

Discount rates and risky sexual behaviors among teenagers and young adults

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Abstract This article examines the relationship between personal discount rates and sexual behaviors in a sample of teenagers and young adults. We find that higher discount rates (an indication of less willingness to forego current consumption for future consumption) are significantly associated with a range of sexual behaviors, including ever having sex, having sex before age 16 years, and past or current pregnancy. These associations are consistent with previous studies showing a link between discounting and other, non-sexual health behaviors.

Keywords Discounting · Health · Sexually transmitted diseases · Risky sex · Young people

JEL Classification D80 · D90 · I10

Teenagers and young adults in the United States are at high risk of acquiring sexually transmitted diseases (STDs), including human immunodeficiency virus (HIV). A recent study suggests that 15–24-year-olds accounted for more than nine million new cases of STDs in

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2000, about half of all cases (Weinstock et al., 2004). The discounted, lifetime medical cost associated with these nine million new cases is estimated at \$6.5 billion (Chesson et al., 2004). In addition to the direct medical costs, STDs in young people impose indirect and intangible costs, such as lost wages due to STD-related illness and the costs of STD-related pain and suffering.

The costs of infection (including indirect and intangible costs) can be lifelong, particularly infection with incurable viral STDs such as HIV or herpes simplex virus type 2 (HSV-2). Because the costs of STDs can extend well into the future, an individual's perception of the cost of acquiring an STD might be influenced by that individual's discount rate.¹ For example, because HIV has a long latency period, infection with HIV might be perceived as less costly to teenagers and young adults with higher discount rates than those with lower discount rates, all else equal. If so, a person's rate of time preference may influence his or her decision of whether or not to engage in risky sexual behaviors.

To our knowledge, no previous study has examined the relationship between time preference and sexual health, although economists and other social scientists provide evidence that time preference is related to health investment and health status (Fuchs, 1982; Evans and Montgomery, 1994). Several studies suggest a link between higher discount rates and risky health behaviors, such as smoking (Viscusi, 1991; Munasinghe and Sicherman, 2000; Viscusi and Hersch, 2001), reduced willingness to receive a flu vaccine (Chapman and Coups, 1999), reduced participation in cancer screening (Picone et al., 2004), heroin and cocaine abuse (Kirby and Petry, 2004), and being obese (Komlos et al., 2004). However, these associations are often weak, and studies of the role of time preference in health-related decision making have yielded mixed results (Fuchs, 1982; Chapman, 2002, 2005). The purpose of this paper is to examine whether or not annual discount rates for monetary gains are related to sexual behaviors and sexual health among teenagers and young adults. We find that higher discount rates are associated with sexual behaviors and sexual health outcomes, such as ever having sex, earlier age of sexual debut, and pregnancy.

The remainder of this paper is structured as follows: Section 1 presents a simple model of sexual behavioral decision making over time and discusses why personal discount rates may or may not be correlated with sexual behaviors. Section 2 describes the data and the methods used to assess individual discount rates. Section 3 presents results, including estimates of individual discount rates, associations between discount rates and sexual behaviors and health, and additional analyses to examine the validity of the discount rate measurement. Concluding remarks are presented in Section 4.

1. A simple model of sexual behavioral decision making

Simple models can illustrate why discount rates might or might not be expected to influence sexual behavioral decision making. Suppose that a person's utility in a given period t is a function of sexual activity level (S) in period t and the costs (C) of sexual activity in period t and in previous periods. This utility function can be written $u_t(S_t, C(\sum_1^t S_i))$ and is decreasing in C , such that the benefits of sexual activity in a given period can be offset (either partially or completely) by the short- and long-term consequences of past and current sexual activity, such as disease acquisition, unwanted pregnancy, and psychological distress

¹ Higher discount rates indicate less willingness to exchange current consumption for future consumption. In this study, for example, persons who were indifferent between receiving \$400 immediately and \$500 in one year were assumed to have a discount rate of 25%.

(Upchurch et al., 2004). In period t the person chooses a sexual activity level to maximize the discounted utility function $U^t \equiv \sum_{\tau=t}^T (\frac{1}{1+\rho})^{\tau-t} u_{\tau}$, where ρ is the person's discount rate (O'Donoghue and Rabin, 2001). Although the costs of sexual activity in period t can extend into subsequent periods, these future costs are discounted, and the decision to engage in sexual activity becomes more attractive as the discount rate increases. Thus, this simple model would suggest that sexual behaviors would be correlated with discount rates. All else equal, persons with higher discount rates would be more likely to have had sex, to have more sexual partners, to have unprotected sex, to become pregnant or to impregnate someone, or to acquire a sexually transmitted disease, than persons with lower discount rates.

This simple model, however, might overstate the role of discount rates on sexual behavioral decision making, for several reasons. For example, many people, perhaps especially teenagers and young adults, have a strong preference for immediate gratification, a preference that is not reflected in the above model. A model that allows for declining discounting over time would more realistically reflect observed decisions under intertemporal choice.² Furthermore, decisions about sexual behavior might be made in the “heat of the moment,” at which time little thought (if any) may be given to the possible future consequences of sexual activity. Recent research has suggested that people in “hot” states (in this case, sexual arousal) often fail to appreciate how much their “hot” state can influence their decision making. Similarly, people in “cold” states (in this case, not sexually aroused) may not be able to imagine or accurately predict what decisions they will make in future “hot” states.³ An imprudent focus on immediate rewards can also be explained by Read and Roelofsma (1999) and Read (2001b), who discuss “intrapersonal dilemmas” in which people make choices that are in their best interest at the time but not in the long run.

To account for an emphasis on short-term gratification, the expected utility model can be adjusted as follows: $U^t \equiv u_t + \beta \sum_{\tau=t+1}^T (\frac{1}{1+\rho})^{\tau-t} u_{\tau}$, where β is a preference for immediate gratification (O'Donoghue and Rabin, 2001).⁴ The preference term (β) can range from 0 to 1, where 0 represents a total focus on immediate gratification (all future periods are disregarded), and 1 corresponds to no additional emphasis on immediate gratification. Although this model would still predict some influence of discount rates on sexual behavior, such influence would be diminished by the preference term (β) and would be eliminated altogether if $\beta = 0$. Thus, it is possible in this simple model that decisions about sexual behavior are situation-specific and unrelated to discount rates. If, however, persons with lower discount rates are more likely to avoid situations which might lead to sexual activity (see O'Donoghue and Rabin, 2001), then discount rates might be expected to be correlated with sexual behaviors.

2. Data description and assessment of individual discount rates

We examined survey responses from a sample recruited from the following populations in Indianapolis and Cincinnati: clients of a public STD clinic, clients of adolescent health clinic, clients of two general medical clinics, and students at a large, public university campus. All of the sites were in urban areas with the exception of one suburban general medicine clinic. Respondents were recruited as part of a larger study examining herpes simplex virus type

² For example, see O'Donoghue and Rabin (2001), Read (2001a), Frederick et al. (2002), and Read and Roelofsma (2003).

³ For discussion of decision making in “hot” and “cold” states, see Loewenstein (2005a and 2005b).

⁴ This model, used by O'Donoghue and Rabin (2001) and others to describe temporal decision making (including sexual behavioral decision making by youth), is based on work by Phelps and Pollak (1968).

Table 1 Demographics, sexual behaviors, and health outcomes of study sample, by site of data collection

	STD clinic	General clinic	University campus	Teen clinic	Total
Sample size	283	259	310	190	1042
Male (%)	53.5	21.6	41.0	53.2	41.8
White (%)	55.0	87.4	80.5	23.2	64.5
Age (mean)	23.2 years	23.2 years	22.3 years	17.2 years	21.8 years
Ever had sexual intercourse (%)	95.4	94.1	85.8	84.7	90.2
Ever had gonorrhea and/or chlamydia (%)	35.7	18.1	4.5	22.3	19.6
Had sexual intercourse before age 16 (%)	47.7	39.6	16.8	62.4	39.1
> 1 sex partner in previous six months (%)	51.6	13.3	16.2	31.5	27.9
Had ≥ 1 unprotected sex act in previous 6 months (%)	72.3	74.5	55.3	40.2	61.9
Is or was pregnant, or has impregnated someone (%)	45.8	62.6	10.7	30.1	36.7
Acceptance of HSV-2 test (%)	90.1	45.6	66.1	54.2	65.4
Presence of HSV-2 antibody (%)	24.7	22.0	8.3	8.7	16.9

Sample size = 1042, although some measures contain missing values. All sexual behaviors and outcomes were self-reported, except for “tested positive for HSV-2” which was obtained from patients who accepted the HSV-2 test.

2 (HSV-2) antibody test acceptance and attitudinal, behavioral, and demographic factors as predictors of HSV-2 test acceptance. Details regarding the recruitment sites and sampling methods have been published elsewhere (Fife et al., 2004; Fortenberry et al., 2004; Zimet et al., 2004). The average age of the respondents was 21.8 years (range: 14–30 years) and most respondents were sexually active (Table 1).

We calculated discount rates based on responses to three hypothetical questions about the possible payoff of a prize. In the first question, each person was asked to choose between a prize of \$400 to be awarded today and a prize of \$1,200 to be awarded one year from today. In the second and third questions, the value of the future prize was reduced to \$800 and \$500, respectively (Table 2). In each question, the respondents were asked whether or not they agreed with the statement “I would prefer to win \$400 today.” Possible responses ranged from strongly disagree (1) to strongly agree (5).

Because the cost of accepting the \$400 instant payoff decreased from question 1 to question 2 (and from question 2 to question 3), we assumed that no subject would have been less willing to accept the \$400 instant payoff when moving from question 1 to question 2 to question 3. For example, a subject who responded “strongly agree” in question 1 would be expected to respond “strongly agree” to questions 2 and 3. In addition, we assumed that no subject would provide a response of “neutral” in more than one of the three questions. We classified subjects who violated either or both of these two assumptions or who failed to respond to all three monetary questions as “inconsistent” ($n = 257$) and excluded them from the main analyses.⁵

⁵ In the consistency check, we distinguished between strength of preference. That is, respondents who changed from “strongly agree” to “agree” or who changed from “disagree” to “strongly disagree” from question 1 to question 2, or from question 2 to question 3, were labeled “inconsistent.” The percentage of subjects responding

Table 2 Survey questions used to measure time preference

Now we are going to ask you questions about money.

Suppose you won a prize, and you get to make a choice about winning your prize today, or waiting a year and receiving a bigger prize.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I would rather get \$400 today than \$1,200 one year from today	O	O	O	O	O
I would rather get \$400 today than \$800 one year from today	O	O	O	O	O
I would rather get \$400 today than \$500 one year from today	O	O	O	O	O

For subjects who responded consistently ($n = 1042$), we assigned a crude estimate of their personal discount rate.

Specifically, each consistent respondent was assigned to one of seven discount rate ranges: $r < 25%$, $r = 25%$, $25% < r < 100%$, $r = 100%$, $100% < r < 200%$, $r = 200%$, $r > 200%$. In assigning the discount rate ranges, no distinction was made between a response of “strongly disagree” or “disagree”, and no distinction was made between a response of “agree” or “strongly agree.”⁶ The discount rate range of $<25%$ was assigned to those who disagreed in question 3, and the discount rate range of $>200%$ was assigned to those who agreed in question 1. The discount rate range of $25% < r < 100%$ ($100% < r < 200%$) was assigned to those whose responses changed from disagree to agree from question 2 to question 3 (question 1 to question 2). The discount rates of 200%, 100%, and 25% were assigned to those who responded “neutral” to question 1, 2, or 3, respectively.

3. Results

3.1. Individual discount rates

Almost half of the subjects exhibited an annual discount rate (r) of 100% or more (Table 3). That is, they required at least \$800 to be awarded in one year to forego receiving \$400 immediately. The estimated discount rate was greater than 200% for one-fifth of the respondents and was less than 25% for only 13% of the respondents.

A recent review of published estimates of discount rates (Frederick et al., 2002) included several studies reporting discount rates above 100% (and above 200% in some cases) when examining tradeoffs over time horizons of one year or less. Although our results were not inconsistent with the upper range of previous assessments of discount rates over a short time horizon, the high discount rates we observed may be attributable in part to “anchoring” to the tradeoff proposed in the first question (see Green et al., 1998 and Frederick et al., 2002). For example, the tradeoff proposed in the first question (\$400 today versus \$1,200 in one year) implies a very high discount rate, which may have biased the responses to the

inconsistently is consistent with that observed in similar surveys such as Viscusi et al. (1991) and Chesson and Viscusi (2000). As described later, we performed additional analyses in which inconsistent responders were included.

⁶ These distinctions of degree of disagreement or agreement were used in the consistency check, but not in establishing the discount rate ranges.

Table 3 Summary of annual personal discount rates (r) implied by responses to prize payoff questions

Implied discount rate (r)	Number (%) of subjects ($N = 1042$)
$r < 25\%$	134 (12.9%)
$r = 25\%$	64 (6.1%)
$25\% < r < 100\%$	352 (33.8%)
$r = 100\%$	112 (10.7%)
$100\% < r < 200\%$	106 (10.2%)
$r = 200\%$	44 (4.2%)
$r > 200\%$	230 (22.1%)

subsequent questions towards a higher discount rate.⁷ Although our measure of discount rates is not well suited to gauge absolute rates of time preference, the responses to the three monetary questions do allow us to assess relative differences in time preference, at least to some degree. In the following section, we examine the association between relative discount rates and sexual behaviors.

3.2. Associations between discount rates and sexual behavior, sexual health

To analyze the association between discount rates and sexual behaviors, we divided the respondents into discount rate groups based on their choices to the monetary payoff questions. Although there were at least seven possible groupings of discount rates based on the responses to the three time-tradeoff questions, we collapsed the responses into four groups ($r \leq 25\%$, $25\% < r \leq 100\%$, $100\% < r \leq 200\%$, and $r > 200\%$) such that the groups would be more comparable in size.⁸ We examined differences across these four groups over a range of sexual behaviors and health outcomes, including: ever having sexual intercourse, having sexual intercourse before age 16, having a history of gonorrhea and/or chlamydia infection, having more than 1 sex partner in the previous six months, having at least one unprotected sex act in the previous six months, pregnancy status, acceptance of an HSV-2 test, and presence of HSV-2 antibody.⁹ The pregnancy status variable was set to 1 for females with previous or current pregnancy and for males who had ever impregnated someone. With the exception of HSV-2 antibody status, all measures were self-reported.

In general, for the full sample, there were significant differences in sexual behaviors and health outcomes associated with discount rates (Table 4, Panel A). Respondents with higher discount rates were more likely to have ever had sexual intercourse, to have ever had gonorrhea or chlamydia, to have had sexual intercourse before age 16 years, to have had more than one sex partner in the previous six months, and to have been or currently be pregnant or to have impregnated someone. There was no significant association between discount rates and having at least one unprotected sex act in the previous six months, acceptance of an HSV-2 test, or presence of HSV-2 antibody. Our measure of unprotected sex, however, did not control for status of the sex partner, and might therefore not be a reliable indicator of risky sexual activity. Evidence suggests that unprotected sex is more common with low-risk partners than with high-risk partners (Peterman et al., 2000). Unprotected sex carries

⁷ We address this issue later by focusing solely on the responses to the first monetary tradeoff question.

⁸ Our results are generally consistent (particularly for the full sample) when we use seven discount rate groups rather than four.

⁹ The subjects were asked the number of times they had sex, and the number of times that a condom was used. We defined having unprotected sex at least once if the former exceeded the latter.

Table 4 Sexual behaviors and health outcomes, by discount rate (*r*)

Self-reported behavior/outcome	Group 1: $r \leq 25\%$	Group 2: $25\% < r \leq 100\%$	Group 3: $100\% < r \leq 200\%$	Group 4: $r > 200\%$	<i>p</i> -value*
Panel A: Full sample					
Ever had sexual intercourse	83.8% (165 of 197)	90.5% (316 of 349)	91.2% (239 of 262)	94.2% (213 of 226)	0.003
Ever had gonorrhea and/or chlamydia	14.2% (28 of 197)	17.8% (62 of 349)	17.9% (46 of 257)	29.1% (66 of 227)	<0.001
Had sexual intercourse before age 16	25.3% (50 of 198)	34.7% (121 of 349)	42.9% (111 of 259)	53.8% (120 of 223)	<0.001
>1 sex partner in previous six months	20.1% (39 of 194)	27.0% (93 of 345)	30.4% (79 of 260)	33.2% (74 of 223)	0.019
Had at least one unprotected sex act in previous six months	60.1% (110 of 183)	63.8% (215 of 337)	56.9% (141 of 248)	66.2% (141 of 213)	0.164
Is or has been pregnant, or has impregnated someone	34.5% (67 of 194)	27.6% (97 of 351)	39.8% (102 of 256)	48.7% (110 of 226)	<0.001
Acceptance of HSV-2 test	64.6% (128 of 198)	68.8% (242 of 352)	61.5% (161 of 262)	65.2% (150 of 230)	0.308
Presence of HSV-2 antibody	21.1% (27 of 128)	14.5% (35 of 242)	14.9% (24 of 161)	19.3% (29 of 150)	0.294
Panel B: STD clinic Sample					
Ever had sexual intercourse	93.5% (43 of 46)	94.9% (93 of 98)	95.8% (68 of 71)	96.9% (63 of 65)	0.849
Ever had gonorrhea and/or chlamydia	32.6% (15 of 46)	31.3% (31 of 99)	33.3% (23 of 69)	47.0% (31 of 66)	0.184
Had sexual intercourse before age 16	45.7% (21 of 46)	40.8% (40 of 98)	45.7% (32 of 70)	61.5% (40 of 65)	0.071
>1 sex partner in previous six months	50.0% (23 of 46)	55.1% (54 of 98)	41.4% (29 of 70)	58.5% (38 of 65)	0.199
Had at least one unprotected sex act in previous six months	78.4% (29 of 37)	75.3% (70 of 93)	66.2% (45 of 68)	71.0% (44 of 62)	0.490
Is or has been pregnant, or has impregnated someone	56.5% (26 of 46)	39.8% (39 of 98)	41.4% (29 of 70)	52.4% (33 of 63)	0.158
Acceptance of HSV-2 test	100% (46 of 46)	94.9% (94 of 99)	76.1% (54 of 71)	91.0% (61 of 67)	<0.001
Presence of HSV-2 antibody	28.3% (13 of 46)	22.3% (21 of 94)	18.5% (10 of 54)	31.1% (19 of 61)	0.381
Panel C: General Adult Clinic					
Ever had sexual intercourse	91.1% (51 of 56)	91.9% (57 of 62)	95.2% (60 of 63)	97.3% (72 of 74)	0.397
Ever had gonorrhea and/or chlamydia	7.0% (4 of 57)	20.6% (13 of 63)	18.3% (11 of 60)	24.3% (18 of 74)	0.074
Had sexual intercourse before age 16	22.8% (13 of 57)	43.5% (27 of 62)	41.3% (26 of 63)	47.9% (35 of 73)	0.025
>1 sex partner in previous six months	8.9% (5 of 56)	9.5% (6 of 63)	19.0% (12 of 63)	14.9% (11 of 74)	0.299
Had at least one unprotected sex act in previous six months	61.1% (33 of 54)	75.4% (46 of 61)	78.7% (48 of 61)	80.6% (54 of 67)	0.072

(continued on next page)

Table 4 (Continued)

Self-reported behavior/outcome	Group 1: $r \leq 25\%$	Group 2: $25\% < r \leq 100\%$	Group 3: $100\% < r \leq 200\%$	Group 4: $r > 200\%$	<i>p</i> -value*
Is or has been pregnant, or has impregnated someone	50.9% (29 of 57)	51.6% (33 of 64)	70.5% (43 of 61)	74.7% (56 of 75)	0.005
Acceptance of HSV-2 test	43.9% (25 of 57)	37.5% (24 of 64)	47.6% (30 of 63)	52.0% (39 of 75)	0.376
Presence of HSV-2 antibody	32.0% (8 of 25)	12.5% (3 of 24)	20.0% (6 of 30)	23.1% (9 of 39)	0.422
Panel D: University campus sample					
Ever had sexual intercourse	74.7% (59 of 79)	89.5% (128 of 143)	89.8% (53 of 59)	89.7% (26 of 29)	0.013
Ever had gonorrhea and/or chlamydia	5.1% (4 of 79)	3.5% (5 of 141)	5.1% (3 of 59)	6.9% (2 of 29)	0.854
Had sexual intercourse before age 16	11.4% (9 of 79)	17.5% (25 of 143)	22.0% (13 of 59)	17.9% (5 of 28)	0.411
>1 sex partner in previous six months	9.1% (7 of 77)	15.1% (21 of 139)	27.1% (16 of 59)	17.9% (5 of 28)	0.041
Had at least one unprotected sex act in previous six months	53.2% (41 of 77)	58.3% (81 of 139)	47.5% (28 of 59)	62.1% (18 of 29)	0.452
Is or has been pregnant, or has impregnated someone	9.2% (7 of 76)	7.7% (11 of 143)	16.9% (10 of 59)	17.2% (5 of 29)	0.157
Acceptance of HSV-2 test	62.0% (49 of 79)	69.2% (99 of 143)	71.2% (42 of 59)	51.7% (15 of 29)	0.206
Presence of HSV-2 antibody	10.2% (5 of 49)	6.1% (6 of 99)	14.3% (6 of 42)	0.0% (0 of 15)	0.238
Panel E: Urban adolescent health clinic sample					
Ever had sexual intercourse	75.0% (12 of 16)	82.6% (38 of 46)	84.1% (58 of 69)	89.7% (52 of 58)	0.488
Ever had gonorrhea and/or chlamydia	33.3% (5 of 15)	28.3% (13 of 46)	13.0% (9 of 69)	25.9% (15 of 58)	0.120
Had sexual intercourse before age 16	43.8% (7 of 16)	63.0% (29 of 46)	59.7% (40 of 67)	70.2% (40 of 57)	0.256
>1 sex partner in previous six months	26.7% (4 of 15)	26.7% (12 of 45)	32.4% (22 of 68)	35.7% (20 of 56)	0.769
Had at least one unprotected sex act in previous six months	46.7% (7 of 15)	40.9% (18 of 44)	33.3% (20 of 60)	45.5% (25 of 55)	0.556
Is or has been pregnant, or has impregnated someone	33.3% (5 of 15)	30.4% (14 of 46)	30.3% (20 of 66)	28.6% (16 of 56)	0.987
Acceptance of HSV-2 test	50.0% (8 of 16)	54.3% (25 of 46)	50.7% (35 of 69)	59.3% (35 of 59)	0.784
Presence of HSV-2 antibody	12.5% (1 of 8)	20.0% (5 of 25)	5.7% (2 of 35)	2.9% (1 of 35)	0.110

*The *p*-values (Pearson's chi-square) test the null hypothesis that there is no association between the self-reported behavior/outcome and the columns (discount rates).

no risk of STD acquisition for a person in a mutually monogamous relationship with an uninfected partner, and unprotected sex within monogamous relationships may be the reason why unprotected sex was more common in the general adult medical clinic sample than in any other site, including the STD clinic. Furthermore, condom usage can vary substantially within subjects over time. For example, youth who report consistent condom usage over a given three-month period might report inconsistent or no condom usage over a subsequent three-month period (Peterman et al., 2006).

The results were similar when we stratified the respondents by sex (not shown). Females with higher discount rates were more likely to ever had gonorrhea or chlamydia, to have had sexual intercourse before age 16 years, and to have been or currently be pregnant. However, for females, the association between discount rates and (1) ever having sex and (2) having more than one sex partner in the previous six months were no longer significant at the $p < 0.05$ level. Males with higher discount rates were more likely to have ever had sexual intercourse, to have ever had gonorrhea or chlamydia, to have had sexual intercourse before age 16 years, and to have had more than one sex partner in the previous six months. For males, the association between discount rates and pregnancy status (which for males indicates ever having impregnated someone) was not significant at the $p < 0.05$ level.

The associations between discount rates and sexual behaviors were more evident for the general medical clinic sample and the university campus sample than for the STD clinic sample and the adolescent health clinic sample. For the STD clinic sample, those in higher discount rate groups were more likely to have had sexual intercourse before age 16 and were less likely to accept HSV-2 antibody testing (Table 4, Panel B). For the general adult medical clinic sample, those in higher discount rate groups were more likely to report ever having gonorrhea or chlamydia, having sexual intercourse before age 16, having at least one unprotected sex act in the previous six months, and having been pregnant or impregnating someone (Table 4, Panel C). In the university campus sample, higher discount rates were associated with ever having sexual intercourse and with having more than one sex partner in the previous six months (Table 4, Panel D). In the teen clinic sample, there were no associations (at the $p < 0.10$ level) between discount rate group and sexual behaviors (Table 4, Panel E).

For the full sample, the associations between discount rates and sexual behaviors and health outcomes were similar when we performed ordinal logistic regression to control for differences in age, sex, race, and site of data collection. We performed eight regressions, each time including one of the sexual behavior/outcome variables as a dependent variable. The independent variable of interest was the discount rate group, and each regression also included age, sex, race and recruitment site variables.¹⁰ Higher discount rates were associated with ever having sexual intercourse, ever having gonorrhea or chlamydia, having sexual intercourse before the age of 16 years, and past or current pregnancy (or impregnating someone) (Table 5).¹¹

To examine what demographic factors influenced the discount rates, we reversed our model and included the discount rate group as the dependent variable and included as independent variables the demographic and site variables and all of the sexual behavioral and

¹⁰ The variable AGE was continuous, and the variables MALE and WHITE were dummy variables set to 1 for male and white respondents, respectively. The site variables were dummy variables for general medical clinic, university, and teen clinic (STD clinic was the omitted site variable).

¹¹ The association between discount rates and having sex before age 16 held when we deleted observations from the small portion of the sample who were under the age of 16. Similarly, deleting observations from respondents without sexual experience (and omitting the “ever having sex” variable) had no substantial impact on the results for the other sexual behavior variables.

Table 5 Ordinal logistic regression models: Associations between discount rates and sexual behaviors and health outcomes

Dependent variable	Estimate of discount rate coefficient (SE)	<i>p</i> -value
Ever had sexual intercourse	0.431 (0.126)	<0.001
Ever had gonorrhea and/or chlamydia	0.167 (0.089)	0.062
Had sexual intercourse before age 16	0.230 (0.071)	0.001
>1 sex partner in previous six months	0.107 (0.080)	0.183
Had at least one unprotected sex act in previous six months	0.076 (0.073)	0.298
Is or has been pregnant, or has impregnated someone	0.152 (0.076)	0.045
Acceptance of HSV-2 test	0.022 (0.074)	0.769
Presence of HSV-2 antibody	−0.051 (0.111)	0.645

This table summarizes the results of eight regressions, each of which included one of the behavioral or outcome variables as the dependent variable. In each regression, we included the discount rate group, AGE, MALE, WHITE, and site variables (general medical clinic, university, teen clinic, STD clinic) as independent variables. Coefficients for AGE, MALE, WHITE, and site variables are not reported but are available from the authors upon request. All behavioral/outcome variables were self-reported except HSV-2 antibody test. Positive coefficients indicate that those in higher discount rate groups were more likely to report the sexual behavior or health outcome.

health outcome variables (except HSV-2 antibody status, which was not available for the full sample). Older respondents and white respondents were more likely to belong to lower discount rate groups (Table 6). Ever having sex, having sex before age 16, and pregnancy status were associated with higher discount rates.

3.3. Additional analyses: Testing the validity of the discount rate measurement

As noted earlier, our measure of discount rates is based on responses to three questions and is better suited for assessing relative differences in time preference rather than absolute rates of time preference. Furthermore, our relative ranking of discount rate groups might reflect the

Table 6 Ordinal logistic regression model: Predictors of higher discount rates

Variable	Estimate (SE)	<i>p</i> value
Age	−0.084 (0.021)	<0.001
Male	0.119 (0.132)	0.368
White	−0.428 (0.155)	0.006
General medical clinic site	0.075 (0.199)	0.707
University site	−0.546 (0.178)	0.002
Teen clinic site	−0.010 (0.231)	0.966
Ever had sexual intercourse	0.696 (0.249)	0.005
Ever had gonorrhea, chlamydia, or both	0.117 (0.178)	0.512
Had sexual intercourse before age 16 years	0.288 (0.146)	0.049
Had more than one sex partner in previous six months	0.111 (0.152)	0.466
Had at least one unprotected sex act in previous six months	−0.128 (0.139)	0.359
Is or has been pregnant, or has impregnated someone	0.248 (0.151)	0.100
Acceptance of HSV-2 test	−0.072 (0.145)	0.618

Note. Overall model was significant (chi-square = 124.7, $p < 0.001$). Positive coefficients indicate a higher probability of having a higher discount rate.

influence of other factors besides time preferences (such as “anchoring” to the first monetary tradeoff, or beliefs about inflation or future consumption, as described by Frederick et al. (2002)) or survey response biases (such as a tendency to respond with “agree” rather than “disagree,” as reviewed by Krosnick (1999)). Although we cannot rule out the possibility of such biases, we can examine the reliability of our results over a range of additional analyses.

First, to account for the potential bias due to anchoring to the first monetary question, and to examine the robustness of our findings to inclusion of inconsistent respondents, we performed additional analyses in which we measured relative differences in discount rates based only on the responses to the first question (without deleting observations due to inconsistent responses to the second and third questions).¹² We obtained similar results, except that the associations between relative discount rates and ever having sex and having more than one recent sex partner were not as strong.

Second, to address the possible bias of acquiescence, we repeated the analysis after excluding all subjects who responded “strongly agree” or “agree” to all three monetary questions. Such patterns of agreement might reflect the passive responses of subjects who did not understand the survey or did not want to exert effort in responding to the survey (Krosnick, 1999). When such responses were excluded, we still detected significant associations between relative discount rates and several sexual behaviors, although these associations were not as strong as when all responses were included.¹³

Third, and perhaps most importantly, we note that the associations we observed between relative discount rate groups and demographic variables (Table 6) were consistent with findings from previous studies. For example, we found that discount rates decreased with age, as has been reported in numerous previous studies.¹⁴ Furthermore, respondents from the university setting had lower discount rates, consistent with previous studies showing a link between discount rates and the decision to seek higher education.¹⁵ We also found that being white was a predictor of lower discount rates, consistent with previous reports.¹⁶ However, this finding might be attributable to differences in income, as higher incomes are also predictors of lower discount rates (see Lawrance, 1991). Regardless, the fact that the correlations we observed between relative discount rates and demographic factors were consistent with previous research adds to the credibility of our assessment of relative discount rates.

4. Conclusions

We found high discount rates in a sample of teenagers and young adults. Higher discount rates were significantly associated with a range of risky sexual behaviors and health outcomes, including having sex before age 16, having gonorrhea or chlamydia, and pregnancy

¹² We classified the participants into five groups, based on their responses to the first monetary payoff question. The possible responses ranged from 1 (strongly disagree) to 5 (strongly agree), with 5 being the highest relative discount rate. The distribution of the responses was 38% (strongly disagree), 25%, 9%, 16%, and 11% (strongly agree).

¹³ Specifically, discount rates were associated (at the $p < 0.05$ level) with ever having sex, having sex before age 16, having more than one sex partner in the previous six months, and pregnancy status, although only the first two associations were significant at the $p < 0.05$ level in the logistic regression models which controlled for age, sex, race, and recruitment site.

¹⁴ For example, see Green et al. (1996), Green et al. (1999), Warner and Pleeter (2001), Read and Read (2004), and Bishai (2004).

¹⁵ Examples include Viscusi and Moore (1989), Warner and Pleeter (2001), and Bishai (2004).

¹⁶ For example, see Lawrance (1991), Warner and Pleeter (2001) and Bishai (2004).

status. Although our findings were robust to alternative analyses designed to address potential shortcomings in our assessment of individual discount rates, our analysis is exploratory in nature, and future research is needed to examine the association between time preference and sexual behaviors in more detail.

If time preference does in fact influence sexual behavioral decision making, the implications could be important. First, the associations we found between sexual behaviors and discount rates suggest that sexual behavior data can potentially be used in studies that require measures correlated with time preference. For example, smoking status and educational attainment are both affected by discount rates, and researchers have used smoking status as an instrument for education in estimating the link between educational attainment and earnings (Evans and Montgomery, 1994; Fersterer and Winter-Ebmer, 2003). Perhaps sexual behavioral data could be adapted for similar purposes in the future.

Second, our findings offer empirical support for the idea that the short-term decision-making focus of teenagers and young adults may be a key factor in the decision to engage in risky sex. Youth may make behavioral choices that they regret later, because they discount the future “too much” or because they fail to realize their preferences might change over time.¹⁷ Thus, as noted by O’Donoghue and Rabin (2001), teenagers and young adults, even if fully aware of the potential consequences of various sexual behaviors, might make choices that adversely affect their health because they greatly discount these future consequences. Furthermore, these results support the recommendation of the Centers for Disease Control and Prevention (2002) that STD prevention messages should highlight the potential short-term consequences of STDs, which might be of more importance to teenagers and young adults than potential long-term consequences.

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¹⁷ This could apply to decisions about sexual behaviors and other choices faced by teenagers and young adults. For examples, see Leibowitz et al. (1986), Chaloupka (1991), Chapman and Elstein (1995), Laux (2000), Levine (2001), Gruber (2001), O’Donoghue and Rabin (2001), Grossman et al. (2002), and Bishai, Mercer, and Tapales (2005).

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