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ORIGINAL ARTICLE

Smart Teens Don't Have Sex (or Kiss Much Either)

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Purpose: **To examine the relationship between an intelligence measure and a wide spectrum of partnered sexual activity ranging from holding hands to sexual intercourse among adolescents.**

Method: **Analyses are based on two separate samples of adolescents. The core sample of the National Longitudinal Study of Adolescent Health (Add Health) includes approximately 12,000 adolescents enrolled in the 7th to 12th grades. The Biosocial Factors in Adolescent Development projects followed approximately 100 white males and 200 black and white females over 3- and 2-year periods, respectively. Both studies used the Peabody Picture Vocabulary Test (PPVT) as an intelligence measure, and confidential self-reports of sexual activity. Logistic regression models were used to examine the relationship between PPVT scores and coital status in Add Health data; proportional hazard models were used to examine the timing of initiation of noncoital and coital activities as a function of PPVT scores in the Biosocial Factors sample.**

Results: **Controlling for age, physical maturity, and mother's education, a significant curvilinear relationship between intelligence and coital status was demonstrated; adolescents at the upper and lower ends of the intelligence distribution were less likely to have sex. Higher intelligence was also associated with postponement of the initiation of the full range of partnered sexual activities. An expanded model incorporating a variety of control and mediator variables was tested to identify mechanisms by which the relationship operates.**

Conclusions: **Higher intelligence operates as a protective factor against early sexual activity during adolescence, and lower intelligence, to a point, is a risk factor. More systematic investigation of the implications of individual differences in cognitive abilities for sexual activities and of the processes that underlie those activities is warranted.** © ***Society for Adolescent Medicine, 2000***

KEY WORDS:
Intelligence
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Adolescent problem behaviors such as drinking, drug use, and delinquent activity tend to cluster together, and early sexual involvement is often part of this cluster, particularly among white adolescents (1,2). Sexual activity that begins early in adolescence is associated with a higher likelihood of unprotected sex, resulting in a greater probability of pregnancy and sexually transmitted infections (3). Furthermore, adolescents may be physically mature but not emotionally prepared for sexual activity. Among females in particular, early and persistent sexual activity may be associated with elevated depressive symptoms (4). Given these physical and psychological risks, early sexual activity, like smoking or drug use, may have significant negative consequences for the adolescent.

There is a large literature examining factors associated with the timing and patterns of adolescent sexual behavior, particularly coital initiation. In this body of work, the one factor that is conspicuous because of virtual absence is intelligence. Although cognitive abilities are often mentioned as attributes of the individual that are relevant to sexual activity (5), they are rarely directly measured and incorporated into models of adolescent sexual behavior.

The neglect of examination of intelligence as a determinant of adolescent sexual activity stands in contrast to its more common inclusion in the inves-

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tigation of other adolescent problem behaviors. There is a generic inverse relationship between intelligence and rule breaking that has been observed across a wide spectrum of behaviors. For example, intelligence is negatively correlated with acquiescence, crime, delinquency, truancy, and out-of-wedlock births, and conversely is positively correlated with moral reasoning and development, and social skills (6–8). For some forms of rule-breaking, the relationship with intelligence may be significantly nonlinear (9).

The clustering of problem behaviors implies the possibility of shared causal agents. Rowe et al.'s (10) sibling analysis of sexual behavior and nonsexual deviance among adolescents suggested that both sets of behaviors are influenced by the same underlying trait(s), which may be familial (possibly genetic) in origin. Because individual differences in intelligence may provide one common link underlying this array of behaviors, investigation of the cognitive and social processes associated with individual differences in intelligence may elucidate some of the dynamics of adolescents' initiation of sexual behavior.

Only a few publications examining the association between measures of intelligence or cognitive abilities and the initiation of sexual experience are based on respondent samples that are not highly selected on the behaviors of interest. These suggest the same inverse relationship between intelligence and sexuality that is seen for adolescent problem behaviors. For example, Cliquet and Balcaen (11) reported a significant relationship between Ravens Progressive Matrices scores and retrospectively reported age at first intercourse. Women with higher Ravens scores initiated sex at later ages and also reported greater delay to the time at which premarital coitus began after becoming acquainted with their partner. Mott (12), in an analysis of data from the National Longitudinal Survey of Labor Force Behavior of Youth, found that scores on the Armed Forces Qualification Test (AFQT) were significant inverse predictors of sexual activity in the past month for never-married males and females ages 17–20 years. Because this analysis appears to include persons who have never had sex, the relationship may also reflect a link between intelligence and the timing of coital initiation.

As with other problem behaviors, available data suggest that higher intelligence may function as a protective factor against early coital initiation. Such an association would be consistent with the literature on academic achievement and coital timing. Despite the historical trend toward earlier ages of onset of sexual intercourse, a number of studies have consistently demonstrated that making better grades in school and/or having higher educational aspirations is associated with postponement of sexual intercourse (12–20). Although these findings have not been discussed in terms of cognitive abilities, they underscore the potential contribution of individual differences in intelligence to sexual behavior.

Relationships between school grades and postponement of sexual intercourse have typically been interpreted as reflections of adolescents' desires to safeguard their future educational and occupational plans by avoiding the risks associated with intercourse. Postponement is thus essentially a manifestation of a bond to conventionality, as delineated in Social Control theory (21). According to this perspective, an individual's choice to abstain from or restrict sexual activity is a logical consequence of conventional goals or values (e.g., educational and career pursuits, religious proscriptions), or of the need for approval from others who hold those values (e.g., parents) (17,18).

This same process may underlie the relationship between intelligence and coital postponement. That is, the desire to avoid the risks associated with early coitus, and thereby to safeguard one's future, may be a key process mediating the link between intelligence and coital postponement. However, if the relationship between intelligence and early coital activity is curvilinear, as is the case with some other problem behaviors, this mediating process may be an inadequate explanation for associations at the very low end of the intelligence distribution. A related issue, which has important implications for the interpretation posed above, is whether higher intelligence is associated with a delay in coital activity exclusively, or with a more generalized delay in the initiation of other types of sexual behavior. If an adolescent is primarily motivated to avoid the risks associated with a more proscribed activity such as coitus, then a relationship between intelligence and noncoital activities (e.g., necking, light petting) that do not entail those risks should not be evident.

The purpose of this article is to examine the relationship between intelligence and sexual activity among adolescent males and females. Based on previous findings, we expected to find an inverse relationship between intelligence and the initiation of coitus. We also tested the relationship between intelligence and a variety of noncoital behaviors to explore the implicit assumption that adolescents of higher intelligence are specifically avoiding coitus and not other noncoital activity.

Method

Sample Descriptions and General Data Collection Sequences

To examine both coital and noncoital behavior, we rely on two separate samples of adolescents. The National Longitudinal Study of Adolescent Health (Add Health) (22) collected two waves of data, separated by about a year, on approximately 12,000 adolescents (core sample) enrolled in the 7th to 12th grades. The Biosocial Factors in Adolescent Development projects (Biosocial Factors) (23,24) followed approximately 100 white males, and 200 black and white females over a 3- and 2-year period, respectively. The projects examined biosocial determinants of behavior, with an emphasis on sexual development. The two studies differed significantly in size and design but used the same measure of intelligence and provide complementary strengths in addressing the relationship between intelligence and adolescent sexuality. The "Biosocial Factors" projects provide longitudinal measures of both noncoital and coital sexual activity from early to middle adolescence. The projects include detailed measures of control variables such as pubertal development, and because of repeated assessments, allow for an analysis of the initiation of a variety of sexual behaviors. The Biosocial projects are limited, however, to relatively small samples of adolescents selected from a single school district in one state. The goal of the Add Health study was to assess the health status of adolescents in the United States; and its greatest strength, in contrast to the Biosocial Factors projects, lies in the construction of a large, nationally representative sample of adolescents. However, Add Health offers limited information about noncoital sexual activity, and measures of some variables of interest were constrained by the practical issues of large-scale field implementation.

Add Health. Add Health began with a school sample that represents a stratified, random sample of all high schools in the United States. In the school sample, questionnaires were collected from more than 90,000 adolescents from 134 discrete schools. All students who completed an in-school questionnaire or who were listed on a school roster were eligible for inclusion in the in-home sample. More than 21,000 Wave I in-home interviews were completed between April and December 1995. For the present analyses, the Wave I core in-home sample of 12,105 adolescents in Grades 7–12 was used. The mean age at Wave I was 15.6 years, and ranged from 11 to 21 years. About 79% of eligible respondents completed a Wave I in-home interview. For more specific information about the research design, in-school and in-home samples, and data instruments used, see Bearman et al. (22).

Add Health respondents completed questionnaires that were administered via laptop computer. For questionnaire sections tapping less sensitive content, the interviewer read questions to the respondent, who responded orally, and the interviewer entered the responses directly into the computer. For questions of sensitive content, the respondent listened to prerecorded questions through earphones and entered their answers directly (audio-CASI). The latter technique served to maintain data security and minimize the possibility that the interviewer or a household member might influence responses.

Biosocial Factors. Males and females in this sample were randomly selected by computer from lists of all seventh- and eighth-grade students enrolled in five middle schools in a county school district in North Carolina. The county school district was a mixture of suburban and rural areas surrounding a medium-sized city, and the population of all five middle schools in the district was represented on the list. The study of males began in 1986, and the parallel study of females began in 1989. At the time of both male and female sample selection, students living in the inner city attended a city school district, which was separate from but surrounded by the county school district. The racial composition of the seventh and eighth grades in the county school district from which these samples were drawn was approximately two-thirds white and one-third black. Only Whites were selected into the male sample. Blacks and Whites were included in the female sample. For males, and within each race for females, potential participants were randomly selected from the student lists by computer and interviewers were sent to their homes to request their participation. Parents and adolescents were given a straightforward description of project goals (i.e., "to study how biological and social factors work together to affect adolescent behavior and development") both verbally and through written brochures, and were asked to review copies of every questionnaire and data collection form as part of the informed consent process. Signed consent was obtained first from a parent, and then the adolescent; thus, for each respondent there were two opportunities for refusal. Because it was critical to control menstrual cycle phase for purposes of hormone measurement in females, only postmenar-

Table 1. Respondent Characteristics at Time—Add Health and Biosocial Factors Projects

	Non-Black* Females	Black Females	Non-Black Males	Black Males
Add Health—core sample†				
N	4779	1173	4421	948
Age (y)				
Mean	15.55	15.60	15.65	15.67
SD	1.77	1.80	1.76	1.84
Minimum/maximum	11/21	11/21	11/21	11/21
% mother college graduate	25%	21%	25%	25%
Standardized AHPVT				
Mean	102.38	92.78	103.54	93.61
SD	14.34	14.49	13.89	14.44
Minimum/maximum	15/138	17/135	14/139	14/138
Biosocial Factors				
N	123	125	127	
Age (y)				
Mean	13.79	13.89	13.26	
SD	0.51	0.48	0.45	
Minimum/maximum	12/14	12/14	12/14	
% mother college graduate	37%	30%	35%	
Standardized PPVT				
Mean	107.47	91.93	111.96	
SD	15.87	16.54	17.04	
Minimum/maximum	75/150	55/146	75/160	

* In the Add Health sample, "non-Black" includes adolescents who are non-Hispanic White, Hispanic, and Asian. Twelve percent of the Wave I core sample self-identified as Hispanic and 4% were Asian. In the Biosocial Factors sample, "non-Black" includes only non-Hispanic Whites.

† Sample size is slightly less than the core sample size of 12,105 owing to missing data on coital status and/or the Add Health Picture Vocabulary Test.

cheal girls were considered to be eligible for study participation. This eliminated very late-maturing girls from the sample, and because of black/white differences in female pubertal timing, was more likely to eliminate Whites. For Blacks, 6.2% of all girls contacted for study recruitment were premenarcheal, and therefore ineligible; for Whites, the percentage was 11.7%.

The acceptance rate for participation among eligible females was about 65%; about half of eligible males agreed to study participation. Levels of sexual activity reported by the males and females in these samples are similar to those based on national samples and other studies of sexual activity from this research line which entailed less respondent burden and obtained higher recruitment rates. Halpern et al. (23–25) give more details regarding analyses of sample selectivity and attrition. Initially, 127 white males, 123 white females, and 125 black females agreed to participate and completed at least one project questionnaire or procedure. The mean age at Round 1 of data collection was 13.6 years and ranged from 12.5 to 14.7 years. Two years later, 100 white males, 102 white females, and 106 black females completed the fifth round of data collection, yielding attrition rates of 16% for females and 21% for males. Among males, respondents who made poorer grades, had advanced pubertal development, and were sexually active were more likely to withdraw. Among females, respondents who were more pubertally developed were more likely to withdraw. Analyses including these variables should not be compromised, however, as measures for all variables are available for study dropouts.

Measures used in current analyses were collected semiannually over a 2-year period (five rounds of measurement); for boys, there was an additional assessment approximately 12 months after the fifth semiannual interview. Questionnaire data were obtained in the adolescents' homes using self-administered, confidential techniques; a project interviewer was present to ensure the confidentiality of respondents' responses from family members. Interviewers did not have access to questionnaire responses. Adolescents were given monetary incentives for the completion of questionnaires and other project procedures. Table 1 summarizes general respondent characteristics for the Add Health and Biosocial Factors samples at the first round of in-home data collection for each project.

Measures

Intelligence. The Peabody Picture Vocabulary Test–Revised (PPVT–R) (26) was designed to measure hearing vocabulary for Standard American English, and is used here as a measure of intelligence. The Peabody has a median correlation of .62 with the Stanford-Binet, and of .64 with the Wechsler Intelligence Scale for Children (full scale) across studies (26), indicating a high general intelligence, or *g*, loading. The instrument is well-suited for use in field surveys. Administration time is relatively short, and does not require the test giver to have specialized training in cognitive assessment. Furthermore, performance on the test is not dependent on the reading ability of the test taker. In the Biosocial Factors projects, the full PPVT–R was administered by registered nurses who had completed training and practice on test administration. Standardized scores based on age norms supplied in the PPVT manual are used in present analyses.

In Add Health a computerized, abridged version of the Peabody [Add Health Picture Vocabulary Test (AHPVT)] was used. For the AHPVT, half of the items included in the original PPVT were used (every other item in the original sequence was selected for use), and basal and ceiling rules were modified to take the smaller number of items into account. In the AHPVT, as in standard PPVT administration, the interviewer reads a word and the respondents selects, from among four simple illustrations, the picture that best illustrates the meaning of the word. Illustrations in the AHPVT were the same as those used in the PPVT. The AHPVT includes 78 items, and raw scores have been standardized by age based on the Add Health sample. The present standardization sample for the AHPVT is larger (19,713) than that used for the PPVT (4200). Both the AHPVT and the PPVT use an intelligence quotient (IQ) metric, with standardized scores having a mean of 100 and a standard deviation of 15.

Biosocial Factors data were used to examine the correspondence between raw PPVT scores generated from standard administration of the entire instrument and raw scores produced by rescoring item responses based on the AHPVT version. Scores from the two administration techniques correlated at .96. Mean PPVT and AHPVT scores for the two samples are listed in Table 1, along with information about sample sizes, race, and mother's education. Although the means and standard deviations for the AHPVT and PPVT in the two samples are relatively similar, it should be noted that the Biosocial Factors samples, unlike the nationally representative Add Health sample, have few respondents with PPVT scores below 80.

Sexual activity. From the Add Health data we rely on a single measure of sexual activity, coital status, measured at Wave I. Respondents were asked, "Have you ever had sexual intercourse? When we say sexual intercourse, we mean when a male inserts his penis into a female's vagina." Answers are coded 0/1 ("no"/"yes"). From the Biosocial Factors data we examine 10 sexual activities: holding hands, kissing, necking (defined as kissing for a long time), feeling breasts over clothes, feeling breasts under clothes or with no clothes on, feeling penis over clothes, feeling penis under clothes or with no clothes on, feeling (girl's) "private parts" over clothes, feeling "private parts" under clothes or with no clothes on, and sexual intercourse. Intercourse was defined as noted above. Each measure is coded 0/1 ("no"/"yes") at each round for purposes of the present analyses, to indicate whether the behavior had been experienced as of the time of each semiannual assessment.

Reports of all sexual activities increased over time in the Biosocial Factors data, and varied by sex/race groups. At study entry, coitus was the least common activity, with 35% of black females, 6% of white females, and 13% of white males reporting coital experience. Holding hands was the most commonly experienced behavior, reported by 97%, 94%, and 90% of the above groups, respectively. Initial reports for other noncoital activities ranged from about 85% (kissing) to 20% (touching penis under clothes). Coital reports among Add Health respondents also varied by sex and race groups, with older respondents within all groups reporting more experience. These reports ranged from about 2% (non-black 12-year-old females) to 82% (black 18-year-old males). Coital experience reports across the Add Health and Biosocial samples were roughly comparable for adolescents of the same age, sex, and race. For example, compared with Biosocial Factors coital figures noted above, comparable figures for Add Health were 29% (black females), 13% (non-black females), and 8% (non-black males).

In addition to age and race, we include measures of mother's education and physical maturity in the analysis of the relationship between AHPVT scores and coital status.

Physical maturity. For the present analyses, a general self-rating of physical maturity is used for the Add Health data. Respondents rated their physical

maturity on a five-point scale ranging from "I look younger than most" (1) to "I look older than most" (5) in response to the question, "How advanced is your physical development compared to other boys (girls) your age?"

For the Biosocial Factors projects, factor scores based on respondents' self-ratings at the semiannual interviews are used. For females, items included in the factor score were Tanner stage ratings (27) of breast and pubic hair development based on line drawings (28), ratings of changes in breast size, amount of leg and axillary hair, and ratings of changes in hip width and body "curviness." For males, items included in the factor score were Tanner stage ratings of genital growth and pubic hair development based on line drawings, ratings of changes in penis growth, location and density of facial hair growth, leg hair, axillary hair, and voice deepening. A validity study of these male and female self-assessment items comparing self-assessment factor scores with pediatrician ratings yielded correlations of .72 and .82, respectively (28–30). Within each gender, ratings from all rounds of data collection were submitted to a factor analysis; scoring weights derived from these analyses were then applied to reports at each semiannual assessment. An adolescent's factor score at any given round thus represents his or her standing relative to all adolescents of the same sex over the full study period. Halpern (23,24) gives more details.

Mother's education. The completed education of the respondent's resident mother or resident mother figure as reported by the respondent is used as a proxy measure for socioeconomic status. The variable is coded in intervals of eighth grade or less (8); more than eighth grade but not high school graduate (10); attended business, trade, or vocational school instead of high school (11); high school graduate (12); completed graduate equivalency diploma (12); attended business, trade, or vocational school after high school (13); attended college but degree not completed (13); college graduate (16); and professional training beyond 4-year college or university (18). The proportions of respondent groups whose mothers completed college or beyond are listed in Table 1.

Statistical Methods

Logistic regression models were used to examine the relationship between AHPVT scores and coital status at Wave I in the Add Health data. Linear and squared AHPVT terms were tested; for initial models, age, race, mother's education, and physical maturity are included as controls. A wide range of control and mediator variables are incorporated in later, expanded models. Descriptions of these variables and their coding schemes are available on request from the first author. For the longitudinal Biosocial Factors data, the timing of initiation of noncoital and coital sexual activities as a function of PPVT scores was examined using proportional hazard models (31); linear and squared PPVT terms were tested. The discrete method was used to accommodate ties in event times (Proc PHREG, SAS). In addition to standardized PPVT–R scores, respondents' age at study entry, physical maturity, and race (for females) were included as predictors; maturity measures are time dependent.

Results

Add Health—Coital Status

First, we report the basic relationship between AHPVT scores and coital status at Wave I in the Add Health data. Because patterns of adolescent sexual activity vary by gender, age, and race, we tested whether the relationship between AHPVT scores and coital status was moderated by these factors. There were statistically significant interactions between the linear and squared AHPVT terms and biological sex, and between age and AHPVT scores. Interactions with race were not significant. To explore these patterns, we computed separate logistic regression equations for males and females who were younger than 15 years, and age 15 years and older. Controlling for age, physical maturity, mother's education, and race, there was a significant curvilinear relationship between AHPVT scores and coital status for both males and females who were age 15 years and older ($p < .01$). For the younger groups, there was a significant ($p < .05$) linear relationship between AHPVT scores and coital status for both males and females.

To illustrate these relationships, the relative odds of ever having had sexual intercourse are plotted in Figures 1 and 2 for AHPVT scores ranging from approximately two standard deviations above and below the mean of 100. Odds are plotted separately for males and females within each age group; an AHPVT score of 100 is the reference, with an odds ratio of 1. Several aspects of these plots are notable. First, controlling for age, physical maturity, mother's education, and race, teens with higher AHPVT scores were significantly less likely to have had sexual intercourse. An adolescent with an AHPVT score of 100 is 1.5–5 times as likely to have had sexual intercourse compared with teens with scores of 120

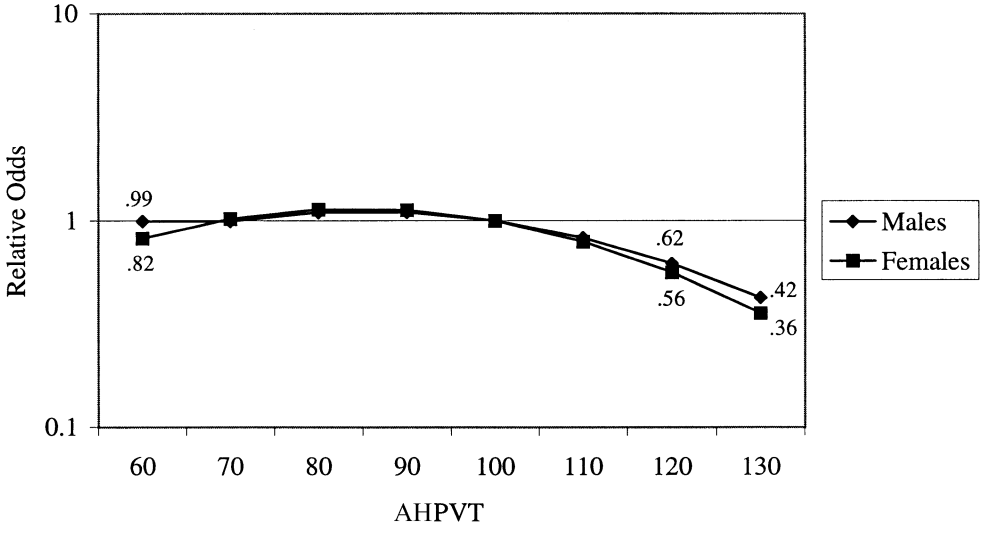

Figure 1. *Odds of ever had intercourse: Add Health respondents age 15*

or 130, depending on which age and gender group is considered. Second, the relationship between AHPVT scores and coital status was stronger among females than males, and stronger among older than younger teens. Furthermore, among older teens, the AHPVT relationship was significantly curvilinear. That is, not only were adolescents with high AHPVT scores less likely to have had sex, but adolescents with extremely low scores were also less likely to have had coitus, particularly females.

Biosocial Factors—Coital and Noncoital Activity

We next looked at data from the Biosocial Factors project to determine whether the sexual behavior–intelligence relationship was limited to coitus, or whether postponement was evident for other types of activity as well. Table 2 summarizes the results of hazard models conducted on coital and noncoital measures. As with the Add Health data, males and females were analyzed separately, and age at study entry and physical maturity were included as controls. Models of female reports also included race. Squared PPVT terms were tested, found to be nonsignificant for all behaviors, and dropped from the models. For females, PPVT scores were significant inverse predictors of the transitions to sexual intercourse, touching genitalia, touching breasts over clothes, necking, and hand holding. Relationships for kissing, touching breasts under clothes, and touching

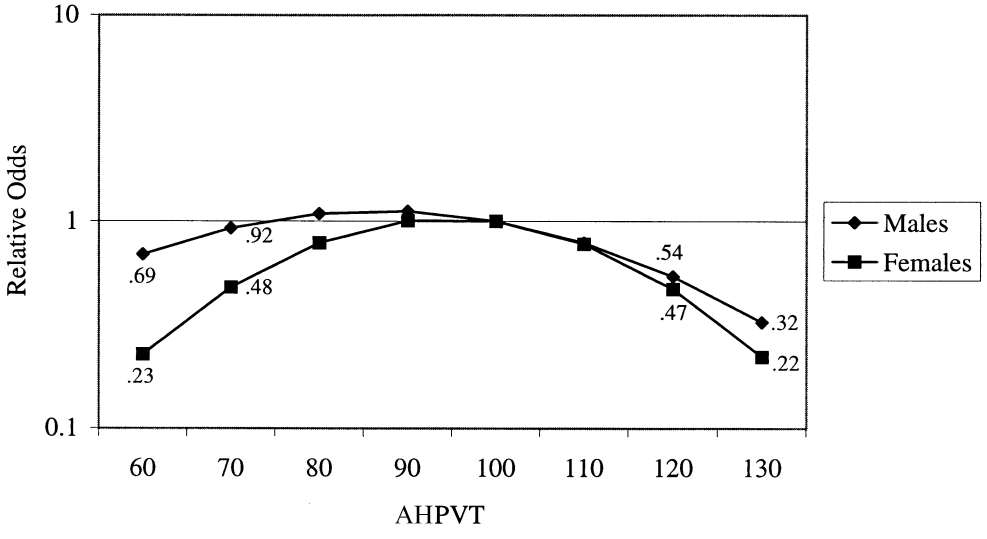

Figure 2. *Odds of ever had intercourse: Add Health respondents age 15 and older*

Table 2. Biosocial Factors—Hazard Ratios (and 95% Confidence Limits) From Proportional Hazard Models of Sexual Transitions

Predictors	Hand Holding	Kissing	Necking	Breasts Over	Breasts Under	Privates Over	Privates Under	Penis Over	Penis Under	Coitus
Black and White females										
Age	1.001	1.035	1.087	1.203	1.497	1.417	1.650	1.457	1.809	1.989
	(0.32, 3.10)	(0.53, 2.00)	(0.65, 1.81)	(0.76, 1.89)	(0.99, 2.24)	(0.92, 2.16)	(1.08, 2.51)	(0.92, 2.28)	(1.16, 2.80)	(1.24, 3.17)
Physical	1.274	1.683	1.458	1.738	1.430	1.348	1.185	1.342	1.126	1.155
Maturity	(0.59, 2.72)	(1.16, 2.43)	(1.09, 1.93)	(1.33, 2.26)	(1.13, 1.80)	(1.06, 1.70)	(0.93, 1.49)	(1.04, 1.72)	(0.88, 1.43)	(0.90, 1.47)
Race	1.026	1.017	1.236	0.754	1.047	1.029	0.955	0.925	1.026	0.538
	(0.24, 4.26)	(0.48, 2.12)	(0.71, 2.12)	(0.46, 1.22)	(0.66, 1.63)	1.029	0.955	0.925	1.026	0.538
PPVT	0.966	0.984	0.984	0.980	0.989	0.980	0.989	0.975	0.983	0.983
	(0.93, 0.99)	(0.96, 1.00)	(0.97, 0.99)	(0.96, 0.99)	(0.97, 1.00)	(0.96, 0.99)	(0.97, 1.00)	(0.96, 0.98)	(0.97, 0.99)	(0.96, 0.99)
White males										
Age	0.074	1.233	0.421	0.354	0.442	0.415	0.582	0.415	0.480	0.508
	(0.01, 0.38)	(0.26, 5.72)	(0.18, 0.96)	(0.15, 0.83)	(0.21, 0.89)	(0.20, 0.85)	(0.28, 1.20)	(0.20, 0.86)	(0.22, 1.01)	(0.21, 1.19)
Physical	2.802	3.188	2.373	3.715	2.379	2.535	2.523	3.220	3.517	3.987
Maturity	(1.27, 6.17)	(1.68, 6.03)	(1.55, 3.62)	(2.34, 5.89)	(1.63, 3.46)	(1.73, 3.69)	(1.69, 3.76)	(2.13, 4.89)	(2.23, 5.53)	(2.38, 6.67)
PPVT	0.961	0.972	0.975	0.966	0.979	0.976	0.980	0.970	0.980	0.972
	(0.92, 1.00)	(0.94, 0.99)	(0.95, 0.99)	(0.94, 0.98)	(0.96, 0.99)	(0.96, 0.99)	(0.96, 0.99)	(0.95, 0.98)	(0.96, 0.99)	(0.95, 0.99)

girls' privates under clothes were all in the same direction, but did not reach statistical significance with a two-tailed test at the .05 level. A Race × PPVT interaction term was tested for each behavior and found to be nonsignificant, indicating similar relationships between PPVT scores and sexual activity for Blacks and Whites, as was the case for coital status among Add Health respondents. For white males, PPVT scores were also significantly and inversely associated with coital transition. There were also significant relationships with each of the early sexual behaviors. In each case, higher PPVT scores were associated with a lower likelihood of transition. Using necking as an example, controlling for age and physical maturity, for each one point increase in PPVT scores, the hazard of necking went down 2.5% for males and 1.6% for females. The hazard of coitus decreased 2.7% and 1.7% for males and females, respectively.

Mediators of Relationship Between Intelligence and Sexual Activity

In both the Add Health and Biosocial Factors samples, higher intelligence was associated with postponement of coital activity. The Add Health data, which reflected a wider range of chronological age and AHPVT scores, indicated that the relationship between intelligence and coitus was actually curvilinear among middle and older adolescents. Both lower and higher than average AHPVT scores were associated with a significantly lower probability of having sex. Analyses of the Biosocial Factors data suggested that the implications of individual differences in intelligence were not limited to coitus, but were evident even in such early behaviors as holding hands and kissing.

To explore the paths through which intelligence may operate, we examined a variety of additional control variables and potential mediators. The association between intelligence and postponement of sexual intercourse implies that differences in intelligence are associated with differences in factors relevant to sexual activity, such as motivation, values, situational opportunities, or expectations that future goals are attainable. Some of these factors are not caused by the adolescent's intelligence, but may covary with it (e.g., physical maturity, mother's education); other factors (mediators) may be partly determined by intelligence and may in turn affect sexual behavior (e.g., perceptions about negative consequences of sex, expectations about college attendance). In our analyses, we therefore included factors that covary with both intelligence and sexual activity and eliminated measures that were unrelated to either intelligence or sexual behavior or that were related in a direction which is inconsistent with a mediating process. Variables for which the above criteria were met were then included in an expanded multivariate model of coital status to determine their contribution to the AHPVT–sex relationship. If we are able to identify meaningful controls and mediating mechanisms, the relationship between intelligence and sexual experience should no longer be statistically significant or should be substantially reduced (32).

To follow through with our original theoretical

model, we examined multiple variables that tap attachment to conventional goals or activities, expectations that goals can be reached, concern with the consequences of coital activity, and concern with the implications these consequences may have for future goals. These measures were adolescents' perceptions of how their mother would feel about the adolescent having sex, adolescents' perceptions of the consequences of pregnancy, adolescents' estimated probability of going to college, grade point average, adolescents' estimated probability of living to age 35 years, whether the adolescent participated in school clubs and sports activities, and attendance at religious services. We also explored a variety of measures tapping the adolescents' emotional responses to problem solving (e.g., difficult problems are upsetting, avoiding dealing with problems), whether the adolescent tended to be impulsive or analytical in problem solving, and the degree of autonomy in decision-making that parents accorded their adolescents. In addition, we controlled for other variables beyond physical maturity that may have had implications for sexual opportunity but were not typically considered in analyses of the relationship between academic achievement and sexual experience. These variables were adolescents' grooming, physical attractiveness, personality attractiveness, and whether the adolescent had a romantic relationship in the 18 months prior to the interview. We also included a control for attending special schools for students with cognitive disabilities. Because some of the key variables in this analysis, such as perceptions of the consequences of pregnancy, were asked only of respondents who were age 15 years and older, the expanded models were limited to adolescents who were age 15 years and older at Wave I. Considered separately, each of the measures listed above was significantly associated with AHPVT scores and with coital status (analyses not shown).

Table 3 presents the results of these logistic regression models of coital status. With the adjustments for control and mediator variables, a significant relationship remained between AHPVT scores and coital status. Differences in the size of the AHPVT coefficients with and without the additional variables in the model are illustrated in Figures 3 (males) and 4 (females). At the upper end of the AHPVT distribution, the relative odds of having had sex increased (relative to an adolescent with an AHPVT score of 100) for both males and females when all the additional variables were taken into consideration. This suggests that the variables added to the model represent some of the ways in which intelligence and sexual postponement are linked. However, it should also be noted that having taken these factors into account, there remained a sizable relationship between higher intelligence and the likelihood of coitus. Adjusting for controls and mediators, males with an AHPVT score of 100 were more than 1.5 times more likely to have had sexual intercourse as a male with an AHPVT score of 130; for the parallel comparison among females, the relative odds were >2. At the lower end of the AHPVT distribution, adjustment for the additional variables had no effect on the relative odds. This is particularly striking among females, for whom the effect was much stronger, and suggests that most of the factors we identified in our model had little relevance for adolescents whose AHPVT scores fell in this extremely low range.

Discussion

Based on data from a large, nationally representative sample of adolescents, we found a significant curvilinear relationship between intelligence, as measured by the AHPVT, and coital status. Controlling for age, pubertal development, and mother's education, adolescents who are at the upper and lower ends of the AHPVT distribution (i.e., ± 1 standard deviation or more) are less likely to have had sex. This relationship does not vary by race, but the shape of the relationship does vary by age. Among early adolescents, the relationship is primarily linear and inverse. Among middle and late adolescents, for whom coital activity is more common, the relationship is distinctly curvilinear. The relationship between PPVT scores and coitus is also evident in a smaller, longitudinal sample of adolescents. However, because the age span of this panel sample was younger, and perhaps also because there were relatively few respondents who scored at the low end of the PPVT distribution, only the linear, inverse relationship was apparent.

The panel data also indicate that the implications of individual differences in intelligence for sexual activity are not limited to coital behavior. Even very "early" behaviors, such as holding hands and kissing, are inversely related to PPVT scores, suggesting that higher intelligence is associated with a generalized delay in the onset of all partnered sexual activities. Unfortunately, the present data do not allow a full exploration of the possibility that the relationship between intelligence and these early behaviors is also curvilinear. A longitudinal study that started behavioral monitoring at even younger ages, and which incorporated a sufficient time frame for fol-

Table 3. Regression Coefficients and (Standard Errors) From Logistic Regression Models of Coital Status—Add Health, Wave I, Respondent Age ≥15 Years

Predictors	Males (N = 3791)	Females (N = 4096)
Intercept	−8.379** (1.244)	−18.605** (1.675)
Age	0.366** (0.037)	0.465** (0.038)
Physical maturity	0.167** (0.037)	0.207** (0.038)
Mother's education	−0.056** (0.019)	−0.034 (0.019)
Black	1.104** (0.129)	0.591** (0.119)
Hispanic	−0.037 (0.129)	−0.451** (0.138)
Asian	−0.201 (0.219)	−0.122 (0.224)
AHPVT	0.060** (0.021)	0.178** (0.030)
AHPVT × AHPVT	−0.0003** (0.0001)	−0.001** (0.0002)
Both biological parents in home	−0.204* (0.085)	−0.402** (0.085)
Well-groomed[a]	0.005 (0.067)	−0.000 (0.062)
Physically attractive	0.002 (0.066)	0.147* (0.059)
Personality attractive	−0.032 (0.063)	−0.044 (0.061)
Grade point average	−0.269** (0.063)	−0.234** (0.063)
Mother approves respondent having sex	0.169** (0.017)	0.219** (0.017)
Pregnancy would not embarrass family	−0.058 (0.054)	−0.217** (0.049)
Pregnancy would not embarrass respondent	0.210** (0.051)	0.352** (0.047)
Pregnancy would not cause respondent to marry wrong person	0.084* (0.034)	0.055 (0.034)
High probability attend college	−0.139** (0.037)	−0.161** (0.042)
High probability live to age 35	−0.309** (0.049)	−0.059 (0.052)
Completed in-school interview	0.028 (0.088)	−0.189* (0.092)
Participate in school clubs	−0.259* (0.102)	−0.247* (0.109)
Participate in sports	0.178 (0.104)	−0.042 (0.098)
Weekly religious attendance	−0.307** (0.092)	−0.297** (0.089)
High decision-making autonomy	0.060* (0.029)	0.079* (0.031)
Attend special school	−0.999 (0.593)	−1.466* (0.693)
Had romantic relationship in past 18 mo	1.735** (0.099)	2.169** (0.117)
Difficult problems not upsetting	−0.029 (0.043)	−0.069 (0.045)
Problem solving not impulsive	−0.183** (0.038)	−0.145** (0.039)
Does not avoid problems	−0.028 (0.042)	−0.062 (0.042)
Problem solving not analytical	−0.030 (0.017)	0.053** (0.017)
Chi-square	$1497.96_{(30)}$ (p = .0001)	$1886.88_{(30)}$ (p = .0001)

[a] Predictor variable labels are worded to indicate the pole which is coded numerically high.
* $p \leq .05$. ** $p \leq .01$.

low-up, could likely track a shift from a linear to a curvilinear association, as well as a rise and subsequent fall in the predictive power of intelligence, as specific sexual behaviors are initially explored by small segments of a cohort, approach age-normative status, and eventually become universal. The curvilinear relationship between intelligence and coital activity we demonstrated here is similar to nonlinear relationships reported in the literature for delinquency and crime. The peak crime rate occurs in the IQ range from 75 to 90 (7); this is approximately the same range in which the probability of having sex is highest in the Add Health sample (using AHPVT scores standardized to an IQ metric). Although many factors influence adolescents' sexual behavior, just as many factors influence delinquency, it is clear that higher intelligence is a protective factor and lower intelligence, to a point, constitutes a risk factor.

The association between scholastic achievement/educational aspirations and sexual activity has been interpreted as a commitment to conventional goals and an attempt by adolescents to safeguard these goals and their future. However, the idea that brighter adolescents postpone holding hands and kissing because they believe that such activity will start them down the path to coitus (and toward the negative consequences that coitus may entail) implies an extremely far-sighted concern with a "slippery slope" that is hard to take seriously. The behavioral postponement that is evident for most facets of partnered sexual activity examined here suggests that another process may underlie the relationship between intelligence and sexual activity, and/or that intelligence is associated with multiple factors and processes which combine to delay all aspects of sexual expression for some period of time.

We explored multiple mechanisms through which intelligence and adolescent sexual activity may be

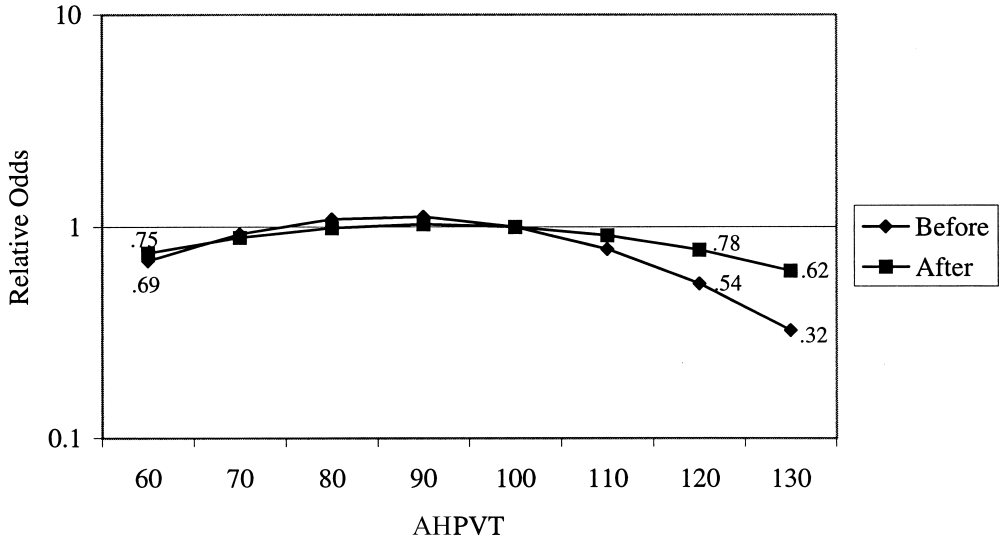

Figure 3. *Odds of intercourse before and after inclusion of control and mediating variables: Add Health male respondents age 15 and older*

linked, with a particular emphasis on indicators of the adolescent's attachment to conventional institutions, values, and goals, as these dimensions are prominent in the literature on problem behaviors. We also controlled for differences related to sexual opportunities, such as pubertal development, physical attractiveness, and having been in a romantic relationship. More intelligent adolescents do evidence a stronger attachment to conventional values and institutions, and higher expectations about goal attainment. For example, they make better grades in school, they have higher expectations about attending college, they believe their parents are more disapproving of sexual activity, they report higher religious attendance, and they are more likely to be involved in structured activities such as school clubs. Each of these factors is also associated with sexual postponement and appears to play a role in the protective effect of intelligence. Although our analyses support the roles of conventionality and opportunity in this process, our results also indicate that other as yet unidentified factors are important. Previous analyses on measures of sexual interest, sexual motivation (e.g., masturbation), and conservatism of sexual attitudes from the Biosocial Factors data (33) indicate that higher intelligence is not associated with lesser sexual interest, just with a postponement of acting on that interest. As demonstrated here, this

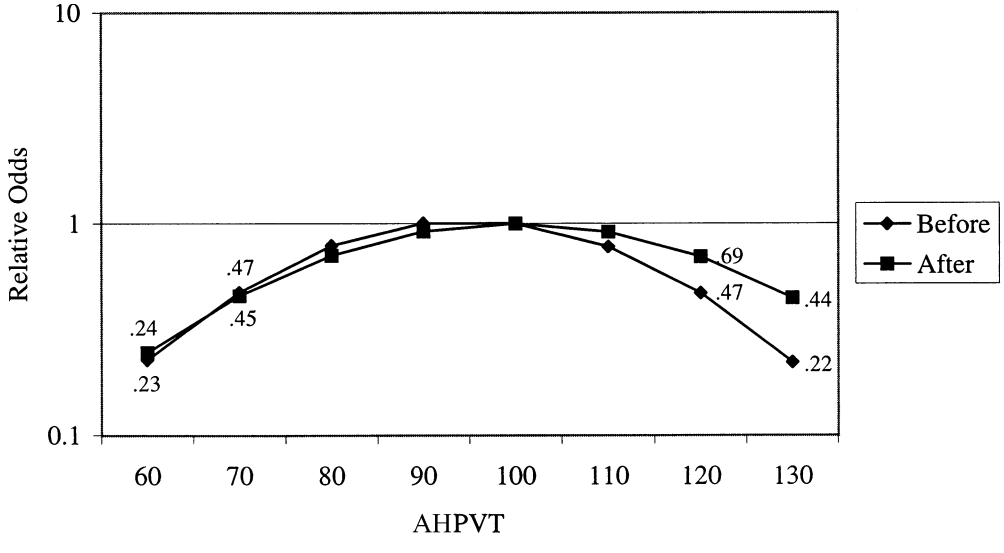

Figure 4. *Odds of intercourse before and after inclusion of control and mediating variables: Add Health female respondents age 15 and older*

postponement is not limited to sexual activities that are socially proscribed, that entail significant social or physical risk, or that are immediate precursors to more "risky" behaviors. Rather, more intelligent adolescents appear to postpone all types of partnered activity, even kissing.

It is also clear that the mediating factors we examined are more relevant to adolescents who fall in the upper half of the AHPVT distribution. The inclusion of multiple control and mediator variables yielded no change in the relative odds of having sex among adolescents who score very low on the AHPVT. This suggests that the elements and dynamics of the protection process differ for adolescents who fall at opposite ends of the intelligence distribution. Although one might expect that adolescents with very limited cognitive abilities would be especially vulnerable to manipulation by others, it appears that these adolescents, especially females, may benefit from situational and opportunity constraints, and from the protective efforts of various adult gatekeepers. If external factors are key protective elements for these individuals during adolescence, the possibility exists for increased vulnerability as these individuals enter adulthood and independent living.

The opportunity to use a nationally representative sample of adolescents in our analyses of coital postponement is a strength of this study. However, a large-scale data collection effort is necessarily limited in the types of measures that can be collected and in some design features. For example, it was necessary to use an abbreviated version of an IQ proxy measure, rather than administering a full battery of cognitive assessments. Relatively simple self-reports of physical maturity were used rather than a clinical examination, and it was not possible to match interviewers and respondents by gender and race. The similarity of findings in the national Add Health project and the smaller scale Biosocial Factors projects, combined with earlier work using school grades, suggests that the relationship between intelligence and sexual postponement is robust. However, the data limitations we have noted may have implications for the magnitude of the relationship with sexuality, and for the patterns of contributions of mediators and controls.

There has been relatively little research on thought processes in adolescent decision making. Our findings indicate the importance of individual differences in intelligence for adolescents' sexual behavior and suggest that future research in adolescent sexuality could benefit from a more systematic treatment of cognitive measures. When faced with sexual choices, reasoning ability, probabilistic thinking, and cognitive functions such as envisioning and evaluating alternatives may be of particular relevance (34). The research task is made more complex by the possibility that adolescents may see all sexual options as entailing some kind of risk (e.g., saying "no" may be perceived as risking loss of partner), and relative risk aversion from the perspectives of the adolescent and public health may not coincide (35). There is no firm consensus about the time frame for the development of abstract thinking. The capacity to imagine sequences of events that may result from early sexual activity, and to weigh the pros and cons of such possibilities, will vary across adolescents and will be correlated with differences in general intellectual abilities. It is unknown whether or which adolescents even go through such mental processes when confronted with the reality of a romantic partner and the necessity of making sexual decisions under the pressures of "real time" and physical excitement. Development of measures of decision-making processes, as applied to specific sexual situations, is one avenue that might be pursued to determine factors that are salient when sexual opportunities exist. Qualitative research techniques, such as the use of open-ended, less structured interviews with adolescents of varying ability levels, might also provide insight into the perceptions of relative risks and the processes by which adolescents reach different sexual decisions. Such approaches might be especially useful for explorations of the processes related to kissing and light petting decisions, versus more "advanced" activity for which adolescents' perceptions of risk may be more similar to adult perceptions.

Investigation of how intelligence fits into the formation and progression of romantic relationships is another logical step for future study. Cliquet and Balcaen (11) provided results suggesting that greater intelligence is associated with the length of delay to coitus after a couple meets. However, there is little information about assortative pairing within adolescent couples, and how partner similarity on important characteristics such as intelligence may affect interpersonal processes, the balance of power in a relationship, and behavioral outcomes of the couple. A better understanding of how intelligence affects the interpersonal dynamics of couples, and therefore their sexual behavior, will allow for the design of more effective educational materials and programs that are directed at both males and females.

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