Short-Term Cost for Long-Term Benefit: Time Preference and Cancer Control

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A tradeoff between short-term costs and long-term gains characterizes many cancer control behaviors, such as behavior change (e.g., quitting smoking), screening (e.g., mammography), and prevention (e.g., healthy diet). One factor that may influence these tradeoffs is time preference, or the value assigned to future outcomes relative to immediate ones. Studies of the relationship between individual differences in time preference and preventive health behaviors, however, have yielded mixed results. Time preference is related to addictive behaviors (e.g., smoking) but not to other preventive health behaviors (e.g., vaccination). This pattern of results suggests that time preference measures reflect an ability to forgo immediate gratification that is applicable to hot behaviors, such as smoking, but not to cold behaviors, such as vaccination.

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Many factors that determine who gets cancer and who does not, or who survives and who does not, are not under the control of the people who might be diagnosed with cancer. Other factors, however, are under behavioral control. A number of behaviors can reduce the risk of developing cancer or increase the odds of surviving cancer by finding it at an early, treatable stage. The behavior with the strongest link to cancer is smoking. Refraining from smoking, or quitting once one has started, can greatly reduce the risk of developing lung cancer as well as other diseases. For example, according to the National Cancer Institute’s (n.d.) cancer control Web site, a man who smokes a pack a day starting at age 22 has a lifetime risk of dying from lung cancer that is 10 times greater than that of a comparable nonsmoker. For smokers who started before the age of 18, the lifetime risk of lung cancer death is 15 times higher than that of a nonsmoker.

Although behaviors other than smoking do not have as large an effect on cancer incidence and mortality, they do influence the risk. Prevention behaviors, such as sun protection, healthy diet, exercise, early child bearing, and extended breast feeding, also reduce the risk of developing cancer. Screening behaviors, such as mammography, prostate-specific antigen screening, Pap testing, and colonoscopy, do not prevent cancer but do detect it at an earlier (presumably more treatable) stage than otherwise. Hence, they reduce cancer mortality.

Why do people fail to engage in cancer control behaviors that would reduce their chances of developing or dying from cancer? Given that cancer is such a feared event and that some behaviors play a role in preventing this event, why are these behaviors not executed more faithfully? Although there are many potential answers to this question, the current article focuses on one: the fact that the benefits of the behaviors are delayed, whereas the costs are immediate. Perhaps one reason many people fail to engage in cancer control behaviors is that they place too little value on future outcomes.

The purpose of the current article is to review the literature on the relationship between preventive health behaviors (especially cancer control behaviors) and the amount of value that people place on future outcomes, a concept known as time preference. The remainder of the article is structured as follows. First, I discuss the concept of time preference. Second, I review empirical studies that examine the relation between time preference and health behavior. The next section considers whether the concept of hot–cold empathy gaps (see Loewenstein, 2005) can help explain findings in the time preference literature. A following section considers the overlap between time preference and other individual-differences attributes. In a concluding section, I summarize a potential descriptive account and suggest directions for future research.

Time Preference

Cancer control behaviors instantiate an intertemporal tradeoff: a choice between a small, immediate reward (e.g., lying on the beach this afternoon) and a larger, delayed reward (e.g., having healthy, cancer-free skin when older). According to decision theory, such tradeoffs are resolved by, among other factors, time preference—the value placed on delayed outcomes relative to more immediate outcomes. Thus, a potential explanation for why many people fail to engage in cancer control behaviors is that they discount future outcomes very steeply—that is, that they devalue the future outcomes because of the delay. According to this time preference account, decision makers who value future outcomes much less than comparable present outcomes are said to have a high temporal discount rate or to discount the future steeply. Specifically, a high discount rate is defined to mean that a future outcome loses a large percentage of its value because of the delay. Thus, for example, applying sunscreen is a minor inconvenience, but it occurs immediately for our beachgoer. The benefit of this behavior (reduced...
risk of skin cancer) occurs decades in the future. According to this account, a beachgoer who discounts the future steeply would not apply sunscreen unless the delayed benefit were quite large (e.g., large risk reduction). In contrast, a beachgoer with a low discount rate would apply sunscreen even if the delayed benefit were rather small.

The concept of time preference originated in economic theory. Normative discounted utility theory (Koopsman, 1960) prescribes that although different individuals may have different personal discount rates, each individual should consistently apply the same discount rate to all decisions. The question of whether high discount rates motivate people to avoid cancer control behaviors is part of a broader focus on whether economic concepts may help to explain health behaviors, an idea that has received considerable attention in recent years (e.g., G. S. Becker & Murphy, 1988; Bickel & Vuchinich, 2000; Charlson et al., 2002). This research has shown that economic concepts such as elasticity of demand, substitutable commodities, unit price, and net present value can provide potential explanations of health behavior phenomena such as addiction, healthy diet, health care utilization, and adherence to behavior change recommendations. Economic theory also predicts that people who discount the value of delayed outcomes at a steep rate should be less likely to engage in preventive health behaviors than those who discount future events very little. The current literature review evaluates the evidence relevant to this prediction.

The time preference concept focuses on the timing of outcomes. In reality, however, delayed outcomes are also often more uncertain than are immediate outcomes, and it is therefore difficult to differentiate the effect of time delay from that of uncertainty (e.g., Gafni & Torrance, 1984). Indeed, the perceived uncertainty of an outcome has its own relation to health behavior (e.g., McCaul, Branstetter, Schroeder, & Glasgow, 1996). The value of delayed outcomes may be discounted in part because the delay entails uncertainty (e.g., Keren & Roelofsma, 1995). For example, a beachgoer might fail to apply sunscreen not only because the benefits are delayed but also because the delay entails uncertainty as to whether there will ever be any repercussions of the action (e.g., the beachgoer might think he or she is likely to die from another cause long before he or she would get skin cancer, so sunscreen would have no effect). Although the interplay between time delay and uncertainty in how each affects health behavior is of great interest, the current article focuses solely on time delay.

Any relation between time preference and cancer control behaviors would be of interest for two reasons. First, such a relationship would provide one possible explanation as to why these behaviors do not always occur. Second, it might suggest methods for encouraging these behaviors. Specifically, manipulations that alter time preferences might also increase preventive behaviors.

A number of theories have been proposed to explain when people engage in health behavior, including the health belief model (H. M. Becker & Rosenstock, 1984), the theory of planned behavior (Ajzen, 1991), and the precaution adoption model (Weinstein, 1988). Many of these theories are implicitly decision-making theories, incorporating risk–benefit factors such as the perceived benefits of the health behavior or the perceived risk of the illness. It is notable, however, that none of them incorporates time preference. For example, according to the health belief model, although perceived benefits drive health behavior, this influence is not moderated by the timing of those benefits, as the concept of time preference would predict. Thus, a relation between time preference and health behavior falls outside the current scope of the theories most commonly used to explain health behavior and therefore may expand the range of theoretical constructs used to explain health behavior.

Empirical Studies on Time Preference and Health Behaviors

A number of studies have examined the association between time preference, as measured via choices in hypothetical scenarios, and preventive health behaviors. These studies are summarized in Table 1. Not all of the health behaviors examined are cancer related, but presumably any relation between time preference and preventive behavior applies to both cancer-control behaviors and other health behaviors.

In the studies shown in Table 1, participants were presented with monetary or health scenarios that involved choices between immediate and delayed sums of money (or other outcomes). In most cases, the choices were hypothetical, although Kirby, Petry, and Bickel (1999) and Mitchell (1999) used choices with real consequences.

Studies of vaccination, medication compliance, and exercise show little relation between time preference and behavior. Time preference measures for health outcomes showed a small ($r = .12$) relation with acceptance of the influenza vaccine, such that those who accepted the vaccine discounted the future less steeply than those who declined the vaccine (Chapman et al., 2001; Chapman & Coups, 1999). Time preference for monetary outcomes, however, was unrelated to vaccination in these studies. Time preference measures were unrelated to adherence to medication treatment for hypertension (Chapman, 1998; Chapman et al., 2001) or high cholesterol (Chapman et al., 2001), and they were unrelated to exercise (Chapman, 1998).

In contrast, studies of addictive behaviors show strong evidence for the relation between time preference measures and health behavior (for a review, see Bickel & Marsch, 2001). Temporal discount rates are steeper (meaning the future is devalued more) for heroin or other drug users than for matched nondrug-using controls (Ainslie & Haendel, 1983; Brettville-Jensen, 1999; Kirby et al., 1999; Madden, Bickel, & Jacobs, 1999) and higher for heavy social drinkers and problem drinkers than for light social drinkers (Vuchinich & Simpson, 1998). Discounting is steeper for cigarette smokers than for nonsmokers (Baker, Johnson, & Bickel, 2003; Cairns, 1994; Fuchs, 1982; Mitchell, 1999) and also steeper for current smokers than for ex-smokers (Bickel, Odum, & Madden, 1999; Odum, Madden, & Bickel, 2002).

Addiction-related behaviors that do not involve abuse of chemical substances also show a relation to time preference. For example, needle sharers discount the future more steeply than do non-sharers (Odum, Madden, Badger, & Bickel, 2000), and problem gamblers discount the future more steeply than do nonproblem gamblers (Petry & Casarella, 1999). Thus, the association between time preference and addiction is not explained by a physiological effect of a chemical substance.

Bickel et al. (1999) asked current smokers, ex-smokers, and never smokers to make a series of choices between immediate and delayed monetary amounts. For example, a series of choices would determine the immediate amount of money that was just as attrac-
discount money much more steeply than do never and ex-smokers. Furthermore, current and ex-smokers show essentially identical discounting.

### Meta-Analysis

Table 1 shows the effect size, expressed as a Pearson product–moment correlation, for those studies reporting data that could be converted to correlations. A number of studies of addictive behaviors report only medians and nonparametric statistics; thus, no correlation is reported for them. A meta-analysis was conducted on the 12 studies for which correlations could be computed. Across these studies, the relation between time preference and health behavior was small but statistically significant \((r = .12, 95\% \text{ confidence interval } [CI] = 0.08, 0.16)\), and there was significant heterogeneity across studies, \(Q(11) = 39.05, p < .0001\).

The studies of addictive behavior show significantly larger effect sizes than the studies examining other types of health behavior, \(r(2269) = 7.10, p < .0001\). Among the six studies of addictive behavior included in the analysis, the relation between time preference and health behavior was statistically significant \((r = .26, 95\% \text{ CI} = 0.19, 0.32)\), with no significant heterogeneity across studies, \(Q(5) = 6.27, p = .28\). In contrast, among the six studies of other types of health behavior, there was no significant relation between time preference and health behavior \((r = .04, 95\% \text{ CI} = -0.01, 0.09)\), with no significant heterogeneity across studies, \(Q(5) = 9.69, p = .08\). The meta-analysis confirms that time preference is related to addictive behavior but not to other health behaviors. Thus, the decision theoretic prediction that time preference should be associated with health behavior is not con-
sistently upheld. It holds true only for one class of health behaviors: addictive behaviors. As a consequence, the following sections consider more psychological, less decision theoretic alternative accounts of the results just reviewed.

**Hot Versus Cold States**

Addiction appears to bear a special relation to time preference. An intriguing possibility is that some classes of behaviors reflect time preferences but others do not. For example, hot, emotional, or impulsive behaviors might reflect time preferences more so than cool, considered, or habitual behaviors (e.g., Metcalfe & Mischel, 1999; Mischel, Ayduk, & Mendoza-Denton, 2003).

Loewenstein (1996, 2005) has demonstrated that people discount more steeply when they are in a hot state (e.g., hungry, angry, sexually aroused) than when they are in a cold state (e.g., sated, calm, not aroused). For example, Giordano et al. (2002) examined the time preferences of buprenorphine-maintained opioid-dependent individuals both when they were opioid deprived (hot) and when they were opioid satiated (cold). Discounting was much steeper in the deprived state, indicating that craving, like other visceral drive states, increases discounting. Thus, one explanation for why time preferences are related to addictive behaviors but not other health behaviors is that only the former relation affords a comparison between hot and cold states.

The steeper discounting functions of substance users compared with controls, however, do not appear to be due to the former being in a hot state of craving when expressing their time preferences, whereas control participants are in a cold state. In fact, a number of the studies summarized in Table 1 took efforts to ensure that substance-dependent participants were not in a state of craving when time preference was assessed. For example, Bickel et al. (1999) and Baker et al. (2003) instructed smokers to smoke as usual prior to coming in for the study, with Bickel et al. (1999) even scheduling a cigarette break in the middle of the study. Madden, Petry, Badger, and Bickel (1997) assessed time preferences of heroin-dependent participants within 1 hr after they received their daily maintenance buprenorphine dose. It is possible, of course, even with these precautions, that substance-dependent participants were in a hotter state than were the control participants. Nevertheless, the difference in time preference between users and nonusers appears to be one between two groups with different behavioral histories rather than a difference between people who are and are not in a state of drug craving. It is plausible that a history of repeatedly being in a hot state of deprivation from the addictive substance causes substance users to discount more steeply.

Such an explanation entails that addiction influences time preference rather than vice versa. Bickel and Johnson (2003) presented evidence supporting precisely this idea. The results of their experiment are shown in Figure 2. Cigarette smokers were randomly assigned to an experimental or a control group. Both groups answered hypothetical choice questions to assess their time preference for money outcomes and cigarettes. The y axis of Figure 2 shows $k$, which is a measure of discount rate, with higher values indicating steeper discounting of future outcomes. The experimental group was paid to abstain from smoking for 5 days. Three times

![Figure 2](image-url)

*Figure 2.* The median discount rate for money and cigarettes is plotted for an experimental and a control group of smokers, both at pretest and after the experimental group was paid for a week of abstinence. From “Delay Discounting: A Fundamental Behavioral Process of Drug Dependence” (p. 434), by W. K. Bickel and M. W. Johnson, in *Time and Decision: Economic and Psychological Perspectives on Intertemporal Choice*, edited by G. Loewenstein, D. Read, and R. F. Baumeister, 2003, New York: Russell Sage Foundation. Reprinted with permission of the author. Pre = pretest; Post = posttest.
a day, experimental participants came to the laboratory to provide a carbon monoxide breath sample and were paid $10 each time the reading indicated that they had not smoked. Control participants were asked to follow their usual smoking routine. At the end of the 5 days, time preference was reassessed. As shown in Figure 2, discount rate did not change from pre- to posttest for the control participants, but for the experimental participants, discount rate decreased following abstinence. That is, after the week-long period of abstinence, the experimental group placed more value on future outcomes than they had prior to the abstinence period. These results indicate that a prolonged period of abstinence results in a change in time preference.

It appears to be sustained (not intermittent) abstinence that causes less discounting of the future. The Giordano et al. (2002) study found that being in an opioid-deprived state for a short time increases, not decreases, discounting. Unlike the participants in that study, however, those in the Bickel and Johnson (2003) study were probably not in an active state of craving nicotine when time preference was measured. After the week-long period of sustained abstinence, craving had likely subsided. Even if the experimental group was experiencing some craving at the posttest, any craving they experienced relative to the control group would tend to push the results in the opposite direction (toward steeper discounting among those in a craving state). This study suggests that the repeated act of depriving oneself of immediate gratification over an extended period may result in lasting changes in time preference. The implication is that active substance users have higher discount rates than controls because the repeated act of giving in to immediate gratification results in steeper discounting. Researchers could test this hypothesis by examining how time preference changes over a period of indulgence (e.g., overeating during a string of holiday parties) compared with a period of self-deprivation (e.g., during a religious fast period).

**Time Preference and Individual Differences**

The prediction that time preference will be associated with cancer control and prevention behavior carries with it the implicit assumption that time preference is a stable individual-differences variable. That is, the assumption is that different people discount the future at different rates but that each person is quite consistent in applying his or her discount rate to different decisions, including decisions about whether to smoke, use sunscreen, and so forth as well as hypothetical decisions posed in questionnaires to measure time preference.

There is some evidence supporting the idea that time preference is a relatively stable individual-differences variable. Simpson and Vuchinich (2000) found strong test–retest reliability of time preference over a 1-week interval ($r = .85$; $N = 17$), whereas Chapman et al. (2001) found weaker reliability over a 1-year interval (reliabilities ranged from .26 to .39; $N = 152$). In addition, time preference is correlated with individual characteristics such that delayed outcomes are discounted less steeply by people with higher income (Green, Myerson, Lichtman, Rosen, & Fry, 1996) and those with higher levels of education (Maital & Maital, 1978).

Discounting varies with age (Green, Fry, & Myerson, 1994) such that young adults discount most steeply, older adults less steeply, and middle-aged adults least steeply (Read & Read, 2004). Finally, the results of the addiction studies just reviewed are difficult to explain without surmising that the time preference measure captures a stable characteristic. These results imply that although time preference may change over long periods of time (aging) or with major life events (quitting smoking), it is stable over short periods of time and consistent circumstances. Other research, however, indicates that time preference varies greatly over situations, such as gains versus losses or large versus small magnitude outcomes (see Chapman, 1998, for a review), and that time preference for health outcomes is uncorrelated with time preference for money outcomes (Chapman, 1996).

How can these somewhat inconsistent findings be reconciled? One possible account is that time preference is a normative but not a psychological concept. Psychological accounts of intertemporal choice (e.g., Loewenstein, Read, & Baumeister, 2003) differ substantially from normative discounted utility theory. Thus, when lay people approach an intertemporal choice (e.g., “Should I endure smoking cessation now so that I am healthy later?”), the relevant discount rate (or percentage of loss in value for each unit of delay) is not a factor that they explicitly or implicitly consider. Instead, numerous situational and motivational factors influence the salience and weight of the immediate and delayed costs and benefits and the decision rules or strategies applied. Measures of time preference capture some of these psychologically relevant concepts, at least some of the time, which enables time preference to predict behavior in some circumstances.

What psychologically relevant concepts might be captured by time preference measures? A number of individual-differences measures of temporal attitudes are conceptually related to intertemporal choice. One such measure is sensation seeking (Zuckerman, 1994), which is a trait associated with behaviors such as alcohol and drug abuse, gambling, and health behaviors. Mitchell (1999) found that three of the four subscales from the Zuckerman, Eysenck, and Eysenck (1978) sensation-seeking measure were related to smoking status, but only one was related to time preference. Another example of a stable temporal attitude is Consideration of Future Consequences (CFC), a personality scale that is predictive of cancer screening decisions (Orbell, Perugini, & Rakow, 2004). Orbell et al. (2004) found that people with high CFC were most likely to intend to engage in a new type of colorectal cancer screening when a persuasive communication indicated short-term negative but long-term positive consequences of the screening. People with low CFC, however, showed the opposite pattern. Chapman (1998) found CFC to be marginally correlated with time preference for health (but not money) outcomes such that people with high CFC discounted health outcomes less steeply, a pattern that is consistent with Orbell et al.’s results.

Delay of gratification has been studied in the well-known work of Mischel and colleagues (e.g., Mischel et al., 2003; Mischel, Shoda, & Peake, 1988; Mischel, Shoda, & Rodriguez, 1989; Shoda, Mischel, & Peake, 1990). In the delay of gratification task, a small treat (e.g., one marshmallow) is placed in front of a young child, with instructions that if the child waits until the experimenter returns (15 min), the child can have a large treat (e.g., two marshmallows). Alternatively, if the child rings a bell anytime during the interim, the experimenter will return immediately, but the child can then have only the small treat. Findings revealed that the amount of time that the child waited was significantly correlated a decade later with Verbal and Quantitative SAT scores and parental ratings of the adolescent’s ability to cope with frustration...
and stress and to pursue goals. This relation was found only if the delay of gratification task was conducted with the small reward visible to the child (rather than being covered) and the child was not given any instructions about using distracting thoughts—in other words, conditions in which the child needed to use his or her own self-control strategies. That is, behavior in a hot state (when the tempting marshmallow is immediately accessible) is indicative of self-control behavior a decade later, whereas behavior in a cooler state (when the marshmallow is out of sight) is not. This finding suggests that ability to cope with hot states may be an important trait that is predictive of future behavior.

Several of the studies summarized in Table 1 examined individual-differences measures in addition to time preference. Madden et al. (1997) found that scores on the Impulsivity subscale of the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1978) were both significantly higher for opioid-dependent participants than matched control participants and also correlated with discount rates ($r = .40$). Kirby et al. (1999) found that, compared with controls, heroin-dependent participants scored higher on the Impulsivity and Venturesomeness subscales of the Eysenck questionnaire and on all subscales of the Barratt Impulsiveness Scale (Barratt, 1985). Further, discount rates were correlated with scores on all of these (with the exception of the Motor Impulsiveness subscale of the Barratt Impulsiveness Scale). In a study by Mitchell (1999), smokers were more impulsive than nonsmokers on both the Eysenck and the Barratt scales as well as on three other personality scales of impulsiveness. In this study, however, scores on the personality scales were largely uncorrelated with discount rate.

None of these studies examined whether addiction status was related to discount rate after statistically controlling for the impulsiveness scales, so we do not know whether the impulsiveness scores can explain the relation between addiction status and discount rate. If time preference was no longer related to addiction status after controlling for, for instance, impulsiveness, it would indicate that time preference predicts addiction behavior because the time preference measure captures a component of impulsiveness. Impulsiveness may, in turn, be relevant only to health behaviors that involve a hot state. That would explain why time preference predicts addiction behavior but not other health behaviors.

**Future Directions**

The studies summarized in Table 1 indicate that time preference is related to addictive behaviors but not to other health behaviors. As argued above, this pattern of results is not consistent with the original prediction from decision theory, but it can be explained if one surmises that time preference measures capture a psychological concept such as impulsiveness or ability to withstand temptation—a concept that is relevant to regulation of hot behaviors such as smoking or drug use but not to cool behaviors such as vaccination or medication compliance.

The largest amount of evidence for a relation between time preference and health behavior comes from studies on smoking and drug and alcohol use. Five of the six smoking studies shown in Table 1 found that smokers discount future outcomes more steeply than do nonsmokers, and four of the five drug and alcohol studies found that substance-dependent individuals discount future outcomes more steeply than do controls. Furthermore, one of the more revealing studies on the mechanism by which discounting is related to health behavior was conducted in the domain of smoking (Bickel & Johnson, 2003). Thus, it seems that further research on discounting and behavior might be most fruitfully conducted in studies of smoking or drug and alcohol use. Because smoking is the health behavior most strongly related to cancer prevention and control, further exploration of the role of temporal discounting in smoking is a prime candidate for research on decision making and cancer prevention.

Apart from research on smoking and other addictive behaviors, the evidence for a link between time preference and preventive health behavior is much weaker. This pattern suggests that time preference is relevant only to health behavior with a hot component. It is plausible that it is not time preference per se that is associated with hot behavior but rather another personality characteristic, such as impulsiveness, that is partially captured by the time preference measure. Exploration of this account awaits future research that assesses time preference, health behavior, and other temporal attitudes, such as delay of gratification or impulsiveness.

Such future research requires the study of time preference in conjunction with other constructs to determine what variables are associated both with time preference measures and with health behavior and thus may serve as mediators. For example, one possibility is that being in a hot state causes one to infer that delayed outcomes are very uncertain, thus leading to steeper discounting of delayed outcomes and an association between time preference measures and behavior. In contrast, being in a cold state may cause one to consider delay to be distinct from uncertainty. Another topic for future research is whether manipulations that alter time preference or other temporal attitudes result in changes in health behavior. For example, because being in a hot state, as opposed to a cold state, causes one to discount the future more steeply, a person in a cold state may make different cancer prevention decisions than someone in a hot state. For example, it should be easier to make the initial commitment to start a weight-loss diet right after dessert (when one is not hungry) rather than right before dinner (when one is hungry). Similarly, it should be easier to commit to smoking cessation right after a cigarette (when one is not craving nicotine) rather than before the first cigarette of the morning. Likewise, it should be easier to consider the long-term implications of cancer treatment when one is not currently in pain.

A final topic for continuing research is why people often fail to engage in cancer control behaviors that have delayed benefits. Because time preference and related constructs apparently contribute to the explanation only for certain classes of behavior (addiction), additional types of explanation are needed for why health behaviors with delayed benefits are particularly difficult to encourage. It may be, for example, that people view delayed harms as posing less of a risk than immediate hazards or that they view precautionary measures with delayed benefits as less effective than those with immediate benefits. Tradeoffs between immediate and future consequences characterize many decisions, including decisions about behaviors that can prevent or detect cancer. An understanding of the psychological processes that guide these kinds of decisions consequently has the potential to yield insights into encouraging healthy behavior that can improve cancer outcomes.
References


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