Time Preference, Time Discounting, and Smoking Decisions*

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Abstract

This study examines the relationship between time discounting, other sources of time preference, and choices about smoking. Using a survey fielded for our analysis, we elicit rates of time discount from choices in financial and health domains. We also examine the relationship between other determinants of time preference and smoking status. We find very high rates of time discount in the financial realm for a horizon of one year, irrespective of smoking status. In the health domain, the implied rates of time discount decline with the length of the time delay (hyperbolic discounting) and the sign of the payoff (the sign effect). We use a series of questions about the willingness to undergo a colonoscopy to elicit short- and long-run rates of discount in a quasi-hyperbolic discounting framework, finding no evidence that short-run and long-run rates of discount differ by smoking status. Using more general measures of time preference, i.e., impulsivity and length of financial planning horizon, smokers are more impatient. However, neither of these measures is significantly correlated with the measures of time discounting. Our results indicate that subjective rates of time discount revealed through committed choice scenarios are not related to differences in smoking behavior. Rather, a combination of more general measures of time preference and self-control, i.e., impulsivity and financial planning, are more closely related to the smoking decision.

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I. Introduction

The recent economics literature on anomalies of intertemporal choice and self-control has been focused on alternatives to the standard assumption of exponential time-discounting. Building on Strotz (1956) and Phelps and Pollak (1968), research by Laibson (1997) and O'Donoghue and Rabin (1999) sparked a large new literature that explores the consequences of (quasi)-hyperbolic discounting in many areas, including savings behavior, labor, environmental, and health economics, and corporate finance. Models of hyperbolic discounting have often augmented or replaced the insights derived from standard models, rationalized puzzling behaviors, and generated new testable predictions. Importantly, certain welfare consequences of government policy have been shown to depend critically on whether consumers are (quasi-) hyperbolic rather than standard, exponential discounters (O'Donoghue and Rabin 2005). For example, if agents are hyperbolic discounters, a measure of the welfare benefits of an increased tax on cigarettes may be greatly magnified because problems of self-control induce net costs of smoking that are *internal* to the smoker (Gruber and Köszegi 2001, 2004; Sloan, Ostermann, Picone et al. 2004).

The literature on hyperbolic discounting has grown rapidly, in part, because experimental evidence of hyperbolic discounting is voluminous. When choosing now *to commit to* present or future intertemporal tradeoffs, individuals commonly reveal declining (hyperbolic) rates of time discount. As Strotz (1956) first demonstrated, declining rates of time discount imply time-inconsistency and problems of self-control when choices are *uncommitted*. There are, however, other potential sources of time preference and problems of self-control not reflected in time discount functions and thus in the committed choices of individual decision makers. In models of dual selves (or cognitive processes) and of

temptation costs, for example, present-biased time preference, tastes for commitment, and apparent time-inconsistency may emerge for reasons unrelated to the time discount function.[1] Recent empirical work is also consistent with the idea that substantially improving models of intertemporal choice may require more than the proper calibration of the discount function (Bernheim, Skinner, and Weinberg 2001; Ameriks, Caplin, and Leahy, 2003; Ameriks, Caplin, Leahy, and Tyler 2004).

In this study, using data collected for our research, we examine the relationship between time discounting, other sources of time preference, and choices about smoking. The decision to smoke represents an interremporal tradeoff with substantial implications for individual and social welfare, and thus provides a natural context in which to study these issues. We elicit rates of time discount from choices in both financial and health domains. We also examine the relationship between other determinants of time preference and smoking status. Specifically, we employ a proxy for respondents' degree of self-control using measures of impulsivity in individual behaviors. We investigate whether these and other measures of self-control differ by smoking status and to what extent these measures are correlated with subjective rates of time discount.

Using standard questions regarding committed intertemporal choices in the financial and health domains, we find patterns consistent with previous research on subjective rates of time discount. Responses to now standard hypothetical choice scenarios reveal very high rates of time discount in the financial realm for a horizon of one year, irrespective of smoking status. Consistent with previous research, we find evidence that

[1] See, e.g., Laibson (2001) and Bernheim and Rangel (2004) on cue-triggered consumption, Thaler and Shefrin (1988), Benhabib and Bisin (2005), Loewenstein and O'Donoghue (2005), Fudenberg and Levine (forthcoming), and Ozdenoren, Salant, and Silverman (2006), on dual self/system models, and Gul and Pesendorfer (2001) on models of costly self-control.

these implied rates of time discount decline with the length of the time delay, (hyperbolic discounting), and depend on the sign of the payoff (the "sign" effect). We also find an effect of the size of stakes on choices for gains but not for losses (the "magnitude" effect). Further, we use a series of questions about the willingness to undergo a colonoscopy, a procedure recommended for all persons in the age group of respondents to our survey, irrespective of smoking status, to elicit short- and long-run rates of discount in a quasi-hyperbolic discounting framework. We find no evidence that, for adults, short-run and long-run rates of discount differ by smoking status.

While several measures of time discounting in our data replicate patterns seen consistently in the literature, there is no correlation between these measures and smoking status. Our findings thus indicate that variation in time discounting is not a driving force behind differences in smoking behavior.[2]

However, we find that measures of impulsivity and the length of the financial planning horizon are related to smoking decisions. Those who are more impulsive are also significantly more likely to have smoked or to continue to smoke.[3] Similarly, current smokers tend to have shorter financial planning horizons, even conditional on their longevity expectations. Neither of these measures of planning or self-control is significantly correlated with the standard measures of time discounting. We find that

[2] To the extent that critical smoking decisions are made earlier in life, this implication of our findings rests on the assumption that time discounting is, within person, well-correlated over the life course; i.e., those who were relatively patient when young tend to remain relatively patient when older. While there are studies of the relationship between the rate of time discounting and age in the financial domain, see, e.g., Read and Read (2004) and Green, Fry, and Myerson (1994), to our knowledge there are no panel data of substantial length on time discounting.

[3] This finding is qualitatively consistent with results in experimental psychology which draw on (typically small) samples of younger people. See, for example, Mitchell (1999) with 20 college-aged smokers and references contained therein.

subjective rates of time discount revealed through committed choice scenarios are unrelated to smoking status. Rather a combination of more general measures of self-control, impulsivity and financial planning, is related to the smoking decision.

This paper proceeds as follows. The next section describes our data source and shows how the smokers in our sample exhibit many of the characteristics and behaviors noted previously in the literature. Section III presents our methods and results regarding subjective rates of time discount in the financial and health domains, and their relationship to smoking decisions. This section ends with analysis of alternative sources of time preference--impulsivity and length of planning horizon. Section IV concludes.

II. Data

Our analysis relies on data from the Survey on Smoking (SOS). The SOS was conducted by the research firm Battelle from October 2004-January 2005 at three sites where Battelle offices are located, Durham, North Carolina, St. Louis, Missouri, and Seattle, Washington. The SOS consists of three interviews: a screener to determine age eligibility and smoking status administered by telephone; a second longer interview also conducted by telephone; and an in-person computer-assisted interview. All information used in this paper comes from the screener and the longer telephone interview. The SOS is more comprehensive in asking questions about time preference, self control, and impulsivity than are previous surveys on smoking.

The SOS sample consists of adults aged 50-70 at the interview date, who were current, former, or never smokers. Since much of the survey deals with smoking status, current smokers were oversampled. The analysis sample from the first survey consists of 663 individuals, 252 current, 257 former, and 154 never smokers. The response rate for the

longer telephone interview was approximately 80%. The analysis sample from the follow-up survey consists of 431 individuals, 149 current, 165 former, and 117 never smokers. The follow-up survey includes questions on time discounting in the health domain, risk preference, and the value of avoiding smoking-related illness.

Descriptive statistics for the sample of persons who responded to both SOS surveys and the sample of those who only responded to the first survey are shown in Table 1. Higher proportions of current and former smokers responded to both surveys and a correspondingly lower proportion of never smokers responded to both. On average, persons who responded to both surveys have lower educational attainment. Persons who responded to both surveys also have lower self-reported health on average.

Stylized facts about smokers reported by others (see e.g., Brigham 1998, Sloan, Smith, and Taylor 2003; Sloan, Ostermann, Picone et al. 2004, Slovic 2001) are also found in the SOS data (not shown in Table 1), although respondents to the SOS are much older than respondents to the vast majority of previous surveys on smoking. The mean age at which individuals begin smoking is 17 years. Current smokers consume between 11 and 20 cigarettes a day on average. Of current smokers, 85% say that they had tried quitting in the past. The mean age at which they first tried to quit is 37 years. On average, they report having quit for more than a month on 1.7 occasions. For persons who were former smokers at the interview date, the number of quit attempts for longer than a month is 2. Among current smokers, 76% report that they would like to quit smoking. Important reasons for relapses among current smokers who had quit are stress (41%), habit or physical addiction

(14%), and desire to be social (13%). Major factors leading to quitting are health shocks (44%),[4] precaution against future health shocks (14%), and family reasons (11%).

These facts indicate that (1) a substantial number of persons quit, (2) many people try to quit and relapse, (3) a minority of people who have ever smoked have never tried to quit, and (4) judging from the reasons people give for quitting and relapsing, more is at work than simple physical addiction. Only 13.7 percent of current smokers report relapsing because they are physically addicted. Taken together, these patterns of behavior are consistent with problems of self-control and a taste for commitment.

Indeed, in the SOS the vast majority of smokers use commitment devices to curb their smoking, suggesting that they are aware of a self control problem. The SOS asks, "To limit my smoking, I buy packs rather than cartons. Do you: disagree strongly, disagree, disagree somewhat, agree somewhat, agree, and agree strongly?"[5] Twenty-seven percent of current smokers say that they at least somewhat agreed with the statement that they buy packs for this reason. The SOS also contains an open-ended question about other commitment devices that smokers use. "In no more than a few sentences, could you describe other strategies you use to limit the amount you smoke?" Eighty-one percent use some type of self-control device.[6] The responses to the open-ended question indicate that *almost everyone* claims to use a commitment device of some sort.

[4] Sloan, Smith, and Taylor (2003), using data from the Health and Retirement Study, found that health shocks were the major determinant of quitting among mature smokers.

[5] Not all choices that might be considered commitment devices are unambiguous indications of self-control problems. For example, new information may lead a rational agent addicted to cigarettes to use a nicotine patch as a way to reduce smoking to a new optimal level with less unpleasant withdrawal symptoms. However, other behaviors that are intended to limit choice sets and increase the current costs of smoking, such as buying packs rather than cartons, would seem to require a model of self-control problems and not merely addiction.

[6] Respondents listed several commitment devices other than buying packs rather than cartons: (1) keep busy, keep hands busy, work out in the yard, do a lot of reading and crossword puzzles, washing dishes and cleaning, talk to someone on the telephone; (2) stop smoking in the house, go outside, no smoking at work, put myself in places where smoking is not allowed; (3) keep diary to see when last smoked, limit myself to one cigarette each

The literature on hyperbolic discounting has also been motivated in part by an observation that people seem to make time-inconsistent choices in that their behavior does not match their stated plans. For example, a stylized fact used by Gruber and Köszegi (2001) to motivate their analysis of smoking decisions is that smokers are unable to carry out their own plans for future cigarette consumption. Gruber and Köszegi state that "unrealized intentions to quit at some future date are a common feature of stated smoker preferences" (p.1279). They provide evidence that, among high school seniors, 56% claimed that they would quit in five years, but only 31% quit in that time.

Evidence from much older respondents to the SOS is consistent with this finding. The SOS question is "Roughly how many cigarettes do you expect to smoke per day two years from now?" Those smokers who said that they would be smoking zero cigarettes were classified as self-assessed quitters. The self-assessed probability of quitting was compared with actual quit rates computed from the Health and Retirement Study (HRS), a national longitudinal survey of persons aged over 50.[7] The mean subjective probability from SOS of having quit in two years is 0.41. In the HRS, by comparison, the corresponding, objective two-year quit rate is 0.16.[8] Like youths, mature smokers thus appear to be overly optimistic about quitting. This is further evidence that people have difficulty implementing their plans about intertemporal consumption, at least in the context of smoking.

III. Methods and Results

III. A. Time Discounting in the Financial Domain

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half an hour, leave cigarette burning after two puffs, smoke first half of cigarette, do not smoke early in the morning; (4) chew gum or hard candy, eating, I brush my teeth when I got a big craving for a cigarette, drink water; (5) put cigarettes out of reach when I am at home, try not to have any in the house, don't take them with me; (6) patch, medicine; (7) avoid other smokers.

[7] See Juster and Suzman (1995) for details.

[8] We also estimated probits which included age, marital status, gender, educational attainment, race, and self-rated health status as regressors to correct for differences in sample characteristics between the SOS and HRS. The results were almost identical to those reported.

Much of the evidence discussed in the previous subsection is qualitatively consistent with the problems of self-control that would emerge from hyperbolic time discounting. In this section we begin our *direct* examination of time discounting with the responses to intertemporal tradeoffs in the financial domain. The first SOS interview asks four questions about winning or losing money now versus a year from now. The questions were worded as "Would you rather win (lose) $x now or $y a year from now?" Values of x were set at $20 or $1,000, and values of y were $30 and, alternatively, $1,500. This structure allowed us to gauge whether the stakes involved affect the choices.

These questions are typical of the literature on time discounting; they are designed to reveal preferences under commitment and, absent consideration of arbitrage opportunities with respect to the real interest rate,[9] answers should thus reflect the standard notion of subjective time discounting.

To evaluate whether revealed rates of time discounting in the financial domain differ by smoking status and by the amounts at stake, we estimate regressions of the following form:

$$d_i = \kappa + \theta^* cs_i + \mu^* fs_i + \varphi^* w_i + \lambda^* l_i + \pi^* v_i + \varepsilon_i \quad (1),$$

where i is a subscript for an individual, d_i is an indicator variable that equals 1 for the more impatient choice, i.e., if the person elects to receive the money now and or pay the money later and equals 0 otherwise; cs_i and fs_i are indicator variables for current and former smokers respectively (never smokers are the omitted group), w_i is an indicator variable for

[9] Arbitrage opportunities are available in these experiments whenever the intertemporal tradeoffs involve (easily) tradeable goods. Money rewards are, of course, particularly susceptible. If these arbitrage opportunities are salient, then, for example, rational respondents should never forgo an intertemporal tradeoff that implies a rate of return far in excess of the market rate. While these money tradeoff questions are thus problematic, we adopt them here to allow our results to be more closely related better to the literature on (hyperbolic) time discounting.

the choice of winning \$20 now or \$30 a year later, l_i is an indicator variable for the choice of losing \$30 a year later or \$20 now, and v_i is an indicator for the choice of losing \$1,500 a year later or \$1,000 now (choice of winning \$1,000 now versus \$1,500 a year later is the omitted group).

We find that 51% of respondents would rather win \$1,000 now than \$1,500 in a year (Table 2, col. 1). When the scale of the reward is decreased to \$20 now versus \$30 a year from now, 67% of individuals prefer to have the money immediately. This is consistent with previous findings on the magnitude effect; individuals are more present-oriented when the stakes are small (see e.g., Thaler 1981, Loewenstein 1987, Benzion, Rapoport, and Yagil 1989).

However, 32% of individuals would prefer to lose \$30 a year from now rather than \$20 now. When faced with the choice of losing \$1,500 a year from now versus \$1,000 now, 38% would prefer to delay their loss. Although these results for losses are inconsistent with the magnitude effect, when compared with those concerning financial gains these findings *are* consistent with previous research showing the sign effect, gains are discounted more than losses (see e.g., Thaler 1981; Benzion, Rapoport, and Yagil 1989). Most important for our analysis, the coefficients on smoking status indicate no difference in financial tradeoffs by smoking status.

We repeat the analysis separately for each of the smoking groups, and find that the parameters are very similar among the groups (Table 2, cols. 2-4). We conclude that (1) there is evidence for both the sign and magnitude effects found previously in the literature but, (2) time discounting as measured by these financial tradeoff questions does not differ by smoking status.

II. B. Time Discounting in the Health Domain

In this section, we investigate the relationship between time discounting and the decision to smoke using questions about the health domain. We do this in the health domain as it is plausibly the appropriate domain to examine time discounting for health-related intertemporal choices such as smoking.[10]

III. B.1. Healthy Days

To measure time discounting in the health domain we use responses to the following questions from the second (the in-person) SOS interview. Responses were elicited to the following statement: "20 extra days in perfect health this year would be just as good as ____ extra days in perfect health x year(s) from now" where x is alternatively 1, 5, 10, and 20 and n is the number of extra healthy days. Assuming exponential time discounting, where ρ is the rate of time preference, if the individual is indifferent between n extra healthy days at time x, and 20 extra healthy days this year, then

$e^{-[\rho t]} * U(20) = e^{-[\rho(t+x)]} * U(n)$, which implies that $\rho = [\ln(U(n)) - \ln(U(20))]/x$.

We assume that utility is linear with respect to these extra days of health.[11] We pool all responses to all questions and run regressions of the following form:

$$\rho_i = \kappa + \theta * cs_i + \mu * fs_i + \varphi * t5_i + \lambda * t10_i + \pi * t20_i + \varepsilon_i \qquad (2),$$

[10] The questions do not, however, refer to smoking versus health tradeoffs *per se*. Such tradeoffs would more likely depend directly on smoking behavior and thus capture less well an underlying tendency toward (im)patience in the health domain.

[11] We justify the linearity assumption on the grounds that the change in days of health represents, for most, a relatively small change in (remaining) lifetime health. The linearity assumption also has the advantage of avoiding knotty issues regarding the proper units for measuring the (utility of) additional health. If utility is linear in additional health, our calculation of the time discount rate does not depend on units of measurement (weeks vs. days of extra health) or on whether 21 days of health generate 1 unit or 100 more units of utility than 20 days. If, instead, preferences reflected some diminishing marginal returns over the relevant domain, then the degree of concavity in the utility function is a cardinal property, and thus the units in which the (utility of) additional health matters critically.

where i is a subscript for an individual, $t5_i$, $t10_i$,and $t20_i$ are indicator variables for the relevant comparison years and number of extra days a year from now is the omitted group.

When the question elicits the equivalent, a year from now, of 20 healthy days this year, ρ is estimated to be 0.52 for never smokers (Table 3, col. 1). Thus, the implied discount rate is extremely high, which is similar to our finding for financial discount rates based on a horizon of one year (see Table 1). However, when the comparison is extra healthy days in five, 10, and 20 years from now versus 20 extra healthy days this year, the estimates of ρ decrease to 0.14, 0.08, and 0.05, respectively. Thus the implied rate of time discount declines sharply as the tradeoff is pushed futher into the future. We find no differences by smoking status. In columns 3-5, we stratify by smoking status and find results that are qualitatively similar to the pooled findings.[12]

In sum, our analysis reveals that revealed time discount rates for health fall dramatically with the length of the time horizon, a pattern that is consistent with hyperbolic discounting. However, this finding is, as argued by Read (2001, 2003), observationally equivalent to "subadditive discounting." With standard, additive discounting, the discount rate one would calculate over a *delay*—the difference between the time when the outcome is realized and the time when the choice is made -- is independent of the number of intervals in the delay over which the discount rate is calculated, where an *interval* is the difference in time between two outcomes for which there is an intertemporal tradeoff. With Read's subadditive discounting, the total discount rate for a given magnitude of delay becomes larger as the number of intervals within the delay is increased.[13]

[12] The exception is that the point estimates indicate that former smokers have lower short-term rates of time discount than do either current or never smokers. These differences are not, however, statistically significant.
[13] For details, see Read (2003).

Our finding that time discounting decreases with increases in the delay, which is common in the previous literature, is based on questions that confound delay and the interval. In our analysis, the delay is the time difference between this year and some distant year, e.g., five, 10, or 20 years whereas by the nature of the questions, this coincides with the interval since the tradeoff is between healthy days this year and the distant year. To disentangle these two effects, it is sufficient to keep constant the interval between the two choices while varying period between the present and when the later outcome is to be realized. The questions used in the previous analysis follow conventions of the literature and are subject to Read's critique. Hence, as described in the following section, the SOS asked another set of questions to measure time discounting that is not subject to this critique.

III. B.2. Months of Life Extention from Colonoscopy

Hyperbolic time discounting has been proposed as a potential explanation for continued smoking (Gruber and Köszegi 2001). In this subsection, we seek direct evidence on short- and long-run discount rates and examine whether or not these differ by smoking status.

We again use a survey-based approach for estimating the short- and long-run discount rates. The second interview of the SOS contains a series of questions about the longevity benefit needed at different points in time for the respondent to be willing to undergo a colonoscopy. A colonoscopy is a procedure to screen and prevent colon cancer. It involves uncomfortable preparations, some form of sedation, and inconvenience. Although unpleasant and time consuming, the procedure is highly accurate in detecting polyps or tumors in the colon and is recommended for persons in the SOS age cohort,

irrespective of smoking status (Singh, Turner, Xue et al. 2006). The procedure thus offers a potential benefit in terms of increased longevity. These characteristics make questions about a colonoscopy a good instrument for eliciting rates of time discounting from both nonsmokers and smokers in the health domain. After presenting a description of the procedure and the required preparation, the SOS asked respondents to rate on a scale from 0 to 10 the degree of discomfort associated with the procedure, based on the description they just heard. Since the vast majority of persons are likely to have insurance for this procedure, time and discomfort involved are plausibly the major costs to individuals of having a colonoscopy. There are no statistically significant differences in the mean rating of discomfort between current and never and former and never smokers.

We elicit discount rates using responses to intertemporal choices about willingness to undergo colonoscopy. The SOS asks three questions about the payoff in terms of added life expectancy required for the individual to choose to get a colonoscopy.[14]

Assuming a finite lifespan consisting of periods indexed by *t*, for each individual i at time t, the SOS elicits the individual's subjective life expectancy (N_{it}). The first

[14]This is the text explaining to respondents what a colonoscopy entails. This explanation was provided before the sequence of questions about willingness to undergo this procedure were asked.

"People differ in how they think about the value of preventive care. The following items are about a preventive test that many people receive after the age of 50. The procedure is called a colonoscopy.

- The colon is the large intestine. This procedure is the best method for screening patients for colon cancer. By preventing colon cancer, life can often be extended as some of the disability and discomfort from the disease can often be avoided. Before the doctor begins the procedure, the patient is given anesthesia to reduce discomfort from the procedure. Because the patient may be sleepy afterwards, it is necessary for someone to drive the patient to the clinic where the procedure is done.
- A colonoscope, a long flexible tubular instrument, is inserted into the rectum. The other end of the scope has video visualization enabling the physician to directly inspect the lining of the colon. Other instruments, such as biopsy forceps, can be passed through the colonoscope to perform certain surgical procedures.

Before the procedure:

- Colonoscopy can be performed in either hospitals or outpatient surgical centers. It is very important to follow the instructions carefully because the colon must be completely clean for a successful test.
- The patient is asked not to eat or drink anything for at least 8 hours before the colonoscopy. A clear liquid diet is required the day before the exam.

  The patient also takes a liquid bowel stimulant the day before the procedure to cleanse out the colon."

colonoscopy question seeks to determine the number of months of added life expectancy (X_{1i}) needed to induce the person to get a colonoscopy now.[15] For individual i, let c_i be the instantaneous disutility of having a colonoscopy, and $V_i(N_{it} - t)$ be the utility of the anticipated remaining years of life at t. If the annual rate of time discount is $\gamma + \rho$ over the first year, and ρ over subsequent years, then if the individual is indifferent between having a colonoscopy and receiving X_{1i} additional years of life, we get an indifference equation of the following form:

$$V_i(N_{it} - t) = -c_i + V_i(N_{it} - t) + e^{-\gamma_i - \rho_i (N_{it} - t)} \alpha_i X_{1i} ,$$

where the additional months of life required to achieve this indifference (X_{1i}) arrive at the end of the expected life time and are therefore discounted by $e^{-\gamma_i - \rho_i (N_{it} - t)}$.[16] The parameter α_i is the individual-specific, time invariant value of an extra month of life, where again we assume that utility is well approximated by a linear function for the relevant (small) changes in life-expectancy. This indifference equation implies that

[15] Question 1 is phrased as: "Suppose you were told that by having the colonoscopy, you could extend your life expectancy from (N to N+ X_1). Would you have the colonoscopy now?" The starting value for X_1 was randomly drawn from 6 months to 5 years; iterations continued until the person chose to have a colonoscopy. 7.3 percent of responses were left-censored at 6 months and 0.3 percent of responses were right-censored at 5 years. We assume values at these limits in cases in which persons gave left- or right-censored values.

The second question is phrased as: "Suppose you were told that by having the colonoscopy a **year from now**, you could extend your life expectancy from (N to N+ X_2) years, would you be willing to have the procedure a **year from now**?" The SOS followed the same rules for picking starting values and determining values for the censored observations as in Question 1. 7.7 percent of values were left- and 0.7 percent of values were right-censored.

The third question is phrased as: "Now suppose that your life expectancy was **(N+1)**, that is, your life expectancy was extended by a year from the life expectancy you gave me earlier, and suppose you were told that by having a colonoscopy a year from **now,** you could extend your life expectancy from (N+1 to N+1+X_3) years, would you be willing to have the procedure a **year from now**?" The SOS followed the same rules for picking starting values and determining values for the censored observations as in Question 1. 11.0 percent of values were left- and 0.8 percent of values were right-censored.

[16] In principal, changes in life expectancy should reflect differences in the survival probability at each year to some distant terminal year. Our questions abstract from this process by specifying an extension of life that arrives at the expected end of life. To the extent that the survival hazard is high and flat at younger ages and declines steeply at older ages, our formulation will be a good approximation of the true dynamics of the hazard. The SOS abstracted from these dynamics for two reasons. First, even in this simple form, the questions on willingness to undergo a colonoscopy are complex. A more analytically correct formulation would have made the questions much more difficult for the respondents. Second, the colonoscopy questions are designed to be analogous to the financial tradeoff questions which specify a payoff at a particular date in the future.

$$c_i = e^{-\gamma_i - \rho_i (N_{it} - t)} \alpha_i X_{1i} \quad (3).$$

A second question asks the extra months of life expectancy needed for the person to be willing to have a colonoscopy a year from now (X_{2i}) keeping the longevity expectations the same. Life expectancy is kept constant in this question, despite the delay in the colonoscopy, because the response is meant to capture the intertemporal tradeoffs reflected in *committed* choices. If the respondent is committing to the colonoscopy now, the relevant life expectancy is the current one. Responses to this question imply a second indifference equation of the form:

$$V_i(N_{it} - t) = - e^{-\gamma_i - \rho_i} c_i + V_i(N_{it} - t) + e^{-\gamma_i - \rho_i (N_{it} - t)} \alpha_i X_{2i} .$$

The cost of a colonoscopy is unchanged but is discounted since the colonoscopy is delayed by a year. The second indifference equation implies

$$e^{-\rho_i} c_i = e^{-\rho_i (N_{it} - t)} \alpha_i X_{2i} \quad (4).$$

Equations (3) and (4) yield

$$e^{-\rho_i (N_{it} - t)} \alpha_i X_{2i} = e^{-\gamma_i - \rho_i (N_{it} - t+1)} \alpha_i X_{1i} ,$$

or $(\ln(X_{1i}/X_{2i}) = \gamma_i + \rho_i$.

The SOS includes a third question that delayed the benefits from the colonoscopy. This question added a year to the individual's subjective life expectancy (N_{it}+12), and then asked what the added months of life expectancy would have to be for the person to get a colonoscopy a year from now (X_{3i}). Responses to this question imply an indifference equation of the following form:

$$V_i(N_{it} - t) + e^{-\gamma_i - \rho_i (N_{it} - t)} \alpha_i * 12 = - e^{-\gamma_i - \rho_i} c_i + V_i(N_{it} - t) + e^{-\gamma_i - \rho_i (N_{it} - t)} \alpha_i * 12 + e^{-\gamma_i - \rho_i (N_{it} - t+1)} \alpha_i X_{3i},$$

where the arrival of the extra 12 months of longevity is postponed to the end of the person's life and the extra months are made available to the individual even if the person refuses to have a colonoscopy. This indifference equation implies

$$e^{-\rho_i} c_i = e^{-\rho_i (N_{it} - t + 1)} \alpha_i X_{3i} \quad (5).$$

Equations (4) and (5) yield

$$e^{-\rho_i (N_{it} - t + 1)} \alpha_i X_{3i} = e^{-\rho_i (N_{it} - t)} \alpha_i X_{2i},$$

or $\ln(X_{3i}/X_{2i}) = \rho_i$. Hence, $\ln(X_{1i}/X_{3i}) = \gamma_i$.

We use the recovered values of ρ and γ to investigate whether there is (quasi) hyperbolic time discounting and whether there are differences in average discounting by smoking status.

As a preliminary step, we run regressions with the dependent variable being the months needed to be willing to get a colonoscopy of the form:

$$X_i = \kappa + \theta * cs_i + \mu * fs_i + \varphi * Q2_i + \lambda * Q3_i + \varepsilon_i \quad (6),$$

where the dependent variable X_i is the response to questions 1, 2, or 3, and $Q2_i$ ($Q3_i$) is an indicator variable for question 2 (3); the omitted category is question 1.

The regression in Table 4, column 1 pools data on all three smoking categories. Never smokers, the omitted group, require an additional 13.25 months to their life expectancy on average to undergo a colonoscopy now.[17] To have a colonoscopy a year from now, all individuals require an average of 1.02 months less additional life expectancy.

[17] The SOS allows responses to the colonoscopy questions to vary from 6 months to 59 months. As a result, 7.3 percent of the observations to question 1 are left-censored, and 0.3 percent are right-censored. We use the mid-point between 0 and 6 months for the left-censored observations and an equal number of extra months for the right-censored observations. For question 2, 7.7 percent of observations are left-censored, and none are right-censored. For question 3, 11.0 percent of observations are left- and 0.8 percent are right-censored. To gauge the sensitivity of our findings to assumptions made about the value used for right-censoring, we substituted a value of 75 months for the value of 62.25 months used in the main calculations. There was virtually no change in the results.

When individuals are queried about getting a colonoscopy a year from now assuming their life expectancy is also increased by a year, then all individuals require an average of 1.36 months less than if they were to have the colonoscopy now.

Our mean estimate of the extra months of longevity people require to have a colonscopy exceed estimates of the objective longevity return to the procedure (Lin, Kozarek, Schembre et al. 2006). For person of mean age in the SOS sample, the mean life extension from having a colonoscopy is 7.6 months.[18] This gap should be viewed in light of the fact that the most recent published results appeared two years after the SOS was conducted. Also, the SOS elicits the asking price, which, given that many persons in this age group do not get colonoscopies, should be higher on average than the objective amount of life extension. In view of these considerations, the stated asking prices obtained from SOS respondents are quite reasonable. Our finding that fewer months are required to induce a colonoscopy if performed a year from now is consistent with discounting, either exponential or hyperbolic. Compared to responses from the second question, delaying benefits by a year in the third question should have led to more rather than fewer months being required to have a colonoscopy. The cost in the second and the third questions is the same, as the procedure is delayed by a year in both cases. However, given the extra year of life expectancy in the third question and perhaps declining marginal utility from large increases in longevity, the additional months of life expectancy needed to induce an individual to undergo the procedure should be larger. The difference in Table 4, col. is quite small -- 0.36 of a month --, but in the wrong direction. Importantly, there are no

[18] According to Lin, Kozarek, Schembre et al. (2006), mean life extension from having a colonoscopy was 0.85 years for 50-54 year olds and 0.17 for 75-79 year olds. Using linear interpolation to compute the decline in expected life extension for each additional year of life yields 0.63 years for a person aged 60. Converting 0.63 years into months yields the estimate reported in the text.

statistically significant differences by smoking status just as for the analysis of the financial tradeoff and extra healthy days questions reported above.

To obtain estimates of $\gamma+\rho$ and ρ, we estimate two regressions of the following form:

$$\ln(X_{1i}/X_{2i}) = \kappa + \theta^* cs_i + \mu^* fs_i + \varphi^* r_i + \varepsilon_i \quad (7a)$$

and

$$\ln(X_{3i}/X_{2i}) = \kappa + \theta^* cs_i + \mu^* fs_i + \varphi^* r_i + \varepsilon_i \quad (7b),$$

where X_{1i}, X_{2i}, and X_{3i} are responses to the first, second, and third colonoscopy questions, respectively, and r_i is an indicator with the value zero if the dependent variable is from (7a) and the value one if the dependent variable is from (7b).

The estimate of the sum of the parameters $\gamma+\rho$ for never smokers, the omitted group, is -0.039 but with large standard errors. The estimate of ρ is qualitatively similar (=-0.021, Table 5, col. 1). In each case, the estimated average discount rates are not statistically different from zero. Moreover, there are no statistically significant differences by smoking status. In column 2, which is based on the sample of current smokers, the estimate of $\gamma+\rho$ is 0.073 and the estimate of ρ is -0.077, implying that γ for current smokers is about 0.14. Both parameter estimates are not statistically significant from zero, as in column 1. In column 3, for former smokers, $\gamma+\rho$ is -0.030 and the estimate of ρ is -0.044, implying that γ for current smokers is slightly positive. However, these estimates also are not statistically significant. Finally, in column 4, for never smokers, $\gamma+\rho$ is -0.083 and the estimate of ρ is 0.074, implying that γ for current smokers is negative, which is opposite of the pattern of current smokers. Since these too are insignificant, we do not attach great importance to these differences in parameter estimates. The reason why our

point estimates of $\gamma + \rho$ are negative in column 1 is that respondents required fewer months for a colonoscopy when the benefits were delayed by a year in the third question. Importantly, a pattern consistent with the responses to questions discussed above is that there are no statistically significant differences by smoking status.

To our knowledge, the SOS is the first attempt to elicit short- and long-run rates of time preference this way. Overall, the estimated additional years of life required to be willing to obtain a colonoscopy are within a plausible range. Fewer than 10 percent of responses were either left- or right censored. However, the questions became increasing taxing on respondents (especially the third question). While the approach is promising, we make two suggestions for future research. First, respondents should be given a few practice questions (perhaps in the financial domain) to get more used to the time discounting concepts in the context of a structured survey. Second, the survey should account for the possibility that the value of a life year may change as longevity is extended.[19]

III. C. Alternative Sources of Time Preferences

III. C. 1. Planning

Thus far, we have assessed differences in time discounting. We now investigate a more general framework which allows other psychological motives to enter in intertemporal decisions. We begin with an examination of the financial planning horizon. The length of the planning horizon should capture longevity expectations, but also other factors such as planning ability or more general problems of self control (Ameriks, Caplan, and Leahy 2003). The SOS telephone interview asks respondents "In planning your savings and spending, which of the following time periods is most important to you and your

[19] For a time interval as short as a year, the simplifying assumption of no change in life expectancy is plausible.

household?" Choices available to respondents were: "the next few months, the next year, the next few years, the next 5-10 years, longer than 10 years."

We estimate an equation of the following form:

$$z_i = \kappa + \theta^* cs_i + \mu^* fs_i + \varphi^* p_i + \lambda^* A_i + \varepsilon_i \quad (8),$$

where i is a subscript for an individual, z_i is the length in years of the person's planning horizon, p_i is the individual's subjective probablity of surviving to age 75, and A_i is the person's age. Together, p_i and A_i measure the person's expected longevity, which would influence the person's planning horizon. We convert responses to questions for discrete planning horizon categories to a continuous measure in years as follows: < year = 0.5 year; next year = 1 year; next few years = 2.5 years; next 5-10 years = 7.5 years; and longer than 10 years = 20 years. Since the final category is open-ended, in an alternative specification, we replace 20 with 10 years to examine robustness of our findings to our assumption about the mean value of the response category.

Without controlling for other factors, current smokers have shorter financial planning horizons, irrespective of the value assigned to the open-ended category (Table 6, cols. 1 and 3). Using a 20-year value (10-year value) for the open-ended category, current smokers on average have a financial planning horizon which is 1.7 years (1.2 years) less than for never smokers. Planning horizons of former smokers do not differ from those of never smokers. The observed difference between current and never smokers is reduced to 1.2 years (0.9) when we control for age and the subjective probability of living to age 75.[20] Thus, some but not all of the observed difference between current and never smokers in financial horizon is due to the individuals' subjective beliefs about longevity.

[20] We also use ordered probit analysis, which does not require an assumption about the value of the open-ended category. The results are qualitatively the same as those reported.

In sum, current smokers have a shorter financial planning horizon than never smokers. This suggests that smokers are more present-oriented in ways not captured by the above analysis of time discounting. The questions regarding financial planning horizons seem to reflect determinants of time preference that are independent of both time discounting and longevity expectations. Hence, in the next section, we explore differences by smoking status with a still more general measure of time preference.

III. C. 2. Impulsivity

In this subsection, we measure a still more general source of time preference and relate it to the smoking decision. We use *impulsivity* as a measure of an individual's ability to set goals and to exercise self-control. The telephone interview of SOS recovered impulsivity using a series of 14 statements, such as "I make hasty decisions," I do not control my temper," and "I act on impulse."[21] Respondents were asked whether they "disagree strongly," "disagree," "neither disagree nor agree," "agree," or "strongly agree" with each of these statements. The actual wording of the questions varies so that "strongly agree" sometimes implies high self-control and low impulsivity and sometimes implies the opposite. In our analysis, we convert the answers to a consistent form in which "strongly agree" always implies high impulsivity and low self-control.

We create an index of impulsivity and self-control by converting the responses to a five-point scale with "disagree strongly" =1 and "agree strongly" =5 and summing the scores for individual items.[22] The index varies from 14 to 70 with higher values implying greater impulsivity. In Fig. 1, which shows the distribution of scores by smoking status, proportionally more current smokers than others have scores of 40 and above.

[21] We thank George Loewenstein for providing us with these questions.
[22] Specific items are listed in Appendix Table 1. This table also presents difference in means and in distributions by smoking status for each of the items in our impulsivity index.

To examine differences in the index by smoking status we estimate an equation regression of the form

$$b_i = \kappa + \theta * cs_i + \mu * fs_i + \Phi' * H_i + \varepsilon_i \quad (9),$$

where i is a subscript for an individual, b_i is the index defined above, and H_i is a vector of demographic characteristics.

On average, never smokers have an index of 33.9 (Table 7, col. 1). Current smokers on average have an index which is 2.1 points higher. For former smokers, the index is 2.2 points higher. These means are quite tightly estimated and, thus, both current and former smokers are significantly more impulsive than never smokers.

Controlling for years of education, gender, race, and age, the index for never smokers rises to 34.7. The difference for current smokers is 1.5 and former smokers is 1.7. Education makes people less impulsive; males tend to be more impulsive on average. As with financial planning, smokers tend to be more impulsive which is a more general measure of time preference. The results for smokers are robust to controls for important demographic characteristics.

Our results thus indicate that there is not much difference in time discounting by smoking status, but there are differences in measures of time preference related to financial planning and other measures of self-control as reflected in our index of impulsivity. Within domains, measures of time discounting are positively correlated, but not across financial and health domains (Table 8). The financial planning horizon is positively correlated with financial discounting. There is a negative correlation between the financial planning horizon and the impulsivity index, suggesting that financial planning reflects both time discounting and other elements of time preference.

IV. Conclusion

Based on data from a survey fielded for our research, our key finding is that there are no significant differences in revealed rates of time discounting by smoking status. While our results replicate various patterns in time discounting that have been used to explain time inconsistency in intertemporal decision making--in particular, declining rates of time discounting as the time period is extended, the average time discount function of smokers is not different from that of non-smokers. Differences in smoking behavior late in life, therefore seem likely to reflect factors other than time discounting.[23]

Subtler patterns reported previously in the literature on time discounting also appeared in our data: the measured rates of time discount reflected a dependence on magnitude, sign and domain that the previous literature has also noted. Our respondents demonstrated considerable over-optimism about quitting rates and substantial reliance on commitment devices. In this sense, much of our evidence is consistent with hyperbolic discounting. Nevertheless, we find little evidence that differences in rates of time discount are importantly related to differences in smoking decisions. Our findings are in contrast to those of a seminal study (Fuchs 1982), which examined associations between rates of time discounting and smoking. Our results suggest that it may be problematic to proxy time preference with measures of smoking behavior.

However, time discounting, as revealed by the intertemporal tradeoffs made by committed consumers, is just one potential determinant of time preference revealed by

[23] With the exception of Becker and Mulligan (1997), most work treats time discounting as a primitive of an economic model. We follow that convention here. Reynolds (2006) uses a sample of 15 smokers and 15 non-smokers who were on average in their early 30s and finds that the smokers discount delay at a higher rate. Bickel, Odum, and Madden (1999), using a sample of 23 current, 21 former smokers, and 22 never smokers which on average had mean ages in the early 30s found that current smokers had higher discount rates than did former or never smokers. There were no differences in discounting between former and never smokers. Although this result conflicts with ours, they did find that current smokers were relatively impulsive, a qualitatively similar result to ours.

uncommitted choices. The intertemporal tradeoffs represented by actual smoking decisions, the tastes for commitment revealed by smokers and their over-optimism about quitting all may emerge through many channels. Even though variations in time discounting do not appear to be a primary force behind differences in smoking decisions, measures that reflect self-control and other psychological processes are better correlated with the smoking decision. Both a measure of impulsivity and of financial time horizon (net of longevity expectations) are related to smoking decisions. Those who are more impulsive and plan less for the future are more likely to smoke. In this way, our findings suggest that problems of self control in intertemporal choices may not be well captured by time-varying rates of time discount.

Our findings thus provide further motivation for models that "open the black box" of time preference to model and investigate the behavioral implications of alternative psychological processes. Rather than identifying smoking simply with higher rates of time discount or more present-biased time discounting, our results indicate that smoking may be a marker for greater problems of self-control that emerge through other channels. Specifically, the relative strength of the relationship between measures of impulsivity, planning horizons and smoking decisions points toward a growing literature that models ideas such as costly-self control, dual selves and decision processes, and cue-theories of consumption. Our findings indicate that, in the smoking domain, the predictions of such modeling may prove a useful complement to research on alternatives to the standard exponential discount function.

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Table 1. Summary Statistics

Variables	Full Sample		Persons Participating in Both Interviews		Persons Only Participating in Telephone Interview	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Smoking status						
Current smoker	0.380	0.486	0.346*	0.476	0.444	0.498
Former smoker	0.388	0.488	0.383	0.487	0.397	0.490
Never smoker	0.232	0.423	0.271**	0.445	0.159	0.367
Demographic characteristics						
Age	59.620	5.823	59.343	5.736	60.138	5.959
Non-Hispanic white	0.863	0.344	0.868	0.339	0.853	0.355
African American	0.107	0.309	0.102	0.303	0.116	0.320
Hispanic	0.003	0.055	0.002	0.048	0.004	0.067
Other races	0.018	0.134	0.028	0.165	0.026	0.159
Male	0.357	0.479	0.378	0.485	0.319	0.467
Married	0.587	0.493	0.577	0.495	0.607	0.489
Years of education	14.334	2.583	14.640**	2.585	13.753	2.482
Self-reported health						
Excellent	0.172	0.378	0.193*	0.395	0.134	0.341
Very good	0.299	0.458	0.329*	0.471	0.241	0.429
Good	0.287	0.453	0.274	0.446	0.310	0.464
Fair	0.149	0.357	0.135	0.342	0.177	0.382
Poor	0.090	0.287	0.070	0.255	0.129	0.336
Impulsivity index	35.570	5.436	35.379	5.365	35.933	5.564
Financial tradeoff variables						
Win$1k now v. $1.5k in year	0.637	0.481	0.617	0.487	0.674	0.470
Win $20 now v. $30 in year	0.800	0.401	0.771**	0.421	0.854	0.354
Lose $1.5k in year v. $1k now	0.507	0.500	0.502	0.501	0.516	0.501
Lose $30 in year v. $20 now	0.452	0.498	0.457	0.499	0.441	0.498
Planning horizon I	6.798	6.733	7.071	6.744	6.269	6.697
Planning horizon II	5.025	3.614	5.231*	3.583	4.626	3.648
Number of observations	663		431		232	

*The difference in means between the two sub-samples is significant at 5% level.
**The difference in means between the two sub-samples is significant at 1% level.

Table 1. cont.

Variables	Full Sample Mean	Full Sample Std. Dev.	Persons Participating in Both Interviews Mean	Persons Participating in Both Interviews Std. Dev.	Persons Participating in Only Telephone Interview Mean	Persons Participating in Only Telephone Interview Std. Dev.
Healthy days tradeoff						
Extra healthy days 1 year from now equal to 20 healthy days now			68.264	111.800		
Extra healthy days 5 years from now equal to 20 healthy days now.			83.770	118.375		
Extra healthy days 10 years from now equal to 20 healthy days now.			99.567	128.937		
Extra healthy days 20 years from now equal to 20 healthy days now.			110.325	141.129		
Having a colonoscopy						
Extra months of life needed to undergo colonoscopy now			13.517	12.282		
Extra months of life needed to undergo colonoscopy in year			12.512	10.329		
Extra months of life needed to undergo colonoscopy a year now if life expectancy is extended by 1 year now			12.265	10.316		
Number of observations	663		431		232	

*The difference in means between the two sub-samples is significant at 5% level.
**The difference in means between the two sub-samples is significant at 1% level.

Table 2. Financial Tradeoffs: Choices of Payment Now Versus a Year from Now

Dependent variable: choice of payoff now = 1 versus payoff a year from now = 0.	Sample			
	All	Current Smoker	Former Smoker	Never Smoker
Win $20 now v. $30 in year	0.163**	0.161**	0.178**	0.143**
	(0.018)	(0.028)	(0.031)	(0.036)
Lose $1,500 in year v. $1,000 now	-0.130**	-0.115**	-0.131**	-0.150**
	(0.022)	(0.036)	(0.037)	(0.042)
Lose $30 in year v. $20 now	-0.185**	-0.194**	-0.177**	-0.184**
	(0.023)	(0.038)	(0.038)	(0.043)
Current smoker	0.044			
	(0.037)			
Former smoker	0.016			
	(0.036)			
Age	0.002			
	(0.002)			
Constant	0.506**	0.657**	0.625**	0.623**
	(0.142)	(0.030)	(0.031)	(0.039)
R^2	0.077	0.076	0.079	0.070
N	2,582	973	1,005	604

Robust standard errors are in parentheses.
Omitted groups are winning $1,000 now v. $1,500 a year from now and never smokers.
*Significantly different from zero at 5% level.
** Significantly different from zero at 1% level.

Table 3. Healthy Days Tradeoff: Number of Extra Healthy Days in the Future Equal to 20 Extra Healthy Days This Year

	Sample			
	All	Current Smoker	Former Smoker	Never Smoker
This year v. 5 years from now	-0.357**	-0.414**	-0.292**	-0.378**
	(0.044)	(0.082)	(0.065)	(0.085)
This year v. 10 years from now	-0.416**	-0.465**	-0.360**	-0.435**
	(0.047)	(0.086)	(0.072)	(0.091)
This year v. 20 years from now	-0.454**	-0.501**	-0.397**	-0.475**
	(0.049)	(0.089)	(0.074)	(0.095)
Current smoker	-0.007			
	(0.044)			
Former smoker	-0.026			
	(0.041)			
Age	0.004			
	(0.003)			
Constant	0.500**	0.535**	0.432**	0.515**
	(0.058)	(0.092)	(0.077)	(0.098)
R^2	0.104	0.113	0.089	0.117
N	1,547	524	593	430

Robust standard errors are in parentheses.
Omitted groups are this year v. 1 year from now and never smokers.
*Significantly different from zero at 5% level.
** Significantly different from zero at 1% level.

Table 4. Extra Months Needed to Get a Colonoscopy

		Sample		
	All	Current Smoker	Former Smoker	Never Smoker
Get colonoscopy a year from now	-1.020*	-1.774*	-0.976	-0.217
	(0.507)	(0.847)	(0.835)	(0.969)
Get colonoscopy a year from now with one more year of life expectancy	-1.358*	-1.238	-1.747	-0.979
	(0.575)	(1.008)	(0.949)	(1.048)
Current smoker	0.778			
	(1.631)			
Former smoker	-0.559			
	(1.312)			
Constant	13.245**	14.232**	12.784**	12.870**
	(1.129)	(1.314)	(0.997)	(1.228)
R^2	0.005	0.003	0.006	0.001
N	905	299	348	258

Omitted groups: get colonoscopy now and never smoker.
Robust standard errors are in parentheses.
*Significantly different from zero at 5% level.
** Significantly different from zero at 1% level.

Table 5. Discount Rates in First Year and Subsequent Years by Smoking Status

Dependent variable: first year discount rate	Sample: All	Current Smoker	Former Smoker	Never Smoker
Discount rate: subsequent years	-0.021	-0.077	-0.044	0.074
	(0.034)	(0.056)	(0.055)	(0.065)
Current smoker	0.085			
	(0.068)			
Former smoker	-0.002			
	(0.064)			
Constant	-0.039	0.073	-0.030	-0.083
	(0.051)	(0.052)	(0.045)	(0.059)
R^2	0.006	0.005	0.002	0.005
N	562	185	217	160

Robust standard errors are in parentheses.
*Significantly different from zero at 5% level.
** Significantly different from zero at 1% level.

Table 6. Financial Planning Horizon by Smoking Status

	Planning Horizon I		Planning Horizon II	
	(1)	(2)	(3)	(4)
Current	-1.711*	-1.195	-1.172**	-0.902*
smoker	(0.706)	(0. 717)	(0.369)	(0. 376)
Former	-0.970	-0.567	-0.533	-0.311
smoker	(0.696)	(0.710)	(0.362)	(0.366)
Subjective		3.658**		1.846**
probability of		(0.889)		(0.507)
living to 75				
Age		0.057		0.017
		(0.046)		(0.024)
Constant	7.808**	1.274	5.666**	3.061*
	(0.558)	(2.813)	(0.282)	(1.524)
N	643	638	643	638
R^2	0.009	0.034	0.016	0.037

Robust standard errors are in parentheses.
*Significantly different from zero at 5% level.
** Significantly different from zero at 1% level.
Planning horizon I: 0.5 yr, 1 yr, 2.5 yr, 7.5 yr, 20 yr.
Planning horizon II: 0.5 yr, 1 yr, 2.5 yr, 7.5 yr, 10 yr.

Fig. 1. Impulsivity Index.

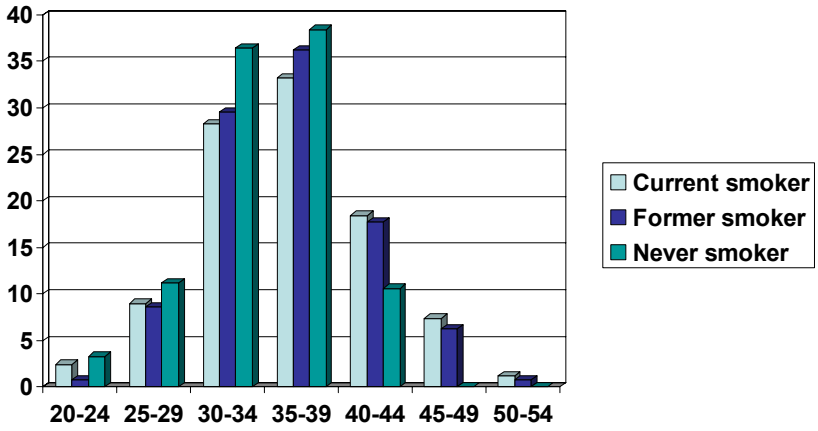

Table 7. Impulsivity Index

	(1)	(2)
Current smoker	2.121**	1.475**
	(0.524)	(0.549)
Former smoker	2.211**	1.688**
	(0.492)	(0.491)
Years of education		-0.313**
		(0.083)
Black		0.156
		(0.635)
Hispanic		0.310
		(2.230)
Other races		-1.389
		(1.248)
Male		1.058*
		(0.445)
Age		0.064
		(0.035)
Constant	33.907**	34.697**
	(0.362)	(2.496)
R^2	0.029	0.061
N	649	645

Robust standard errors are in parentheses.
*Significantly different from zero at 5% level.
** Significantly different from zero at 1% level.

Table 8. Correlations among Financial Planning Horizon and Discounting Variables

	Win $1k Now v. Win $1.5k in Year	Lose $1.5k in Year v. Lose $1k Now	Healthy Days trade (1 year)	Healthy Days Trade (10 years)	Healthy Days Trade (20 years)	Discount rate: first year	Discount rate: subsequent years	Financial Planning Horizon I
Lose $1.5k in year v. lose $1k now	0.35 (0.00)							
Healthy days trade (1 year)	0.06 (0.26)	0.10 (0.06)						
Healthy days trade (10 years)	0.05 (0.30)	0.05 (0.34)	0.57 (0.00)					
Healthy days trade (20 years)	0.05 (0.32)	0.05 (0.34)	0.47 (0.00)	0.93 (0.00)				
Discount rate: first year	0.06 (0.33)	0.03 (0.61)	-0.12 (0.04)	-0.11 (0.08)	-0.10 (0.10)			
Discount rate: subsequent years	0.01 (0.89)	-0.07 (0.24)	-0.13 (0.04)	-0.05 (0.46)	-0.03 (0.64)	0.46 (0.00)		
Financial Planning Horizon I	-0.17 (0.00)	-0.12 (0.00)	-0.08 (0.12)	-0.06 (0.27)	-0.08 (0.13)	-0.06 (0.34)	-0.03 (0.58)	
Impulsivity index	0.00 (0.99)	0.02 (0.69)	0.10 (0.04)	0.00 (0.94)	0.01 (0.87)	0.05 (0.35)	-0.02 (0.72)	-0.16 (0.00)

p-values are in parentheses.

Appendix Table 1. Differences in Personal Attributes by Smoking Status

	Chi Square Tests for Differences in Frequency Distributions		Means		
Questions	Current v. never smoker	Former v. never smoker	Current smoker[1]	Former smoker[2]	Never smoker
I rarely make hasty decisions	10.82*	14.70	2.727	2.798	2.675
I am able to get organized[#]	42.32**	8.66	3.635	3.389	3.409
I do not fly off the handle[#]	18.97**	34.13**	2.165*	2.320**	1.908
There are so many little jobs that need to be done, but I never just ignore them. [#]	40.03**	5.24	2.976**	2.695	2.558
I control my temper	56.73**	65.38**	2.024**	2.113**	1.779
I do not things on impulse that I later regret[#]	21.18**	13.86**	2.396	2.473*	2.240
I do control my angry feelings	10.60*	15.67**	2.124	2.172	2.071
I do worry about things that might go wrong	30.32**	5.94	2.851	2.859	2.838
I do consider consequences before I take action	29.29**	41.99**	2.373**	2.441**	2.110
I am a worrier[#]	21.24**	1.50	3.132	3.129	3.170
I do plan for the future	29.32**	24.59**	2.292**	2.172	2.032
I never do things on the spur of the moment	78.55**	27.83**	2.892	2.969	3.084
I do finish what I start	16.30**	23.58**	2.137	2.312	2.916
I do not act "on impulse" [#]	41.93**	23.94**	2.580**	2.545*	2.312

scale: 1: disagree strongly, 2: disagree, 3: neither disagree nor agree, 4: agree, 5: agree strongly

[1] t-test comparing means for current v. never smokers

[2] t-test comparing means for former v. never smokers

*Significantly different from zero at 5% level. ** Significantly different from zero at 1% level.

[#]: Questions format reversed to make the higher values on the scale more impulsive.