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Evaluating Impacts of Early Adolescent Romance in High School on Academic Outcomes

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This study used the propensity score method to investigate the effects of early adolescent romance in the 9th grade on academic performance, as measured by high school graduation and college enrollment. The study sample included 2,895 9th graders from the National Longitudinal Study of Youth, 1997. Findings from the study uncovered mixed effects of early adolescent romance on student performance. While frequent dating behaviors and early sexual experiences showed significant negative impacts on both academic outcomes, moderate dating activities had an estimated positive impact. Implications from this study may help inform educators and families in developing appropriate policies and educational conversations to guide youth toward a moderate, timely manner of dating

Keywords: *Adolescent romance, high schools, graduation rate, college enrollment*

1. Introduction

A romantic relationship is an important element in an adolescent life. Youth spend much of their time thinking, talking, and engaging in romantic relationships. Strong positive or negative emotions in youth are more commonly caused by romantic relationships as opposed to other kinds of relationships (such as with friends, parents, or school staff) (Furman & Shaffer, 2003). It is often believed that romantic relationships may negatively affect youth's academic outcomes because the time spent with a romantic partner might distract one from schoolwork. This intuition is supported by many empirical studies in the literature.

Early studies, e.g., Grinder (1966), Larson et al. (1976), and Simmons et al. (1979), found that romantic relationships during high school were linked with lower GPAs or standardized test scores. Some more recent research also reports similar findings. Both Neemann et al. (1995) and Halpern et al. (2000) reported negative associations between

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academic achievement and romantic relationship in early adolescence. Quatman et al. (2001) found that students who date frequently (more than twice per month) exhibited lower academic achievement and motivation. Rector, Johnson, Noyes & Martin (2003), found that early sexual activity initiated among young girls was related to negative health outcomes (such as an increased rate of getting an STD, increased likelihood of having an abortion, increased rates of depression, and decreased happiness), which are likely to foster negative academic outcomes.

However, the existing literature does not conclusively address the causal effect of romantic relationships on academic outcomes. Many existing empirical studies, including more recent ones, were limited in the analyses conducted. For example, Rector et al. (2003) provides a descriptive analysis in which no covariates were controlled for. The potential sample selection bias is not well addressed either. Namely, students who choose to date frequently may be predisposed to poor academic outcomes, and romantic relationships and poor academic outcomes may be consequences of other unobserved factors that these students have in common. Similar concerns were raised by Halpern et al. (2000), who found that those who were less academically motivated were more likely to initiate sexual activities early, and those who score higher on intelligence measures were much less likely to be involved in sexual activities during high school. Halpern et al. (2000) suggested a possible reason that highly intelligent students tend to actively postpone romantic activities as a demonstration of their desire to safeguard their future educational plans and avoid risks associated with sexual intercourse (e.g., pregnancy and STDs).

To address these problems in the empirical findings, this research investigates the causal effects of early adolescent romance on student performance. Researchers used two indicators of academic performance in high school: (1) graduation and (2) college enrollment. We focused on early dating and sexual behaviors among 9th graders. As the youngest cohort in high school, they are the target population for potential policy interventions. Additionally, as the literature on teenage romance and its consequences tends to focus more on girls than boys (Simmons et al., 1979; Rector, Johnson, Noyes & Martin, 2003), we investigated the effects of early adolescent romance by gender. This paper is organized as follows: following the introduction, section two describes the data used in the study; section three documents the propensity score method; section four summarizes the estimated effects of early adolescent romance; and the final two sections summarize and discuss study findings and implications.

2. Data and Variables

The dataset used in this study came from the National Longitudinal Study of Youth 1997 (NLSY97). The NLSY97 is a longitudinal study which followed a nationally representative sample of approximately 9,000 youth who were 12 to 16 years old as of December 31, 1996. Those youth were interviewed annually through 2005. The survey provides extensive information on students' demographic characteristics and educational experiences over time, as well as students' dating and sexual experiences. The data also include some information about parents, such as socioeconomic background. The 2,895 individuals who attended 9th grade in the survey and whose academic outcomes (i.e., graduation from high school and college enrollment) could be observed by the end of the last wave of surveying in 2005 were analyzed in this study.

For this study, we constructed two outcome variables: (1) an indicator of whether the individual graduated from high school by the age of 20 and (2) an indicator of whether the student enrolled in college as of 2005 (the last time of survey data collection). We further

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constructed three treatment variables based on the data. The first treatment variable was created based on a combination of the dating frequency and sexual activity of the 9th graders. These behaviors were used to group students into 3 categories: 1) *non-daters:* students who did not date in 9th grade, regardless of their sexual history; 2) *moderate daters:* students who dated less often than once per week and never had sex; and 3) *serious daters:* students who dated less often than once per week but had had sex by 9th grade, or students who dated once per week or more, regardless of their sexual history. This variable is described in Figure 1.

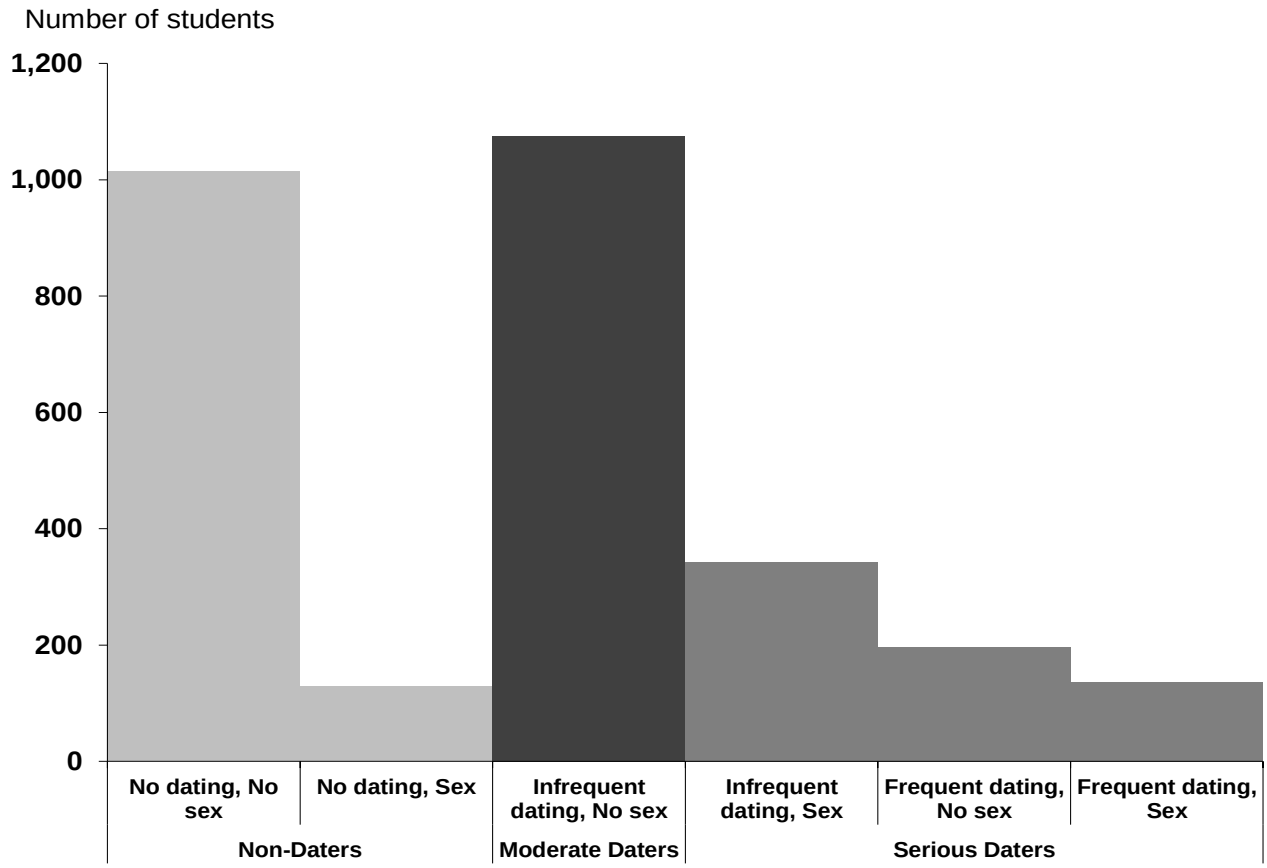

Figure 1: Multiple-dose treatment variable groupings (2 reasons)

The second treatment variable was a binary variable indicating whether the student dated or did not date in 9th grade. The intention of this variable was to separate the "pure" effects of dating from the effects of sexual activity. Similarly, the third treatment variable was another binary variable indicating whether the student had sex or did not have sex in 9th grade. Again, the purpose of this variable was to distinguish the effects of sexual activity from dating. Because the population of students who had sex before 9th grade was small and the characteristics of these students were more similar to those who had sex in 9th grade than those who never had sex, we grouped them with the 9th graders who had had sex. The analysis with this treatment variable was intended to separate the effects of sexual activity from the effects of dating.

Covariates controlled for in the analyses included gender; race/ethnicity (dummied out); age at the start of 9th grade; mother's education in years; student AFQT score percentile[i]; a continuous variable ranging from 1 to 8 indicating 8th grade course

performance (mostly below Ds, mostly Ds, about half Cs and half Ds, mostly Cs, about half Cs and half Bs, mostly Bs, about half Bs and half As, and mostly As); an indicator of both parents living together; family income in deciles; school type (public or non-public); an indicator of gang-related activities in the neighborhood or school; and student urbanicity. By creating a binary dating treatment variable, we also controlled for sexual activity; the analysis using the binary treatment variable for sexual activity also controlled for dating behavior. These variables were selected based on a review of the literature and the potential correlation between these variables and both the treatment and outcome variables. Detailed descriptions of these variables are presented in Appendix 1.

3. Methods

In this study, we utilized the propensity score stratification method (Rosenbaum and Rubin, 1983) to estimate the causal effect of the treatment (dating and sexual activities). This method constructs a counter-factual set of observations such that the causal effect can be estimated in an unbiased manner.

The propensity score method was extended to accommodate the multiple treatment doses (e.g., no dating, moderate dating, and serious dating) (Lu, Zanutto, Hornik & Rosenbaum, 2001; Zanutto, Lu & Hornik, 2005). For the multiple treatment doses, the linear predictions from an ordinal logistic regression were used as the propensity scores, i.e., a measure of the likelihood of a subject being treated.

Following the standard procedure of stratification from Lu et al. (2001) and Zanuto, Lu, & Hornik (2005), the estimated propensity scores were separated into five strata and observations with extreme propensity scores were removed. This process is analogous to dividing observations into five groups and randomly assigning the treatment to individuals within each group. Table 1 describes the distribution of observations across strata by treatment level.

Table 1: Number of observations in each stratum by treatment level

		Stratum				
Treatment Level	Group	1	2	3	4	5
	Non-daters	104	374	485	138	15
Dose Treatment	Moderate	31	210	573	229	20
	Serious	7	64	287	229	60
Dating Only	Non-daters	78	398	470	154	21
	Daters	20	214	716	566	185
Sex Only	No Sex	239	526	876	486	36
	Sex	20	9	97	337	127

To check whether post-stratification balance was achieved, for each covariate, researchers ran a two-way ANOVA model, where the covariate was the dependent variable, and treatment and stratum indicators were the two factors (treatment was the "main" effect and the interaction between the treatment and stratum indicators was the "interaction effect"). Balance is achieved in a covariate if the main effect of the treatment and the interaction of the strata indicator and treatment are not statistically significant for that covariate. The assessment of pre- and post-stratification balance is presented in Appendix 2. The treatment effect was first estimated within each stratum. The average treatment effect is the weighted average of the effects of all strata. The overall standard deviations are equal to the standard

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deviations of the weighted averages. The formulae below represent the average treatment effect (M_i) and the overall standard deviations (SD_i).

$$M_i = \sum_{k=1}^{5} \left(\frac{N_k}{N} * M_{k_i}\right)$$

$$SD_i = \sqrt{\sum_{k=1}^{5} \left(\frac{N_k}{N} * sd_{k_i}\right)^2}$$

M_i is the overall mean of treatment level i $(i = 1,2,3)$. M_{k_i} is the mean of treatment level i in stratum k. N is the total sample size. N_k is the sample size of stratum k. SD_i is the overall standard deviation of treatment level i; sd_{k_i} is the standard deviation of treatment level i in stratum k. After calculating the mean of each treatment level, we calculated the treatment effects within each stratum and tested for statistical significance using a two-sample Z test. In estimating the treatment effect, we also adjusted for the survey weight of the NLSY using the post-stratification weight. The post-stratification weight (as adapted from Zanutto, Lu & Hornik (2005)) is calculated using the formula:

$$W_{kij}^{new} = W_{kij}\left(\frac{\sum_i \sum_j W_{kij}}{\sum_j W_{kij}}\right)$$

where W_{kij}^{new} is the post-stratification weight, and W_{kij} is the survey weight of observation *j*, treatment level *i*, and stratum *k*.

4. Results

We will first discuss the impact of adolescent romance based on the multiple treatment doses method. Analyses for both outcomes (high school graduation and college enrollment) showed a common pattern. Serious daters were much less likely to graduate from high school and enroll in college than were non-daters and moderate daters. While non-daters and moderate daters graduated from high school by the age of 20 at fairly high rates (85 and 86 percent respectively), only 73 percent of serious daters graduated from high school (see Table 2). Similarly, only 59 percent of serious daters had enrolled in college by the last wave of survey data collection, compared to 71 percent of moderate daters and 66 percent of non-daters (see Table 3). It is interesting to note that moderate daters performed slightly better than non-daters in both outcomes.

Table 2: Estimated effects of early adolescent romance on high school graduation – using the multiple treatment doses method

					Moderate daters Vs Non-daters	Serious daters Vs Non daters	Serious daters Vs Moderate daters
		N	Mean	SD	Effect size	Effect size	Effect size
Stratum 1	Non-daters	104	0.82	0.39	0.07	-0.08	-0.16
	Moderate	31	0.89	0.31			
	Serious	7	0.73	0.48			
Stratum 2	Non daters	374	0.92	0.28	-0.03	-0.13*	-0.10
	Moderate	210	0.89	0.32			
	Serious	64	0.79	0.41			
Stratum 3	Non-daters	485	0.88	0.33	0.00	-0.12*	-0.12*
	Moderate	573	0.88	0.33			
	Serious	287	0.76	0.43			
Stratum 4	Non-daters	138	0.75	0.44	0.03	-0.10*	-0.14*
	Moderate	229	0.78	0.41			
	Serious	229	0.64	0.48			
Stratum 5	Non-daters	15	0.76	0.44	0.00	-0.36*	-0.36*
	Moderate	20	0.76	0.44			
	Serious	60	0.39	0.49			
Overall	Non-daters	1,116	0.85	0.19	0.01	-0.12*	-0.13*
	Moderate	1,063	0.86	0.19			
	Serious	647	0.73	0.25			
N		2,826					

Table 3: Estimated effects of early adolescent romance on college enrollment – using the multiple treatment doses method

					Moderate daters Vs Non-daters	Serious daters Vs Non daters	Serious daters Vs Moderate daters
		N	Mean	SD	Effect size	Effect size	Effect size
Stratum 1	Non-daters	104	0.72	0.45	0.04	0.02	-0.02
	Moderate	31	0.75	0.44			
	Serious	7	0.73	0.48			
Stratum 2	Non daters	374	0.75	0.44	-0.02	-0.08	-0.06
	Moderate	210	0.72	0.45			
	Serious	64	0.66	0.48			
Stratum 3	Non-daters	485	0.69	0.46	0.08*	-0.10*	-0.18*
	Moderate	573	0.77	0.42			
	Serious	287	0.59	0.49			
Stratum 4	Non-daters	138	0.56	0.50	0.05	-0.05	-0.10*
	Moderate	229	0.61	0.49			
	Serious	229	0.51	0.50			
Stratum 5	Non-daters	15	0.21	0.42	0.16	0.10	-0.06
	Moderate	20	0.37	0.50			
	Serious	60	0.31	0.47			
Overall	Non-daters	1,116	0.66	0.26	0.05*	-0.07*	-0.12*
	Moderate	1,063	0.71	0.25			
	Serious	647	0.59	0.28			
N		2,826					

Note: * Indicates statistical significance at the 0.05 level.

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After controlling for the sexual nature of the relationship, the analyses showed that dating alone only accounted for a small gap in the high school graduation rate (3 percentage points; see Table 4) and no difference in the rate of college enrollment (both groups went to college at a rate of 66 percent; see Table 5).

Table 4: Estimated effects of dating on high school graduation – using the binary dating method

		N	Mean	SD	Effect size
Stratum1	Non-dater	78	0.93	0.25	-0.09
	Dater	20	0.85	0.37	
Stratum2	Non-dater	398	0.88	0.32	-0.08*
	Dater	214	0.80	0.40	
Stratum3	Non-dater	470	0.88	0.32	-0.03
	Dater	716	0.85	0.35	
Stratum4	Non-dater	154	0.83	0.38	-0.04
	Dater	566	0.79	0.41	
Stratum5	Non-dater	21	0.47	0.51	0.12
	Dater	185	0.59	0.49	
Overall	Non-dater	1,121	0.84	0.18	-0.03*
	Dater	1,701	0.81	0.20	
	N	2,822			

Table 5: Estimated effects of dating on college enrollment – using the binary dating method

		N	Mean	SD	Effect size
Stratum1	Non-dater	78	0.70	0.46	-0.15
	Dater	20	0.54	0.51	
Stratum2	Non-dater	395	0.68	0.47	-0.02
	Dater	210	0.66	0.47	
Stratum3	Non-dater	469	0.74	0.44	-0.04
	Dater	707	0.70	0.46	
Stratum4	Non-dater	153	0.60	0.49	0.05
	Dater	556	0.66	0.48	
Stratum5	Non-dater	21	0.30	0.47	0.19
	Dater	184	0.49	0.50	
Overall	Non-dater	1,116	0.66	0.25	0.00
	Dater	1,677	0.66	0.25	
	N	2,793			

However, when assessing the pure impact of early sexual involvement, consistent with early findings in Rector, Johnson, Noyes & Martin (2003), our analyses showed that early sexual activity seriously impacted youth academic outcomes. After controlling for dating frequency, the graduation rate gap between students who chose to have sex after 9th grade and those who had sex before or in 9th grade was still very large (12 percentage points; see Table 6). Similarly, the college enrollment rate gap between the two groups was also significant (5 percentage points; see Table 7).

Table 6: Estimated effects of early sexual activity on high school graduation – using the binary sexual activity method

		N	Mean	SD	Effect size
stratum1	No sex	239	0.97	0.18	0.00
	Sex	20	0.97	0.18	
stratum2	No sex	526	0.95	0.21	0.03
	Sex	9	0.98	0.15	
stratum3	No sex	876	0.85	0.36	-0.19*
	Sex	97	0.66	0.48	
stratum4	No sex	486	0.78	0.42	-0.18*
	Sex	337	0.60	0.49	
stratum5	No sex	36	0.56	0.50	-0.15
	Sex	127	0.41	0.49	
Overall	No sex	2,163	0.84	0.19	-0.12*
	Sex	572	0.72	0.23	
	N	2,753			

Note:* Indicates statistical significance at the 0.05 level

Table 7: Estimated effects of early sexual activity on college enrollment – using the binary sexual activity method

		N	Mean	SD	Effect size
stratum1	No sex	239	0.90	0.30	0.00
	Sex	20	0.90	0.30	
stratum2	No sex	524	0.84	0.37	0.01
	Sex	9	0.85	0.38	
stratum3	No sex	872	0.69	0.46	-0.13*
	Sex	96	0.56	0.50	
stratum4	No sex	478	0.49	0.50	-0.05
	Sex	330	0.44	0.50	
stratum5	No sex	34	0.28	0.46	-0.03
	Sex	123	0.25	0.44	
Overall	No sex	2,147	0.65	0.24	-0.05*
	Sex	560	0.60	0.25	
	N	2,725			

Note:* Indicates statistical significance at the 0.05 level.

The "multiple treatment doses" analysis by gender, described in Figure 2, showed little evidence that early adolescent romance affects females differently than males. The gaps in high school graduation rates between serious daters and non-daters were about equal for males and females (12 percentage points for males and 13 percentage points for females). Similarly, the college enrollment rates across treatment levels by gender shared the same pattern, with the highest rates for moderate daters, followed by non-daters and a significant drop when looking at serious daters. However, serious dating appeared to affect boys slightly more than girls. The gap in college enrollment rates between serious daters and non-daters for boys was 10 percentage points, while this gap was only 6 percentage points for girls (both gaps were statistically significant at the 0.05 level).

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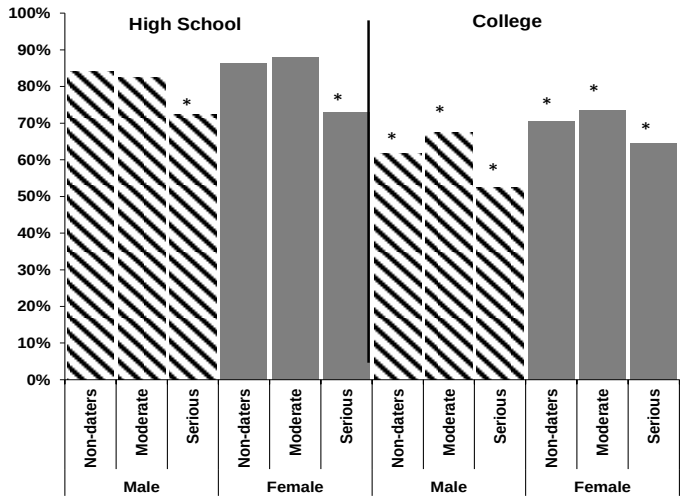

Figure 2: Summary of high school graduation rates and college enrollment rates across levels of treatment by gender – using the multiple treatment doses method

NOTE: * Indicates statistical significance at the 0.05 level compared to the remaining two treatment groups.

Binary treatment analyses (see Figures 3 and 4) revealed no difference in the impact of adolescent romance on adolescent outcomes between males and females. The gaps in the high school graduation rates were about the same and there were no significant differences in college enrollment rates between daters and non-daters for both males and females (see Figure 3). Similarly, the gaps in the high school graduation and college enrollment rates between students who had sex in or before 9th grade and those who had sex after 9th grade were relatively equal (see Figure 4).

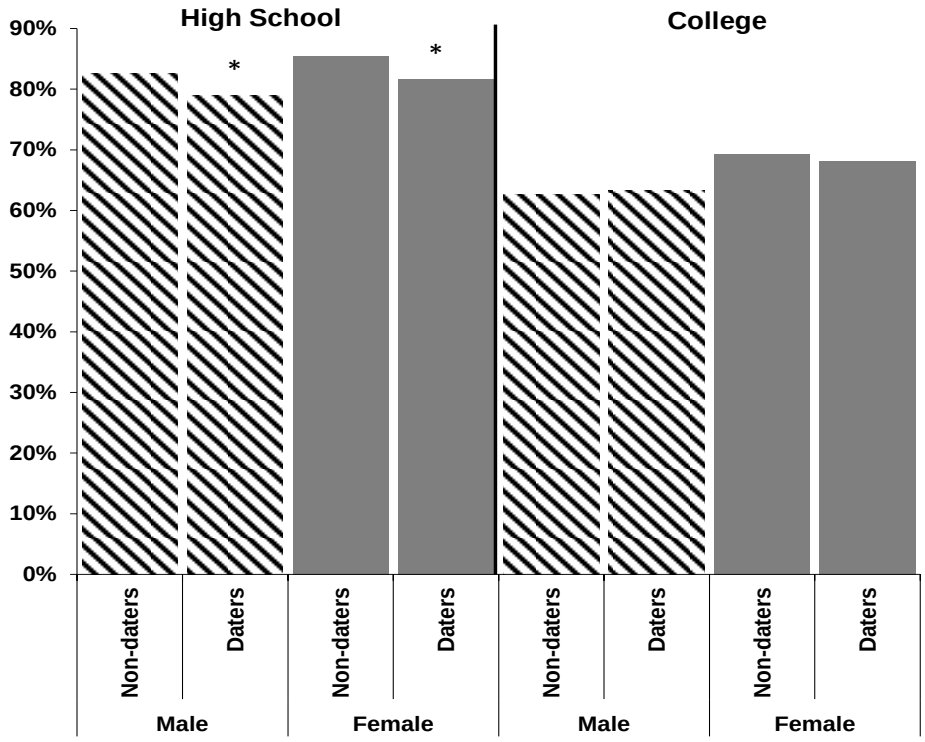

Figure 3: Summary of high school graduation rates and college enrollment rates across levels of treatment by gender - non-daters versus daters – using the binary dating method

NOTE: * Indicates statistical significance at the 0.05 level compared to the remaining treatment group.

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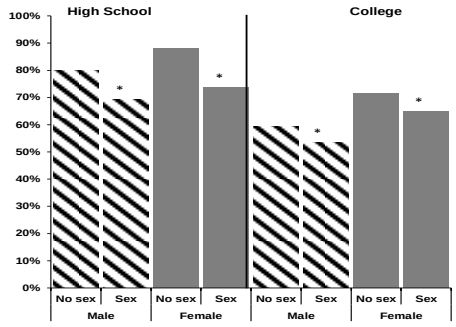

Figure 4: Summary of high school graduation rates and college enrollment rates across levels of treatment by gender - students who had sex in or before 9th grade versus those who did not – using the binary sexual activity method

NOTE: * Indicates statistical significance at the 0.05 level compared to the remaining treatment group.

5. Discussion and Conclusions

While dating overall had very little impact on educational outcomes, dating frequency and the involvement of early sexual activities did appear to matter. Interestingly, moderate dating did not show any impact on high school graduation, but showed a positive impact on college enrollment compared to non-daters. However, serious dating, consisting of early sexual intercourse and a high dating frequency, showed a significant negative impact. These behaviors are linked to a 12 percentage point decrease in the students' high school graduation rate, and a 7 percentage point decrease in the college enrollment rate (see Tables 2 and 3). When separating out the impact of early sexual activity, we also found that it had a negative impact on both high school graduation (12 percentage points) and college enrollment (5 percentage points) (see Tables 6 and 7).

There are a number of possible reasons that high dating frequency and sexual involvement might be harmful. First, these activities may take time away from studying. Second, students who date seriously too early may not be experienced enough to handle such complex relationships, leading to situations that might trigger negative feelings. Although Rector, Johnson, Noyes & Martin (2003) only found early sexual activity to be linked with negative health outcomes such as increased rates of STD, abortion, and depression, and

decreased happiness, we expect that these health outcomes are likely linked with negative academic outcomes.

On the other hand, moderate dating may be beneficial because it does not take away too much time from studying, and the time taken away might be necessary for the students to develop social skills (e.g., interpersonal skills, or skills in coping with relatively complex relationships). It has been shown that dating can facilitate the process through which youth understand who they are and what they value, and provide a training ground for youth to develop interpersonal skills (Sorensen, 2007). These skills might have a positive impact on youth's school work. Further, dating may also provide students with a higher level of self-esteem through earning respect from peers for being "cool" enough to attract a girlfriend or boyfriend, or through social interaction (Furman & Schaffer, 2003; Kopfler, 2009). The feeling of competency in dating and a resulting increase in self-esteem may have a self-perpetuating influence on student performance. In addition, daters may find mental support from their partners when school does not go well for them, or they may learn more effectively when they study together.

Nevertheless, the results of this study should be viewed with caution because the propensity score method, even when the balance on covariates is well achieved, only controls for observable variables. This method can remove imbalances in almost all important observed covariates that we can find in the literature, but there may be imbalances in unobservable covariates (such as personal motivation, school quality, teacher/counselor influence), which could impact the analyses. Moderate dating may be a symptom of other variables, such as positive social support in the home, which may also be linked with higher self-esteem and positive school outcomes. Additionally, the NLSY97 is a self-reported survey, and thus is subject to measurement errors when the individuals do not report truthfully. This dataset also had significant survey attrition. This could be problematic if, for instance, daters who were high school dropouts also tended to drop out of the sample more than non-daters. We were not able to test if this was the case. Furthermore, the mixed findings may be due to the nature of the dating relationships, which we were unable to control for. For example, Berndt & Keefe (1995) and Furman & Shaffer (2003) argue that the effect could be positive or negative depending on the characteristics of the partner and the nature of the relationship, just as in the case of friendship. Those with supportive partners tend to become more involved in school; others with disruptive or abusive partners, or who experienced events such as contracting STDs or pregnancy, tend to become less involved in school. Despite these limitations, this study does shed some light on a much under-researched area and contributes to our understanding of the impact of early adolescent romance. It also helps inform educators and families regarding the development of appropriate policies and action plans to guide youth toward a moderate level and a timelier manner of dating. These implications are discussed further in the section below.

6. Implications

There are a number of possible implications that emerge from this research. The primary targets of this information include school counselors and other school staff as well as parents. This research provides evidence that moderate dating may have a positive effect on student performance in the form college going rates, while high frequency dating and early sexual activity have negative effects. This is important information for school personnel, such as school counselors and social workers, teachers of health and sexual education courses, and other key staff who work with students and their parents. School personnel can communicate these data to students, thereby providing research-based evidence to encourage moderation in

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pursuing romantic relationships. For example, these results could be incorporated into a "healthy relationships" segment in sexual education/health courses in middle and high schools, or a psychology course for high school students. Furthermore, dating may be a mediator for self-esteem and the development of positive relationships and social interactions, which may impact student performance. As such, this study provides further evidence to the development of student "assets" and resiliency, an important discussion for mental health staff at schools.

In addition to school staff, this information could provide useful data for parents when having discussions with their children about dating and early sexual activity. Research shows that youth whose parents have the conversations about sexual education with them are more likely to postpone sexual activity (Blake, et al., 2001). This research provides additional evidence and a new take for parents in educating their children about dating and sex. Results from the study may allow parents to have slightly more relaxed views of dating relationships in high school for their children, encouraging balance over not dating at all. Dating and romantic relationships are often a topic of contention between parents and their children. Increased stress in parent-child relationships may impact students' performance in school. An authoritative parenting style has been shown to be associated with higher levels of student achievement (Baumrind, 1991; Spera, 2005) greater enjoyment of school (Annear & Yates, 2010), and a decreased likelihood of dropping out of school (Blondal and Adalbjarnardottir, 2009). If parents can have a conversation with their children in which they allow their child to date while educating them about the academic risks, in addition to the health and social risks, of pursuing a more serious relationship, they may be able to mitigate some of the strain in the parent-child relationship associated with the topic.

Parent conferences with teachers or school counselors may be one mechanism for disseminating this information to parents. Another avenue for this discussion may be in programs designed for parents of first-generation college applicants. These programs give parents information on how to help their child succeed in school and be college-ready. This may be a setting to have a conversation with parents about the relationship between moderate dating and positive student academic outcomes.

While further research is needed to better understand the relationship between moderate dating, self-esteem, socialization, and student outcomes, this study contributes to the literature on adolescent relationships and provides important information for educators and parents. Results from this research may help guide educators and families toward developing appropriate policies and having informed conversations with adolescents about balance and moderation in dating and how those behaviors are linked to their future success.

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Appendix

Detailed Description of Covariates

"Gender" was a dummy variable indicating whether the student was female or male. Analyses revealed that female students, in general, performed better academically than males (Hirschman, Pharris-Ciurej, & Willhoft, 2006). However, women tend to be more mature than male students for their age, and thus might be more likely to be involved in dating.

"Race/ethnicity" was a categorical variable with three categories: White, African American, and Hispanic. While analyses revealed that race did not have a causal effect on educational achievement, the literature shows that African-American and Hispanic students are less likely to graduate from high school (Hirschman, Pharris-Ciurej, & Willhoft, 2006). At the same time, Wood, Avellar, & Goesling (2008) found that White teens were more likely and African American teens were less likely to date than other teens. However, African Americans were more likely to initiate early sexual activity than White and Hispanic students.

"Age at the start of 9th grade" was a continuous variable measuring the age of each individual at the time of first enrollment in 9th grade. Earlier grade retention (and hence being older than most students in that grade) is an important determinant of school failing (Alexander, Entwistle, & Horsey, 1997; Goldschmidt & Wang, 1999; Grisson & Shepard, 1989; Jimerson, 1999; Kaufman & Bradby, 1992; Roderick, 1994; Roderick, Nagaoka, Bacon, & Easton, 2000). Being "old for the grade" also means the students are more physically mature, and thus may be more likely to date.

"Mother's education" was a continuous variable indicating the number of years of education completed by the student's mother. Mother's level of education is positively correlated with student achievement (Astone & McLanahan, 1991; Rumberger, 1995), and higher educational attainment of the mother may be associated with reduced chances of early romantic relationship because more highly educated parents (who also tend to have higher SES) may be more likely to have discussions about dating and sexual activity with their children, and/or may be able to provide more supervision for their children through day care/after school programs.

Student ability is undoubtedly causally linked with academic achievement, and highly intelligent students tend to be more likely to delay their dating activities to safeguard their educational plan (Halpern et al., 2000). We used two variables as proxies for student ability: students' Arm Force Qualification Test scores ("AFQT"), and students' "8th grade performance." It is expected that both variables provide close approximations of the students' ability levels. However, AFQT scores are derived from a test that was administered only one time in 1999, so some students took the test before their 9th grade year, some took it in 9th grade, and some took it after. Therefore, this proxy might not fully reflect the ability of the student since AFQT scores are expected to be correlated with the highest grade completed. For this reason, we also included 8th grade course performance in the analyses. This was a continuous variable measuring the overall grade the individual received in 8th grade, with eight levels: mostly below Ds, mostly Ds, about half Cs and half Ds, mostly Cs, about half Cs and half Bs, mostly Bs, about half Bs and half As, and mostly As.

"Both parents live together" was a dummy variable indicating whether both biological parents of the student were married and lived together. This is an indicator of an intact

family, as opposed to living with a single parent or a parent and a step parent, etc. Single-parenthood and step families are found to be positively associated with high school dropout (Astone & McLanahan, 1991; Ekstrom et al., 1986; Goldschmidt & Wang, 1999; McNeal, 1999; Rumberger, 1995; Rumberger & Larson, 1998; Swanson & Schneider, 1999; Teachman, Paasch, & Carver,1996). Furthermore, Wood, Avellar, & Goesling (2008) found that teenagers from non-intact families were typically more likely to be involved in romantic relationship and cohabitation.

It is well established in research that family income is an important determinant of school performance (Hirschman, Pharris-Ciurej, & Willhoft, 2006; Neild & Balfanz, 2006). Students from low-income families are more likely to be involved in early adolescent romance (Wood, Avellar, & Goesling, 2008). Family income in deciles was included in the analyses.

"Student urbanicity" was defined as the urban/rural status of the student at the beginning of the study in 1997. Greene (2001) found that students from urban school districts were more likely to drop out of high school. While we are not aware of literature on the likelihood of dating among urban students compared to their rural counterparts, we expect that students living in urban areas may have different tendencies to date due to differences in social interactions.

"Pubic school" was used to indicate whether the student attended a public high school (rather than a private school). This variable was only collected once at the beginning of the survey.

"Neighborhood gang" was an indicator of whether the student reported that there were gang activities in their home neighborhood or at or near their school. This variable was measured multiple times but the definition of gang activities seems to have differed across surveys from year to year. As a result, we decided to use the data from the survey administered in 2000 when most of the students in the sample were surveyed.

Appendix 2

Accessing Pre and Post Stratification Balance

For the analysis with the multiple treatment doses, 68 observations were removed because they fell in propensity score ranges that did not cover all treatment levels. Following the removal of these observations, researchers examined pre and post-stratification imbalances for the covariates among three treatment levels: non-daters, moderate daters, and serious daters. Table 2.1 suggests that before stratification, only the percentage of Hispanic students and mother's years of education were relatively balanced among treatment groups. All other covariates showed statistical significance in the one-way ANOVA tests, implying initial biases, especially for "age at the start of 9th grade," student ability (both AFQT and 8th grade performance), percentages of females, Whites, and African American students, and family income. Stratification removed almost all initial biases due to covariates (as indicated by small post-stratification F values). Only the percentage of African American students still showed statistical significance in the main-effect F statistic. This indicates that the level of balance achieved was as good as that of a randomized experiment, where we would expect about one F statistic significant at the 0.05 level.

Similarly, Table 2.2 shows the balance/imbalance of covariates between daters and non-daters pre- and post-stratification, identifying the effects of dating only. The initial sample

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was imbalanced for 9 out of the 14 covariates. In particular, daters were much more likely to have had sex in 9th grade, tended to be older, had a lower GPA in 8th grade, and had higher family incomes than non-daters. The percentages of females, Whites, and African Americans were also very imbalanced between the two groups. After dropping 73 observations whose propensity scores were not in the ranges that covered all treatment levels, stratification almost completely removed these biases. Out of 28 F statistics, only the interaction effect (of dating and the strata indicator) for the neighborhood gang dummy variable was still significant at the 0.05 level.

Table 2.3 describes the balance/imbalance of covariates between those who had sex in or before 9th grade and those who did not, pre- and post-stratification. Fifteen out of 16 pre-stratification F statistics were significant, indicating that the characteristics of the "sex" and "no sex" groups were very different. After dropping 142 observations whose propensity scores were not in ranges that covered all treatment levels, stratification removed all initial imbalances due to covariates between the two groups (31 out of 32 post-stratification F statistics were insignificant).

Tables

Table 2.1: Assessing balance on covariates: multiple treatment doses method

	Pre Adjustment							Post Adjustment	
	Non-daters		Moderate		Serious		1 Way Anova	2 Way Anova	N=2827
	(N= 1,143)		(N=1,076)		N=676		N= 2,895	F values	
	Mean	Sd	Mean	Sd	Mean	Sd	F values	Main	Interaction
Female	0.58	0.49	0.48	0.50	0.42	0.49	23.62 *	0.56	0.91
White	0.45	0.50	0.59	0.49	0.46	0.50	25.61*	1.9	1.53
African American	0.32	0.47	0.21	0.41	0.33	0.47	20.90 *	3.85*	1.52
Hispanic	0.23	0.42	0.20	0.40	0.21	0.41	1.74	0.34	0.62
Mother education (years)	12.38	3.01	12.81	2.76	12.30	2.63	9.15*	0.12	1.26
AFQT percentile	45.51	28.00	49.82	26.30	39.48	24.94	31.25 *	1.01	1.64
8th grade performance	5.76	1.69	5.75	1.68	5.08	1.77	40.41*	1.97	1.9
Both parents live together	0.53	0.50	0.54	0.50	0.40	0.49	20.12 *	1.72	0.47
Family income deciles	5.14	2.31	5.62	2.37	4.96	2.4	19.84*	1.07	1.24
Age at start of 9th grade	14.25	0.80	14.34	0.77	14.60	0.83	42.65 *	1.68	1.24
Public school	0.91	0.28	0.91	0.29	0.93	0.25	1.65	0.29	1.04
Neighborhood gang	0.23	0.42	0.24	0.43	0.26	0.44	1.05	1.66	1.18
Urban	0.73	0.44	0.76	0.43	0.78	0.42	2.18 *	1.38	1.64

NOTE: * Indicates statistical significance at the 0.05 level.

Table 2.2: Assessing balance on covariates: binary dating method

					Pre Adjustment	Post Adjustment	
	Non-dater		Dater		1 way Anova	2 Way Anova	N= 2,822
	(N= 1,143)		(N= 1752)		N= 2,895	F Values	
	Mean	Sd	Mean	Sd	F values	Main	Interaction
Had sex in 9th grade	0.38	0.49	0.46	0.50	111.52*	0.01	0.19
Female	0.58	0.49	0.46	0.50	41.11*	0.14	0.50
White	0.45	0.50	0.54	0.50	21.48*	2.58	1.09
African American	0.32	0.47	0.26	0.44	12.73*	2.15	1.20
Hispanic	0.23	0.42	0.20	0.40	2.97	0.10	0.40
Mother education (years)	12.38	3.01	12.62	2.72	4.86*	0.04	0.53
AFQT percentile	45.51	28.00	45.83	26.26	0.10	0.47	0.71
8th grade GPA	5.76	1.69	5.49	1.75	16.55*	1.04	1.10
Both parents live together	0.53	0.50	0.49	0.50	4.64*	0.67	0.64
Family income deciles	5.14	2.31	5.37	2.40	6.66*	0.02	0.55
Age at start of 9th grade	14.25	0.80	14.44	0.80	40.65*	1.07	1.31
Public school	0.91	0.28	0.92	0.27	0.28	0.92	0.94
Neighborhood gang	0.23	0.42	0.25	0.43	1.23	1.74	3.6*
Urban	0.73	0.44	0.76	0.43	3.73	0.03	1.25

Note: * Indicates statistical significance at the 0.05 level.

Table 2.3: Assessing balance on covariates: binary sexual activity method

					Pre Adjustment	Post Adjustment	
	No sex		Sex		1 way Anova	2 Way Anova	N= 2,753
	(N= 2,287)		(N=608)		N= 2,895	F Values	
	Mean	Sd	Mean	Sd	F values	Main	Interaction
No dating in 9th grade	0.44	0.50	0.21	0.41	114.61*	0.11	0.42
Infrequent dating	0.47	0.50	0.57	0.50	17.75*	0.00	0.76
Frequent dating	0.09	0.28	0.22	0.42	92.94*	0.18	1.49
Female	0.52	0.50	0.42	0.49	19.3*	0.12	0.83
White	0.55	0.50	0.33	0.47	100.09*	0.28	1.23
African American	0.23	0.42	0.47	0.50	136.76*	0.02	1.49
Hispanic	0.22	0.41	0.21	0.41	0.28	0.57	2.19
Mother education (years)	12.68	2.93	11.95	2.38	31.83*	0.24	0.96
AFQT percentile	49.09	26.93	32.98	22.96	182.41*	0.54	1.83
8th grade GPA	5.83	1.67	4.74	1.66	203.47*	1.30	2.54*
Both parents live together	0.55	0.50	0.31	0.46	114.74*	0.14	0.36
Family income decile	5.51	2.35	4.39	2.23	111.48*	0.64	0.37
Age at start of 9th grade	14.27	0.77	14.75	0.83	181.65*	0.49	2.01
Public school	0.91	0.29	0.94	0.23	7.54*	0.64	1.20
Neighborhood gang	0.23	0.42	0.27	0.45	5.6*	0.95	1.94
Urban	0.74	0.44	0.78	0.41	3.86*	0.00	1.83

Note:* Indicates statistical significance at the 0.05 level.

The Armed Force Qualification Test (AFQT) is a composite of four core tests that measure knowledge in a group of typical high school level academic disciplines. AFQT in this study was used as a proxy of student ability.

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