2004). Twin pairs were identified by asking each participating respondent if he/she had a twin who would also be willing to be surveyed. If a single household reported having one or more pairs of twins, then all twins willing to participate in the study were included in the data collection process. Zygosity was determined by eight self-report items within the twin interview regarding their physical characteristics and opinion of their zygosity. Similar methods of determining zygosity have been shown to be over 95% accurate (Reitveld et al., 2000). The twin sub-sample included in the first wave of data collection included 998 MZ and DZ twin pairs.

The final analytic sample used in the current study was restricted to same-sex MZ and DZ twin pairs. Only Wave 1 data were included in the current study. Due to undetermined zygosity at Wave 1, 25 twins were dropped from the sibling sub-sample. In addition, another 4 twins were dropped due to mismatching zygosity between twin 1 and twin 2 (i.e., one twin was coded as MZ while their co-twin was coded as DZ). Only one randomly selected twin pair from each household was included in the final analytic sample. Across the univariate and bivariate models, sample sizes ranged from 544 to 639 twin pairs.

Measures

Parent-Child Relations

Mother-Child Relationship Quality

A five-item mother-child relationship measure was created using responses from the Wave 1 self-administered questionnaire (see Appendix A). Respondents were asked to report on various characteristics of their relationship with their biological mother or the woman who raised them during the years they were growing up. Specifically, respondents were asked to rate their overall relationship, how much their mother understood their problems and worries, how much they felt they could confide in their mother, how much love and affection their mother gave them, and how much time and attention their mother gave them. Due to differences in original coding, all items were standardized before summing them together to create a composite mother-child relationship index. Higher values reflect a more positive and close relationship between mother and child while growing up. The resulting 5-item scale demonstrated good internal consistency ($\alpha = .92$) and confirmatory factor analysis with varimax rotation revealed that all items loaded highly on a common factor. Table 1 contains descriptive statistics for the maternal warmth measure.

Insert Table 1 about Here

Father-Child Relationship Quality

Similar to the composite mother-child relationship measure, a composite father-child relationship measure was created using five items from the Wave 1 self-administered questionnaire (see Appendix B). Respondents were asked to report on various characteristics of their relationship with their biological father or the man who raised them during the majority of their childhood and adolescent years. Specifically, respondents were asked to rate their overall relationship, how much their father understood their problems and worries, how much they could confide in their father, how much love and affection their father gave them, and how much time and attention their father gave them. Due to differences in original coding, all items were standardized before the five items were summed to create the composite father-child relationship index. The father-child relationship measure demonstrated excellent internal consistency ($\alpha = .97$) and confirmatory factor analysis indicated that all items loaded highly on a common factor. Higher values reflect more paternal warmth given to the child.

Adult Intimate Partner Relationship Quality

The current study employed a 26-item adult intimate partner relationship quality measure created from the Wave 1 self-administered questionnaire. If the respondent was not currently married or living with a partner in a marriage-like relationship then they were instructed to skip to the next section of the questionnaire. By drawing from multiple aspects of adult relationship quality measures, a global measure of adult intimate partner relationship quality was created. Specifically, respondents reported their joint decision-making processes, the division of household labor, their partner's empathic concern, relationship strain, frequency of emotional support given or received (by the respondent) and general relationship quality. Due to differences in original coding, all items were first standardized before summing. Appendix C lists all of the individual items comprising the adult relationship quality index. Of the quality index, 16 items were drawn from three existing MIDUS indices (spouse/partner strain, empathy, and relationship decision making) used by previous researchers (Grzywacz & Marks, 2001; Gerstorf, Roche, & Lachman, 2011; Ryff, Singer, Palmersheim, 2004). The remaining 10 individual items were drawn from the general relationship, household chores, and normative primary social obligation sections. Higher values on the quality measure reflect a more supportive and cooperative relationship characterized by trust, commitment, and overall satisfaction. All individual items were summed together with higher values representing higher levels of adult relationship quality ($\alpha = .98$). Factor analysis indicated that all 26 items loaded highly on a single common factor.

Plan of Analysis

The analysis for the current study proceeded in three interrelated steps. First, univariate biometric ACE models were used to estimate the genetic and environmental effects on variance in mother-child relationship quality, father-child relationship quality, and adult intimate partner relationship quality. Figure 1 presents a graphical depiction of a univariate ACE model which was estimated separately for each parent-child relationship measure and the adult intimate partner relationship quality measure. The rectangular boxes contain each twin's score on a measure (parent-child relationship or adult intimate partner relationship quality) while the circles (A, C, and E) represent separate latent variance components that provide estimates for the genetic, shared

environmental, and nonshared environmental effects on each measure. The set correlation from A1 to A2 (1.00; .50) represents the amount of genetic material shared between twins. Thus, the correlation is set to 1.00 for MZ twin pairs and .50 for DZ twin pairs. The shared environment correlation from C1 to C2 is held constant at 1.00 since twins are assumed to share 100 percent of the same environment, while the nonshared environment component is unconstrained and free to vary as it represents unique environment experiences to each twin. The size of each A, C, and E latent variance component is computed by comparing observed cross-sibling correlations to predicted cross-sibling correlations generated by the model.

Insert Figure 1 about Here

For each model, the full ACE model was estimated first, followed by a series of constrained models (AE, CE, A, C, E). In cases where the full ACE model was not the best fitting model, subsequent models were evaluated based on model fit indices such as the comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA). Parameter estimates for all models are reported.

In the second stage of the analysis, bivariate Cholesky decomposition models were estimated to decompose the correlation or covariance between measures of parent-child relationship quality and adult intimate partner relationship quality. Bivariate Cholesky models decompose the covariance between two measures that is explained by common additive genetic influences (A), common shared environmental influences (C), and nonshared environmental influences (E). Measurement error is also captured by the nonshared environmental component in this model. As can be seen in Figure 2, the four rectangular boxes represent each twin's score on a measure of parent-child relationship quality and adult intimate partner relationship quality. The circles represent the additive genetic (A), shared environmental (C), and nonshared environmental (E) latent variance components. Similar to the univariate ACE model, the genetic correlations vary depending on genetic relatedness (1.00 or .50), while the correlations for the shared environment are set to 1.00 as twins are assumed to share 100 percent of their shared environment. The correlations between the nonshared environmental components are set to 0 since twins are assumed to share 0 percent of their nonshared environment.

Insert Figure 2 about Here

Each outcome was regressed on sex, race, and household income. The residuals from this analysis

were then saved and used in all biometric univariate and bivariate models. All models were estimated using the structural equation modeling program *Mplus* 7.1 (Muthén & Muthén, 1998-2012) using full information maximum likelihood (FIML) estimation to account for missing data. Model fit was assessed based on conventional fit indices such as the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). Difference in χ^2 coefficient tests were used to assess model fit for nested models alongside baseline models. As recommended, the following acceptable model fit cut-off points were used to assess model fit: CFI > .95, TLI > .95, and RMSEA < .05 (Hu & Bentler, 1998, 1999).

Results

The analysis began by estimating intraclass correlations for each parent-child relationship quality and adult intimate partner relationship quality measure separately for MZ and same-sex DZ twins. As shown in Table 1, the intraclass correlation coefficients for MZ twin pairs were larger than those for DZ twin pairs implying that the relationship measures are under some degree of genetic influence.

Table 2 shows bivariate correlation coefficients for associations between mother-child relationship quality, father-child relationship quality, adult intimate partner relationship quality, age, household income, race, and sex. As can be seen, each parent-child relationship measure was significantly ($p < .05$) and positively associated with adult intimate partner relationship quality. Thus, while the pattern of the correlational estimates suggests that early parent-child relationship quality and adult intimate partner relationship quality are at least somewhat influenced by genetic factors and significantly related to one another, the relative importance of genetic influences compared to environmental influences on each measure and the association among all three cannot be fully appreciated. To do so, univariate and bivariate decomposition models are required.

Insert Table 2 about Here

Univariate model parameter estimates for each relationship measure are presented in Table 3. The best-fitting model for the mother-child relationship quality measure was an AE model whereas the ACE model was the best-fitting model for the father-child relationship quality measure. Based on model fit statistics, the AE model for adult intimate partner relationship quality was a better fitting model compared to the baseline ACE model. As shown in Table 3, parameter estimates from the AE model revealed

that genetic factors accounted for 65% of the variance in mother-child relationship quality, while the nonshared environment (including error) explained the remaining 35% of the variance. For father-child relationship quality, genetic factors accounted for 41% of the variance while the shared environment accounted for 18% and the nonshared environment (including error) explained 41% of the variance. With respect to adult intimate partner relationship quality, parameter estimates indicated that 34% of the variance was explained by genetic factors and 66% of the variance was explained by nonshared environmental factors (including error).

Insert Table 3 about Here

Table 4 presents the results of the bivariate Cholesky models for each parent-child relationship quality measure with the adult intimate relationship quality measure separately. In the first three columns of the table, parameter estimates are provided for each best-fitting bivariate Cholesky model. To the right of the parameter estimates are model fit statistics for each Cholesky model, followed by the number of observations included in each model. As can be seen, common additive genetic factors accounted for the majority (81%) of the covariance between mother-child relationship quality status and adult intimate partner relationship quality. The nonshared environment (including error) accounted for the remaining covariance (19%). Similarly, common additive genetic factors explained the majority of the covariance (83%) between the father-child relationship quality status and adult intimate partner relationship quality, while the nonshared environment (including error) explained the remaining variance including error (17%).

Insert Table 4 about Here

Supplemental Analysis

Based on supporting evidence for the nonshared environment on reports of parent-child relations and intimate partner relationship quality, supplemental analyses were conducted to examine whether parent-child relationship environmental differences predicted differences in marital relationship quality. To do so, a series of MZ-difference-score models were calculated. MZ-difference-score models are considered by many to be the “gold standard” approach for estimating whether nonshared environmental differences predict variation in outcomes of interest (Asbury et al., 2003; Caspi et al., 2004; Pike et al., 1996). The goal of the MZ-difference-score approach is to isolate the nonshared environmental component, which is the only difference between MZ twins as they share 100 percent of their genetic material. In the current

study, difference scores were created for mother-child and father-child relationship quality as well as adult intimate partner relationship quality. Thus, the difference between two twins on either variable (mother-child relationship quality or father-child relationship quality) is calculated and interpreted as a non-shared environmental variable that is used to predict differences in adult intimate partner relationship quality. If the coefficient is significant, then the nonshared environmental component of the parent-child relationship quality measure is a significant predictor of the nonshared environmental component of adult intimate partner relationship quality, beyond the influence of genetic factors.

Table 5 presents the results for each MZ-difference-score model. As can be seen, neither the composite mother-child nor the father-child relationship quality measure significantly predicted adult intimate partner relationship quality. Although the composite models were nonsignificant, it still was possible that the individual components of each parent-child relationship quality measure were differentially related to the adult intimate partner relationship quality measure. Thus to investigate this possibility, the five individual components were modeled separately. Of the individual mother-child and father-child relationship quality models, none of the specific nonshared environmental components significantly predicted nonshared environmental variation in adult intimate partner relationship quality.

Insert Table 5 about Here

Discussion

The early parent-child relationship is believed to have a relatively strong influence on a range of later-life outcomes including the quality of adult relationships. Although previous social science studies have theorized a direct and predominately social link between the early parent-child bond and later-life relationships (Assor & Tal, 2012; Fuemmeler et al 2012; Knutson, DeGarmo, Koepl & Reid, 2005; Lopez, Melendez, & Rice, 2000; Sher-Censor, Oppenheim & Sagi-Schwartz, 2012), these findings remain open to attacks of confounding based on unmeasured genetic influences (Harris, 1998; Rowe, 1994). In order to address this criticism, the current study employed a series of genetically informative analyses to examine the relation between early parent-child relationships and adult intimate partner relationship status.

Using twin pairs drawn from the Survey of Midlife Development (MIDUS), three broad

findings emerged. First, genetic factors explained a moderate to large amount of variance in mother-child and father-child relationship quality as well as adult intimate partner relationship quality (34-65%). Nonshared environmental factors (including error) accounted for the majority of the remaining variance (35-66%). Second, the majority of the covariance between parent-child relationships and intimate partner relationship quality was accounted for by common additive genetic factors (81-83%) while the nonshared environment (including error) explained between 17% and 19%. Third, the MZ-difference-score analysis revealed that once genetic factors were controlled for, the environmental differences in the composite parent-child relationship measure did not significantly predict environmental differences in adult intimate partner relationship quality. The same pattern of results held for individual components of each parent-child relationship measure. These findings suggest that nonshared environmental effects on individual differences in parent-child relationship quality are not the same unique environmental influences that explain individual differences in intimate partner relationship quality later in life.

Findings from the present study add to a growing body of literature highlighting the need to employ genetically informed research designs when assessing the link between early parent-child relationships and later-life outcomes (Beaver, 2011; Beaver, Ferguson & Lynn-Whaley, 2010; D'Onofrio et al., 2007; Horwitz & Neiderhiser, 2011; Pederson, Spotts & Kato, 2005; Spotts et al., 2004, 2005a, 2005b, 2006; Wright et al., 2012). As the univariate and bivariate Cholesky decomposition models indicate, common genetic and nonshared environmental factors account for the majority of the variance in parent-child relationship quality and adult relationship quality. Of course, this is not to say that there are genes that code directly for relationship quality; rather, the genetic influences that are detected on social environments likely operate via indirect pathways, such as genetically influenced personality traits (D'Onofrio et al., 2006). For example, more conscientiousness and agreeable children will likely be more attentive and responsive to their partner's needs than highly neurotic children. Based on this logic, findings from the present study offer evidence for an evocative *r*GE as well as an active *r*GE between parent-child relationship quality and adult intimate partner formation. For example, whereas individuals' genetically influenced personality traits may evoke certain responses from their parents early in life or intimate partners later in life (i.e., evocative

rGE), individuals' genetically-driven characteristics may also influence mate choice wherein they actively select to engage in intimate relations with individuals who possess certain behavioral traits that compliment their own behavioral traits (i.e., active *rGE*). For example, an individual who is agreeable will be more likely to search for mates with agreeable tendencies that are familiar to them and will make relating to their mate easier.

Although the results of the study contribute to the field of adult relationships using a global measure of adult relationship quality and a genetically sensitive design, the results should be interpreted in light of at least two key limitations. First, the current study employed a sample of MZ and same-sex DZ twin pairs drawn from the USA. While no significant differences were found for the parent-child and adult relationship efficacy measures between the full sample and the subsample used in this study, it cannot be said for certain that the twin pairs did not differ in other important ways. Current research, however, has been conducted on other large, prospective samples without any indication that twins differ from non-twins on key behavioral, personality, and demographic characteristics (Barnes & Boutwell, 2012). Moreover, given that the results were generated on a sample drawn from the US, the extent to which these findings can be generalizable to other societies awaits future research. Second, the parent-child relationship measure was drawn from Wave 1 responses when the average age of subjects was 44 years old. Although retrospective reports are

commonly used in the literature (Davey, Tucker, Fingerman & Savla, 2009; Fuemmeler et al 2012; Hardt & Rutter, 2004; Rothrauff, Cooney & An, 2009; Greenfield & Marks, 2009), such reports are not without potential issues. Respondents, such as those in the current study, may suffer from bias and memory issues regarding their childhood experiences and interactions with parents. Of importance though, no significant patterns of missingness were found for items included in the current study. Third, the current study used cross-sectional data thus limiting the study to make conclusions about causal order. Future longitudinal studies that are able to address these limitations would be of great use in determining the robustness of the results reported here.

The findings here lend credence to the call by some researchers for the need to explore the parent-child relationship using genetically informed samples and techniques (Harris, 1998; Rowe, 1994; Wright & Beaver, 2005). As the findings from the current study have suggested, the environmental differences in parent-child relationships failed to predict differences in relationship quality for adult committed relationships when tested under stringent methodological conditions. Such results are in contrast to previous SSSM research on the etiological development of social relationships and demonstrate the importance of considering such topics through a multidisciplinary lens that focuses on assessing the genetic and environmental influences on personal relationships across different stages of the life course.

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Appendix A. Items Included in the Maternal Warmth Index

1. How would you rate your relationship with your mother (or the women who raised you) during the years you were growing up?
 2. How much did she understand your problems and worries?
 3. How much could you confide in her about things that were bothering you?
 4. How much love and affection did she give you?
 5. How much time and attention did she give you when you needed it?
-

Appendix B. Items included in the Paternal Warmth Index

1. How would you rate your relationship with your father (or the man who raised you) during the years you were growing up?
 2. How much did he understand your problems and worries?
 3. How much could you confide in him about things that were bothering you?
 4. How much love and affection did he give you?
 5. How much time and attention did he give you when you needed it?
-

Appendix C. Items included in the Adult Intimate Partner Relationship Quality Index

1. How would you rate your marriage or close relationship these days?
2. Looking back 10 years ago, how would you rate your marriage or close relationship at that time?
3. Looking ahead 10 years in the future, what do you expect your marriage or close relationship to be like at that time?
4. How would you rate the amount of control you have in your marriage or close relationship these days?
5. How much thought and effort do you put in your marriage or close relationship these days?
6. How much does your spouse or partner really care about you?
7. How much does he or she understand the way you feel about things?
8. How much does he or she appreciate you?
9. How much can you rely on him or her for help if you have a serious problem?
10. How much can you open up to him or her if you need to talk about your worries?
11. How much can you relax and be yourself around him or her?
12. How much do you and your spouse or partner disagree about money matters?
13. How much do you and your spouse or partner disagree about household tasks?
14. How much do you and your spouse or partner disagree about leisure time activities?
15. How often does your spouse or partner make too many demands on you?
16. How often does your spouse or partner make you feel tense?
17. How often does your spouse or partner argue with you?
18. How often does your spouse or partner criticize you?
19. How often does your spouse or partner let you down when you are counting on him or her?
20. How often does your spouse or partner get on your nerves?

21. How fair do you think the household chores arrangement is to you?
22. How fair do you think the household chores arrangement is to your spouse or partner?
23. My partner and I are a team when it comes to making decisions.
24. Things turn out better when I talk things over with my partner.
25. I do not make plans for the future without talking it over with my partner.
26. When I have to make decisions about medical, financial, or family issues I ask my partner for advice.

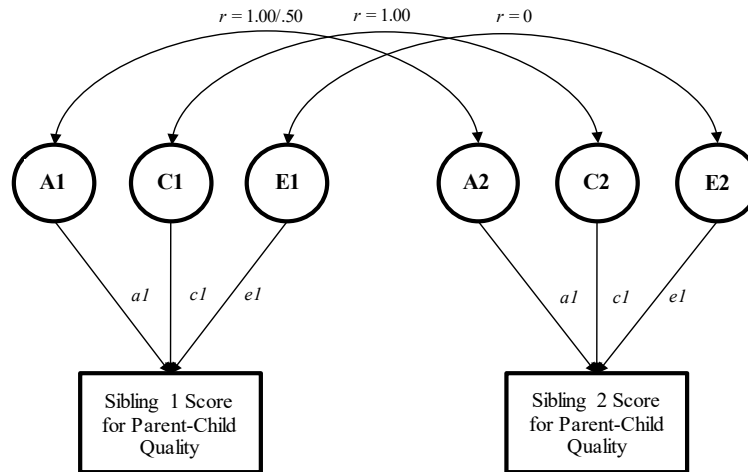


Figure 1 – Univariate Biometric ACE Model for Parent-Child Relationship Quality

Note: r values from A1 to A2 represent genetic relatedness model constraints, while the r value from C1 to C2 represents the shared environment model constraint and r value from E1 to E2 represents the nonshared environment model constraint. Path coefficients from each latent A, C, and E component (i.e., a_1 , c_1 , e_1 , a_2 , c_2 , and e_2) leading to the observed variable (i.e., parent-child relationship quality) will provide information on the amount of variance accounted for by additive genetic influences (A), shared environmental influences (C), and nonshared environmental influences and measurement error (E).

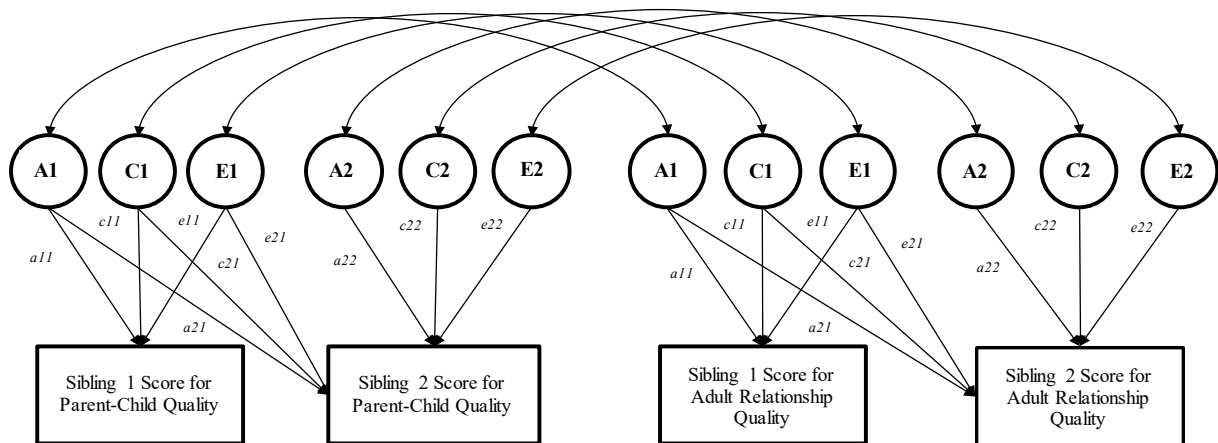


Figure 2 – Bivariate Cholesky Model for Parent-Child Relationship Quality and Adult Intimate Partner Relationship Quality

Note: Path correlations from A1 to A2 are set to 1.00 or .50 based on genetic relatedness. Path correlations from C1 to C2 are set to 1.00 and path correlations from E1 to E2 are set to 0. Coefficients for a_{11} , c_{11} , e_{11} , a_{21} , c_{21} , e_{21} are used to estimate the amount of covariance that is accounted for by additive genetic influences (A), shared environmental influences (C), and nonshared environmental influences and measurement error (E).

Table 1 – Descriptive Statistics for Full Sample and Twin Sample

Variable	Mean	SD	Minimum- Maximum	MZ Intraclass Correlation	DZ Intraclass Correlation
<i>Parent-Child Relationship Variables</i>					
Mother-Child	11.50	4.03	0-16	.70**	.44**
Father-Child	9.06	4.39	0-16	.73**	.50**
<i>Adulthood Variables</i>					
Adult Relationship Efficacy	2.04	24.90	-18-50	.47**	.25*
<i>Demographics</i>					
Age	44	12	25-74	-	-
Household Income	42,721	39,210	0-10	-	-
	Percent	SD	Minimum- Maximum	MZ Intraclass Correlation	DZ Intraclass Correlation
Sex	-	-	0-1	-	-
Male	42.84	-	-	-	-
Female	57.16	-	-	-	-
Race	-	-	0-1	-	-
Nonwhite	6.25	-	0-1	-	-
White	93.75	-	0-1	-	-

Note: ** $p \leq .01$; * $p \leq .05$

Table 2 – Correlation Matrix for Parent-Child Relationships, Adult Relationship Quality, and Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Mother-Child Relationship	-						
(2) Father-Child Relationship	.30**	-					
(3) Adult Relationship Quality	.13**	.10*	-				
(4) Age	.02	-.01	-.06	-			
(5) Household Income	.09*	.05	.13**	.14**	-		
(6) Sex	.12**	.04	.10**	-.07	.05	-	
(7) Race	-.03	.07*	.17**	-.01	.02	-.14*	-

Note: ** $p \leq .01$; * $p \leq .05$

Table 3. Univariate Parameter Estimates for Parent-Child Relationships and Intimate Partner Relationship Quality

Model	A	C	E	$\Delta\chi^2$	Δ df	CFI	TLI	RMSEA
Mother-Child Relationship								
ACE	.28** (.22-.34)	.27** (.21-.35)	.45** (.33-.57)	-	-	.91	.95	.05
CE	.00 (.00-.00)	.46** (.44-.49)	.54** (.52-.56)	254.10**	1	.90	.92	.06
AE	.65** (.62-.75)	.00 (.00-.00)	.35** (.25-.38)	141.87	1	.95	.98	.03
E	.00 (.00-.00)	.00 (.00-.00)	1.00 (1.00-1.00)	1653.62**	2	.59	.68	.14
Father-Child Relationship								
ACE	.41** (.25-.63)	.18** (.10-.46)	.41** (.23-.32)	-	-	.92	.94	.04
CE	.00 (.00-.00)	.49** (.47-.51)	.51** (.49-.53)	175.98**	1	.90	.93	.05
AE	.84** (.82-.87)	.00 (.00-.00)	.16** (.13-.18)	260.54**	1	.88	.91	.05
E	.00 (.00-.00)	.00 (.00-.00)	1.00 (1.00-1.00)	1743.63**	2	.52	.64	.16
Intimate Partner Relationship								
ACE	.29** (.18-.40)	.18** (.09-.26)	.53** (.35-.71)	-	-	.87	.90	.06
CE	.00 (.00-.00)	.37* (.22-.46)	.63** (.54-.78)	254.12**	1	.84	.88	.08
AE	.34** (.28-.44)	.00 (.00-.00)	.66** (.56-.72)	146.22	1	.92	.96	.04
E	.00 (.00-.00)	.00 (.00-.00)	1.00 (1.00-1.00)	1539.98**	2	.58	.63	.14

Note: The best-fitting univariate model is bolded. 95 percent confidence intervals included in parentheses. ** $p \leq .01$ * $p \leq .05$

Table 4 – Bivariate Parameter Estimates for Parent-Child Relationships and Intimate Partner Relationship Quality

Model	A	C	E	$\Delta\chi^2$	Δdf	CFI	TLI	RMSEA
Mother-Child Relationship & Intimate Partner Relationship								
ACE	.59** (.42-.67)	.12* (.09-.21)	.29** (.20-.33)	-	-	.91	.95	.05
CE	.00 (.00-.00)	.37** (.28-.41)	.63** (.59-.72)	270.89**	1	.87	.91	.07
AE	.85** (.64-.92)	.00 (.00-.00)	.15** (.08-.36)	152.56	1	.93	.97	.03
E	.00 (.00-.00)	.00 (.00-.00)	1.00 (1.00-1.00)	1932.67**	2	.64	.69	.11
Father-Child Relationship & Intimate Partner Relationship								
ACE	.47** (.33-.57)	.10* (.07-.15)	.43** (.35-.51)	-	-	.89	.92	.06
CE	.00 (.00-.00)	.27** (.21-.38)	.73** (.62-.79)	264.21**	1	.87	.90	.07
AE	.87** (.75-.93)	.00 (.00-.00)	.13** (.07-.25)	163.23	1	.90	.93	.04
E	.00 (.00-.00)	.00 (.00-.00)	1.00 (1.00-1.00)	1254.21**	2	.60	.64	.13

Note: The best-fitting bivariate model is bolded. 95 percent confidence intervals included in parentheses. ** $p \leq .01$ * $p \leq .05$

Table 5 – Monozygotic (MZ) Twin Difference Score Estimates Predicting Intimate Partner Relationship Quality

Variable	Composite Relationship Model				Mother-Child Relationship Model		Father-Child Relationship Model	
	<i>b</i>	<i>Beta</i>	<i>b</i>	<i>Beta</i>	<i>b</i>	<i>Beta</i>	<i>b</i>	<i>Beta</i>
Mother-Child	0.48 (.57)	0.06	-	-	-	-	-	-
Father-Child	-	-	-.01 (.58)	-.001	-	-	-	-
<i>Individual Items</i>								
Overall	-	-	-	-	.40 (2.28)	.02	-.72 (2.63)	-.03
Attention	-	-	-	-	1.99 (2.31)	.08	3.48 (2.68)	.13
Confide	-	-	-	-	.26 (2.46)	.01	-3.12 (2.47)	-.13
Understanding	-	-	-	-	-3.35 (2.52)	-.13	.30 (2.78)	.01
Love	-	-	-	-	3.66 (2.60)	.13	.55 (2.91)	.02

Note: Standard errors in parentheses. Difference scores were created using standardized scores.