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EMPIRICAL RESEARCH

Adolescent Sexual Activity and the Development of Delinquent Behavior: The Role of Relationship Context

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Abstract Despite the well-established association between adolescent sexual activity and delinquent behavior, little research has examined the potential importance of relationship contexts in moderating this association. The current study used longitudinal, behavioral genetic data on 519 same-sex twin pairs (48.6% female) divided into two age cohorts (13–15 and 16–18 years olds) drawn from the National Longitudinal Study of Adolescent Health. Analyses tested whether adolescent sexual activity that occurred in romantic versus non-romantic relationships was associated with delinquency from adolescence to early adulthood, after controlling for genetic influences. Results indicated that, for both younger and older adolescents, common underlying genes influence both sexual behavior and delinquency. After controlling for these genetic influences, there was no within-twin pair association between sexual activity and delinquency in younger adolescents. In older adolescents, sexual activity that occurred in romantic relationships predicted lower levels of delinquency, both cross-sectionally and longitudinally, whereas sexual activity in non-romantic relationships predicted higher levels of delinquency. These results are consistent with emerging research that suggests that the psychological correlates of adolescent sexual activity may be moderated by the social context in which this activity occurs.

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Introduction

As the number of sexually active American teenagers has increased over the past half-century (Kotchick et al. 2001), both researchers and policymakers have expressed concern about the sequelae of such behavior, particularly whether sexual activity during adolescence might precipitate adverse psychosocial consequences. Current federal sex education policy directly states that "sexual activity outside the context of marriage is likely to have harmful *psychological* and physical effects" (Section 510, Federal Social Security Act; emphasis added). This government policy draws on a wide body of research demonstrating that teenagers who are sexually active also report a breadth of psychosocial problems, including poor academic achievement, depression, and low self- esteem (Hallfors et al. 2005; Meier 2007; Spriggs and Halpern 2008). Historically, an earlier initiation of sexual activity has been seen as a marker of externalizing problems (Jessor and Jessor 1977). Sexually active adolescents are more likely to engage in delinquent activities (Armour and Haynie 2007; Leitenberg and Saltzman 2000), and adolescents with a history of childhood conduct disorder tend to have earlier ages at first intercourse and higher rates of teenage pregnancy (Emery et al. 1999; Woodward and Fergusson 1999).

While the correlation between adolescent sexual behavior and externalizing problems is well-documented, understanding how adolescent sexual experiences may impact the development of delinquency remains unclear. In the current article, we address two challenges to understanding the mechanisms by which sexual activity and delinquency are

associated. First, we consider the diversity of relationship contexts in which adolescent sexual activity occurs. Second, we control for the role of common underlying genetic factors that impact both sexual activity and delinquency in adolescence. By simultaneously considering both the environmental contexts of adolescent sexual experience and the role of genetic predispositions, we hope to advance a more nuanced understanding of the developmental impact of adolescent sexual activity.

Romantic Versus Non-Romantic Relationship Contexts

One challenge in examining the psychosocial sequelae of adolescent sexual behavior is that teenagers are sexually active within different types of relationships, and these relationship contexts may moderate the developmental impact of sexual behaviors. In contrast to the perspective that adolescent sexual activity, in and of itself, is a manifestation of underlying adjustment difficulties, most adolescents first experience sexual intercourse in the course of a romantic relationship (Manning et al. 2000), and romantic relationships are a normative part of adolescent life. More than 70% of 18-year-olds report involvement in a romantic partnership in the preceding 18 months (Carver et al. 2003), and the average duration of these relationships is 12 months. Despite the obvious link between romantic relationships and sexual experiences—and the high subjective importance of romantic relationships for adolescents themselves—research on adolescent sexuality has paid little attention to the characteristics of relationships (Collins et al. 2009). In addition, although adolescents most commonly *initiate* sexual intercourse within the context of romantic relationships, they also have sex with people who are not established romantic partners and with whom there are no clear expectations of emotional intimacy, exclusivity, or commitment. For example, Manning and colleagues (Manning et al. 2005, 2006) reported that the majority of sexually active adolescents have engaged in sexual activity in both romantic and non-romantic relationships, with acquaintances, friends, and former romantic partners being the most common non-romantic sexual partners. These non-romantic sexual experiences may have different developmental sequelae than sex that occurs exclusively within the context of a romantic relationship.

Colloquially, non-romantic sexual experiences are referred to as "hooking up" or "friends with benefits." The popular media broadly denigrates "hooking up" and its negative effects on adolescent well-being (e.g., Blow 2008; Denizet-Lewis 2004; Stepp 2007). However, few empirical studies have directly examined the developmental impact of sexual activity in non-romantic relationships. Of this limited body of research, results reported by McCarthy and Casey (2008) are most relevant for understanding the association between sex and delinquency. Using a combination of longitudinal data and measured covariates to control for selection effects, they found that sexual activity that occurred in the context of non-romantic relationships predicted a 20% increase in delinquency and a 31% increase in substance use, but that sexual activity occurring exclusively in a romantic relationship was not associated with either delinquency or substance use (McCarthy and Casey 2008). Similar patterns have been reported for internalizing outcomes, including negative emotions (Donald et al. 1995) and depressive symptoms (Meier 2007). In contrast, other researchers have found negative effects for sex in non-romantic relationships only for girls (Grello et al. 2006; Shulman et al. 2009). Finally, still other studies have failed to find any effects of sex in non-romantic relationships, after controlling for preexisting differences in adolescents' psychosocial functioning (Eisenberg et al. 2009; Grello et al. 2003; Monahan and Lee 2008). It therefore remains unclear whether non-romantic sex can precipitate delinquent behavior, or whether adolescents with pre-existing psychosocial problems are simply more likely to have sex in non-romantic relationship contexts.

The Role of Genes in the Link between Sexual Activity and Delinquency

An additional challenge when examining the psychosocial correlates of adolescent sexual activity is the importance of genetic factors and, specifically, that the association between sexual activity and adolescent delinquency may be partly due to a common set of genes influencing both traits. Developmental research has largely neglected the role of genes in adolescent sexual behavior, but it is certainly clear that adolescents actively shape and select their social environments—including their romantic and sexual experiences. This process is, in part, governed by their own genetically influenced traits and interests, including their personality traits and their levels of physical development. Thus, adolescent sexual activity can be seen as an example of *gene-environment correlation* (rGE), because the likelihood of an adolescent experiencing sexual intercourse within a particular type of relationship is related to his or her genetic propensities.

Three related lines of research support the importance of considering genes in the association between delinquency and adolescent sexual behavior. First, a number of twin studies have demonstrated that a variety of sexual behaviors—including whether a teenager is sexually active, when he or she first becomes sexually active, and his or her number of sexual partners—are all genetically influenced (Bricker et al. 2006; Dunne et al. 1997; Martin et al. 1977; Mustanski et al. 2007). Molecular genetic analyses suggest

that genes related to the dopamine system, which is known to be important for sensation-seeking personality traits (Derringer et al. 2010), are also associated with earlier ages at first sex (Guo and Tong 2006; Miller et al. 1999), likelihood of having had sex (Eisenberg et al. 2007), and number of sexual partners (Guo et al. 2007, 2008; Halpern et al. 2007). In addition, genes influence a variety of other fertility-related phenotypes that are positively correlated with age at first sex (Udry and Cliquet 1982), such as age at menarche (Rowe 2002) and age at first birth (Kohler et al. 2002). Second, both twin and molecular genetic studies have shown that genes influence delinquency and antisocial behavior (e.g., Arsenault et al. 2003; D'Onofrio et al. 2007; Scourfield et al. 2004; Slutske et al. 1997; Young et al. 2002; for reviews see Miles and Carey 1997; Raine 2002; Rhee and Waldman 2002; Rowe 2001). Third, and most relevant for the current project, bivariate behavior genetic analyses suggest that the genes influencing sexual behavior overlap with those influencing antisocial behavior. For example, Verweij et al. (2009) found that the correlation between risky sexual behavior (e.g., sex without a condom, multiple partners in 24-h period) and antisocial behavior in adults was primarily attributable to common genetic influences. Similar results have been obtained in a cross-generational analysis: The association between teenage childbearing and children's externalizing problems is due, in part, to the parent-to-child transmission of genes influencing both sexual behavior and externalizing symptomatology (Harden et al. 2007).

Analyses that control for the genetic influences common to adolescent sexual activity and delinquency can yield surprising results. In a previous article using twin data from the National Longitudinal Study of Adolescent Health (Add Health), we reported that earlier age at first sex was actually associated with *lower* involvement in delinquency in early adulthood after controlling genetic influences on both delinquency and age at first intercourse (Harden et al. 2008). This provocative finding suggests that adolescent sexual activity may represent a marker for underlying genetic predispositions for delinquent behavior, while also being a developmental transition that may confer some psychosocial benefits. Our previous study focused on a single dimension of sexual experience—age of first sexual intercourse. As we discussed above, however, sexual activity may occur in a variety of social contexts that may modify the relation between sex and delinquency.

Goals of the Current Article

In the current article, we extend previous behavior genetic analyses of the association between adolescent sexual activity and delinquency by examining differences between sexual activity that occurs in romantic relationships versus non-romantic relationships. These analyses use longitudinal, behavioral genetic data drawn from the National Longitudinal Study of Adolescent Health. Specifically, we address two research questions. First, to what extent do common genetic factors account for the associations between delinquency and sexual activity in romantic and non-romantic relationship contexts? Given results from previous research, we hypothesize that a substantial proportion of the association between delinquency and sexual activity, regardless of context, will be attributable to common genetic factors. Second, after controlling for these common genetic factors, does the association between sexual activity and the development of delinquent behavior differ between romantic and non-romantic contexts? Building from the results from our previous genetically informed research on this topic (Harden et al. 2008), we hypothesize that sexual activity in romantic relationships, in particular, will be associated with reductions in delinquent behavior, whereas sexual activity in non-romantic relationships may be associated with elevated risk for delinquent behavior.

Method

Participants: National Longitudinal Study of Adolescent Health

Data are drawn from the National Longitudinal Study of Adolescent Health (Add Health; Udry 2003), a nationally representative study designed to evaluate adolescent health behaviors. The Add Health study targeted a stratified random sample of US high schools, and 79% of selected schools agreed to participate in the study ($N = 134$ schools). Of the participating schools, 96% allowed students ($N = 90{,}118$) to complete a confidential in-school survey during the 1994–1995 academic year. The rosters of participating schools were used to randomly select a subsample of 20,745 participants who completed a follow-up, 90-min in-home interview between April and December 1995 (Wave I interview; 10,480 female; 10,264 male). Participants in the full AddHealth sample ranged in age from 11 to 21 at Wave I ($M = 16$ years, 25th–75th percentile = 14–17 years).

During the in-school interview, adolescents were asked whether they currently lived with another adolescent in the same household. This information was used to deliberately oversample adolescent sibling pairs, even if one member of the pair did not attend a high school in the original probability sample. The focus of the current analyses is a subsample of 519 same-sex twin pairs divided into two age cohorts: *younger adolescents* were ages 13–15 at Wave I

($N = 114$ DZ pairs, 126 MZ pairs) and *older adolescents* were ages 16–18 at Wave I ($N = 126$ DZ pairs, 153 MZ pairs). Twin zygosity was determined primarily on the basis of self-report and responses to four questionnaire items concerning similarity of appearance and frequency of being confused for one's twin. Similar questionnaires have been utilized widely in twin research and have been repeatedly cross-validated with zygosity determinations based on DNA (e.g., Spitz et al. 1996). Analyses were restricted to same-sex twins, in order to prevent bias in estimates of genetic influence due to MZ twins necessarily being identical for sex. That is, to the extent that there are gender-specific differences in the etiology of age at first sex (such as differences in parental monitoring or other parenting between girls and boys, or different cultural expectations regarding the "appropriate" age for sexual initiation), same-sex MZ twins would be more similar than opposite-sex DZ twins, even if there were no genetic influences on age at first sex. Just over half of the twin pairs were non-Hispanic White (56.5%, $N = 293$ pairs), 123 (23.7%) were non-Hispanic Black, 74 (14.3%) were Hispanic/Latino, 21 (3.9%) were Asian, and the remaining 8 pairs (1.5%) reported they were another race/ethnicity or did not report race/ethnicity. Jacobson and Rowe (1999) compared the sociodemographic composition of sibling pairs to the full AddHealth sample and found negligible differences.

There have been three follow-up interviews with the Add Health participants: Wave II in 1996, Wave III in August 2001–2002, and Wave IV in 2007–2008. The current study examines the effects of sexual activity on desistance from delinquency from adolescence to early adulthood, thus we use data from the Wave I (adolescent) and Wave III (early adulthood; 6 year follow-up) interviews. At Wave III, the younger cohort was 19–21 years old, while the older cohort was 22–24 years old.

Measures

Delinquency

The current analyses use 6 items from the Wave I and Wave III interviews that measure engagement in the following delinquent activities: painting graffiti, deliberately damaging someone else's property, stealing something worth more than $50, stealing something worth less than $50, taking something from a house or store, and selling marijuana or drugs. These items were selected based on consistency of administration across waves of data collection and appropriateness for both adolescent and early adult samples (Armour and Haynie 2007; Harden et al. 2008). Participants rated how often they had engaged in each delinquent act in the past 12 months: *Never* (0), *One or Two Times* (1), *Three or Four Times* (2), or *Five or More Times* (3). Delinquency scores were obtained by summing the items, and then square-root transforming to reduce skew. As expected, mean levels of delinquency were higher in adolescence (ages 13–15: $M = 0.78$, SD = .99; ages 16–18: $M = 0.57$, SD = .91) than in early adulthood (ages 19–21: $M = 0.27$, SD = 0.56; ages 22–24: $M = 0.21$, SD = 0.53).

Sexual Activity

During the Wave I In-Home interview, adolescents reported whether or not they had ever had sexual intercourse. Sexual intercourse was specifically defined as heterosexual vaginal penetration. Adolescents who reported a past history of sexual activity were classified as having had sex in romantic relationships and/or non-romantic relationships. First, adolescents reported whether they had a "special romantic relationship" with anyone in the last 18 months. If an adolescent denied being in a "special romantic relationship," but reported that he or she had told another person (who was not a family member) that he or she "loved or liked them," and had held hands and kissed this person, then the adolescent was classified as being in a "liked relationship." For each romantic or liked relationship in the last 18 months (up to 3 relationships), adolescents reported whether they had sexual intercourse in that relationship. If an adolescent reported intercourse in either a "special romantic" or a "liked" relationship in the last 18 months, then they were classified as Romantic Sex = 1. Adolescents also reported at Wave I whether they had ever had a "sexual relationship" with anyone, "not counting the people you described as romantic relationships." Adolescents who reported sexual activity in the context of a non-romantic relationship were classified as Non-Romantic Sex = 1. Sex in romantic and non-romantic contexts were not mutually exclusive categories: Adolescents who reported both were scored as Romantic Sex = 1, Non-Romantic Sex = 1. This made it possible for us to estimate a bivariate association between the two types of sexual activity. Finally, adolescents who reported that they were virgins were classified as not having sex in either romantic or non-romantic relationships [Romantic Sex = 0; Non-Romantic Sex = 0].

The proportions of adolescents in the younger and older cohorts who reported sexual intercourse in romantic and non-romantic relationships is summarized in Table 1. As expected, a history of sexual intercourse was more common among older adolescents (approximately 42% of adolescents ages 16–18) than among younger adolescents (approximately 13% of adolescents ages 13–15). An additional 15 adolescents had missing data for one or more sexual activity variables; these participants were retained in

Table 1 Proportion of participants reporting romantic and non-romantic sex by age group

	Ages 13–15	Ages 16–18
No sexual activity	$N = 412$ (86.6%)	$N = 317$ (58.0%)
Romantic sex only	$N = 23$ (4.8%)	$N = 84$ (15.4%)
Non-romantic sex only	$N = 15$ (3.5%)	$N = 43$ (7.9%)
Both romantic and non-romantic sex	$N = 26$ (5.5%)	$N = 103$ (18.3%)

analyses because their data were informative regarding familial similarity for delinquency.

Analyses

Data was analyzed using structural equation modeling in the software program Mplus (Muthén and Muthén 1998–2010). Models were estimated using Full Information Maximum Likelihood to account for missing data. All models were fit separately for the two age groups (ages 13–15 and ages 16–18), and included gender as covariate.

Twin Models of Sex in Romantic and Non-Romantic Relationships

The basic behavioral genetic model of sex in romantic relationships is shown in Fig. 1. The current model assumes that a standardized normal continuous distribution underlies the observed categorical variable of sexual activity (coded as 0 or 1). Observed variance in sexual activity is divided into three latent components. The first, labeled *A*, is variance due to additive genetic influences. The *A* components in the first and second member of each twin pair are correlated 1.0 in MZ twins and 0.5 in DZ twins, consistent with genetic theory. The second component, labeled *C*, is variance due to environmental influences that make twins similar, i.e., the shared environment. The *C* components in the first and second member of each twin pair are correlated 1.0 for both MZ and DZ twins. The third component, labeled *E*, is variance due to environmental influences that make twins different, i.e., the non-shared environment. The *E* components in the first and second member of each twin pair are uncorrelated for both MZ and DZ twins. Together, the additive genetic, shared environmental, and non-shared environmental components are commonly called *ACE* components. The variances of the *ACE* components are fixed to 1.0 and the paths from the *ACE* components to sexual experience are estimated. The square of the path from the A component (h) represents the proportion of variance in sexual experience due to genetic influences, i.e., the heritability coefficient (h^2). Similarly, the squares of the c and e paths represent the proportions of variance in sexual experience due to shared environmental and non-shared environmental influences, respectively. For complete details on the logic and parameterization of twin models, see Neale and Cardon (1992). The univariate model for sex in non-romantic relationships is identical to the one shown in Fig. 1.

The basic univariate model was then extended to estimate the extent to which genetic and environmental influences on sexual activity in non-romantic relationships overlapped with the influences on sexual activity in romantic relationships. This bivariate model is shown in Fig. 2. The paths labeled β_A, β_C, and β_E test the extent to which the genetic, shared environmental, and non-shared environmental influences on sex in romantic relationships significantly predict involvement in non-romantic sex. A significant genetic path (β_A) would indicate that the same genetic factors that influence propensity to engage in sexual activity in romantic relationships also increases propensity to engage in sex in non-romantic relationships. In contrast, the non-shared environmental path (β_E) tests whether twins who differ (for environmental reasons) in whether they have had sex in the context of a romantic relationship also differ in whether they have had sex in a non-romantic relationship. A significant β_E path would be consistent with a "gateway" model, in which an adolescent's initial sexual experience in romantic relationships

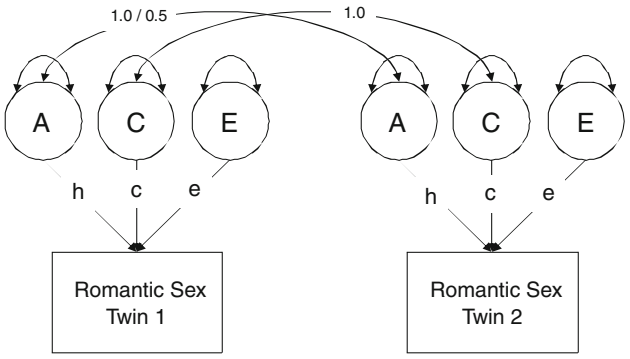

Fig. 1 Twin model of sex in romantic relationships

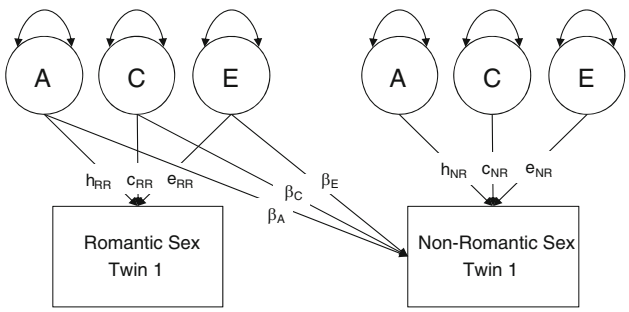

Fig. 2 Bivariate twin model of sex in romantic and non-romantic relationships. *Note*: Only one twin shown for illustrative clarity

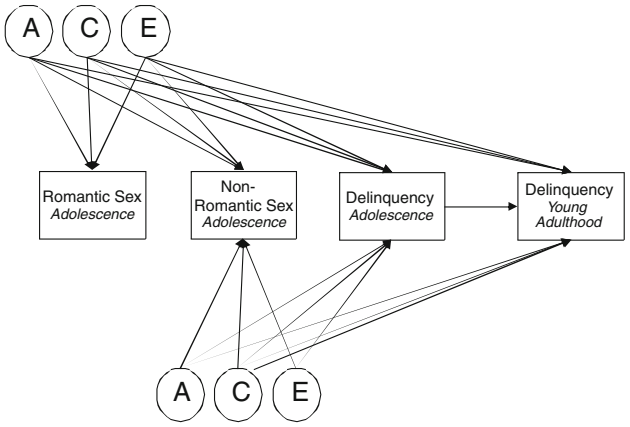

Fig. 3 Multivariate twin model of sexual activity and delinquency. *Note*: Only one twin shown for illustrative clarity

increases their subsequent likelihood to have sexual intercourse in a non-romantic relationship.

Longitudinal Twin Models of Sex and Delinquency from Adolescence to Early Adulthood

The behavior genetic model for the relations among sex in romantic relationships, sex in non-romantic relationships, and delinquency is shown in Fig. 3. As in the basic model, the variances of romantic and non-romantic sex were divided into *A, C,* and *E* components. In turn, delinquency at both time points was regressed on the *A*, *C*, and *E* components of sex in romantic and sex in non-romantic relationships. The regressions on *A* and *C* components test whether additive genetic and shared environmental influences on sexual experience also influence delinquency in adolescence and early adulthood. In contrast, the regression on the *E* component tests whether twins who differ (for environmental reasons) in their sexual experiences also differ in their delinquent behavior. A significant *E* path is consistent with a causal effect of sexual activity on delinquency, because it controls for genetic and shared environmental differences between families, although it remains confounded by any environmental differences between twins that co-vary systematically with sexual activity.

Results

Genetic and Environmental Influences on Sexual Activity in Romantic and Non-Romantic Relationships

Twin Correlations

The tetrachoric correlations between the first and second member of each twin pair for sex in romantic and non-romantic relationships are summarized in the top half of Table 2. Three notable patterns are evident. First, for both romantic and non-romantic sex in both older and younger adolescents, the MZ twin correlation substantially exceeded the DZ correlation, indicating the existence of genetic influences on adolescent sexual behavior generally. Second, the MZ correlations were higher for younger adolescents than for older adolescents, indicating that non-shared environmental influences were less important in younger adolescents. In fact, the correlation for non-romantic sex approached unity in younger adolescents: There were very few younger adolescent pairs discordant for reporting a history of non-romantic sex. Third, non-romantic sex in older adolescents was the only instance in which the MZ correlation did not exceed twice the value of the DZ correlation, suggesting that the role of shared environment was limited.

Table 2 MZ and DZ twin correlations for sexual behavior and delinquency by age group

	MZ twins	DZ twins
Romantic sex		
Ages 13–15	.88 ($N = 126$)	.39 ($N = 114$)
Ages 16–18	.66 ($N = 153$)	.12 ($N = 126$)
Non-romantic sex		
Ages 13–15	.99 ($N = 126$)	.33 ($N = 111$)
Ages 16–18	.45 ($N = 146$)	.33 ($N = 123$)
Adolescent delinquency		
Ages 13–15	.36 ($N = 128$)	.39 ($N = 114$)
Ages 16–18	.50 ($N = 153$)	.32 ($N = 126$)
Early adult delinquency		
Ages 19–21†	.46 ($N = 100$)	.11 ($N = 83$)
Ages 22–24††	.38 ($N = 116$)	.03 ($N = 96$)

*N*s refer to number of twin pairs

† Ages 19–21 are 6-year follow-up data from participants ages 13–15 at Wave I

†† Ages 21–24 are 6-year follow-up data from participants ages 16–18 at Wave I

Univariate ACE Models for Younger Adolescents (Ages 13–15)

Results from the twin models for younger adolescents are summarized in the left side of Table 3. The final models of both romantic and non-romantic sex fit the data very well Consistent with the observed twin correlations, sexual activity in younger adolescents was very strongly influenced by genetic factors ($h^2 = 86\%$ for romantic and 92% for non-romantic sex), plus small non-shared environmental influences ($e^2 = 14\%$ for romantic and 8% for non-romantic sex). Shared environmental influences were negligible and could be fixed to zero without significant decrement in model fit.

Table 3 Results from Univariate Twin Models of Sex in Romantic and Non-Romantic Contexts

Model parameters	Ages 13–15		Ages 16–18	
	Romantic	Non-romantic	Romantic	Non-romantic
Additive genetic	.93 (.04)*	.96 (.26)*	.79 (.25)*	.48 (.40)
Shared environmental	[.00]	[.00]	[.00]	.46 (.35)
Non-shared environmental	.36 (.11)*	.27 (.09)*	.61 (.11)*	.74 (.08)*
Model fit				
χ^2 (*df*, *P*)	2.10 (3, .55)	2.94 (3, .40)	2.89 (4, .58)	3.25 (3, .35)
CFI	1.00	1.00	1.00	.99
RMSEA	.00	.00	.00	.02

* Parameter significant at $P < .05$

Among 13–15 years olds, sexual activity, in both romantic and non-romantic contexts, is a relatively rare behavior that is almost entirely attributable to genetic factors.

Univariate ACE Models for Older Adolescents (Ages 16–18)

Results from the twin models for older adolescents are summarized in the right side of Table 3. The final models of both romantic and non-romantic sex also had very good fit to the data. For romantic sex, 62% of the variance was due to genetic factors, and the remaining 37% to non-shared environmental influences. Again, shared environmental influence was negligible and could be fixed to zero without significant change in model fit. For non-romantic sex, however, only 23% of the variance was due to genetic factors, with an additional 21% due to the shared environment, and 55% due to the non-shared environment. Among 16–18 year olds, then, the etiology of sexual activity differs by relationship context, with sex in romantic relationships more attributable to genes and sex in non-romantic relationships more attributable to environmental factors.

Bivariate ACE Models

Results from the bivariate twin models are summarized in Table 4. The final models fit the data well. For younger adolescents, the association between romantic and non-romantic sex was due entirely to a genetic path, whereas environmental differences between twins' sexual experiences in romantic relationships did not significantly predict non-romantic sex. Of the total variance in non-romantic sex in younger adolescents, 81% was due to genetic influences shared with romantic sex, 12% was due to genetic influences independent of romantic sex, and the final 7% was due to unique environmental influences.

In contrast, the association between romantic and non-romantic sex in older adolescents was due to both genetic *and* environmental pathways. Of the total variance in non-romantic sex in older adolescents, 29% was due to genetic influences shared with romantic sex, 24% was due to non-shared environmental influences shared with romantic sex, 16% was due to unique shared environmental influences, 30% was due to unique non-shared environmental influences. There were no genetic influences unique to non-romantic sex for older adolescents.

Table 4 Results from bivariate twin models of sex in romantic and non-romantic contexts

Model parameters	Ages 13–15	Ages 16–18
Influences on romantic sex		
Additive genetic	.93 (.04)*	.79 (.05)*
Non-shared environmental	.36 (.11)*	.61 (.07)*
Romantic → non-romantic		
Genetic path	.90 (.07)*	.54 (.10)*
Non-shared environ. path	.08 (.14)	.49 (.13)*
Residual influences on non-romantic sex		
Additive genetic	.34 (.17)*	[.00]
Shared environmental	[.00]	.41 (.39)*
Non-shared environmental	.26 (.09)*	.41 (.12)*
Indices of model fit		
χ^2 (*df*, *P*)	7.29 (9, .61)	10.11 (11, .52)
CFI	1.00	1.00
RMSEA	.00	.00

* Parameter significant at $P < .05$

Environmental and Genetic Paths from Sexual Activity to Delinquency

Longitudinal ACE Models for Younger Adolescents (Ages 13–15 to Ages 19–21)

Results from the longitudinal twin model for younger adolescents are summarized in the left side of Table 5. The overall fit of the model was very good. Notably, the only significant association was between genetic influences on sex in romantic relationships and delinquency in adolescence; however, this association did not persist into early adulthood. Moreover, unique genetic influences on sex in

Table 5 Results from multivariate twin models of sexual activity and delinquency

Model parameters	Younger cohort (Ages 13–15)	Older cohort (Ages 16–18)
Sex in romantic relationships		
A → Adolescent delinquency	.31 (.08)*	.34 (.08)*
A → Early adult delinquency	.08 (.07)	.18 (.08)*
E → Adolescent delinquency	−.11 (.25)	−.19 (.09)*
E → Early adult delinquency	−.18 (.17)	−.20 (.07)*
Sex in non-romantic relationships		
A → Adolescent delinquency	.02 (.19)	[.00]
A → Early adult delinquency	−.11 (.14)	[.00]
C → Adolescent delinquency	[.00]	−.23 (.09)*
C → Early adult delinquency	[.00]	−.33 (.10)*
E → Adolescent delinquency	.14 (.37)	.39 (.11)*
E → Early adult delinquency	.05 (.25)	.25 (.13)*
Indices of model fit		
χ^2 (*df*, *P*)	30.84 (37, .75)	38.06 (44, .72)
CFI	1.00	1.00
RMSEA	.00	.00

* Parameter significant at $P < .05$

non-romantic relationships that were independent of sex in romantic relationships did not predict delinquency at either time point. Finally, twins who differed in their sexual experiences did not show significantly different levels of delinquency in either adolescence or early adulthood. Overall, for younger adolescents (ages 13–15), associations between sexual activity and delinquency were limited to adolescence and were entirely driven by genetic factors.

Longitudinal ACE Model for Older Adolescents (Ages 16–18 to Ages 22–24)

Results from the longitudinal model for older adolescents are summarized in the right hand side of Table 5. Again, the model had excellent fit to the data. Three results are particularly notable from this model. First, genetic influences on romantic sex predicted higher levels of delinquency in adolescence, as well as increases in delinquency from adolescence to early adulthood. Second, after controlling for these genetic influences, twins who differed in whether they had sex in a romantic relationship showed significantly different levels of delinquency, such that the twin who had experienced sexual intercourse in a romantic relationship showed *lower* levels of delinquency. Moreover, this within-twin pair association persisted into early adulthood, with the twin who had experienced sex in a romantic relationship showing greater decreases in delinquent behavior. Third, there were also significant within-twin pair associations for sex in the context of a non-romantic relationship; however, the direction was reversed, such that the twin who had experienced non-romantic sex showed *higher* levels of delinquency cross-sectionally, and greater increases in delinquent behavior in early adulthood. Fourth, there was a significant association between shared environmental influences unique to non-romantic sex and delinquency. Surprisingly, the direction of this effect was negative. Overall, the model predicted 54% of the variance in adolescent delinquency and 47% of variance in early adult delinquency. A nested model in which the genetic path to adolescent delinquency was fixed to zero (not shown in table) resulted in a decrease in the R^2 to 24%, indicating that genetic influences on sexual activity account for a substantial portion of the genetic variance in delinquent behavior in adolescence.

Discussion

Few topics galvanize public interest so much as the sexual experiences of adolescents. Motivated by concern about both the medical consequences of unprotected sex (unintended pregnancy and sexually transmitted infections) and the putative adverse *psychological* consequences of adolescent sex, governmental agencies have enacted public policies specifically targeted towards reducing the incidence of teenage sexual relationships. Similarly, academic discourse on this topic has largely adopted a risk perspective, which conceptualizes sexual activity as universally detrimental for adolescent health and well-being. In contrast, the current article contributes to an emerging literature that offers a more nuanced perspective on the impact of sexual relationships on adolescent development. We emphasize two key points that challenge the prevailing research paradigms on adolescent sexual activity. First, sexual activity, particularly in early adolescence, is strongly influenced by genetic propensities, and these same genetic propensities may account for the elevated risk for adverse psychosocial outcomes evident among sexually active teens. Standard epidemiological research designs, which do not control for genetic differences between individuals, may give misleading estimates regarding the "true" effects of sex in adolescence. Second, all sexual relationships are not the same. Like adults, teenagers have sex with partners to whom they are highly committed and emotionally attached, with partners whom they hardly know, and everything in between. A finer discrimination among types of sexual relationships, rather than a simple focus on virgin versus non-virgin, is necessary if researchers hope to understand the psychosocial risks—and possible psychosocial benefits—conferred by sexual experiences in adolescence.

The current article presents results from analyses of longitudinal, behavioral genetic data on sexual activity in romantic relationships and non-romantic relationships. We compared MZ and DZ twin pairs, in order to control for unmeasured genes that influence both sexual behavior and delinquent behavior. Overall, our results are consistent with the hypothesis that the etiology and developmental impact of adolescent sexual activity depends on the relationship context and the developmental stage in which it occurs. For younger adolescents (ages 13–15), sexual activity was a relatively rare occurrence, and a common set of genetic factors was the predominant influence on sexual activity in both romantic and non-romantic relationship contexts. These genetic influences on sexual activity, in turn, were entirely responsible for the association between sexual activity and delinquency in early adolescents. That is, genetic propensities to engage in sex during early adolescence also increase propensity to engage in delinquent behavior. Notably, there was no evidence for an environmental path between sexual activity and delinquency among younger adolescents. That is, the few young adolescent twin pairs who were discordant for sexual activity did not demonstrate differing levels of involvement in delinquent behavior. Moreover, sexual activity at ages 13–15 was not significantly associated with future levels of delinquency in early adulthood beyond what could be predicted given initial levels of delinquency in adolescence.

A different pattern was evident for older adolescents (ages 16–18). Not only was sexual activity, regardless of context, more common, but it was also more influenced by environmental differences. Genetic influences on sexual activity were not context-specific; a common set of genetic factors influenced sexual activity in both romantic and non-romantic contexts, but there was evidence of shared environmental influences specific to non-romantic sex. Genetic propensities to engage in sexual intercourse predicted higher involvement in delinquent behavior in adolescence, and predicted greater increases in delinquent behavior 6 years later in early adulthood. After controlling for these genetic influences, however, sex in romantic relationships was associated with *lower* levels of delinquency in adolescence and predicted future decreases in delinquency in early adulthood, whereas sex in non-romantic relationships was cross-sectionally associated with *higher* levels of delinquency in adolescence and predicted future increases in delinquency in early adulthood. Thus, the current article adds to a small but growing body of literature suggesting that the psychological correlates of adolescent sexual behavior are complex, and that—particularly for older adolescents—certain negative outcomes are only evident for sex outside the context of a romantic relationship (McCarthy and Casey 2008; Meier 2007).

Although the current results suggest that adolescents who are sexually active within romantic relationship show decreased engagement in delinquent behavior, whether this constitutes a "true" protective effect remains unclear, because of methodological and theoretical challenges. First, it is important to note that the behavioral genetic design used here controls for all genetic and environmental influences shared by siblings raised in the same home, but environmental variables that differ between twins, and vary systematically with sexual behavior, remain potential confounds to this analysis. This means that it is uncertain whether sexual activity in a romantic relationship *per se*, versus other co-varying environmental characteristics, is responsible for the observed effect. Most obviously, it is difficult to discriminate the possible psychosocial benefits of being sexually active within the context of a romantic relationship from the benefits of the relationship itself. That is, is the reduction in the delinquency observed in the current article also evident among teenagers who are dating but do not have intercourse with their romantic partners? Or does the combination of emotional and sexual intimacy experienced by adolescents in sexually active dating relationships hold more salience for their behavior? Remarkably, little is known about how sexual intercourse changes the dynamics and psychological significance of dating relationships for the adolescent, and this remains an important avenue for future research. A related challenge is that relationship context is likely confounded with other differences in adolescents' sexual experiences, such as the characteristics of the sexual partner (e.g., partner age) and the total number of sexual partners. Finally, our analysis treats romantic and non-romantic sex as between-person variables that are positively correlated: An adolescent who has had sex in one context is more likely to have had sex in the other. However, these variables most likely have a different relationship within-person: Time spent in a romantic relationship reduces the opportunity for non-romantic sexual encounters. Disentangling the within-person versus between-person associations between relationship contexts and delinquency would require densely spaced longitudinal data that is not available.

Given these challenges, and the paucity of previous research, our theoretical interpretations are necessarily tentative. Certainly, stable romantic attachments, particularly marriage relationships, are a well-established correlate of desistence from crime in adults (Sampson and Laub 1990). This "marriage effect" is often attributed to the emotional attachments inherent in a committed romantic relationship, which would be threatened by criminal or deviant behavior (Laub et al. 1998). By extension, when adolescents are both sexually and romantically involved with their partners, these relationships may be a source of social and emotional support. These attachments, in turn,

may supplement weakening bonds to parents or to conventional social organizations. Alternatively, it may be that the capacity and interest for forming partnerships is a sign of individual resiliency, which is further illustrated through desistance from delinquent behaviors. In addition, forming sexual and romantic attachments during adolescence may cause more general changes in an adolescent's social relationships. Self-perceived competence in romantic relationships becomes a predictor of general social competence by late adolescence (Masten et al. 1995). If the formation of a romantic relationship with a sexual partner bolsters adolescents' sense of competency, this may result in more effective social skills in interactions outside the relationship, including with peers. Improved social skills, in turn, are associated with decreased delinquency (Fagan et al. 2007). The social benefits of romantic relationships during adolescence seem to persist through the transition to early adulthood. Romantic relationships in adolescence characterized by supportiveness and intimacy are linked to more positive and committed relationships in early adulthood, suggesting quality romantic relationships in adolescence may benefit social development (Collins et al. 1997; Seiffge-Krenke et al. 2001). Lastly, being sexually involved with a romantic partner may trigger changes in the amount of time spent with same-sex friends, or one's peer group may shift to accommodate a partner's friends. Since delinquent behavior is commonly amplified by exposure to acting-out peers (e.g., deviancy training, Dishion et al. 1996), reductions in the amount of time spent with friends may result in decreased delinquency. This would be of particular importance for at-risk youth, who may have high exposure to environmental strains and deviant peers.

Sources of Genetic Influence on Adolescent Sexual Behavior

Our results suggest that there is significant overlap in genetic influences for sexual activity and delinquent behavior, but the twin design does not implicate specific genes involved in this association. In fact, there are probably very many genes influencing sexual behavior, because the process by which adolescents select their sexual experiences is shaped by many different characteristics (e.g., extraversion, impulsivity, sociability, physical attractiveness, sensation-seeking, pubertal maturation, just to name a few). That being said, one possibility is that genes related to the dopamine system may be important sources of common genetic influence. Dopamine neurotransmission in the mesocorticolimbic pathway is critical for the encoding of rewards and for reward-motivated behavior, including both risk-taking and sexual behavior. A recent study by Derringer et al. (2010) found that multiple genetic polymorphisms related to the dopamine system predicted sensation-seeking, a personality trait that is robustly associated with risk for delinquency and other externalizing phenotypes. In addition, animal and human studies have found that dopamine agonists enhance male sexual behavior, while dopamine antagonists impair sexual behavior (Dominguez and Hull 2005). Consistent with the theoretical importance of dopamine for sexual behavior, polymorphisms in the dopamine transporter gene (DAT1) and dopamine receptor genes (DRD2 and DRD4) have been associated with individual differences in age at first sexual intercourse (Guo and Tong 2006; Miller et al. 1999), likelihood of having had sex in early adulthood (Eisenberg et al. 2007), and number of sexual partners (Guo et al. 2007). Lastly, dopaminergic genes may interact with social contexts in predicting sexual behavior: Guo et al. (2008) found that school composition (proportion of sexually active students and average cognitive ability) interacted with DRD2 to predict number of sexual partners. It has been argued that the 3R and 7R alleles of the DRD4 gene are relatively recent (40,000–50,000 years) mutations from the ancestral allele (4R); an interesting evolutionary hypothesis is that these minor alleles have been selected for because they result in earlier, more frequent, or more promiscuous sexual activity. Thus, there is growing theoretical and empirical support for the hypothesis that dopaminergic genes play an important role in genetic differences in sexual behavior; however, these initial candidate gene studies should be interpreted with caution, as most have not yet been widely replicated, and some researchers (e.g., Halpern et al. 2007) have found contradictory patterns of results.

In addition, genes involved in the timing of pubertal development may also be a significant source of genetic differences in sexual activity. Twin studies have consistently shown that pubertal timing is heritable (Doughty and Rodgers 2000; Ge et al. 2007; Meyers et al. 1991; Mustanski et al. 2004; Rowe 2002), with heritability estimates for age at menarche and self-reports of pubertal development ranging from 0.43 to 0.88. Age at the onset of puberty is one of the strongest predictors of when adolescents first experience sexual desire, begin dating relationships, begin partnered activities such as kissing or petting, and first have sexual intercourse (Flannery et al. 1993; Kim and Smith 1999; Lam et al. 2002; Wyatt et al. 1999). In previous research using the AddHealth twin sample, Rowe (2002) estimated that genetic influences on menarche substantially overlapped with genetic influences on age at first intercourse, with a genetic correlation of 0.72. Similar results were obtained by Rodgers et al. (2008). Despite clear evidence of genetic influence on pubertal timing, specific genes for early pubertal timing, which also account for variance in sexual behavior and delinquency, have not

been identified. Genes related to receptors for steroid hormones are a possible avenue for investigation. For example, Comings et al. (2002) found that the X-linked androgen receptor gene, AR1, was shown to predict a both earlier age at menarche in females and aggression, impulsivity, and high number of sexual partners in males (though see Jorm et al. 2004, for a failure to replicate). Another possibility is that the genes that precipitate early development create a set of environmental circumstances that make both sexual activity and delinquency more likely. In particular, relatively advanced pubertal maturation is associated with affiliation with older peer groups; older peers, in turn, are known to facilitate access to alcohol, increase the likelihood of delinquent behavior, and provide more opportunities to meet potential sexual partners (Caspi et al. 1993; Marin et al. 2000; Mezzich et al. 1999).

Limitations

In addition to the methodological challenges outlined above, two limitations of the study should be noted. First, we selected delinquency items that were consistent across assessment waves, resulting in a measure that captures non-violent rule-breaking, primarily property crime and theft. Several researchers have noted that non-violent delinquency differs from aggressive forms of delinquent behavior, both in terms of genetic etiology and in life course persistence (e.g., Moffitt 1993). Additional research is necessary to assess whether the developmental impact of sexual experiences in adolescence in consistent across different forms of delinquent behavior. Second, sample size restrictions have prohibited us from examining a potentially important moderator of the effects of adolescent sexual activity—gender. Previous research has found significant differences between boys and girls in their experiences in sexual and romantic relationships. Most obviously, girls face the possibility of pregnancy, whereas boys do not. Evolutionary psychology suggests gender differences in investment required for potential offspring will shape gender differences in their attitudes about and likelihood of engaging in sex outside of a romantic relationship (Gangestad and Simpson 2000). In addition to facing higher physical consequences, girls' psychosocial well-being seems to be more negatively affected by non-romantic sexual experiences and by relationship disruptions than boys (Grello et al. 2006; Joyner and Udry 2000). Furthermore, preadolescent social groups are largely gender-segregated, and may instill different expectations regarding exclusivity, intimacy, and emotional engagement in girls versus boys. Adolescents who apply these expectations from their same-sex peer relationships to their romantic relationships may experience disappointment and challenge (Underwood and Rosen 2009). It is important for future research to investigate whether gender moderates the effects of sex in romantic versus non-romantic relationships.

Conclusions

The current study contributes to a nascent body of research that is moving away from the basic question of whether sexual activity is detrimental for adolescents to a more nuanced understanding of the transition to sexual maturity. While this line of research must necessarily be considered preliminary, our study makes two key contributions to research on sexual development. First, sexual activity is strongly influenced by genetic propensities, particularly sexual intercourse in early adolescence (before age 15), and these same genetic propensities accounts for the elevated involvement in delinquent behavior seen in sexually active teens. The need for researchers in epidemiology, developmental psychology, and psychopathology to take genetic differences seriously has been emphasized previously by multiple authors (e.g., Lahey and D'Onofrio 2010; Moffitt 2005; Scarr and McCartney 1983), and the study of sexuality is no exception. Second, particularly for older adolescents (ages 16 or older), sex in romantic versus non-romantic contexts showed diverging patterns of association with delinquent behavior in adolescence and early adulthood. In contrast to the perspective that adolescent sexual activity, in and of itself, is a manifestation of adjustment difficulties, our findings suggest that "adolescent sexual activity" is a relatively heterogeneous construct that may confer either psychosocial risks or benefits, depending on other moderating factors. Overall, research that moves beyond a narrow risk perspective holds promise for better understanding the developmental sequelae of adolescents' sexual experiences.

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