Personality and Sexual Development in Adolescence: Selection, Corresponsive Effects, and Genetic and Environmental Influences

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Abstract

Though sexuality and personality are related domains of personhood, the dynamics of their co-development remains relatively unexplored, especially during adolescence when partnered sexual behaviors tend to emerge. We examined the co-development between personality and sexuality at phenotypic and genetic levels of analysis from middle childhood to late adolescence (ages 11, 14, and 17) using a longitudinal twin sample ($N = 3762$). In terms of selecting into sexual experiences, extraversion was associated with more normative sexual behaviors (e.g., dating) while low agreeableness, low conscientiousness, and neuroticism were associated with more non-normative sexual behaviors (e.g., sexual intercourse, pregnancy, earlier age of initiation in general). We also found evidence of corresponsive effects, specifically, sexual experiences were associated with subsequent increases in extraversion and neuroticism and decreases in agreeableness. Genetic influences accounted for associations between normative sexual behaviors and extraversion, and between sexual behaviors and emotion-related personality traits. Shared environmental influences largely accounted for associations between non-normative sexual behaviors and personality, and between sexual behaviors and traits related to behavioral control. These findings identify distinct personality processes—one genetically mediated via emotionality and the other through shared environmental influences on behavioral control processes—that contribute to and are shaped by sexual development in adolescence.

Keywords: Personality, Sexual development, Adolescence, Behavioral genetics, Heritability

Introduction

Personality and sexuality are each major domains of psychological functioning, exerting considerable influence on what people value and how they choose to commit their time, energy, and resources (John, Naumann, & Soto, 2008; WHO, 2006). Consequently, personality and sexuality shape what we experience in the world, and how we ascribe meaning to those experiences. Although some early theorists proposed that sexuality itself is a core driver of personality (Pettit & Hegarty, 2014; Westen, Gabbard, & Ortigo, 2008), most contemporary researchers define personality and sexuality in ways that leave them as distinct—albeit related—areas of personhood (Agocha, Asenico, & Decena, 2014). One insight that has endured from earlier theoretical models, however, is that personality and sexuality develop and unfold in concert across the lifespan. That is, the expression, psychological meaning, and consequences of various aspect of sexuality can only be understood within their broader developmental contexts (Hensel & Fortenberry, 2014; O’Sullivan & Thompson, 2014). Similarly, individual differences in personality emerge as early as infancy, but undergo significant transformations across the lifespan in their manifestation, structure, and mean levels (Mroczek & Little, 2006). Therefore, personality traits likely influence the timing, frequency, and quality of sexual experiences, and sexual experiences in turn may contribute to change and stability in personality traits (Donnellan, Trzesniewski, & Robins, 2006; Schmitt, 2004). Few prospective studies, however, have examined the co-development between personality and sexuality. Moreover, none have described their interrelationships during adolescence, when processes of sexual identity development intensify and partner-related sexual behaviors typically emerge.

Adolescent sexual development is important for identity formation and psychosocial adjustment, and also occupies a place of significant cultural interest that influences public health

policy (Zimmer-Gembeck & Helfand, 2008). Accordingly, understanding the contributions of personality to the emergence of adolescent sexual behaviors is a topic of broad interest with real-world consequences. For example, greater understanding of the role of personality in sexuality may influence the extent to which adolescent sexual behaviors are conceptualized as health-risk behaviors or normative developmental milestones (Harden, 2014). Therefore, we investigated the co-development between personality and sexuality—specifically, adolescent sexual behaviors—at both the phenotypic and genetic level using a longitudinal twin study to examine how and why these domains are linked, and to inform discussions about the psychological contexts associated with individual differences in sexual behaviors.

Adolescent Sexual Development and Behavior Genetics

Sexuality refers to how people experience and express themselves sexually. This includes processes such as sexual thoughts and desires, physiological arousal responses, solo and partnered behaviors, and sexual orientation (WHO, 2006). Adolescence is a particularly important time in the lifespan for the development of sexuality (O’Sullivan & Thompson, 2014). Adolescence begins following the onset of puberty, which initiates numerous hormonal changes leading to reproductive maturity. Adolescence is also characterized by the emergence of romantic relationships and partnered sexual behaviors. In the United States, most people begin to date by 15-16 years old (Carver, Joyner, & Udry, 2003), and the majority have engaged in sexual intercourse by 17-19 years old (Halpern & Haydon, 2012). Underlying these general trends, however, is considerable variation in the onset, frequency, and context of different adolescent sexual behaviors (Zimmer-Gembeck & Helfand, 2008). Genetic factors contribute to some of this variability in sexuality (Harden, 2014), but contextual factors also have a substantial impact (Marston & King, 2006). For example, the cultural norms and legal restrictions that societies

place around certain aspects of sexuality are explicit attempts to regulate and shape certain sexual behaviors (Kendall, 2014).

Conceptual frameworks for understanding adolescent sexual behaviors and romantic relationships differ according to the perspective they bring to these developmental phenomena (Harden, 2014; Savin-Williams & Diamond, 2004; Zimmer-Gembeck & Helfand, 2008). One perspective, exemplified by health-risk models, is built around understanding factors that contribute to outcomes such as sexually transmitted disease and unwanted pregnancy. These models tend to conceptualize sexual behaviors as part of a suite of highly co-occurring adolescent problem behaviors that also include delinquency, substance use, and risk taking (Jessor & Jessor, 1977; McGue & Iacono, 2005). In contrast, sex positive models conceptualize sexual behaviors and romantic relationships as key developmental milestones that are necessary for positive psychosocial adjustment (Tolman & McClelland, 2011). Both perspectives have merit, as the emergence of romantic relationships and sexual behaviors are normative developmental tasks that can promote positive adjustment (Giordano, Manning, & Longmore, 2010; Stone & Ingham, 2002), but some behaviors do carry risks (e.g., pregnancy; Boden, Fergusson & Horwood, 2008) that—depending on their context—may be indicative of broader maladjustment.

To strike a balance between these perspectives, we recently proposed a model in which different adolescent sexual behaviors are conceptualized as falling on a continuum that ranges from normative (i.e., high prevalence and social approval) to non-normative (i.e., low prevalence and socially discouraged) (Clark et al., 2020). Where a given sexual behavior falls on this continuum can help contextualize its origins, correlates, and consequences for psychosocial functioning. Further, sexual behaviors can shift on this normativeness continuum depending

upon the developmental context (i.e., increase or decrease in prevalence and social approval), which then impacts its correlates and associations with positive adjustment. That is, our conceptualization of normativeness goes beyond the mere frequency of a given behavior in a population and incorporates its developmental and societal context.

To begin to validate the concept of a normativeness continuum, we demonstrated that some of its key concepts can be effectively quantified using item response theory (IRT) models. Specifically, we fit IRT models to five adolescent sexual behaviors (dating, breaking up, sexual intercourse, afraid pregnant, pregnancy) at ages 14 and 17, using a large twin sample (also used in this report; Clark et al., 2020). Each behavior was a strong indicator of a general propensity to engage in sexual behavior, and the difficulty parameters for each behavior provided a quantitative measure of how normative the behavior was in adolescence. For example, dating and breaking up were highly normative, especially relative to the less normative behaviors of sexual intercourse and pregnancy. Further, the difficulty of each behavior declined from ages 14 to 17, indicating a move toward greater normativeness for all behaviors over time.

An especially interesting finding was that the heritability of these adolescent sexual behaviors consistently increased as the difficulty of the behaviors decreased. That is, genetic differences among people accounted for more of the variability in normative adolescent sexual behaviors than for non-normative behaviors. Further, non-normative (i.e., high difficulty) behaviors exhibited substantial shared, or common, environmental influences (i.e., environmental influences that contribute to similarity among relatives). These results suggest that as restrictions on sexual behaviors are relaxed, heritable influences play a greater role in the expression of sexual behaviors. For non-normative behaviors, however, shared environmental influences may suppress genetic influences.

Adolescent Sexual Development and Personality

To better understand psychosexual development, it is important to explore the processes underlying these broad genetic and environmental trends. Personality traits may act as intervening variables that mediate the transactions between a person's environmental context and the expression of their sexual dispositions. Personality refers to people's characteristic ways of thinking, feeling, and behaving in response to certain salient situations that are consistent across time (Funder, 2001). Variation in personality has a large genetic component, and some of these genetic influences may contribute to characteristics that promote or inhibit opportunities for sexual expression (Johnson, Vernon, & Feiler, 2008). Furthermore, personality may shape responses to the environment, in particular, individuals' responses to constraints that are often placed on adolescents' sexual behaviors (Donnellan et al., 2006).

There are many trait models of personality, but the "Big Five" is currently the most prominent (John, Naumann, & Soto, 2008). It uses five broad trait constructs to summarize dispositional variation across individuals, namely: extraversion, neuroticism, conscientiousness, agreeableness, and openness. Extraversion captures individual differences in sociability and the frequency with which people experience positive emotions (e.g., joy, happiness, contentment). Neuroticism refers to the proneness to feel psychological distress as evidenced by the propensity to experience negative emotions, such as fear, anxiety, sadness, and anger. Conscientiousness encompasses traits related to being planful, controlled, and industriousness versus impulsive, disinhibited, and irresponsible. Agreeableness includes facets related to being cooperative, compliant, and prosocial (e.g., empathic, helpful, truthful) versus conflictual, rebellious, and antisocial (e.g., callous, exploitative, rule breaking). Finally, openness captures individual

differences in creativity, artistic interests, broad-mindedness, and comfort with novel experiences.

A recent meta-analysis reported associations between numerous aspects of sexuality and the Big Five traits (Allen & Walter, 2018). Extraversion was associated with greater sexual activity, casual sex, sexual satisfaction, and risky sex (e.g., lack of contraception use, sex while under the influence of alcohol and drugs), and fewer negative emotions related to sex (e.g., anxiety, guilt, frustration) and less sexual dysfunction. Neuroticism was associated with less sexual satisfaction, more negative emotions and sexual dysfunction, and greater hypersexual behavior, sexually transmitted infections, and sexual aggression. Openness was associated with more lifetime partners, sexual desire and cognitions, non-heterosexual orientation, liberal sexual attitudes, and less homophobia, sexual dysfunction, and sexual violence. Agreeableness was associated with lower levels of casual sex, sexual infidelity, hypersexual behavior, risky sexual behavior, and sexual aggression. Conscientiousness was also associated with less sexual infidelity, sexual dysfunction, and sexual aggression. An important limitation of this meta-analysis was that most studies were cross sectional and focused on adults. Consequently, more longitudinal studies are needed to examine the developmental dynamics between personality and sexuality, particularly in adolescence.

Indeed, personality traits can help to refine and validate the concept of a continuum of normative versus non normative sexual behaviors in adolescence and beyond. Low conscientiousness, low agreeableness, and high neuroticism are typically associated with poorer psychosocial functioning (Kotov et al., 2010; Ozer & Benet-Martinez, 2006). Consequently, associations between adolescent sexual behaviors and these traits would be further evidence of a continuum of non-normativeness for each behavior. In contrast, extraversion is typically either

unrelated to psychopathology or has modest positive associations with adjustment. Accordingly, extraversion would be predicted to be less relevant to non-normative behaviors. However, given the makeup of the trait of extraversion, it is reasonable to expect some relevance to sexual behaviors. That is, more outgoing individuals will likely have more opportunities to engage in dating and sexual behaviors of all kinds, but especially those that are less proscribed (i.e., are more accessible). Finally, if the trait correlates of particular sexual behaviors change over time, that would provide further evidence for our model wherein different behaviors increase in their normativeness at later ages. For example, extraversion may be more strongly related to sexual intercourse in late adolescence and adulthood compared to early adolescence, because there are fewer constraints on sexual activity in later the developmental periods.

Co-Development of Personality and Sexuality

Longitudinal analyses are uniquely informative for testing how and why the associations between personality and adolescent sexual behaviors vary as a function of their normativeness. Broadly speaking, there are two major types of associations across time that need to be considered: selection and corresponsivity. Personality differences emerge well prior to adolescent sexual behaviors (Putnam, Ellis, & Rothbart, 2001). Therefore, it is first necessary to consider *selection effects*, or how pre-existing personality traits are associated with an earlier onset and frequency of adolescent sexual behaviors. Personality is also sensitive to experiences, and so entering into romantic relationships and engaging in sexual behaviors may change the developmental trajectory of certain personality traits (Donnellan et al., 2006). The phenomenon of traits helping to select people into environments and experiences that then accentuate those traits is known as *corresponsivity*. This is particularly important to consider given that the onset of romantic and sexual behaviors is one of the key transitions of adolescence. For example,

extraverted people may be more likely to engage in early adolescent sexual behaviors than their peers (selection), an experience which could in turn facilitate an increase in their level of extraversion relative to peers (corresponsivity). Alternatively, adolescents low on conscientious and agreeableness tend to disregard rules and violate norms in general and so may be more likely to engage in non-normative sexual behaviors (e.g., early sexual intercourse; selection), experiences which may further accentuate their propensity to resist constraints on their behavior.

Notably, selection and corresponsive effects involve different levels of analysis, specifically, the levels of between-person differences and within-person change. Selection effects refer to a person's trait level predicting an increased likelihood of exposure to some experience. They can be conceptualized in both a broad between-person, and more process-oriented within-person, sense. Between-person effects capture associations between individual differences in personality and adolescent sexual behaviors across people, for example, more extraverted youth are more likely to date than their peers. Within-person change refers to changes in personality and sexual behavior over time for a specific person. To examine selection and corresponsivity, we used two variants of the random intercept cross lagged panel model (RI-CLPM; Hamaker, Kuiper, & Grasman, 2015), which can help isolate stable personality trait variance over time from occasion specific variability. Associations between the stable personality trait factor and adolescent sexual behavior help address the question of between-person differences (i.e., between-person selection), while associations over time between the occasion-specific residuals and sexual behavior can provide information about within-person change (i.e., corresponsivity).

The extent to which genetic and environmental influences contribute to these co-developmental processes is also important for better understanding adolescent sexual and personality development, and expanding upon the findings regarding the etiology of more versus

less normative sexual behaviors. Personality traits in adulthood typically exhibit equal proportions of genetic and nonshared environmental variance, and the covariance between personality and other variables is usually attributable to common genetic influences (Johnson et al., 2008). However, traits assessed in childhood and adolescence often exhibit more shared environmental influences, which is consistent with the fact that there are more environmental constraints on behavior early in the lifespan (Burt, 2014; Clark, Durbin, Hicks, Iacono, & McGue, 2017).

Given the empirical associations between personality and sexuality, and our findings regarding the differential heritability of normative versus non normative sexual behaviors, we posited two broad mechanisms through which personality and sexuality are related across adolescence. First, for more normative behaviors, the associations with personality traits will be mediated primarily via shared genetic influences. Second, shared environmental influences will primarily account for the associations between personality traits and less normative behaviors. We expect that extraversion is most relevant for the first pathway (normative behaviors and genetic mediation), and that low agreeableness and low conscientiousness are most relevant for the second pathway (non-normative behaviors and environmental mediation). Extraversion and related traits select people into social situations with others, and are likely to elicit positive responses that increase the likelihood of sexual behaviors. These processes will be freer to operate for behaviors that are relatively easier to engage in and which are more common. By contrast, due to cultural pressures to constrain sexual behaviors in adolescence, traits related to following rules, concerns about conformity and reputation, and being controlled rather than disinhibited (i.e., agreeableness and conscientiousness) are likely important for understanding who engages in non-normative sexual behaviors.

Present Study

To better understand the co-development between personality and adolescent sexual behaviors, we examined the phenotypic and etiologic associations between the two domains in a longitudinal twin sample. Teacher ratings were used to assess personality at ages 11, 14, and 17, an uncommon approach that has several advantages relative to self-reports (Clark et al., 2017; Teglasi, 1998). First, this approach removed any overlap between personality and sexual behavior due to a shared informant. Second, teacher ratings of personality are especially strong predictors of outcomes that commonly co-occur with adolescent sexual behaviors (e.g., antisocial behavior and substance use), likely due to teachers' knowledge of behavioral norms they have accumulated through their experience with many children at specific developmental stages (Clark et al., 2017; Hicks et al., 2014). Relatedly, the school setting presses for many behaviors that are salient to the personality traits associated with sexual behavior (e.g., sociability, industriousness, and cooperativeness for extraversion, conscientiousness, and agreeableness, respectively). Third, the longitudinal design entailed different teachers rating each participant at different ages and in different school contexts (i.e., 6th grade classrooms and schedules are structured differently than in the 12th grade). This provided an excellent design for separating occasion-specific from stable trait variance that is consistent across raters, time, and situations.

Our goals were to examine (1) the associations between major personality trait constructs and several adolescent sexual behaviors that varied from normative (e.g., dating) to non-normative (e.g., pregnancy) at ages 11, 14, and 17, (2) the prospective between- and within-person associations between personality traits and adolescent sexual behaviors to identify selection and corresponsive effects, and (3) the genetic and environmental contributions to the co-development between personality and adolescent sexual behaviors. This approach provides

one of the most thorough analyses of the co-development between personality and adolescent sexual behavior yet reported (Allen & Walter, 2018; Donnellan et al., 2006) as well as information that can be used to promote positive adolescent development and sexual health.

Method

Participants

The sample consisted of 3762 (52% female) twins (1881 pairs) from the ongoing Minnesota Twin Family Study (MTFS), a longitudinal study investigating the development of mental health, substance use, and psychosocial adjustment (Iacono et al., 1999; Keyes et al., 2009). All twin pairs were the same sex and living with at least one biological parent at the time of recruitment. Participants had to live within driving distance to the University of Minnesota laboratories and be free of any cognitive or physical disability that would interfere with study participation. Twins were recruited the year they turned either 11-years old ($n = 2510$; the younger cohort) or 17-years old ($n = 1252$; the older cohort) and invited to return for follow-up assessments every 3-5 years. Twins in the younger cohort were born between 1977 and 1994, while twins in the older cohort were born between 1972 and 1979. Families were representative of the area they were drawn from in terms of socioeconomic status, history of mental health treatment, and urban vs rural residence (Iacono et al., 1999). Consistent with the demographics of Minnesota for the target birth years, 96% of participants reported European American ancestry.

All twins were assessed at age 17 ($M_{\text{age}} = 17.85$ years; $SD = .64$ years), but only the younger cohort was assessed at ages 11 ($M_{\text{age}} = 11.78$ years; $SD = .43$ years) and 14 ($M_{\text{age}} = 14.90$ years; $SD = .31$ years). Therefore, the smaller sample sizes at ages 11 and 14 were not due to attrition, which was low for twins of the younger cohort (retention rates were 91.4% and

86.3% at ages 14 and 17, respectively). At the age 11 assessment, there were 395 male and 394 female monozygotic (MZ) twin pairs, and 220 male and 246 female dizygotic (DZ) twin pairs. At the age 14 assessment, there were 364 male and 370 female MZ twin pairs, and 203 and 230 DZ twin pairs. At the age 17 assessment, there were 529 male and 582 female MZ twin pairs, and 299 male and 331 female DZ twin pairs. Zygosity was originally assessed by parents' reports on a standard zygosity questionnaire and staff evaluations of physical similarity of eyes, hair, face, ears, and fingerprint ridge counts (Iacono et al., 1999). Zygosity was later confirmed by genome wide genotyping (McGue, et al., 2013).

Adolescent Sexual Behaviors

Adolescent sexual behaviors were assessed using the Life Events Interview for Adolescents, a structured interview developed by MTFS staff to assesses a variety of experiences (Billing, Hershberger, Iacono, & McGue, 1996; Bemmels et al., 2008). We focused on five questions related to dating, sexual intercourse, and pregnancy: "Have you started dating?", "Have you and a romantic partner ever broken up?", "Have you had intercourse?", "Were you ever really afraid that you might be pregnant?" (female twins) or "Were you ever really afraid you got a girl pregnant? (male twins; not asked for males of the older cohort), and "Did you ever become pregnant?" (female twins) or "Did you get a girl pregnant?" (male twins). The adolescent sexual behavior items were only assessed at ages 14 and 17, but were available for nearly all twins that participated at those ages (see Table 1).

Personality

Personality traits were assessed using 28 items from a teacher rating form that was completed by up to 3 teachers nominated by the twin participants. Items consisted of short descriptors (see online supplemental material; <https://osf.io/mk5ps/>) that were designed as

markers of the primary scales of the Multidimensional Personality Questionnaire (Tellegen & Waller, 2008) and other trait constructs. For each item, teachers were instructed to rank the target twin in reference to their classmates as falling in either the lowest 5%, lower 30%, middle 30%, higher 30%, or highest 5% of students in class. The mean rating across teachers was used whenever more than one teacher rating was available (~75% of participants with teacher rating data had at least two teacher informants). Teacher ratings were collected at each assessment and were available for 91.2%, 84.2%, and 78.2% of participants at ages 11, 14, and 17, respectively. It was Minnesota state policy to place members of twin pairs in separate classrooms whenever possible, which minimizes any bias due to twin contrast or comparison.

We analyzed the psychometric structure of the items from the teacher rating form to streamline analyses and increase the generalizability to the existing literature, which tends to emphasize broad trait dimensions (e.g., the Big Five). We submitted the 28 items to exploratory factor analyses (EFA) separately at ages 11, 14, and 17. Oblique geomin rotation was used, and a parallel analysis with 1000 random draws was run with each EFA. For each age, a four factor solution was best supported based on examinations of the scree plot, the results of parallel analyses, and the psychological interpretability of the factors.

The factors roughly corresponded to the extraversion/positive affect, conscientiousness, neuroticism/negative affect, and agreeableness/prosociality constructs in Big Five trait models of personality. After identifying these target constructs we refined scale measures by excluding items that did not load well on any factor (i.e., $\lambda < .40$; e.g., “artistic”), had high cross-loadings across factors that were inconsistent across ages (e.g., “nervous, fearful, timid” loaded on both neuroticism and extraversion, but to different extents across ages), did not seem relevant to personality (e.g., “athletic”), or whose content seemed to overlap with adolescent sexual

behaviors (e.g., “charming with the opposite sex”). The final extraversion scale included 6 items: cheerful, interested, optimistic; persuasive, dominant, socially visible; gregarious, people orientated, warm; thrill seeking, adventurous, risk-taking; popular; entertaining. The neuroticism scale included 4 items: tense, sensitive, moody; feels treated poorly, exploited, unlucky; tough, unforgiving, aggressive; miserable, unhappy, distressed. The conscientiousness scale included 5 items¹: ambitious, hard driving, persevering; careful, level-headed, planful; intelligent; mature; confident. The agreeableness scale included 5 items: values a good reputation, endorses strictness, respects authority; truthful, trustworthy; law abiding; nurturant; manipulative (reverse scored).

The four trait scales had high internal consistency reliability (Cronbach’s α), and high average factor loadings (λ) from 1-factor confirmatory factor analytic models fit at ages 11, 14, and 17: Extraversion (mean α = .86, mean λ = .86), Neuroticism (mean α = .76, mean λ = .84), Conscientiousness (mean α = .91, mean λ = .82), Agreeableness (mean α = .89, mean λ = .80). Scale scores were calculated by taking the mean of the items. All of the individual items of the teacher form, their factor assignment, and their correlations with the adolescent sexual behaviors, can be found in the online supplemental material (<https://osf.io/mk5ps/>).

Data Analytic Strategy

Biserial correlations between the personality traits and adolescent sexual behaviors were initially examined, both within and between time points. Multiple regression models were also fit wherein each sexual behavior was regressed on the four personality traits from a single occasion of measurement (e.g., sexual intercourse at age 14 was predicted by ratings of extraversion, neuroticism, conscientiousness, and agreeableness at age 11). These models complemented the

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¹ Although intelligence per se is not typically considered a personality trait, in terms of teachers’ impressions of children this descriptor is a strong marker of the broader conscientiousness construct. Relatedly, “confident” in this context reflects a sense of self-efficacy rather than general bravado.

biserial correlations by highlighting the relative predictive power of each trait after adjusting for the shared variance among the trait measures. The multiple regression models were fit using weighted least squares estimation with mean and variance adjustments (WLSMV) to account for the dichotomous nature of the outcome variable.

We then fit two variants of the RI-CLPMs because a model including all between- and within-person effects was not identified with only two waves of sexual behavior data, and also because of the difficulties associated with modeling a residual structure with dichotomous indicators (was there a grimm paper here, or do I just do muthen personal communication?). Each pairing of a personality trait and an adolescent sexual behavior was fit in turn. The first version of the RI-CLPM—the random intercept predictor model (RI-PM; see panel **a** in Figure 1)—was used to examine selection effects over time, operationalized as the association between the random intercept factor for a personality trait (representing the stable trait variance over time) and the adolescent sexual behaviors at ages 14 and 17 (S_{14} , S_{17}). Teacher ratings for a given trait at each time point (P_{11} , P_{14} , P_{17}) were specified to load on the random intercept factor (RI). Factor loadings were fixed to 1, and indicator intercepts were allowed to vary. The mean of the random intercept was fixed to 0 and the variance was freely estimated. Occasion-specific residual factors (R_{11} , R_{14} , R_{17}) were then specified. Factor loadings on the residual factors were fixed to 1, the means of the residual factors were fixed to 0, and the residual factor variances were freely estimated. Autoregressive paths were added from one residual factor to the next subsequent residual factor, and from the adolescent sexual behavior at age 14 to the same behavior at age 17 (α in Figure 1). Paths were then specified from the random intercept to the adolescent sexual behavior at age 14 and age 17 (β in Figure 1).

The second model—the random intercept cross lag model (RI-CLM; see panel **b** in Figure 1)—was used to examine corresponive effects over time. The random intercept and residual structure was specified as described for the RI-PM. In this model, however, paths were specified from the residual personality factors at ages 11 and 14 to the adolescent sexual behaviors at ages 14 and 17, respectively (γ in Figure 1). A path was also specified from the adolescent sexual behavior at age 14 to the residual personality factor at age 17 (γ in Figure 1). An autoregressive path was also specified between the adolescent sexual behaviors (α in Figure 1), as were within-occasion covariances between the adolescent sexual behaviors and residual personality factors.

Finally, we estimated the genetic and environmental contributions to the associations between personality and adolescent sexual behaviors. First, we fit univariate ACE models for the personality trait measures and adolescent sexual behaviors at each occasion, as well as for the random intercept and residual structure of the personality trait measures in the longitudinal models (Prescott, 2004). In these models, the intraclass correlations between twins for MZ and DZ twins were used to parse the phenotypic variance into additive genetic (a^2), common or shared environmental (c^2), and non-shared environmental (e^2 ; i.e., environmental influences that contribute to differences among relatives) variance components. Next, we fit a biometric version of the RI-PM (see Figure 2). Variance in adolescent sexual behavior at age 14 was specified as a function of ACE effects on the random intercept factor (i.e., the stable portion of personality over time), and residual ACE components. Similarly, the variance decomposition for adolescent sexual behavior at age 17 included ACE effects on the random intercept of the personality trait measures, residual ACE influences shared with adolescent sexual behaviors at age 14, and residual ACE influences unique to the adolescent sexual behavior at age 17. The paths from the

random intercept ACE components to the adolescent sexual behaviors capture the extent to which the ACE influences that act on the stable personality variance explain variation in the adolescent sexual behaviors.

To facilitate the estimation of these computationally complex models, the ACE path estimates in the random intercept and the residual structure were fixed to the estimates derived from the univariate random intercept ACE models. Additionally, ACE components that explained less than 10% of total variance in the univariate models were fixed to 0 in the biometric RI-PM (e.g., if there were no shared environmental influences on the extraversion random intercept then no overlap in shared environmental influence was estimated between extraversion and the adolescent sexual behaviors). A biometric version of the RI-CLM was not used here as these models encountered serious convergence difficulties. Although a limitation, ACE components are inherently between-person constructs, making them better suited conceptually for examining the between-person associations between personality and the adolescent sexual behaviors. Furthermore, the asymmetrical nature of the ACE composition of the residual factors, paired with the biometric RI-PM results, can facilitate conceptual inferences about shared etiologies.

All models were fit in Mplus version 8.1 (Muthen & Muthen, 2018) using either WLSMV or full information maximum likelihood (for the univariate personality ACE models) estimation. The phenotypic and biometric models were run using non-parametric percentile bootstrap procedures with 1000 draws, which provides reliable confidence intervals under a variety of complex data conditions (Falk, 2018). The Mplus Automation Package (Hallquist & Wiley, 2018) in R (R Development Core Team, 2016) was also used to facilitate the analyses.

Results

Descriptive information for the personality traits and adolescent sexual behaviors can be found in Table 1. There was moderate rank-order stability across time in the personality traits (r s from 0.30 to 0.61; mean $r = 0.49$), with neuroticism being the least stable across time. Mean differences across time in the personality traits were small. Overall, these results are consistent with past evidence about adolescent personality development (i.e., moderate rank order stability, fairly high mean level stability; Donnellan et al., 2006; Roberts, Walton, & Viechtbauer, 2006). Each adolescent sexual behavior increased in prevalence from age 14 to age 17, though the relative ordering of behaviors was consistent across time such that dating was always the most commonly endorsed behavior, followed by breaking up, sexual intercourse, afraid pregnant, and pregnant. Cross-time tetrachoric correlations were large (r s from 0.56 to 0.71; mean $r = 0.63$).

The biserial correlations between the personality traits and the adolescent sexual behaviors at each time point, and the standardized regression coefficients from the multiple regression models, are presented in Table 2². Extraversion was most consistently associated with dating and breaking up (r s > 0.15). In the multiple regression models, extraversion was a robust (β s greater than 0.15) predictor of all adolescent sexual behaviors at age 17, but not age 14. Further, the associations between extraversion and sexual behaviors at ages 14 and 17 were larger in the regression models after adjusting for overlapping variance in the other personality trait measures, indicative of suppressor effects. Low agreeableness was robustly associated with each adolescent sexual behavior at ages 14 and 17 (mean $r = -0.25$; mean $\beta = -0.24$). Low conscientiousness and neuroticism were most consistently associated with sexual intercourse, afraid pregnant, and pregnant. In the multiple regression models, however, these associations

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² The biserial correlations between the individual items from the teacher rating form and the sex behaviors can be found in the supplemental material (<https://osf.io/mk5ps/>)

were considerably reduced (mean r s = -0.23 and 0.18 while mean β s = -0.14 and 0.04, for conscientiousness and neuroticism, respectively).

Phenotypic Associations Over Time

Selection Effects. Standardized coefficients for the paths from the RI-PM are reported in Table 3. The RI-PMs fit the data well by conventional standards (West, Taylor, & Wu, 2012; <https://osf.io/mk5ps/>). Given the extremely low prevalence of pregnancy at age 14 (0.01%; Table 1), in these and subsequent longitudinal pregnancy models, the afraid pregnant variable at 14 was included in place of the pregnancy at age 14 variable.

The extraversion random intercept was associated with dating and breaking up at ages 14 and 17 (mean β = 0.21), and sexual intercourse at age 17 (β = 0.20). The random intercept factors for agreeableness (mean β = -0.40), conscientiousness (mean β = -0.26), and neuroticism (mean β = 0.29) were associated with all the sexual behaviors at age 14. These effect sizes were much smaller for associations with the sexual behaviors at age 17 (conscientiousness mean β = -0.05, neuroticism mean β = 0.06), though the random intercept factor for agreeableness (mean β = -0.14) remained a consistent predictor of the sexual behaviors. These findings are consistent with our prediction that extraversion would have selection effects for more normative behaviors while low agreeableness, low conscientiousness, and neuroticism had stronger selection effects for more non-normative sexual behaviors. This was evidenced by associations with sexual behaviors at younger ages (when all behaviors are less normative), and the relatively smaller associations with the more normative behaviors.

Corresponsive Effects. The standardized cross lagged paths between the personality traits and adolescent sexual behaviors from the RI-CLMs can also be found in Table 3. Notably, three models (extraversion and afraid pregnant, extraversion and pregnant,

conscientiousness and break up) encountered serious convergence problems, and were instead estimated as traditional cross lag panel models (i.e., autoregressive and cross lagged paths were estimated without the random intercept). The cross lag paths from these models thus represent a more ambiguous blend of between and within person trends and should be interpreted more cautiously. The cross lag models consistently fit the data well by conventional standards (see <https://osf.io/mk5ps/>).

The residual extraversion factors at ages 11 and 14 were associated with subsequent dating and breaking up at ages 14 and 17 (β s range from 0.09 to 0.24); the residual extraversion factor at age 14 also predicted sexual intercourse at age 17 ($\beta = 0.21$). The residual factors for agreeableness (mean $\beta = -0.33$), conscientiousness (mean $\beta = -0.21$), and neuroticism (mean $\beta = 0.15$) at age 11 were associated with all the adolescent sexual behaviors at age 14 (except for conscientiousness and breaking up). Effect sizes were smaller for the associations between the residual personality factors at age 14 and the sexual behaviors at age 17: agreeableness mean $\beta = -0.19$, conscientiousness mean $\beta = -0.08$, neuroticism mean $\beta = 0.03$. The only significant associations were for low agreeableness with breaking up and sexual intercourse, and conscientiousness and dating (though opposite of the predicted direction). These results are again largely consistent with selection effects, this time at the within-person level, for extraversion and normative adolescent sexual behaviors and for low agreeableness, low conscientiousness, and neuroticism for more non-normative sexual behaviors (i.e., earlier age).

Adolescent sexual behaviors at age 14 were associated with many of the residual personality factors at age 17. Endorsement of the adolescent sexual behaviors at age 14 was most consistently associated with higher extraversion and neuroticism (most β s between 0.10 and 0.20; estimates from the cross lagged models without the random intercept were larger, but as

noted these should be interpreted cautiously as merely suggesting an association). That is, youth who initiated sexual behaviors at age 14 were rated as more extraverted and neurotic than expected based on the common trait variance from ages 11 to 17. Sexual behaviors at age 14 were also associated with lower conscientiousness and agreeableness scores at age 17 (β s ranged from -0.20 to -0.29; Table 3). Although effect sizes and directions were largely consistent across analyses, the paths from dating and breaking up at age 14 to personality at age 17 were the most consistently statistically significant (Table 3).

Genetic and Environmental Influences

The univariate ACE estimates for the observed personality trait scores, the random intercept and residual factors, and the adolescent sexual behaviors are presented in Table 4. The observed personality trait scores were primarily explained by the additive genetic and nonshared environmental variance components. Shared environmental influences were also detected for conscientiousness and agreeableness at ages 11 and 14, and neuroticism at age 14. Variation in the random intercept was primarily explained by either the genetic variance component exclusively (extraversion and neuroticism) or the genetic and shared environmental variance component (conscientiousness and agreeableness). Non-shared environmental influences on the random intercepts were negligible. With only two exceptions—neuroticism and agreeableness at age 14—variance in the residual factors were primarily attributed to genetic and nonshared environmental influences. For the adolescent sexual behaviors, dating and breaking up were largely a function of additive genetic and non-shared environmental influences, while sexual intercourse, afraid pregnant, and pregnant were largely attributable to shared and non-shared environmental influences, though the heritability of sexual intercourse increased from age 14 to 17.

The genetic and environmental overlap between the random trait intercepts and the adolescent sexual behaviors are presented in Table 5. The associations between extraversion and neuroticism, and dating, breaking up, and sexual intercourse, were attributable to shared genetic influences. These shared genetic influences accounted for between 1% and 28% of the total variance in the adolescent sexual behaviors. The genetic component of extraversion was most relevant for dating, while the genetic component of neuroticism was most relevant for sexual intercourse. Shared environmental influences accounted for the associations between conscientiousness and agreeableness and most of the adolescent sexual behaviors. These shared environmental influences accounted for 11% to 29% of the total variance in the adolescent sexual behaviors. Shared additive genetic influences also contributed to the associations between sexual intercourse and these personality traits, while the associations with break ups were accounted for exclusively by shared genetic influences.

Ancillary Analyses: Sex Differences

Sex differences between male and female twins were also probed given the differences in rates of maturation, behavioral frequencies, and subjective experiences of sexuality that have been documented across adolescence in the United States (CDC, 2017; O'Sullivan & Ronis, 2013; O'Sullivan & Thompson, 2014). Sex differences were evaluated by comparing multi-group models where parameter estimates were constrained to equality across males and females to models in which these estimates were unconstrained. Constraints across males and females were rejected when the fit of the constrained model was notably worse than that of the less constrained model. This was determined by considering the chi square difference test, changes in RMSEA, CFI, TLI, SRMR, and a comparison of the AIC, BIC, and SBIC (i.e., sample size adjusted BIC) values where applicable (i.e., some fit statistics are not provided in Mplus when

certain estimation algorithms are used). Occasionally the more complex multi-group models (e.g., the RI-CLM) failed to converge. In these cases, single group models were fit separately for males and females. Although this makes direct comparisons of parameter estimates more difficult, it still allows for the identification of any qualitative differences in conclusions across males and females.

Some sex differences were observed across the major analyses, but they were generally small, inconsistent across time, traits, and behaviors, and quantitative versus qualitative (i.e., one association was slightly stronger for one sex at one age). Two somewhat consistent trends did emerge though. The first suggested that the association between neuroticism and the adolescent sexual behaviors may differ across males and females at the within-person level such that males' neuroticism was mostly associated with selection effects on sexual behaviors in the RI-CLM (mean $\beta_{\text{males}} = .19$, mean $\beta_{\text{females}} = .09$), while females' neuroticism was more responsive to prior sexual behavior (i.e., increased following sexual behavior; mean $\beta_{\text{males}} = .03$, mean $\beta_{\text{females}} = .22$). That is, males that were rated as more neurotic were more likely to engage in sexual behaviors in the future, whereas females who initiated sexual behaviors at age 14 were rated as more neurotic at age 17 than expected based on their random intercept alone. Differences for the between-person neuroticism selection effects in the RI-PM models were less pronounced, though paths were generally somewhat larger for females (mean $\beta_{\text{males}} = .28$, mean $\beta_{\text{females}} = .37$).

Second, shared environmental influences tended to be larger for females, while additive genetic influences tended to be larger for males (e.g., from the univariate personality ACE models: mean $a^2_{\text{males}} = .61$, mean $a^2_{\text{females}} = .54$; mean $c^2_{\text{males}} = .07$, mean $c^2_{\text{females}} = .12$). This trend was most consistently observed for agreeableness, but there was also evidence of a reversal at age 17 such that shared environmental influences were stronger for males. Overall, given the

number of analyses, computational complexity of many of the models, and the fact that the sample size for estimating effects was considerably reduced for each group, the sex differences discussed here should be interpreted with caution.

Discussion

To our knowledge, this is the first longitudinal twin study that examines co-development between personality and adolescent sexual behavior, thus providing important new information about the dispositional origins of sexuality during this key developmental period. The major findings can be interpreted through the framework of our recent conceptualization of adolescent sexual behaviors as indicators of a sexual propensity trait that ranges from more normative (i.e., higher prevalence and high social approval) to non-normative (i.e., low prevalence and socially discouraged) behaviors (Clark et al., 2020). Previously, we found that normative adolescent sexual behaviors were more heritable while non-normative behaviors exhibited substantial shared environmental influences. In terms of relations with personality, we identified two consistent patterns that aligned with this model: a genetically mediated association between extraversion and more normative adolescent sexual behaviors, and an association between low agreeableness/low conscientiousness and non-normative adolescent sexual behaviors that was primarily due to shared environmental influences.

Extraversion and Normative Sexual Behaviors

Extraversion scores at ages 11, 14, and 17 had consistent prospective and cross-sectional associations with dating and breaking up at ages 14 and 17, which were the most normative adolescent sexual behaviors we examined. Extraversion scores at each age were also associated with sexual intercourse at age 17 but not age 14. Notably, the prevalence of sexual intercourse increased dramatically from 4% at age 14 to 37% at age 17, which is consistent with the notion

that extraversion is primarily relevant to developmentally normative sexual behaviors, and by extension, to individual differences in adaptive psychosexual development.

Interestingly, effect sizes for the associations between extraversion and all the adolescent sexual behaviors were larger after adjusting for the common variance with neuroticism, conscientiousness, and agreeableness in the multiple regression models. This is often referred to as a suppressor effect (Paulhus et al., 2004), and indicates that it is the aspects of extraversion independent of other personality traits that are associated with adolescent sexual behavior. The item level associations presented in the supplemental material (<https://osf.io/mk5ps/>) indicate that content related to social dominance, visibility, and thrill seeking had the largest and most consistent associations with the adolescent sexual behaviors. This suggests that it is the traits associated with social overtures and social impressions that are associated with sexual behaviors, not necessarily general cheerfulness or interpersonal warmth. This content notably overlaps with the concept of boldness, a personality construct that incorporates elements of social dominance, stress resilience, and thrill seeking. Boldness is highly correlated with extraversion, but relatively independent of disinhibition and externalizing problems (Hicks et al., 2014; Patrick et al., in press). Future investigations should pay particular attention to these aspects of extraversion when attempting to understand the associations between personality and sexual behaviors.

Our longitudinal design also allowed us to examine the developmental interplay between personality and adolescent sexual behavior over time. For extraversion, we detected selection effects of extraversion on dating and breaking up at ages 14 and 17 as well as for sexual intercourse at age 17, as evidenced by associations with the random intercept factor for extraversion. That is, more extraverted youth were more likely to date, break up with a romantic partner, and initiate sexual intercourse by late adolescence. We also detected possible

corresponsive effects between extraversion and adolescent sexual behaviors. That is, romantic experiences were associated with increases in extraversion within the residual structure (i.e., after controlling for the stable trait variance). This may be because the social rewards provided by dating and physical intimacy are particularly rewarding for those high in extraversion (Lucas et al., 2008). Overall, this supports the notion that personality continues to be shaped by numerous contextual presses in adolescence, particularly those in the social domain (Donnellan et al., 2006).

Common genetic influences accounted for the associations between extraversion and the more normative adolescent sexual behaviors. This was a likely outcome given the high heritability of both extraversion and the more normative adolescent sexual behaviors. These results suggest that when there are fewer environmental restrictions on sexual behaviors, genetic differences among youth will account for a greater proportion of differences in sexuality, and extraversion in turn will contribute to the expression of these sexual dispositions.

Agreeableness, Conscientiousness, Neuroticism and Non-normative Sexual Behaviors

The other notable pattern of relations between personality and the sex behaviors emerged through associations with low agreeableness, low conscientiousness, and to a lesser extent neuroticism. In the correlation and regression analyses, low agreeableness exhibited the largest and most consistent associations with the adolescent sexual behaviors, particularly the non-normative behaviors (i.e., sexual intercourse and pregnancy). Results were similar for low conscientiousness though the effect sizes were not as large or consistent, and often disappeared after adjusting for other personality traits in the regression models. Neuroticism was only associated with the non-normative behaviors, and these effects were also substantially reduced after adjusting for the other personality trait measures.

In terms of developmental interplay, each adolescent sexual behavior at age 14 was associated with the random intercept factors representing stable trait variance across adolescence in agreeableness, conscientiousness, and neuroticism. This is indicative of relatively strong selection effects to engage in earlier and, therefore more non-normative, sexual behavior. Notably, these selection effects were much weaker for the adolescent sexual behaviors at age 17, with low agreeableness being the only consistent predictor. We also detected selection in the residual structure for sexual behaviors at age 14. That is, people that were particularly antagonistic, disinhibited, and neurotic at age 11 relative to their stable trait levels across adolescence were more likely to engage in each adolescent sexual behavior at age 14. These effects were mostly non-significant for sexual behaviors at age 17. There was also evidence of corresponsive effects. Dating, breaking up, and sexual intercourse at age 14 were associated with greater neuroticism and lower agreeableness at age 17, and sexual intercourse at age 14 was also associated with lower conscientiousness at age 17. That is, engaging in these sexual behaviors at age 14 was associated with higher neuroticism, lower agreeableness, and lower conscientiousness at age 17 than expected on the basis of the stable trait variance captured by the random intercept. This is further evidence of the sensitivity of personality to experiences, in this case, traits most related to engaging in non-normative sexual behaviors were the most intensified following those experiences. This is consistent with sexual risk models that show earlier onset of some sexual behaviors are indicative of greater overall maladjustment (Armor & Haynie, 2007).

Notably, effect sizes for the associations between agreeableness and sexual behaviors were larger than the meta-analytic effects reported by Allen and Walter (2018). These differences were likely due to both the nature of our agreeableness measure, and the age of the sample. Several of our teacher-reported agreeableness items tap into conventionality and

willingness to follow rules (e.g., values a good reputation, law abiding, truthful), which aligns well with conceptions of prosociality or (reversed) callous/unemotional traits (Lahey et al., 2010; Waller et al., 2019). Further, prior work with this sample has shown that these items are strong predictors of various non-normative behaviors in adolescence and young adulthood (e.g., antisocial behavior and substance use; Hicks et al., 2014). Taken together, this suggests that this agreeableness measure taps into a non-specific norm violation personality process rather than sexual behavior in particular. Given the content of the scale and the fact that sexual behaviors are more discouraged in adolescence relative to adulthood, it is thus understandable that the effects for agreeableness fall in the upper range of prior reported effect sizes. That is, conventionality and an unwillingness to violate norms in general are personality traits especially relevant to engaging in sexual behavior in adolescence when autonomy is still constrained in numerous domains by rules and norms restricting sexual behaviors that are less relevant in adulthood.

The behavior genetic analyses revealed substantial shared environmental influences on the random intercept for agreeableness and to a lesser extent for conscientiousness, though each was smaller than the large genetic influences on these traits. For both extraversion and neuroticism, the variance of the random intercept was almost entirely attributable to genetic influences. These findings are relatively novel, and suggest that the stable aspects of emotion-related traits are almost entirely heritable while traits related to behavioral control also exhibit shared environmental influences, at least in adolescence. The rigor of the longitudinal teacher rating assessments of personality provide additional confidence in these findings. For example, the design of having different teachers rate personality traits at different ages in different classrooms helped to reduce bias associated with a single rater. Further, the multiple assessments afforded fitting a latent random intercept factor, which removes measurement error and increases

the power to detect genetic and shared environmental variance. Notably, the random intercept factors for extraversion and neuroticism exhibited almost no non-shared environmental variance suggesting we reached the ceiling for estimates of additive genetic and shared environmental variance.

In terms of the overlap with adolescent sexual behaviors, shared environmental influences accounted for much of the associations with conscientiousness and agreeableness, though common genetic influences also contributed to the association between agreeableness and breaking up and sexual intercourse. In contrast, only common genetic influences accounted for the associations between neuroticism and the adolescent sexual behaviors. This suggests that the link between adolescent sexual behaviors and emotion-related traits (i.e., extraversion and neuroticism) is due to genetic influences while shared environmental influences make important contributions to the overlap between personality traits related to behavioral control (i.e., agreeableness and conscientiousness) and adolescent sexual behaviors, especially non-normative behaviors. That is, certain traits are more sensitive to environmental pressures, some of which are the same environmental constraints acting on adolescent sexual behaviors, especially non-normative behaviors.

The findings for shared environmental influences on behavioral control-related traits and their overlap with sexual behaviors differs from prior studies on adults that have found that genetic influences mostly accounted for the link between sexual behaviors (Zietsch et al., 2010). Prior studies with the MTFS sample, however, have also found shared environmental influences on other adolescent problem behaviors especially, in middle adolescence (McGue et al., 2006). A key area for future research then is to gain a better understanding of the shared environmental influences contributing to adolescent sexual behaviors, problem behaviors, *and* that are actively

shaping personality in adolescence. For example, family environments that stress conformity to rules and adult authority, honesty, and academic success, while discouraging antisocial behavior, substance use, and romantic activities may be one such source of these shared environmental influences.

Limitations and Future Directions

The study had some notable limitations. First, although the sexual behaviors examined cover a range from normative to non-normative, many sexual behaviors ranging from more to less common were not included (e.g., kissing, oral sex). Second, additional waves of data in adolescence would have allowed for a more fine-grained examination of developmental trends; indeed the small number of waves and categorical sexual behavior indicators made it difficult to separate within and between and effects over time as cleanly as would be desired. However, the assessments did span the majority of adolescence and were well timed to capture normative age-related changes from when sexual behaviors are either absent or uncommon to when at least some sexual behaviors are relatively normative. The RI-CLPM variants also, although not as conceptually rich as the full model, still provide considerable information about potential processes at different levels of analysis.

Additionally, the sample lacked racial and ethnic diversity, and information on sexual orientation at this age was not available. Caution is thus needed when attempting to generalize these findings. Also, the MTFS began roughly 3 decades ago (circa 1990; Iacono et al., 1999). Since that time, rates of adolescent sexual behavior have been declining (CDC, 2017), implying that the sexual behaviors assessed in this study are becoming slightly more non-normative in general. It is currently unclear how this secular change impacts the generalizability of these findings to younger cohorts.

In addition to the future directions already mentioned, it is important to extend these findings further out in the lifespan. The normativeness of various sexual behaviors changes throughout the lifespan—both in the direction of behaviors becoming more (e.g., pregnancy in adulthood) and less (e.g., dating in older ages) normative—as do the amount of constraints on behavior. Accordingly, it is important to continue to evaluate whether the broad trends observed here regarding the associations between personality and sexual behaviors—more normative behaviors sharing genetic influences with extraversion and neuroticism, less normative behaviors sharing environmental influences with conscientiousness and agreeableness—carry over into adulthood as the repertoire of sexual behaviors tends to expand both qualitatively and quantitatively.

Further, it will also be important to consider other variables beyond personality and their relations to sexual development across adolescence. In addition to environmental factors already mentioned, fruitful avenues of future investigation include variables related to mental health and peer influences. Many forms of psychopathology increase in prevalence across adolescence, and the influences of peers on behavior increases during this time. Exploring the developmental transactions between these sexual behaviors, personality, and these additional variables across adolescence at both phenotypic and genetic levels of analysis could help to further flesh out the nature of the trends observed here.

Conclusion

Personality and sexuality each represent major domains of adolescent development. We found that personality helps determine which youth select into romantic relationships and certain sexual experiences, and that personality, in turn, is shaped by these experiences. Furthermore, genetic influences accounted for the link between adolescent sexual behaviors and emotion-

related personality traits (extraversion and neuroticism), whereas shared environmental influences largely accounted for the associations between adolescent sexual behaviors and personality related to behavioral control (agreeableness and conscientiousness). These trends were also related to the normativeness of the sexual behaviors such that more normative sexual behaviors (i.e., more prevalent) were related to personality due to shared genetic influences, while shared environmental influences contributed to links between personality and more non-normative sexual behaviors. The results greatly expand upon our prior understanding of the co-development between personality and sexuality in adolescence, and help to shape a theoretical framework to guide future investigations to identify additional mechanisms that contribute to these phenotypes and their co-development.

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Table 1
Descriptive Information for Personality Traits and Sexual Behaviors Across Time

	Personality				Sex Behaviors				
	Extraversion	Neuroticism	Conscientiousness	Agreeableness	Dating	Break Up	Sexual Intercourse	Afraid Pregnant	Pregnant
Age 11									
M/%	3.21	1.74	3.39	3.94					
SD	.70	.71	.80	.77					
N	2292	2291	2291	2291					
Age 14									
M/%	3.20	1.70	3.53	3.96	45%	24%	4%	1%	.01%
SD	.70	.67	.77	.73					
N	1932	1928	1933	1929	2328	2289	2322	2325	2325
r11	.52	.37	.61	.52					
Age 17									
M/%	3.35	1.76	3.64	3.98	83%	66%	37%	13%	3%
SD	.66	.68	.72	.70					
N	2672	2662	2672	2670	3412	3410	3384	2838	3405
r11	.47	.30	.56	.46					
r14	.54	.37	.59	.53	.69	.57	.71	.56	.62*

Note. M/% = mean (for continuous variables) or endorsement percentage (for dichotomous variables); SD = standard deviation; N = number of ratings; r11 = correlation with corresponding variable at age 11; r14 = correlation with corresponding variable at age 14; * = correlation between afraid pregnant at 14, and pregnant at 17.

Table 2
Phenotypic Associations between Personality Traits and Sexual Behaviors Across Ages

	Sexual Behaviors at Age 14				Sexual Behaviors at Age 17				
	Dating	Break up	Sexual Intercourse	Afraid Pregnant	Dating	Break up	Sexual Intercourse	Afraid Pregnant	Pregnant
Personality at Age 11	r / β	r / β	r / β	r / β	r / β	r / β	r / β	r / β	r / β
Extraversion	.15 / .31	.14 / .26	-.13 / .05	-.02 / .12	.24 / .31	.13 / .19	.08 / .28	.05 / .19	-.10 / .13
Neuroticism	.08 / -.08	.07 / -.01	.23 / .03	.16 / .09	-.01 / -.07	.04 / -.02	.11 / -.03	.08 / .03	.10 / -.01
Conscientiousness	-.13 / -.16	-.07 / -.12	-.28 / -.11	-.17 / -.16	.05 / .00	-.01 / .00	-.18 / -.22	-.12 / -.20	-.28 / -.34
Agreeableness	-.25 / -.29	-.16 / -.16	-.33 / -.25	-.19 / -.07	-.13 / -.28	-.13 / -.21	-.25 / -.21	-.13 / -.04	-.19 / -.03
Personality at Age 14									
Extraversion	.18 / .37	.14 / .27	-.08 / .11	-.07 / .05	.22 / .31	.14 / .22	.07 / .27	.01 / .17	-.09 / .09
Neuroticism	.13 / -.07	.08 / -.06	.29 / .05	.21 / .02	.04 / -.10	.08 / -.06	.24 / .05	.14 / -.05	.20 / .02
Conscientiousness	-.22 / -.22	-.13 / -.13	-.31 / -.03	-.25 / -.04	-.08 / -.03	-.11 / -.02	-.29 / -.20	-.25 / -.22	-.29 / -.18
Agreeableness	-.33 / -.31	-.22 / -.24	-.39 / -.37	-.29 / -.27	-.27 / -.40	-.25 / -.33	-.38 / -.28	-.27 / -.18	-.29 / -.17
Personality at Age 17									
Extraversion	.18 / .32	.10 / .19	.06 / .13	.13 / .24	.31 / .45	.20 / .32	.07 / .26	-.01 / .15	-.07 / .01
Neuroticism	.10 / -.03	.08 / -.01	.20 / .03	.09 / -.05	.07 / -.02	.10 / -.02	.24 / .03	.21 / .04	.15 / -.01
Conscientiousness	-.15 / -.11	-.09 / -.01	-.18 / .06	-.14 / -.14	-.06 / -.09	-.12 / -.07	-.26 / -.07	-.24 / -.11	-.17 / .04
Agreeableness	-.25 / -.29	-.17 / -.23	-.25 / -.32	-.17 / -.19	-.22 / -.32	-.24 / -.31	-.38 / -.39	-.29 / -.23	-.23 / -.26

Note. Correlations to the right of the slash; standardized regression coefficients from multiple-regression model controlling for all other personality traits at that age of assessment to the left of slash. Coefficients above |.15| presented in bold.

Table 3
Path Coefficients from Random Intercept Cross Lagged Panel Models

	Random Intercept Paths		Cross Lag Paths		
	RI→S ₁₄	RI→S ₁₇	R _{P11} →S ₁₄	R _{P14} →S ₁₇	S ₁₄ →P ₁₇
Extraversion					
Dating	.25*	.24*	.24*	.17*	.19*
Break Up	.20*	.13*	.21*	.09*	.11*
Sexual Intercourse	-.13	.20*	-.02	.21*	.11
Afraid Pregnant [†]	-.05	.05	.12	.08	.73*
Pregnant [†]	-.05	-.04	.13	-.04	.72*
Neuroticism					
Dating ^{††}	.20*	-.07	.07*	-.07	.10*
Break Up	.15*	.06	.08*	.04	.09*
Sexual Intercourse	.46*	.06	.22*	.05	.20*
Afraid Pregnant	.32*	.11	.17*	.03	.08
Pregnant	.32*	.12	-	.10	.08
Conscientiousness					
Dating ^{††}	-.23*	.12*	-.12*	.16*	-.09
Break Up [†]	-.13*	-.04	-.04	-.01	.05
Sexual Intercourse	-.39*	-.04	-.35*	-.11	-.25*
Afraid Pregnant	-.28*	-.14	-.23*	-.20	-.21
Pregnant	-.28*	-.17*	-	-.24	-.23
Agreeableness					
Dating	-.42*	.02	-.29*	-.06	-.29*
Break Up	-.28*	-.17*	-.21*	-.18*	-.20*
Sexual Intercourse	-.52*	-.20*	-.40*	-.17*	-.27*
Afraid Pregnant	-.38*	-.18*	-.25*	-.16	-.19
Pregnant	-.38*	-.17	-	-.17	-.10

Note. RI→S₁₄ = path coefficients from random intercept to age 14 sexual behavior; RI→S₁₇ = path coefficients from random intercept to age 17 sexual behavior; R_{P11}→S₁₄ = path coefficients from age 11 personality to age 14 sexual behavior; R_{P14}→S₁₇ = path coefficients from age 14 personality to age 17 sexual behavior; S₁₄→P₁₇ = path coefficients from age 14 sexual behavior to age 17 personality; * = 95% confidence interval (derived via non-parametric percentile bootstrap with 1000 draws) does not include 0; [†] = Cross lag estimates come from CLPM without random intercept as RI-CLPM encountered serious convergence difficulties; ^{††} personality autoregressive paths were fixed to equality to facilitate convergence in cross lag model. Random intercept path coefficients and cross lag path coefficients come from separate models (see Figure 1).

Table 4
Univariate ACE Estimates for Personality Traits and Sexual Behaviors Across Ages

	Random Intercept			Age 11			Age 14			Age 17		
	a ²	c ²	e ²	a ²	c ²	e ²	a ²	c ²	e ²	a ²	c ²	e ²
Personality Traits – Observed												
Extraversion				.70*	.00	.30*	.72*	.00	.28*	.66*	.00	.34*
Neuroticism				.63*	.01	.36*	.23*	.34*	.43*	.46*	.01	.53*
Conscientiousness				.70*	.10	.20*	.40*	.13	.27*	.67*	.02	.31*
Agreeableness				.53*	.24*	.23*	.35*	.37*	.28*	.63*	.08	.29*
Personality Traits – Random Intercept and Residual Structure												
Extraversion	.98*	.00	.02	.46*	.00	.54*	.45*	.00	.55*	.33*	.00	.67*
Neuroticism	.89*	.08	.03	.51*	.00	.49*	.00	.39*	.61*	.24	.03	.73*
Conscientiousness	.76*	.21*	.03	.60*	.00	.40*	.41*	.04	.54*	.32*	.00	.68*
Agreeableness	.56*	.42*	.02	.54*	.05	.41*	.14	.33*	.53*	.45*	.00	.55*
Adolescent Sexual Behaviors												
Dating							.57*	.20	.23*	.60*	.19	.21*
Break Up							.61*	.00	.39*	.51*	.09	.41*
Sexual Intercourse							.20	.61*	.19*	.31*	.50*	.19*
Afraid Pregnant							.00	.83*	.17*	.08	.45*	.47*
Pregnant										.00	.44*	.56*

Note. a² = additive genetic variance; c² = shared environmental variance; e² = non-shared environmental variance; Personality Traits – Observed = ACE components for individual personality variables at each time point; Personality Traits – Random Intercept and Residual Structure = ACE components for random intercept, and time-point specific deviations (i.e., residual factors); * = 95% confidence interval (derived via non-parametric percentile bootstrap with 1000 draws) does not include 0.

Table 5
Proportion of Variance in Sex behaviors Explained by Personality Random Intercept
ACE Components

	% Of Variance Explained in Age 14 Sex Behavior				% Of Variance Explained in Age 17 Sex Behavior			
	a ²	c ²	e ²	Total	a ²	c ²	e ²	Total
Extraversion								
Dating	6	0	0	6%	15	0	0	15%
Break Up	4	0	0	4%	6	0	0	6%
Sexual Intercourse	2	0	0	2%	1	0	0	1%
Afraid Pregnant	0	0	0	0%	0	0	0	0%
Pregnant	0	0	0	0%	0	0	0	0%
Neuroticism								
Dating	5	0	0	5%	1	0	0	1%
Break Up	2	0	0	2%	3	0	0	3%
Sexual Intercourse	28	0	0	28%	14	0	0	14%
Afraid Pregnant	0	0	0	0%	0	0	0	0%
Pregnant	0	0	0	0%	0	0	0	0%
Conscientiousness								
Dating	0	29	0	29%	4	21	0	25%
Break Up	3	0	0	3%	2	0	0	2%
Sexual Intercourse	4	27	0	31%	8	4	0	12%
Afraid Pregnant	0	9	0	9%	0	33	0	33%
Pregnant	0	9	0	9%	0	35	0	35%
Agreeableness								
Dating	0	26	0	26%	0	15	0	15%
Break Up	12	0	0	12%	15	0	0	15%
Sexual Intercourse	10	18	0	28%	18	7	0	25%
Afraid Pregnant	0	11	0	11%	0	26	0	26%
Pregnant	0	11	0	11%	0	29	0	29%

Note. a² = additive genetic variance; c² = shared environmental variance; e² = non-shared environmental variance; Total = total variance explained by random intercept ACE components. Paths from the random intercept ACE components to the sex behaviors were fixed to 0 for variance components that explained less than 10% of the variance in the random intercepts or sexual behaviors in the univariate ACE models (see Table 5).

Figure 1. Random Intercept Cross Lagged Panel Models (RI-CLPM). Panel a depicts the random intercept predictor model (RI-PM); panel b depicts random intercept cross lag model (RI-CLM). RI = random intercept; $P_{11} - P_{17}$ = personality ratings at age 11 through age 17; $R_{11} - R_{17}$ = personality residuals at age 11 through age 17; $S_{14} - S_{17}$ = sexual behaviors at age 11 through age 17; α = autoregressive paths; β = paths from random intercept to sex behaviors; γ = cross lag paths. Variances and mean structure omitted from figure for clarity of presentation.

Figure 2. Biometric Random Intercept Model. RI = random intercept; $P_{11} - P_{17}$ = personality ratings at age 11 through age 17; $R_{11} - R_{17}$ = personality residuals at age 11 through age 17; $S_{14} - S_{17}$ = sexual behaviors at age 11 through age 17; A = additive genetic variance components. Shared and non-shared environmental variance components, and mean structure, omitted from figure for clarity of presentation. Twin 2 model also not pictured. Two equivalent models were specified, one for twin 1 and one for twin 2, and covariances were added between the twin 1 and 2 A and C variance components. The covariance between the A components was fixed to either 1.0 (MZ twins) or 0.5 (DZ twins), and the covariance between the C components was fixed to 1.0 (MZ and DZ twins).