Discounting, Time Preference, and Identity

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Abstract

Discounting, Time Preference, & Identity

Shane Frederick

There are many reasons to care less about (or "discount") future outcomes. I propose a conceptual framework for sorting through the distinct theoretical concepts which are often confounded in discussions of discounting and intertemporal choice. I emphasize the distinction between discounting a future consequence because it will confer less utility in the future and discounting future utility, per se. The normative legitimacy of discounting future utility is controversial. Many philosophers contend that there is no rational basis for it. However, some philosophers have defended the rationality of discounting utility by appealing to a complex view of personal identity. They argue that there is no enduring entity over time to whom future utility can be ascribed; that discounting one's "own" future utility is akin to discounting someone else's utility, because the separation between the temporal stages of one individual are as "deep" as the separation between individuals. I discuss this philosophical view on personal identity and its implications regarding the normative legitimacy of discounting future utility. I present an empirical study designed to help quantify the degree of discounting that might be justified by this philosophical perspective. The final chapter focuses on intergenerational time preference, in the context of life-saving policies. Much of the prior research on intergenerational discount rates has concluded that people care much less about the welfare of future generations. However, the studies I present raise doubts about this conclusion.
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Chapter 1: DISCOUNTING

Many personal and public decisions entail consequences that extend across time. Lying in the sun confers an attractive tan in the near future but unattractive wrinkles in the distant future. Vaccination is painful and inconvenient, but may prevent future disease. Using coal as a fuel source reduces the costs of electricity for this generation, but may contribute to global climate warming that may harm future generations.

In most formal analyses of such decisions, future consequences are given less weight or "discounted" relative to more immediate consequences. Typically, discounting is codified via the discounted utility model (DU), which dictates that the overall value, \( V \), of a sequence of outcomes, \( (x_0, x_1, ..., x_t) \), equals the sum of the discounted utilities of each of the individual consequences, where \( \delta^t \) is the discount factor applied to the utility in period \( t \). (See equation 1 below).

\[
(1) \quad V(x_0, x_1, ..., x_t) = u(x_0) + \delta^1 u(x_1) + ... \delta^t u(x_t)
\]

In most applications of DU, discount rates range from 2 to 10 percent per year (Lyon, 1990). The choice of the discount rate is often critical. It can determine the

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1 Discounting is not inherent in DU, because the model could be applied with \( \delta \geq 1 \). However, the inclusion of \( \delta \) in the model strongly implies that it may take a value other than 1, and the name discount factor certainly suggests that it is less than one.

DU is a particular instantiation of a more generalized model of intertemporal choice, in which the overall value of a stream of consequences is some unspecified function of the utilities of the those consequences: \( V(x_0, x_1, ..., x_t) = f(u_0(x_0), u_1(x_1), ..., u_t(x_t)) \). DU explicitly assumes that the overall value (or "global utility") of a sequence is equal to the sum of (discounted or undiscounted) utilities of each period; that any two sequences with equivalent discounted utilities should be valued the same and that the distribution of utility across time makes no difference beyond that dictated by discounting (which penalizes utility that is experienced later). Although the assumption of additive separability of utility has rarely been discussed or challenged (and will not be treated further in this thesis), its implications are far from innocuous. It implies, for example, that a long mediocre life and a short great life can be directly compared in terms of their total utility, and that the longer life should be preferred provided the discounted utility is greater. Similarly, it suggests that one should be indifferent between being manic-depressive and having a more normally stable mood, provided that the integral of discounted utility is the same.
cost-effectiveness of "Pap" smears (Eddy, 1990), hypertension treatment (Coyle and Tolley, 1992), and screening programs for gastrointestinal parasites (Anderson & Moser, 1985); the appropriate strategy for dealing with heart disease (Cretin, 1977), kidney failure (Klarman, Francis, and Rosenthal, 1968; Stange & Sumner, 1978), and prostate tumors (Woodward, Boyarsky, and Barnett, 1983); the relative social importance of different tropical diseases (Barnum, 1987); and the appropriateness of implementing a national vaccination program for hepatitis (Krahn and Detsky, 1993), circumcising male infants (Ganiats et al., 1991), performing elective hysterectomies (Cole and Berlin, 1977), saving premature babies (Boyle et al., 1983), recovering helium from natural gas production (Owen, 1983), or accounting for future health risks from a nuclear waste storage facility (Schulze, Brookshire, and Saddler, 1981).

Although the discount rate is a crucial parameter in many policy decisions, it is often assigned with little explicit justification. As Baumol (1970, p. 273) comments: "Despite the critical nature of [the discount rate], in some calculations it is assigned a value almost cavalierly, with little attempt to show that the selected figure is not chosen arbitrarily and capriciously." Similarly, Krahn and Gafni (1993, p. 415) remark: "Most analyses, including those who take great care to measure costs and consequences, pull their discount rates either out of the air or off the shelf, and the lucky number is most often 5%.

The lack of explicit justification for the magnitude of the discount rate reflects a more fundamental failure to identify the theoretical basis for discounting. As Goodin (1982, p. 54) comments:

... justifications [for discounting] tend ... to come in the rushed preliminaries to more detailed discussions ... We are asked to make do with brief allusions to an ill-sorted jumble of slightly different arguments having rather different bases and quite different implications.
When justifications for discounting are offered, they often differ across analyses. Sometimes discounting is justified by appealing to concepts of investment and opportunity costs (a future consequence is worth less when expressed in terms of today's dollars if a dollar today can be exchanged for more than a dollar in the future). Elsewhere, discounting is used to reflect the common assumption that people have a time preference; that they care less about future utility than about current utility. In still other cases, discounting has been used to reflect uncertainty or anticipated decreases in the utility of future consumption. For consequences that span generations, discounting has been used to reflect diminution in empathy for the welfare of people who are more temporally distant.

Figure 1.1 outlines a conceptual framework for sorting out the various factors that are often conflated in discussions about discounting. The left side of Figure 1.1 lists six factors that may affect the expected amount of utility a future consequence will confer: (1) its probability, (2) changes in the objective consequence itself, (3) changes in utility functions, (4) utility from anticipation, (5) utility from memory, and (6) opportunity costs. Each of these will be discussed in section 1.1. These factors must be distinguished from time preference ($\delta$, in the upper right side of the figure) which pertains to the relative weight given to future utility. Strictly, the DU model expresses time preference, because the discount factor operates on utility itself. This concept of time preference relevant to outcomes that occur later within one's own life must, however, be distinguished from the concept of an intergenerational time preference.

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2 I will use the term discounting broadly to encompass any reason for caring less (or more) about a future consequence, including factors that affect the amount of utility of a future consequence and time preference (preference for immediate utility over delayed utility, or vice versa). Broome (1995, p. 128-129) notes that some of the controversy about discounting results from differences in how the term is used: "On the face of it ... typical economists and typical philosophers seem to disagree. But actually I think there is more misunderstanding here than disagreement ... When economists and philosophers think of discounting, they typically think of discounting different things. Economists typically discount the sorts of goods that are bought and sold in markets [whereas] philosophers are typically thinking of a more fundamental good, people's well-being ... It is perfectly consistent to discount commodities and not well-being."
preference, which pertains to the degree of concern one has for the welfare of future individuals. There is an important difference between discounting one's own future utility and discounting the utility of someone else who will be alive in the future. The type of time preference pertinent to distant outcomes might be considered as an empathic discount rate (\( \eta \) in the lower right part of figure 1.1), which represents the diminution of empathy felt for people who are more temporally remote.\(^3\)

Much of the continued controversy about discounting has been sustained by the tendency to confuse the distinct theoretical concepts represented in Figure 1.1. Resolving these distinct concepts may help to illuminate several continuing areas of controversy, including: what the discount rate should be, whether all outcomes should be discounted at the same rate, whether the discount rate should be the same in the long term as it is in the short term.

1.1 Factors affecting the expected amount of utility a future consequence confers

1.1.1 probability

The passage of time may affect the probability that a future consequence will actually occur. The government may collapse before your bond matures, you may die before getting a chance to cash it in, and so on.\(^4\) The probability of a consequence does not necessarily decrease with time, however. For example, corrosion may

\(^3\) Part of the confusion is also due to the diversity of terms used in discussions of discounting, including: discount factor, discount rate, marginal private rate of discount, social discount rate, utility discount rate, marginal social rate of discount, pure discounting, deep-future discounting, time preference, subjective rate of time preference, pure time preference, marginal rate of time preference, social rate of time preference, overall time preference, impatience, time bias, temporal orientation, consumption rate of interest, time positivity inclination, and the pure futurity effect. Sometimes different terms are used to represent the same concept, and sometimes the same terms are used to represent different concepts (or sets of concepts).

\(^4\) Slemrod (1986) and Russett & Lackey (1987) each found a negative relation between savings rates and the fear of nuclear war (which is presumably correlated with the subjective probability of future death).
increase the probability that a particular barrel will spill its contents during the next year.

It is clearly reasonable to value future outcomes differently than immediate outcomes if they have a different probability of occurring. This is true at both the social and individual level. For example, when calculating the number of expected cancers caused by a future radiation spill, it seems reasonable to account for the possibility that scientists will develop a cancer-preventing drug by then. It may also be appropriate to discount that number to reflect the possibility that civilization will already have been destroyed by an asteroid before the radiation spill occurs.

Discounting at conventional rates, however, would imply either an unrealistic optimism about the promise of future technological fixes or pathological pessimism about the likelihood of future extinction. The discounted utility model has no explicit term to account for changes in probability. Thus, if the probabilities of future events are different than those for current consequences, this must be represented separately.5

1.1.2 quality, magnitude, and duration

The passage of time may affect the quality of a consequence (what kind of thing it is) or its magnitude (how much of it there is). For example, chemical reactions may change the flavor of a bottle of wine, atomic decay may reduce the radioactivity of a barrel of nuclear waste, and so on. In some cases, the timing of a consequence

5 Occasionally, diminishing probability is explicitly offered as the justification for discounting. For example, Stange and Sumner (1978) discount future life years at the market interest rate and defend this practice by arguing: "an additional year of life now is more valuable than one in the future, which, owing to uncertainty, may not be experienced as predicted." This argument is severely flawed. First, the probability of continued survival does not diminish at the market interest rate (or at any constant rate). Furthermore, uncertainty is being double counted in this analysis, because the authors are discounting expected life years, which already accounts for the uncertainty of continued survival.
determines its duration as well. For example, if the FDA delays the sale of Viagra for 5 years, current sufferers of impotence will experience 5 fewer years of benefits.

If the passage of time affects the nature or duration of a future consequence, it is reasonable to take that into account when calculating its value (or disvalue). This argument is unchanged from the perspective of society as a whole. For example, if atomic decay reduces the radioactivity of a barrel of nuclear waste, a future spill may have less severe impacts, and if global climate warming can be postponed, one less generation might suffer its effects. These considerations do not pose any special problem for DU, provided that the consequences (the \( x_i \)'s) are specified in sufficient detail.

1.1.3 changing utility functions

The subjective value of a given objective consequence may change over time. On a short time scale, the pleasure of food, water, sex, and other stimuli depends on levels of recent "consumption." It is better to eat when hungry, drink when thirsty, and have sex when amorous.\(^6\) On a longer time scale, tastes change -- getting muddy and eating cotton candy become less pleasurable with age, while shuffleboard and symphonies become more so. Anticipated changes in the utility of a consequence would provide an obvious reason for caring when it occurs, because, ceteris paribus, people will prefer experiencing something when it will be most enjoyed.\(^7\)

\(^6\) Rachlin (1992) argues that diminishing marginal utility is derivative of time preference; that marginal value diminishes with amount because consumption of the marginal unit must be increasingly delayed (e.g., the tenth apple is valued less than the first apple, because the tenth apple must be eaten later). He argues that satiation cannot, by itself, explain diminishing marginal utility, because consumption could be sufficiently spaced out to avoid satiation, with no loss in value if the discount rate was zero. (However, as Rachlin admits, this argument cannot account for all forms of diminishing marginal utility. For example, the second teaspoon of sugar may improve the taste of a glass of iced tea less than the first teaspoon, but does not delay its consumption.)

\(^7\) Changes in wealth may also affect the utility of some consequences. Anticipated increases in wealth has sometimes been offered as a reason why a person might discount a future consequence. However, if wealth increases are anticipated and capital markets are perfect, a person could borrow against their future wealth to maintain constant consumption (and constant marginal utility of consumption) across
The social discount rate is sometimes based on the assumptions that people are becoming wealthier and will have correspondingly lower marginal utilities in the future. For example, the 1990 report of the Intergovernmental Panel on Climate Change (IPCC) recommended a social discount rate of 2.4% per year, based on estimates that GNP would grow by 1.6% per year and that the consumption elasticity of marginal utility was 1.5.8

Discounting future consequences for anticipated increases in wealth is questionable on several grounds. First, wealth may not continue to increase.9 Second, with so much inequality across people at a given time, the average per-capita income of a generation is not necessarily representative of the marginal utilities of the parties involved in any particular intergenerational transfer. For example, future Indians might be wealthier than current Indians, but still be much poorer than current US citizens who could make sacrifices on their behalf. Third, the utility (or disutility) of a consequence need not be a function of wealth. The irritation to one's eyes caused by air pollution may be just as aversive to a wealthy person as to a poor one.

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8 Discounting the future to account for economic growth is somewhat odd. The very fact that economic growth is positive suggests that generations are investing sufficiently in the future (sufficiently from an equity perspective at least). Thus, it seems strange to build in a discount factor to offset our unfettered tendency to invest too heavily in the future. (The concept is made less strange, to the extent that some economic growth results from technological innovation that is not attributable to a bequest motive, per se.)

9 Dasgupta, Maler, and Barret (1999, p. 65) comment: "... we doubt if it is prudent to postulate everlasting increases in ... per capita output. To do so would be to place an enormous burden of proof on an experience that is not much more than a few hundred years old. Extrapolation into the past is a sobering exercise: over the long haul (say, a few thousand years), the rate of growth of per capita income has not been much more than zero."
1.1.4 utility from anticipation

People often derive utility from anticipating good things and disutility from anticipating bad things. Thus, delaying a good thing may increase the utility it confers by prolonging the period of pleasurable anticipation. Conversely, it may be best to get bad things over with as quickly as possible to minimize the period of dread.10

However, when considering outcomes that extend beyond one's own lifetime, it is not generally reasonable to invoke utility from anticipation. One may derive vicarious pleasure from imagining benefits that will be enjoyed by others in the future (especially if one can identify with, or at least identify) the people who will experience them. However, it doesn't follow that one would derive more anticipatory utility from a benefit delayed by 200 years than from one delayed by 100 years, because one will not be around to reap any utility during that delayed 100-year interval.

1.1.5 utility from memory

People also derive utility from remembering good things that occurred in the past, and disutility from looking back upon bad experiences. Utility from memory may have the opposite effect of utility from anticipation. It could cause people to want

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10 The prospect of a favorable future consequence is not always pleasurable. The expectation of an improved future state can be frustrating if the future is a salient reference to the present. For example, the prospect of earning $90,000 may, on the whole, be aversive to a graduate student if it sufficiently reduces their satisfaction with their $10,000 stipend. Similarly, negative future consequences may make the current situation seem bright, by comparison. I recall the last day of summer vacation being somewhat more enjoyable than an average summer day, because of the salient contrast of having to go back to school the next day. However, it is important in these cases to distinguish between the utility of anticipation per se, and the effects of anticipated future utility on the utility of current consumption. Baron (1988, p. 449) suggests that one may also derive pleasure from appreciating that an anticipated bad outcome is still in the distant rather than near future, but that this emotion is rare and has no common name. (Perhaps it could be called "enjoying the moment.") Loewenstein (1987) and Elster and Loewenstein (1992) discuss some of these issues, although the contextual factors that determine the valence and intensity of anticipal pleasure are still largely unstudied.
good things to occur sooner so that they might enjoy that memory for a greater number of years and to postpone bad things so that they have fewer years to suffer troubling memories when recalling it. However, for experiences that are eventually forgotten (or which cease to affect utility when recalled), delay would not reduce the duration of the memory, and, thus, would not reduce the total utility from memory. In these cases, utility from memory would not provide a normative basis for preferring good things sooner or bad things later -- unless there is a reason to count future utility differently than current utility (see section 1.2).11

Utility from memory is relevant at the social level as well. However, it is difficult to think of any examples where it would be a very important consideration in any public policy decision.

1.1.6 opportunity cost

Consequences that can be invested at a positive real interest rate are worth less when received later because profitable investment opportunities are foregone. When expressing the value of a future consequence in terms of this year’s dollars, it is appropriate to discount, because if 1 dollar today can be exchanged for \((1+r)^t\) dollars in the future, something worth $X in the future is worth just \(X/(1+r)^t\) today. This means that \(X/(1+r)^t\) invested today at \(r\) percent for \(t\) years will return $X. It does not mean that \(X/(1+r)^t\) of consumption now confers the same benefit as \(X\) worth of consumption in year \(t\), or that those dated consumption levels should be considered equally attractive. As Cowen and Parfit (1992, p. 153) note, "may be transformed into" should not be confused with "is as good as." One may be able to transform a

11 Elster and Loewenstein (1992, p. 229) suggest that such utility from memory provides a reason to advance pleasurable consumption: "the backward consumption effect [utility from memory] should cause people to shift pleasurable experiences forward in time (to the present), so they can be enjoyed later through recollection." It is unclear whether this is a descriptive or a normative claim.
frog into a prince, but that does not mean that a frog is a prince, or that a frog who remains a frog is as good as a prince.

Discounting expresses the multiple of compound interest, \((1+r)^t\), as a dividing factor, to give us discounted future consequences. However, it would be mathematically equivalent and conceptually clearer to express costs and benefits from a future perspective: as undiscounted future effects and compounded opportunity costs of past expenditures.

Whether expressed as a divisor or a multiplier, the legitimacy of the compounding factor, \((1+r)^t\), rests on the requirement that investment actually occur. For example, the choice to forego spending \(X\) today to prevent \(10X\) of damages in year \(t\) might be justified by arguing that if the \(X\) was invested at rate \(r\) for \(t\) years, the resulting amount would cover the cost of the damages (that is, \(X(1+r)^t > 10X\)). However, it is inappropriate to multiply \(X\) by \((1+r)^t\) unless the \(X\) will, in fact, invested at rate \(r\) for \(t\) years. If the \(X\) will be consumed rather than invested, the interest rate is irrelevant, and cannot be used to justify discounting.\(^{12}\)

Discounting future outcomes at the market interest rate is often controversial for outcomes such as health, where the legitimacy of the investment metaphor is unclear.\(^{13}\) For example, Eddy (1990) calculated that a program which triannually

\(^{12}\) This important point is underappreciated (or, in any case, is rarely explicitly articulated). However, Lind (1999, p. 177) remarks: "We are so used to assuming the ability to transfer resources over time [that] we sometimes forget that if we can't, then it is not appropriate to convert all flows to a present value."

\(^{13}\) For example, Stokey and Zeckhauser (1978, p. 175) consider the possibility that "ordinary discount rates are not appropriate for discounting flows that consist of intangibles such as pain and suffering, or improved health, or especially changes in the risk of death," yet Fuchs and Zeckhauser (1987, p. 265) contend that "Self-respecting economists should not ... use different [discount] rates because it is health that is being valued." Similarly, while many have contended that health outcomes should be discounted at rates below the market interest rate (see, e.g., Coyle & Tolley 1992), Moore and Viscusi (1990b, p. 394) draw the opposite conclusion: "Most observers are reluctant to use the discount rates applied in other markets [for health] because of the belief that markets for health cannot be perfect, so that financial market discount rates ... would provide only a lower-bound estimate of the appropriate discount rate to apply in evaluating health policy."
screened women for cervical cancer would increase life expectancy by 96 days. He then goes on to report (p. 219): "After discounting [by] 5%, the increase in life expectancy is approximately 10 days." The legitimacy of this procedure depends on the context of the choice. If the decision is between spending money on the screening program or investing it at a real interest rate of 5%, discounting the future life years is a legitimate (though awkward) way of expressing the compounded opportunity cost of present expenditures.14 (Again, however, it would be conceptually clearer to simply report the undiscounted figure (96 days) and then compare the value of this undiscounted amount to the value of the future benefits obtainable by investing the money.)

However, discounting is not legitimate if the decision is between spending money now on this screening program or spending money now on some other program, because, if the money is spent rather than invested, compounding will not occur. When there is no compound interest to be expressed, there is no remaining reason to discount the additional years of life at the market interest rate.15 Indeed, it would

14 Weinstein and Stason (1977, p. 720) explain:

The reason for discounting future life years saved is not that life years can, in any sense, be invested to yield more life years, as dollars can be invested to yield more dollars. Nor is it necessary to assume that life years in the future are less valuable than life years today in any absolute utilitarian sense. Rather, the reason for discounting future life years is precisely that they are being valued relative to dollars and, since a dollar in the future is discounted relative to a present dollar, so must a life year in the future be discounted relative to a present dollar.

15 Similarly, discounting for opportunity costs is also inappropriate if one is comparing outcomes that cannot be invested. For example, although money can be invested and (perhaps) be used to save future lives, a life itself cannot be "invested" to offset or negate lives lost in the future. Consider the following thought experiment: Two asteroids are threatening to collide with earth. The smaller asteroid is projected to collide with earth in 10 years, killing a few hundred people. The larger asteroid is projected to collide with earth in 1000 years, killing a few billion people. NASA can blow up one of the asteroids, but not both. If future deaths were discounted at the market interest rate, blowing up the small asteroid may be judged to be more worthwhile. However, defending that choice with an opportunity cost argument requires an account of how the people who are saved from the smaller asteroid can be "invested" to compensate for the much larger loss of life that will later occur when the larger asteroid collides. It is difficult to understand how that would work. (The people who are saved by preventing the impact of the small asteroid could, through reproduction, create more people, but it would be strange to interpret this as compensation for the later loss of life.)
then make no more sense to discount these future life years than it would to report that the life expectancy in the US is "really" only 19 years -- that it is reported to be 75 years only because people forget to discount future life years by 5% per year. The women whose lives are extended by the prevention of cervical cancer will fully live the additional days of their life, not some discounted version of them.

Discounting at the market interest rate is also controversial for long-term outcomes. Although most analysts accept the common practice of discounting near-term outcomes at market interest rates, many feel uncomfortable when such discounting is applied to very distant outcomes. For example, many balk at the implication that it is not worth spending $1 today to prevent $1 billion dollars of damages 425 years from now, which a 5% discount rate implies. As Cline (1992, p. 235-236) notes, many reject the practice of discounting distant future consequences with the following argument: (1) Distant future consequences are important. (2) If discounted at conventional rates, distant future consequences are not important. (3) Therefore, discounting distant consequences at conventional rates is wrong.

Though the conclusions of this argument seem correct, its second premise is false (or at least ambiguous). Discounting future consequences at the market interest rate does not mean that future consequences are considered less important. Rather, such discounting is merely a way to account for the enormous future opportunity costs of current expenditures (by expressing them as a dividing factor, as discussed above). However, the legitimacy of discounting distant future consequences at the market interest rate does rest on two strong assumptions: (1) that the interest rate will, on

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16 Two points must be clarified here. First, although life saving interventions which occur at later ages confer fewer life years (because expected time until death decreases at a rate of (almost) one year per year), the 96 days of additional life which Eddy computes is already an expectation -- it already accounts for the fact that cancers prevented in older women confer fewer additional life years. Second, while it is possible that a year of life to an older person is "worth" less than a year of life to a younger person in the sense that life is less good when one is older (because of diminished virility or mentally acuity or something), that is a separate issue which bears no relation to the market interest rate.
average, remain equally high throughout this period, and (2) that intermediate
generations will continue to invest the money. These assumptions may be
unrealistic.17

Cowen and Parfit (1992) argue that opportunity costs may not provide an
independent reason for discounting, when viewed from the perspective of society as a
whole. They argue that opportunity costs are determined by the marginal return to
capital, and that this, in turn, depends on social investment levels, which depend upon
how highly future benefits are weighted. If society as a whole valued all future
periods equally, it would continue to be willing to make intergenerational investments
until the rate of return (and, thus, the opportunity cost) was driven to zero. Thus, they
argue that opportunity costs cannot be used to justify the social discount rate, unless
the return to capital would be positive at all investment levels; that opportunity costs
may be a result of valuing future outcomes less, not a reason for doing so.18

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17 Cline (1999, p. 134) comments:

The fundamental problem with discounting the very long term at today's rate of return on
capital is that [it] promises something that cannot be delivered: that today's generation and all
intervening generations will keep intact an investment fund that is capable of continued real
returns at today's level to generate a distant-future payment that will compensate a future
generation for damage inflicted. This commitment is simply not credible.

18 Cowen and Parfit (1992, p. 151) explain their argument as follows:

The Argument from Opportunity Costs errs in taking the marginal productivity of capital as
exogenous to other social decisions. In fact, the marginal productivity of capital depends on
other social decisions, most notably the community's rate of savings. If the rate of savings is
determined by how we discount the future, the productivity of capital cannot be invoked as an
independent determinant of the discount rate. Instead, the choice of discount rate determines
the marginal productivity of capital.

This point is analogous to one made by Loewenstein (1992, p. 14) regarding the circularity of
invoking time preference to explain savings rates (see footnote 7). In Cowen and Parfit's point, the
objectionable circularity is: (social discount rate → community savings rate → productivity of capital
& opportunity cost → social discount rate). In Loewenstein's point, the objectionable circularity is:
(time preference → individual savings decisions → current & future wealth levels → time preference).
1.2. Time preference (discounting future utility)

The previous sections discussed six factors that can affect the expected amount of utility a future consequence confers. Each consideration could be explicitly represented in models of intertemporal choice -- by including a probability term to account for uncertainty, by permitting the utility of consumption to depend on time, by including arguments in the utility function for anticipation and memory, and so on. Table 1.1 shows how DU might be modified to explicitly incorporate these considerations.

However, none of the considerations discussed thus far justifies the type of discounting expressed in the discounted utility model (DU), which dictates that future utility should be discounted -- that a pleasure or pain occurring in the more distant future ought to receive less consideration than pleasure or pain in the nearer future, even if it is equally certain and equally intense when experienced.19

Many believe that discounting utility is irrational (see, e.g., Jevons 1871; Sidgwick, 1874; Pigou, 1920; Ramsey, 1928; Lewis, 1946; Rawls, 1971; Elster 1986; Broome, 1991).20 These critics argue that one should want their life, as a whole, to go as well as possible, and that counting some parts of life more than others interferes with this goal.21,22 By this view, it is irrational to prefer a smaller immediate pleasure.

19 Kahneman and Snell (1990) introduced the term decision utility to refer to the weight that a consequence receives in choice and the term experienced utility to refer to the actual hedonic quality of experience -- the goodness or badness of a consequence. DU dictates that the decision utility accorded to a given amount of anticipated experienced utility diminishes as the experienced utility is increasingly delayed. Though the distinction between decision utility and experienced utility is largely ignored in modern economic literature (see Kahneman, Wakker, & Sarin, 1997, for a discussion), the concepts can be recognized in earlier discussions of intertemporal choice. For example, Bohm-Bawerk (1888, pp. 253) writes: "... we accord to goods which are intended to serve future ends a value which falls short of the true intensity of their future marginal utility."

20 Those who believe that it is irrational to discount future utility often attribute apparent departures from temporal neutrality to a cognitive illusion (which causes people to see future pleasures or pain in some diminished form) or to a weakness of will (which causes people to choose options against their better judgment).

21 If future utility is discounted, there is some \( \varepsilon > 0 \) such that the utility sequence \((1-\varepsilon, 0)\) would be preferred to the sequence \((0,1)\). However, choosing \((1-\varepsilon, 0)\) over \((0,1)\) fails to maximize utility over...
over a greater future pleasure (or a greater future pain over a smaller immediate pain),
because now and later are equally parts of one life. Choosing the smaller good or the
greater bad makes one's life, as a whole, turn out worse. Rawls (1971, p. 293)
comments are characteristic of this view:

Rationality requires an impartial concern for all parts of our life. The mere
difference of location in time, of something's being earlier or later, is not a
rational ground for having more or less regard for it.

Even economists, who are typically loathe to dispute the rationality of individual
preferences (including time preferences), sometimes question whether discounting
future utility is compatible with rationality. For example, Becker and Murphy (1988,
p. 684) ponder:

Although fully myopic behavior is formally consistent with our definition of
rational behavior, should someone who entirely or largely neglects future
consequences of his actions be called rational?

the two period interval, because 1-ε < 1. Some may object that this example presupposes a definition
of maximization which excludes discounting. Though this is correct, the objection has no force. As
an analogy, suppose that I held $0.99 in my left hand and $1.00 in my right hand. You were asked to
pick the contents of either hand so as to maximize the amount of money you would receive. If you
picked the $0.99, you could hardly say that you were maximizing because that smaller amount was
held in my left hand. (In other words, some account is required for why the temporal position of
utility is any more relevant to the question of how to maximize utility than the spatial position of the
two monetary quantities in the foregoing example.)

22 Parfit (1984, p. 125) invites the comparison of time preference with "Tuesday-indifference"-- the
tendency to place no weight on utility which is experienced on Tuesdays. A person with Tuesday-
indifference would be willing to endure excruciating pain on a Tuesday to obtain a trivial pleasure on
any other day of the week. If it seems irrational to give utility less weight because it occurs on a
Tuesday, can it be any more rational to give utility less weight merely because it occurs in the future?

23 Lewis (1946, p. 510 & 484) states this position succinctly: "The moral concern for the whole of life
sets that end to which all particular aims must be subordinated ... By this imperative of rationality, the
future, so it be certain, should weigh with us as much as the present, and possible goodness in the
whole of life must continually outweigh consideration for goodness in any part of it."
The widespread belief that rationality entails temporal neutrality has, however, been challenged by some contemporary philosophers (see, e.g., Parfit, 1971a,b, 1973, 1976, 1982, 1984, 1993; Zemach, 1978, 1987). These philosophers deny the conventional assumption that there is any enduring, irreducible entity over time to whom all future utility can be ascribed; they deny that all parts of one's future are equally parts of oneself. They argue, instead, that a person is a succession of overlapping selves related to varying degrees by memories, physical continuities, and similarities of character and interests, etc. By this view, it may be just as rational to discount one's "own" future utility, as to discount the utility of another distinct individual, because the divisions between the stages of one life may be as "deep" as the distinctions between individuals.

To illustrate this argument with an extreme example, consider the plight of Seth Brundle, the main character in the 1986 movie "The Fly." In a scientific experiment gone awry, Seth becomes genetically fused with a housefly and gradually metamorphoses into "Brundlefly" (a human-fly hybrid). Under these exceptional circumstances, it seems clearly rational for Seth to discount "his" future utility -- to give less weight (perhaps no weight at all) to the future utility of Brundlefly. This example compels the conclusion that some predicted changes would justify diminished concern for one's future utility, and lends credibility to the contention of some philosophers that it can be rational to discount future utility. However, it remains unclear exactly which types of changes ought to affect future concern, and what degree of discounting might be justified in more conventional situations. In Chapter 2, I discuss the issue of personal identity in greater detail. In Chapter 3, I present a study that attempts to quantify the degree of discounting that this philosophical perspective might justify.

Differing views about the rationality of time preference often prompt a debate about whether the social discount rate ought to reflect individual time preferences.
Some believe that it should. For example, Eckstein (1957, p. 75) states: "...a social welfare function based on consumers' sovereignty must accept people's tastes including their intertemporal preferences." Others reject this view. For example, Goodin (1982, pp. 54-55) contends: "There is no more reason that public policy should reflect people's inability to weight time neutrally than that it should reflect people's incapacity to think rationally about large numbers or perform fancy arithmetic." 

If one decides that the social discount rate should reflect individual time preference (either because one believes that time preference is rational or because one believes that the government ought to respect individuals' preferences, whether they are rational or not), it is unclear what rate should be used, because the descriptive research in this area offers little guidance. Over the last two decades, psychologists and economists have conducted roughly fifty empirical studies that have attempted to estimate individual's implicit discount rates. The implicit discount rates in these

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24 Bentham (1789, pp. 187-188) endorsed a less extreme view; arguing that the government ought to make efforts to inform people of the negative consequences of their time preferences: "... a government which does not strive against such [intertemporal] prejudices is wrong in suffering the people, for want of some instruction, which ought to be and might be given to them, to quarrel with their own interest."

25 Lind (1990, p. 22) comments:

... there may not be a well-defined, easily measured rate that can be said to reflect any one individual's time preference, let alone some aggregate of individual rates of time preference that should be used in social decisions. For this reason, searching for measures of individual rates of time preference as the basis for a defensible social discount rate does not appear promising. If we are to find an acceptable social rate of time preference, we will need to determine it on other grounds.

Furthermore, as shown by Arrow (1950), there is no acceptable way of aggregating individual preferences into a social welfare function, without violating at least one appealing axiom. Thus, even if a suitable definition of time preference could be agreed upon and a suitable measure of that found, that information would not be be sufficient to determine the appropriate social discount rate.

studies are tremendously variable, ranging from negative to several thousand percent per year (see Figure 1.2 and Appendices 1.1a through 1.1c). Moreover, researchers are often agnostic as to what, exactly, the "implicit" discount rates imply -- whether they reflect time preference, or some of the other considerations discussed in Section 1.1 (e.g., uncertainty, expectations of greater future wealth, or the perception of opportunity costs) or both. The descriptive studies rarely attempt to isolate or assess the relative effects of these different considerations.27

1.3. Intergenerational time preference (discounting the future utility of others)

When evaluating outcomes that affect people who are not yet born, the concept of time preference discussed in the previous section (which refers to the degree of

Others have estimated discount rates from choices between hypothetical health conditions of varying delays and durations (Lipscomb, 1989; Horowitz & Carson, 1990; Olsen, 1993; MacKeigen et al., 1993; Redelmeier & Heller, 1993; Cairns, 1994; Chapman & Elstein, 1995; Dolan & Gudex, 1995; Chapman, 1996; Cairns & Van der Pol, 1997). Still others have calculated discount rates from consumers' choices between electrical appliances with different purchase prices and operating costs (Hausman, 1979; Gately, 1980; Houston, 1983), wage-risk trade-offs in the labor market (Viscusi & Moore, 1989; Moore & Viscusi, 1988, 1990a,b), or willingness to pay for automobile safety features that reduce the risk of future death (Dreyfus & Viscusi, 1995).

27 To illustrate some typical problems, consider the study by Benzion, Rapaport, and Yagil (1989). First, the authors note that almost all the subjects in their study (which was conducted in Israel) had "extensive experience with money management in an unstable economy with a three-digit inflation rate." Thus, respondents may have been unsure whether the future sums were in real dollars or (potentially much less valuable) nominal dollars. To control for this effect, the authors denominated the money in the experiments in U.S dollars. Though this may have helped, the U.S suffers inflation as well; moreover the subjects had recent experience with high inflation. Second, respondents were instructed that the questions did not have correct answers, but that the answers "might vary from one individual to another depending on his or her present or future financial assets." Presumably this instruction may have cued respondents to think about the changing marginal utilities associated with the present or future amounts. Third, in the cover story, respondents were asked to imagine was that they had just earned $y for their work in a "financially solid" public institute. Upon coming to receive the payment, they are told that the institute is temporarily short of funds and to specify another amount of money, $x, to be received t time periods from now that would make them indifferent to the amount they were supposed to receive immediately. Respondents must have been dubious about how "financially solid" this institution can be if it is unable to pay them the small amount of money they hypothetically earned (amounts ranged from $40 to $5000). Fourth, the real interest rate during this time was positive, so there was an opportunity cost associated with delay. Thus, in this study, the responses may reflect at least four factors other than time preference, including: objective amount, probability, marginal utility, and opportunity cost. Exactly how much of the implicit discount rates (which ranged from 9 to 60 percent) reflect time preference, per se, is unclear.
concern people have for their own future welfare) must be replaced with the concept of an intergenerational time preference (which refers to the degree of concern people have for the welfare of other people who will be alive in the future). Although these two types of time preference are often confounded, there is no close connection between them. Some people may weight their own future utility the same whether it occurs in the near or distant future, but have no concern about consequences that affect others who will be alive after they die. Others may discount their own future welfare heavily (e.g., by ingesting substances that bring them current pleasure but damage their future health) while being deeply concerned about the welfare of distant generations, and, thus, oppose social policies with negative long-term consequences.

28 The term "generation" is ambiguous. If used to refer to all those who were born during a certain interval, then generations "overlap" in the sense that multiple generations coexist. If it is used to designate all those alive during a particular interval, then generations overlap in the sense that an individual's life extends across multiple generations.

29 If one is discounting another person's utility relative to one's own utility, the most significant fact is likely that the future person is not you. If that other person is located in the distant rather than near future, that may be an additional reason for discounting. Of course, temporal proximity is just one of many factors that affect one's concern for another, along with geographical, ethnic, genetic, religious, or cultural proximity.

30 The important distinction between intrapersonal time preference and intergenerational time preferences are often overlooked in discussions of the social discount rate because economic models use infinitely lived agents as a simplification for the reality of overlapping generations. However, for examples of articles that have appreciated the important distinction between intra-personal time preferences and inter-generational time preferences, see Sen, 1957; Tullock, 1964; Fuchs and Zeckhauser, 1987; Lipscomb, 1989; Lind, 1990; Cowen and Parfit, 1992; Broome, 1992; Cline, 1992; Burton, 1993; Schelling, 1995; and Arrow et al., 1996). For example, Schelling (1995, p. 396) comments:

Introspectively, I can find no impatience about an increment of consumption that may accrue to people whom I shall never know and who do not now exist, in the year 2150, compared with an increment closer in time, accruing to the people whom I shall never know, and who do not now exist, who might enjoy it instead in the year 2100 ... No kind of time preference pertinent to discounting ... long-term costs and benefits ... can have anything to do with [an individual's preference for immediate vs. delayed consumption] ... these are not "saving" decisions we are talking about ... but decisions about redistributing our income.

31 Some types of intertemporal choices may, however, reflect both types of preferences. For example, someone's savings may partly act as an insurance policy for their own future consumption and partly
When focusing on intergenerational time preferences, three issues are central: (1) How much *do* people care about future generations? (an empirical question); (2) How much *should* they care about future generations? (an ethical question); and (3) Should government policies display a concern for future generations beyond that which is expressed in the preferences of the current electorate? (a political question).

Some have argued that the intergenerational discount rate should be a political decision, based on the weight that the members of this generation attach to the welfare of future generations (see Chapter 4). Others believe that such preferences are irrelevant, because the government is a representative of future as well as current people and ought to register their (predicted) preferences directly, whether the present generation cares about them or not. Feldstein (1964, p. 365) summarizes this debate when he asks: "*Is the Government's responsibility only to the current population or should it show a concern for the welfare of future generations greater than that which the current electorate would sanction?*" Marglin (1963, p. 97-98) clearly favored the view that any weight given to the future should be derivative of the altruism of the current generation:

> I consider it axiomatic that a democratic government reflects only the preferences of the individuals who are presently members of the body politic ... if after being made aware of future needs, present individuals remain indifferent to the claims of future individuals, then, it seems to me, a democratic view of the state does not countenance governmental intervention on [their] behalf.

The opposing view holds that the state has a direct responsibility to future generations extending beyond the altruism of current citizens (see e.g., Hume, 1751, *reflect their desire to accumulate resources they can bequeath to a succeeding generation* (Epstein 1992).
In a widely cited quote, Pigou (1920) comments:

The state should protect the interests of the future in some degree against the effects of our irrational discounting and of our preference for ourselves over our descendants. It is the clear duty of Government, which is the trustee for unborn generations as well as for its present citizens, to watch over, and if need be, by legislative enactment, to defend the exhaustible natural resources of the country from rash and reckless spoliation.

Some have argued that the utility of future generations must be discounted because utility maximization across generations would otherwise require excessive sacrifice from the current generation. The rationale is as follows: if the return to capital is positive into the indefinite future, and utility is increasing in consumption, then any amount of utility that the current generation sacrifices by foregoing consumption can be more than offset by greater utility gains to distant future generations. In other words, if their utility is not discounted, distant generations become "utility monsters" (Nozick, 1974) on whose behalf earlier generations must be sacrificed in the name of utility maximization. Koopmans (1967) called this result the paradox of the indefinitely postponed splurge. (See also Chakravarty, 1962; Solow, 1974; Arrow, 1983).

Utility maximization models are often used in analyses of social policies. For example, in a paper about the economics of global climate change, Nordhaus (1991, p. 925) writes: "We assume that it is desirable to maximize a social welfare function that is the discounted sum of the utilities of per capita consumption. An optimal program for allocating resources over time maximizes the following":

\[
\sum_{t=0}^{\infty} U(c(t))e^{-\rho t}
\]

where \(U(c(t))\) = social utility derived from consumption at time \(t\), and \(\rho\) = the pure rate of social time preference (the rate at which the utility of future generations is discounted).

However, as the paradox of the indefinitely postponed splurge suggests, intertemporal maximization is the wrong objective. As Arrow (1983, p. 194) comments: "there is no particular reason why the present generation should sacrifice large amounts of consumption indefinitely to achieve ... higher
Keeler and Cretin (1983, p. 305-306) reinvented this "paradox" to "prove" that future health benefits must be discounted at the same rate as costs (at the market interest rate):

... failure to discount benefits implies that we should always be willing to transfer resources away from present health needs to buy additional years of life for future generations ... We conclude that any cost-effectiveness analysis using lower discount rates for benefits than costs is difficult to justify. (original emphasis)

Keeler and Cretin's argument has been widely cited in defense of the common practice of discounting future health benefits at the market interest rate. For example, the guidelines for decision and economic analyses of the Center for Disease Control (1994, p. 72) state:

An example of the inconsistencies that arise when monetary costs are discounted and nonmonetary health outcomes are not discounted is shown below. Assume that an investment of $100 today would result in saving 10 lives (or 1 life per $10 of investment). If the $100 were invested at a 10% rate of return, then 1 year from now the $100 would be worth $110. With $110, it would be possible [to] save 11 lives. In two years, the $100 original investment would net $121, and it would be possible to save 12 lives. On the basis of these calculations, the returns in the future look so appealing that one might never choose to save any lives in the present! To correct for this possible inconsistency, both monetary and non-monetary benefits should be discounted. (my emphasis)

These objections are misplaced. There is nothing "inconsistent" about being willing to forego benefits now for the greater gain of future generations. There may,
however, be limits to our generosity. Thus, rather than concluding that future benefits must be discounted, we should instead be asking how much we are willing to sacrifice to confer benefits upon future generations. If we are unwilling to do what maximization requires, we should reject maximization as a distributional principle (see Rawls 1971, p. 297-298). Discounting the utility of future generations is nothing but an awkward and oblique way of addressing considerations about intergenerational equity that ought to be dealt with explicitly. Moreover, discounting future utility misrepresents the preferences of those who also oppose excessive inequality across generations when future generations bear the costs. For example, suppose that some technology could substantially increase everyone's welfare for the next five generations, but at the expense of greatly decreasing the welfare of the sixth generation (because of some disastrous, but temporary, side effect). Utility maximization might dictate that this technology be adopted, especially if future utility is discounted. However, many would oppose this choice, because of the intergenerational inequity of its effects. When maximization and equity conflict, maximization can give way. Once the dictates of maximization are abandoned, there is no longer any need to discount future utility, so as to prevent utility maximization models from generating patently unreasonable results.

1.4. Overview

In this chapter, I attempted to summarize the reasons why an individual or society might discount future outcomes relative to more immediate outcomes. I emphasized two distinctions: (1) the difference between discounting a future outcome because it confers less utility and discounting future utility per se, and (2) the differences between discounting one's own future utility (an intrapersonal time preference) and discounting the utility of others who will be alive in the future (an intergenerational time preference). In Chapter 2, I discuss some of the philosophical views on personal
identity and their relevance to the question of whether future utility should be
discounted, with particular emphasis on the views of Derek Parfit, who claims that it
is rational to discount future utility because of diminishing connectedness with our
future selves. Chapter 3 presents an empirical study intended to help quantify the
degree of discounting that might be justified by such a view. Chapter 4 discusses
intergenerational time preferences in the context of life-saving policies. It critiques
previous descriptive research in this area and presents new studies that call into
question the validity of previous findings.
Chapter 2: PERSONAL IDENTITY AND FUTURE CONCERN

"A man is said to be the same person from childhood until he is advanced in years; yet though he is called the same he does not at any time possess the same properties; he is continually becoming a new person ... not only in his body but in his soul besides we find none of his manners or habits, his opinions, desires, pleasures, pains or fears, ever abiding the same in his particular self; some things grow in him, while others perish." (Plato, Symposium, 207D - 208B; cited in Borowski, 1976)

2.1 Introduction

Philosophers have long contemplated the nature of personal identity over time. Roughly, there are two competing views: the "simple" and the "complex."

According to the simple view, we are the same person through time, despite the physical and psychological changes we undergo; our existence across time is unified by some indivisible and irreducible entity or essence (a consciousness or ego or soul) to which all of our future experiences can be assigned. In contrast, the complex view of identity denies that there is some irreducible entity or "I" that remains unchanged over time. It argues instead that our identity across time is based on nothing more than the continuity of memories, interests, and other characteristics which can hold to reduced degrees over time.

33 The simple view holds that the nature of personal identity over time is strict, and fundamentally different from the identity of other objects, such as ships, whose identity over time is a loose concept that can hold to intermediate degrees, depending on objective, empirical relations between the object at two points in time (e.g. the proportion of planks that are the same, whether it is powered by a sail or an engine, and so on). Reid (1785, p. 203) argues this point explicitly:

The identity ... which we ascribe to bodies [objects other than people] ... is not perfect identity; it is rather something which, for the conveniency of speech, we call identity ... But identity, when applied to persons, has no ambiguity, and admits not of degrees ... [although my] thoughts and actions and feelings change every moment ... that self or I to which they belong is permanent. (original emphasis)

34 In one widely cited argument in support of the complex view, we are invited to imagine a machine which, by the gradual replacement of cells, can transform Derek Parfit into Greta Garbo. Those who ascribe to the simple view of personal identity are forced to adopt the untenable position that somewhere along this spectrum there is a sharp borderline, on the one side of which we have Derek Parfit, and on the other side Greta Garbo. The complex view handles this puzzle case more easily, because it permits intermediate degrees of identity. We are allowed to speak of the resulting person as being more Parfit-like or more Garbo-like, without having to specify exactly where Parfit ends and Garbo begins. (See Parfit, 1984, p. 277.)
David Hume was among the first to articulate the complex view. In *An Enquiry Concerning the Principles of Morals* (1751, p. 253) he asks: "What ... gives us so great a propension to ascribe an identity to these successive perceptions, and to suppose ourselves possess of an invariable and uninterrupted existence thro' the whole course of our lives?" Among contemporary philosophers, the complex view is endorsed by Derek Parfit (1971, 1973, 1976, 1984), Milton Wachsberg (1983), Eddy Zemach (1978, 1987), David Lewis (1976), and others.35

Once one accepts the complex view of personal identity, which denies the existence of a single entity persisting across time, it is a small step to further conclude that discounting "our" own future utility may be as rational as discounting the utility experienced by someone else.36 Philosophers have appreciated this implication for some time:

[If the complex view of identity is correct, then] it is a fallacy ... to imagine ... our present self will be interested in what will befall us tomorrow ... If the self or person of today, and that of tomorrow, are not the same, but only like persons, the person of today is really no more interested in what will befall the person of tomorrow, than in what will befall any other person. (Butler, 1736, pp. 99 & 105)

35 Among economists, the complex view of identity is rarely discussed, though Strotz (1956, p. 179) appears to endorse it, as he writes: "The individual over time is an infinity of individuals, and the familiar problems of interpersonal utility comparisons are there to plague us."

36 Indeed, philosophers often turn the discounting issue on its head. Rather than seeking to articulate a basis for giving less than full weight to future outcomes, they seek to establish reasons why we should have any special concern about "our" future selves (any concern beyond that which we would feel for any stranger). For example, Perry (1976, p. 74) asks: "If I am told that by pushing a button I will prevent someone from being in great pain tomorrow, I will have a reason to push it. But intuitively, if the person is me, I will have more reason, or perhaps special reasons, for pushing it. What basis can the theory of personal identity sketched provide for this feeling?"
[If] the Ego is merely a system of coherent phenomena [and] the permanent identical "I" is not a fact but a fiction, as Hume and his followers maintain; why, then, should one part of the series of feelings into which the Ego is resolved be concerned with another part of the same series, any more than with any other series? (Sidgwick, 1874, p. 419).

Unlike Butler and Sidgwick, who recognized, but did not endorse, this implication of the complex view, Derek Parfit explicitly argues that the diminishing "connectedness" with our future selves makes discounting rationally permissible:

My concern for my future may correspond to the degree of connectedness between me now and myself in the future ... since connectedness is nearly always weaker over long periods, I can rationally care less about my further future. (Parfit, 1984, p. 313)

According to this view, it can be rational to prefer less utility now over more utility later because it is rational to accord lesser status to the utility experienced by the later selves with whom you are spatio-temporally continuous, but who are not, fully, "you." Indeed, even acts that are ordinarily considered to be greatly imprudent (e.g., excessive drug use) could be rational if the degree of connectedness with the future selves who bear the costs of current actions is sufficiently small (see Parfit, 1984, p. 317). Parfit's claims are normative, not descriptive. He argues that views about rationality must be grounded on a correct view of personal identity, that the complex view is the correct view, and that the complex view permits discounting. He is not positing a descriptive theory that attempts to explain or predict people's intertemporal choices.

Parfit's claims have proven controversial among philosophers. Many critics have tried to undermine his claims by attempting to decouple the relation between

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37 Outside of philosophy journals, the implications of Parfit's view are largely ignored (though see Broome, 1985, pp. 286-289; Baron, 1988, pp. 442 & 446, and Harvey, 1994, pp. 40 & 48).
future connectedness and future concern that he proposes. Some have drawn attention to cases in which concern seems to be required in the absence of connectedness. Others have pointed to examples in which concern does not seem to be required despite full connectedness. Still others argue that identity is something we construct; that we initiate, and do not merely experience, changes in our character, values, goals, and beliefs, and that this continuity of agency integrates our existence through time. The following sections outline these criticisms of Parfit's view.

2.2. critiques of the Parfitian view

2.2.1 connectedness is not necessary for future concern

Many have attacked the Parfitian view with thought experiments involving future pain. We are asked to imagine a profound change in our psychology, followed by a horrific pain. These critics maintain that, in a deep and undeniable sense, it will still be "you" who feels the future pain, regardless of the reduction in psychological connectedness that might precede it:

Physical pain ... is minimally dependent on character or belief. No amount of change in my character or my beliefs would seem to affect substantially the nastiness of tortures applied to me; correspondingly, no degree of predicted change in my character and beliefs can unseat the fear of torture which ... is predicted for me ... the principle that one's fears can extend to future pain whatever psychological changes precede it seems positively straightforward. (Williams, 1970, p. 170 & 180)
[although] concern about future pain presupposes a continuing identity ... it is far from obvious that such concern makes sense if this continuing identity is to be spelled out in terms of psychological continuity. For then it looks as if what we are saying is that the real object of our concern as regards future pain is that the person who will be in pain will have certain memories and personality traits; and it seems absolutely clear that this is not what one is afraid of at all. What one is afraid of is just that the person who will be in pain is oneself. (Madell, 1981, p. 15)

These "future pain" thought experiments do seem to undermine the claim that future concern should be based solely on psychological connectedness. However, they do not completely destroy the relation between concern and connectedness which Parfit claims, because equally compelling thought experiments can be constructed that support Parfit.\textsuperscript{38} For example, suppose that a woman contracts an incurable neural disorder that will gradually cause her to become singularly obsessed with post-colonial Burmese finger puppets. This acquired passion will alter her psychology in profound ways, by displacing her current interests and goals, changing the way she interacts with her friends and family, and so on. It seems clear in this case that it would be rational for her to discount "her" future utility (the future utility of the puppet fanatic she will become) -- to regard that future utility differently than the utility she obtains from satisfying her current desires. It might, for example, be

\textsuperscript{38} Borowski (1978, pp. 252-256) criticizes the "puzzle cases" and "thought experiments" commonly used to (allegedly) advance understanding about the essence of personal identity:

... there is no a priori reason for supposing that a single uniform criterion [of personal identity] should be available; and, even if there were such grounds, the puzzle case approach would in any event remain entirely inconclusive ... no matter what criterion were to be proposed, we would still be able, given sufficient intellectual agility, to describe a possible situation in which our intuitions would conflict with the proposed criterion ... If the search for a criterion is made to depend on puzzle cases, then the process will never cease, and conversely, no criterion at all can be obtained so long as imaginative fiction is taken to be destructive of proposed analyses of the concepts we ordinarily use.
rational for her to live lavishly now, with little regard for how she will finance the extensive puppet collection that she will inevitably want in the future.\(^3^9\)

The predicted degree of connectedness with her future self may not, however, be the only factor determining the degree of concern she has for "her" future welfare. That might also depend how much she currently esteems those future values and interests.\(^4^0\) She might, for example, ascribe more weight to "her" future welfare if she is told that she will become obsessed with chess rather than finger puppets, even if she believes that the chess obsession would reduce psychological connectedness by the same degree. Parfit mostly sidesteps this complication, by assuming that the degree of concern for one's future self should equal the degree of connectedness. However, in one passage of *Reasons and Persons*, he admits that this view is "too crude":

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\(^3^9\) The Parfitian view is greatly complicated if connectedness is permitted to have different relevance to different "kinds" of utility. However, it is not incoherent to conclude that a diminution in psychological connectedness diminishes the relevance of future psychological pleasures and pains, but not physical pleasures and pains. A sufficient reduction in both physical and psychological connectedness may reduce our concern for physical experiences as well. For example, if we knew we were to be transformed into a frog, we might well be relatively unconcerned about further tortures applied to that frog. (I suspect that any residual special concern we feel for the welfare of the particular frog we will become likely results from a tendency to imagine ourselves trapped inside a frog's body, which is different from being transformed into a frog). For related discussions, see Nagel (1974) and Laine (1992).

\(^4^0\) One's concern about the nature of their future utility is analogous to one's concern about the nature of the utility experienced by another individual one cares about. Marglin (1963, p.109) suggests that he cares more about the increased welfare of others if it results from better education than if it results from electric can openers, and Elster and Loewenstein (1992, p. 225) speculate: "we might enjoy knowing our daughter is happy at college, without considering the reasons for her happiness. Alternatively, we might apply our own tastes to her experiences, deriving pleasure if her happiness stems from success in school, but pain if her happiness results from a newfound discovery of the pleasures of hallucinogens."
In judging the value to me of [a future self] we must know how close my relation is to the resulting person. We must also know whether this person will have features that I regard as good or bad. The view just described mistakenly ignores this second question. I [now] suggest the following [revised] view. The value to me of my relation to a person depends both (1) on my degree of connectedness to this person and (2) on the value, in my view, of this person's physical and psychological features. (Parfit, 1984, p. 299)

2.2.2 connectedness is not sufficient for future concern

Others have criticized Parfit's view by arguing that connectedness cannot be sufficient to mandate concern. They argue that full connectedness need not entail full concern; that our identity must consist of something other than connectedness (Robinson 1988, p. 323; Korsgaard, 1989, p. 107). These critics argue that if connectedness is what matters, we ought to be indifferent about whether "we" survive or whether someone who is sufficiently psychologically connected to us does, including a replica of ourselves whom we have never met. The unacceptability of this conclusion is assumed to be self evident:

Suppose that scientists on Mars are mass-producing bio-programmed people to populate other planets. They are able to imprint various information on the brains of these creatures, including personalities, apparent memories, interests, and so on. Suppose that by purely random coincidence they program a man to have a personality, memories, skill, interests, and so on just like mine, so that they unwittingly create a coincidental replica, who would be just as he is if I had never been born. I am about to die. If identity isn't what matters, the fact that this coincidental replica will continue ought to be just as good as survival ... This is plainly mistaken. (Stone 1988, p. 526)

Parfit is forced to say, that if he were to die tomorrow he would find great consolation in the fact that someone who is very much like him will come from Mars to take possession of his house, sleep with his wife, finish the book he (Parfit) has been working on, and get the total love and devotion of
his (Parfit's) children! If all this is candid (which I doubt) Parfit must be very
different from the rest of us. (Zemach, 1987, p. 216)

These are persuasive counterexamples to the view that concern should equal
connectedness. Replacement with a replica does not seem as good as ordinary
survival. However, it surely seems better than ordinary death. Suppose, for example,
that in the airports of the future you enter a special type of scanner that records all of
your physical and psychological characteristics (including dispositions, memories,
and so on). Prior to boarding you are given your (fragile) disk which contains this
information. You may either throw the disk away or give it to the airline agent for
safekeeping. If you throw the disk away, then the result of a plane crash is as it is
now. However, if you give the disk to the airline agent, then, in the event of a plane
crash, the information would be sent to the airport of your destination and an exact
replica of you would be reconstituted from the information on the disk. It seems
unlikely that the fate of the disk would be a matter of indifference for people. This
suggests that something that matters is preserved on the disk. Indeed, I suspect that
some people would be willing to pay a substantial premium to be "backed up" in this
way.41

41 Most readers of science fiction regard teleportation as a form of travel -- not as murder and
recreation. Most people do not mourn the death of Scotty when he asks Captain Kirk to "beam him
up." Perhaps this is because we believe that he will be reconstituted from the exact same molecules,
rather than recreated from raw material. But is identity at the molecular level really what matters?
After all, within a few years nearly all of the molecules that currently constitute our body will have
been replaced by molecules currently residing in pigs and chickens and tomatoes and ears of corn.
2.2.3 connectedness is endogenous

Some philosophers have criticized the Parfitian view because they believe that it treats people as merely passive loci of experiences, rather than as agents whose choices shape their identity across time. In other words, they argue that Parfit inappropriately treats psychological connectedness as being exogenously determined. For example, Elster (1986, p.11) argues: "I have no argument against Parfit's view that a person who expected his future states to be weakly connected would not be irrational in discounting the future. I believe, however, that a person who takes his future states as given, rather than something to be created, is fundamentally irrational." (For related views, see Daniels, 1979, p. 273; McClennen, 1990 p. 218; Whiting, 1986; and Korsgaard, 1989.)

I believe that this objection is only partly successful. While it may be rational to strive for psychological connectedness, this does make it irrational to discount for any loss of connectedness that might occur in spite of such efforts. As an analogy, although one should strive to stay vigorous, it would, nevertheless, be rational to account for the likelihood of becoming less vigorous with age.

2.3 Overview of alternate views of identity and future concern

By the economic view of intertemporal choice, the degree of care that a self, x, should have for the welfare of a later self, y, care(x,y), equals \( \delta^t \), where \( \delta \) is the unexplained discount factor (with a value between 0 and 1), and t is the number of time periods between x and y. In contrast with the ostensibly simple economic view, the philosophical views of future concern hold that care(x,y) should be some function of: (1) the continuity of soul, (2) psychological connectedness, (3) physical continuity, (4) the degree to which x esteems the anticipated attributes of y, and (5) the degree to which the choices of x give rise to the character of y.
Different philosophical views give different weights to these considerations. By the simple view, all future utility belongs to the same irreducible soul or ego; therefore, all future moments should be given equal weight. According to Parfit, there is no evidence for an immaterial soul. Among the remaining four arguments, he emphasizes psychological connectedness (but gives some weight given to physical continuity and the desirability of the features of y). Others, particularly Bernard Williams, have emphasized the importance of physical continuity. Still others, such as Christine Korsgaard, believe that the continuity of agency unifies our existence. By this view, we should care equally about our future selves if the characteristics of those future selves come about through the ordinary course of life (rather than being imposed upon us in our sleep by a demented neurosurgeon or by some other fantastic process that writers on this topic rely so heavily upon).

Philosophers like Parfit, who believe that it can be rational to discount future utility, have not, however, specified what degree of discounting might be appropriate. There are several reasons for their vagueness. First, the definition of "psychological connectedness" is not precise. Parfit suggests only that it is related to "ambitions, achievements, commitments, emotions, memories, and several other

42 Ordinarily, one would expect 0 ≤ care(x,y) ≤ care(x,x) = 1; that the degree of concern varies between having no regard for one's own future welfare, and being temporally neutral (having the same concern for future welfare as present welfare). However, one can imagine situations where care(x,y) > 1 (when one cares more about their future welfare than their current welfare), or where care(x,y) < 0 (when one desires to harm their future self).

43 Much of the writing on the topic of identity and future concern is devoted to offering counterexamples to others' claims, rather than providing positive arguments for one's own favored view of the basis for future concern. Whiting (1986, 551-552) comments: "Of any candidate for what constitutes such identity -- for example, bodily continuity or sameness of immaterial soul -- we can always ask how that candidate justifies concern. And it's not clear that any account has a very satisfactory answer." Similarly, Korsgaard (1989, p. 112) contends: "the metaphysical facts do not obviously settle the question: I must still decide whether the consideration that some future person is "me" has some special normative force for me."

44 Kolm (1985, p. 259) makes a similar observation about the vagueness of the Buddhist theory of self: "Buddhism states that everything changes, everything disappears, without specifying the speed of this process."
psychological features" (1984, p. 284). Second, the relation between connectedness and concern for one's future is never carefully spelled out. In some places, Parfit seems to suggest a one-to-one relation (a view that requires a ratio-scale measure of connectedness); elsewhere, he claims only that the two concepts "correspond" (1984, p. 313). Third, the extent to which connectedness diminishes over time has not been quantified. Parfit says only that it "is nearly always weaker over longer periods" (1984, p. 313).

In addition to the terminological vagueness, there is much disagreement about what exactly Parfit is claiming. Whiting (1986, p. 549) identifies four different interpretations in the literature: (1) the strong absolute claim (that it is irrational for someone to care about their future welfare), (2) the weak absolute claim (that there is no rational requirement to care about one's future welfare), (3) the strong comparative claim (that it is irrational to care more about one's own future welfare than about the welfare of any other person), and (4) the weak comparative claim (that one is not rationally required to care more about their future welfare than about the welfare of any other person). I believe that all of these interpretations are too strong,

45 Shoemaker (1996, p. 320) defines psychological connectedness as: "a scalar relation [that holds] between X and Y just in case there are between them direct psychological relations, such as direct memory connections (Y has a memory of an experience or action had or done by X), intentional connections (Y carries out an action intended by X), character connections (X and Y have the same general character), and connections of beliefs desires and goals (when X and Y share them)."

46 The measurement of connectedness is rarely discussed. In one of the few relevant passages, Nozick (1981, p. 69) comments on the difficulty of defining an objective measure of connectedness:

Which particular properties, features, and dimensions constitute the measure of closeness, and with what relative weights? ... what are the relevant subcomponents of psychological continuity or similarity (for example, plans, ambitions, hobbies, preferences in flavors of ice cream, moral principles) and what relative weights are these to be given in measuring closeness? ... I make no attempt here to fill in the details ... I do not believe there is some one metric space in which to measure closeness for each of our identities. The content of the measure of closeness, and so the content of a person's identity through time, can vary (somewhat) from person to person. What is special about people, about selves, is that what constitutes their identity through time is partially determined by their own conception of themselves.
and that Parfit endorses only a weaker version of the weak absolute claim. That is, he claims only that one is not rationally required to care about one's future welfare to a degree which exceeds the degree of psychological connectedness that obtains between one's current self and one's future self.

When applying Parfit's claims, it is important to maintain the distinction between rationally permissible and rationally required. It would certainly be rationally permissible to weight another person's welfare (e.g., your child's) as much, or even more than, your own. Similarly, it is rationally permissible to give full weight to your own future welfare, even if you would not be rationally required to do so if you anticipated some diminution in connectedness. Whiting (1986) comments:

... my present self needn't base her [intertemporal decisions] on the belief that she will maximize her own long term benefits by acting on behalf of her future selves. She may instead regard her future selves and benefits to them in much the same way that she regards her friends and benefits to them ... she regards certain benefits to them as capable of compensating for burdens imposed on her. (Whiting, 1986, p. 559) (original emphasis)

Furthermore, though diminishing connectedness may make it rationally permissible to discount future utility, it may render it morally impermissible. As future selves gain the status of other people, rational mandates give way to ethical obligations. Parfit comments on this point with respect to imprudent acts of youth:
If I am not acting irrationally there is surely an objection to what I am doing. For the sake of smaller benefits now, I am bringing upon myself in old age greater burdens. This may not be irrational. But it is surely open to criticism. We are right to deplore such behavior. Classical Imprudence is a most regrettable and often (as in the case of smoking) a tragic thing. We need to criticise such behavior ... By acting against my interest in my old age I am doing what, impartially considered, has worse effects, or reduces the sum of benefits minus burdens. We should perhaps begin to claim that this is morally wrong, even when it will be me who will bear the increased burdens. (Parfit, 1973, p. 240-241)

2.4 Personal Identity and the Social Discount Rate

If diminishing connectedness provides a rational basis for an individual to discount his or her own future welfare, it may, correspondingly, provide a reason for society to discount future outcomes. However, this conclusion holds only if one views the government as representing only current selves. If the government represents future selves as well as current selves, then the social discount rate need not correspond with the expressed preferences of current selves.47

To illustrate this point, consider the following example: You are a social planner ("the government") deciding on behalf of a single person ("society"). You must adopt one of two policies, whose consequences (expressed in terms of utility levels) span two time periods. Policy A = (12, 2) and Policy B = (8, 8). Your citizen's time preference is known. For some reason, she gives utility in period two half as much

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47 Broome (1985, p. 288) comments:

A person's future good does not fully register in his present preferences because, if the [Parfitian account] is right, his future good has for him partly the status of other people's good, which he does not care about. But when we assess the actual goodness of a state of affairs, other people's good counts as much as his. Just because his future good is like other people's good, that is no reason [for society] not to count it fully. To the extent that people discount their future good in forming their present preferences, moral judgments must go beyond present preferences.
weight as utility in period one -- that is, her utility discount factor ($\delta$ in the discounted utility model) is 0.5.

Given your citizen's time preference, she may vote for Policy A, because Policy A has greater discounted utility ($[12 + (0.5)^2] = 13$ versus $[8 + (0.5)^8] = 12$). Thus, if you based policy solely on current preferences, you would choose Policy A. However, if you wished to represent your citizen's future self as well as her current self, you might favor Policy B, which has better future consequences. Furthermore, welfare maximization also favors Policy B, because Policy B confers $[8+8] = 16$ units of utility, whereas Policy A confers only $[12+2] = 14$ units.\(^{48}\) Thus, to choose Policy A under these circumstances, one must not only believe that social policies should reflect individuals' time preferences, but that satisfying current preferences is so important that it trumps competing considerations, such as welfare maximization and the democratic rights of future selves.\(^{49}\)

\(^{48}\) A complex view of personal identity complicates matters here, however, because if the stages of one's life are deeply separable, utility maximization fails as a distributional criterion even within lives. This does not mean that total utility across selves is not an important criterion for choice, but that it is not necessarily decisive. However, utility maximization seems most dubious as a distributional criterion in instances where it requires the relatively poorer off to make sacrifices for the greater benefit of the relatively better off. However, this does not arise in the posited example, because total utility and equality of utility pull in the same direction -- Policy B is superior by both criteria. (For further discussion of maximization within and between selves, see Wolf, 1986; Schultz, 1986; Kagan, 1986; Gruzalski, 1986; and Broome, 1991.)

\(^{49}\) Furthermore, on the Parfitian view of identity, no paternalism is involved in representing future selves, because to the extent that future selves have the status of other people, intervention on their behalf can be justified by conventional arguments about individual rights. See Wachsberg (1983) for an extended discussion of the relevance of theories of personal identity for views about paternalism.
2.5 Summary

Derek Parfit and other contemporary philosophers have claimed that discounting future utility can be rational, by appealing to a view of personal identity in which the distinctions between the stages of our life are given the same status as the distinctions between ourselves and other distinct individuals; they argue that we become less "connected" over time and that we might rationally discount our future utility to account for this diminishing "connectedness." These philosophers have not, however, specified what degree of discounting this philosophical perspective would justify. In the following chapter, I present a study which attempts to do so, by defining "connectedness" as "similarity" and asking respondents to judge how similar they were in the past and how similar they expect to be in the future.
Chapter 3: MEASURING PSYCHOLOGICAL CONNECTEDNESS

The previous chapter presented a view of personal identity in which it is rational to discount future utility; a philosophical perspective which maintains that future selves lose full claim on our present concern to the extent that they differ along certain psychological dimensions that are often collectively referred to as "connectedness." This view is not universally accepted, but is taken seriously by many philosophers. However, no one has yet attempted to quantify how much connectedness diminishes over time. Thus, the degree of discounting that might be rationally justified by this philosophical perspective is not known. In this chapter, I present an empirical study which attempts to measure the rate at which psychological connectedness diminishes over time by defining it in terms of "similarity."

3.1 Subjects

228 people participated in this study. I used convenience samples consisting of travelers at the Pittsburgh International Airport, employees of the US Forest Service, competitors at a Pittsburgh Scrabble tournament, and Carnegie Mellon undergraduates. Respondents ranged in age from 13 to 83 (M=38, σ= 16). Each respondent received a $1 lottery ticket for completing the questionnaire.

3.2 Measuring connectedness across time

To measure psychological connectedness, respondents were asked to rate how similar they were at various times in the past, and how similar they expected to be at various times in the future. Both past and future similarity judgments were made for [5/10/20/30, and 40] year intervals, provided that past selves were at least 10 years old and that future selves were younger than 90.
Respondents were asked to rate similarity on a 100 point scale, ranging from 0 ("completely different") to 100 ("exactly the same").\textsuperscript{50} In these similarity judgments, respondents were asked to consider "personality, temperament, likes and dislikes, beliefs, values, ambitions, goals, ideals, etc." These features are some of those which philosophers generally believe to be constituents of psychological connectedness. I hoped that by focusing respondents' similarity judgments on these psychological features, they would be dissuaded from thinking about physical similarity across time, which is, at least in Parfit's view, a much less significant determinant of connectedness.\textsuperscript{51}

Of the 228 respondents, 207 produced usable responses. I excluded respondents whose similarity judgments were not monotonically declining.\textsuperscript{52} I also excluded respondents who reported the same number for all similarity judgments and at least one of the discounting questions, under the assumption that they were not taking the survey seriously.

\subsection*{3.3 Measuring discount rates}
Following the similarity judgments, I elicited two measures of implicit discount rates. To elicit monetary discount rates, I first asked respondents to make a series of choices between $100 tomorrow and one of seven amounts delivered 1 year from now, ranging from $25 to $500.\textsuperscript{53} Following this set of choices, which I hoped would

\footnotesize{\textsuperscript{50} Respondents were shown an unmarked visual analog scale with 0 on the left and 100 on the right, but were asked to respond with numbers for each similarity judgment (see Appendix 3.1).}

\footnotesize{\textsuperscript{51} Parfit defines "connectedness" in terms of the features that he believes are important constituents of personal identity. Thus, those features that are not so viewed are not important constituents of connectedness, by definition.}

\footnotesize{\textsuperscript{52} For example, a person whose predicted a degree of similarity for [5/10/20/30, and 40] years into the future were [95/41/90/35, and 10] would be excluded because 90 is greater than 41.}

\footnotesize{\textsuperscript{53} I included choices between $100 tomorrow and \textit{smaller} future amounts because I did not want to suggest to respondents that they should necessarily prefer the immediate reward to a future reward,}
help respondents converge on an indifference value, I asked respondents to report the amount of money they would require in [1/5/10/20/30, and 40] years to make them indifferent to receiving $100 tomorrow.\textsuperscript{54}

Following the monetary discount rate questions, I elicited implicit discount rates in a non-monetary domain, by asking respondents to imagine that they worked at a job that had equal proportions of pleasant and unpleasant work. They were asked to report the number of additional good days in a future year that would make them indifferent to receiving 20 additional good days (and, thus, 20 fewer bad days) this year. Again, I first asked respondents to make a series of choices between 20 additional good days this year, and several numbers of good days next year, ranging from 5 to 100. I then asked them to indicate the number of additional good days they would require in [1/5/10/20, and 30 years] to make them indifferent to receiving 20 extra good days next year.\textsuperscript{55}

3.4 Results

3.4.1 similarity of future and past selves

The mean predicted similarity of future selves is shown in the right half of Table 3.1 (see columns \texttt{"+5" through \"+40")}. For example, looking [5/10/20/30/40] years into the future, teenagers predict a degree of similarity of [65/55/49/46/42], thereby biasing the valence or magnitude of their implicit discount rates. As expected, however, nearly all of the respondents did, in fact, prefer $100 tomorrow to a smaller future amount.

\textsuperscript{54} I used "tomorrow" rather than "immediately," because I did not want the implicit discount rates to reflect differences in the subjective probability that the reward would actually be delivered. By introducing a small delay for the proximate reward as well, I hoped to at least make the two rewards comparably uncertain.

\textsuperscript{55} I assumed that people would retire by age 70, and excluded responses that required the assumption of working past 70. Many of the respondents older than 40 did not answer all of the questions, writing "will be retired" or "doesn't apply" in at least one of the blanks.
respectively (read "teens" row left to right, starting from "now"). The mean reported similarity of past selves is shown in the left half of Figure 3.1 and Table 3.1 (see columns "-5" through "-40"). For example, looking [5/10/20/30/40] years into the past, respondents sixty and older reported mean degrees of similarity of [84/73/56/46/40], respectively (read "sixty+" row right to left, starting from "now"). Figure 3.1 is a graphical representation of Table 3.1.

The interpretation of both the predictions and the reports is complicated by uncertainty about how the response scale was used. First, the judged degree of similarity depends on the breadth of the judgmental context that the respondent adopted. A german shepherd and boston terrier are very different if the context is "dogs," but very similar if the context is "animals." Similarly, a former self may seem very different when compared to say, one's current close friends, but very similar when compared to, say, an Inuit or a Russian gymnast (or a jellyfish or ballpoint pen).56 Second, similarity has no natural zero point. Thus, it isn't clear whether the difference between 100 and 90 represents the same reduction in similarity as the difference between 20 and 10. For successive judgments of more distant past and future selves, respondents may have used a constant proportional reduction in response to represent the same absolute amount of similarity change (whatever that means). Thus, equal reductions in similarity may be represented by successively smaller differences in responses. Third, respondents may "reserve" the lower end of the response scale to represent extreme changes in similarity that were outside their range of experience. Fourth, the five response categories [5/10/20/30/40

56 In many studies that have elicited similarity judgments, the judgmental context can be inferred from the set of experimental stimuli explicitly presented, which are often a small set of figures that vary along only two or three dimensions, such as sixteen squares that vary in size and brightness (Tversky & Gati, 1982), sixteen drawings of plants that vary in form of pot, and elongation of leaves (Gati & Tversky, 1982), or four schematic faces varying in the shape of the mouth, eyebrows, and nose (Tversky, 1977), or on the presence or absence of beard, glasses, and moustache (Sattath & Tversky, 1987).
years] were unevenly spaced (5 years separated the first two categories, then 10 years for the next three). Generally, finer division of the response categories tends to increase the amount of the response scale allocated to that region (see e.g., Fischhoff, Slovic, & Lichtenstein, 1978; Poulton, 1989).

If these response scale problems are ignored, and the numbers are taken at face value, then respondents believe that similarity will diminish much more quickly in the near future than in the more distant future. For example, overall, respondents predicted similarity to diminish by 34 points over the first 10 years (from 100 to 66), but only 8 additional points over the next ten years (from 66 to 58). Looking in the opposite direction, similarity diminished more quickly in the near past than the more distant past. For example, respondents reported a decline of 41 similarity points over the past 10 years, but an additional decline of only 11 more points over the 10 years previous to that (as seen in mean similarity judgments of 59 and 48, respectively).\textsuperscript{57}

Looking across groups, the judgments suggest an inconsistency: forward looking predictions indicate higher rates of change at younger ages, whereas backward looking reports indicate higher rates of change at older ages. Of course, if respondents are not using the response scale linearly (if equal response differences do not imply equal judged differences in similarity), then it is inappropriate to compare rates of change over different intervals.\textsuperscript{58} I now look at these data in greater detail.

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\textsuperscript{57} Even if respondents used a constant proportional reduction in responses to indicate constant absolute differences in similarity, the data still indicate that similarity is expected to diminish (was perceived to diminish) at declining rates looking forward (backward). For example, looking forward over the intervals [0-5 years / 5-10 years / 10-20 years / 20-30 years, and 30-40 years], the average annual proportional change with respect to the previous judgment was [4.8%/2.6%/1.2%/1.2%, and 0.4%], respectively. Similarly, looking backward over the intervals [0-5 years / 5-10 years / 10-20 years / 20-30 years, and 30-40 years], the average annual proportional decrease in similarity with respect to the previous judgment was [5.6%/3.6%/1.9%/1.9%, and 1.5%], respectively.

\textsuperscript{58} Indeed, it is inappropriate to even speak in terms of rates, if similarity has no natural interpretation on an interval scale.
3.4.2 similarity judgments and age

Predicted similarity of future selves suggests a curvilinear relation with age. In general, the two middle age groups (thirties and forties) predicted greater similarity than either the two youngest age groups (teens and twenties) or the two oldest age groups (fifties and 60+), as can be seen by looking down the columns in Table 3.1 (or into the "z" axis of Figure 3.1). The differences in predicted similarity judgments across age groups were significant for the 10, 20, and 30-year intervals. (The bottom row of Table 3.1 shows the p-value of a Kruskal-Wallis test). Older respondents may have predicted greater change than middle aged respondents because they anticipated greater physical debilitation, or, perhaps, senile dementia.\(^{59}\)

Reported similarity of past selves was positively related with age. Looking back a given number of years, older respondents viewed their previous selves as much more similar than younger respondents did. For example, when comparing one's current self to oneself 5 years ago, teens mean similarity judgment was just 55, compared to 84 for respondents who were sixty and older. The differences among age groups were significant for the 5, 10, and 20-year intervals. (The bottom row of Table 3.1 shows the p-value of a Kruskal-Wallis test).\(^{60}\)

\(^{59}\) Although physical characteristics were not included among the adjectives used to cue similarity judgments, respondents may have thought that they were part of the "etc." They might also have chosen to account for physical characteristics even if they did not consider them as part of the explicit or implicit instructions.

\(^{60}\) The linear correlation between age and similarity judgments \([5/10/20/30, \text{ and } 40] \) years ago are, respectively, \([-0.32 / -0.34 / -0.21 / -0.16, \text{ and } -0.19]\). The significance levels of these correlations are, respectively, \([.000 / .000 / .018 / .143, \text{ and } .172]\).
3.4.3 predicted vs. reported similarity

This was not a longitudinal study, so I could not compare respondents' predicted similarity of a future self with their own reported similarity after that interval had elapsed. However, I could compare respondents' prospective judgments with the corresponding retrospective judgments of other older respondents. For example, the "+5" judgments of all 13 year olds could be compared to the "-5" judgments of all 18 year olds, and so on. Table 3.2 reports the average differences between predicted and reported similarity for matched age groups, both overall, and for a given age range (see Appendix 3.4 for a description of this calculation). Most of the entries are positive, which indicates that, on average, respondents predicted more similarity looking forward than they reported looking backward over the same age interval. This is particularly true for the long intervals, where the differences are substantial (e.g., the projected degree of similarity looking 40 years ahead is almost 15 points higher than the recollected degree of similarity looking 40 years back). Because there is no objective measure of similarity with which to compare these judgments, it is unclear whether people underpredict how much they will change, overreport how much they have changed, or some of each. Furthermore, it is possible that younger and older respondents just use the response scale differently.

3.4.4 similarity judgments and discount rates

Tables 3.3 and 3.4 show median responses and corresponding discount rates to the discount rate questions, both overall, and disaggregated by age category. On the assumption that people would care more about their future welfare if they predicted their future selves to be more similar, I expected a negative correlation between

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61 For the monetary question, implicit discount rates were computed from responses using the formula, \( r = \left[ \left( \frac{\text{# of future dollars}}{100} \right) \right] - 1. \) For the non-monetary question, implicit discount rates were computed from indifference values using the formula, \( r = \left[ \left( \frac{\text{# of future days}}{20} \right) \right] - 1. \)
similarity judgments and implicit discount rates. The data did not support this prediction. In general, neither predicted nor reported similarity correlated significantly with either monetary discount rates or non-monetary (good days) discount rates.  

3.5 Discussion

If one accepts the philosophical notion that future utility may be weighted by the degree to which we are "connected" to future selves and accepts that the similarity judgments elicited here measure "connectedness," the results of this study suggest that, on average, it may be rational to discount future utility by 4% to 13% per year (the rates at which similarity was perceived to decline in the near past for respondents of different ages). This is a true utility discount rate that is separate from, and in addition to, any justification for discounting consequences (such as uncertainty or opportunity cost) that were discussed in Section 1.1.

If one accepts the Parfitian view, the results lend partial support to the normative legitimacy of DU, because many people do report (and predict) substantial change in similarity. However, the data do not support DU's assumption that the discount rate should be constant over time. As discussed in section 3.4.2, neither predicted nor reported similarity is constant with age. Teenagers, for example, both predict and report more rapid change in similarity than the other age groups. Thus, the allegedly higher discount rates exhibited by teens may have a rational basis.

Appendices 3.5 and 3.6 show the rank correlation coefficients between similarity judgments and discount rates, disaggregated by length of temporal interval for the discount questions and the similarity judgments. The only significant correlations were positive. Among respondents fifty and older, there was a significant positive correlation between the reported similarity of past selves, and the monetary discount rate (see bolded cells in "sim -40" column of Appendix 3.5). There was also a significant correlation between the perceived similarity of distant past selves and the non-monetary discount rate for a 10 year time horizon (see bolded cell in "sim -40" column of Appendix 3.6). In other words, older respondents who viewed themselves as being very similar to their more youthful selves had higher implicit discount rates. I have no explanation for these results.
The study showed no relation between connectedness and implicit discount rates. There are several possible explanations for this: (1) *Similarity may not be synonymous with connectedness*. Although respondents were instructed to consider "personality, temperament, likes and dislikes, beliefs, values, ambitions, goals, ideals, etc." which Parfit views as central components of connectedness, their similarity judgments may have been influenced by factors outside Parfit's definition of connectedness, such as anticipated changes in physical characteristics. (2) *There may be no empirical relation between connectedness and concern for one's future*. For example, someone may predict that they will lose their passion for chess as they age, and, thus, be somewhat dissimilar with respect to "likes and dislikes" (one component of connectedness), but not believe that this anticipated change has *any* significance for how much they should care about future monetary rewards. As mentioned in Chapter 2, this would not invalidate Parfit's view, as he is arguing for a modified view of what rationality requires, not making descriptive predictions about what people believe or how they will actually make intertemporal choices. (3) *Implicit discount rates (as assessed by these tasks) may not measure concern for one's future*. Although such matching procedures are commonly used to measure implicit discount rates and (arguably) time preferences, no one has yet been able to demonstrate substantial correlations between these measures and behaviors that might suggest one's concern for their future. For example, Fuchs (1982) failed to find significant correlations between monetary discount rates implied by a similar matching procedure and self-reported behaviors that might suggest concern for one's future, such as seat belt use, smoking, and frequency of exercise. Responses to the matching tasks used to infer implicit discount rates may simply not measure concern for one's future (if there even is such a global trait). As discussed in chapter 1 (see, particularly, footnote 27) discount rate questions may be measuring considerations other than time preference *per se*, such as one's degree of trust that a future reward
will actually be delivered. Furthermore, the tasks may be so difficult that much of the
response variation reflects something unrelated to intertemporal choice entirely, such
as idiosyncracies in number use. In either case, if these implicit discount rates do not
measure concern for one's future, then one would not expect any correlation with
similarity judgments, even if similarity judgments did measure connectedness and
connectedness did affect future concern.

If diminishing connectedness really does provide a basis for treating one's future
selves as other people, the difference between intrapersonal time preference (concern
for one's own future) and intergenerational time preference (concern for the welfare
of others who will be alive in the future) may not be quite as distinct as it was made
out to be in Chapter 1. The following chapter will focus on intergenerational time
preferences. I discuss various ways to measure the concern that people have for the
welfare of others in future generations, studied in the context of their preferences
regarding life-saving policies.
Chapter 4: DISCOUNTING FUTURE LIVES

4.1 Introduction

Many public policy decisions require tradeoffs between lives in this generation and lives in future generations. For example, widening a mountain highway may cost the lives of construction workers now, but save lives of future motorists. Sequestering waste in a repository may reduce risks to future generations, but transporting it to the repository may increase risks for this generation. Money spent on heart transplants will have immediate benefits, whereas money spent on biomedical research may primarily benefit people who aren't yet born.

To choose among such programs and policies, policy makers need to know how current and future lives should be compared -- whether future lives should be discounted relative to current lives and, if so, what discount rate is appropriate. Discounting lives is a controversial topic, with disagreement about both the magnitude of the discount rate and the theoretical basis for discounting.

Many have argued that the discount rate for outcomes affecting future generations ought to be a political decision based on the relative weight that citizens assign to current vs. future generations. However, there has been very little descriptive research attempting to quantify public values of current and future generations in a form amenable to economic analyses. By far, the most influential studies of this type were conducted by Cropper, Aydede, & Portney (1991, 1992, 1994). Those studies had respondents make choices between hypothetical life-saving

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63 Some reject the view that the social rate of time preference ought to be determined by surveying and aggregating the intergenerational preferences of the current members of society. Page (1977, p. 169-170) characterizes this practice from the viewpoint of a future generation:

As you grow up, it is explained to you that the world is going to end very shortly because earlier generations wanted to live well ... You might well call out to the ghosts of the first generation, demanding by what right it made its decision. It would hardly be satisfying to hear the answer, "We took a vote of all those present and decided to follow our own time preferences."
programs, described as saving a specified number of lives either now or in some future year. The authors interpreted their results as showing that the public values the lives of people in future generations much less than they value the lives of people in this generation. For example, they concluded that the median respondent is indifferent between saving 1 life now and saving 44 lives one hundred years from now.

Such findings could have important implications for many public policies, particularly health and safety regulations. For example, some carcinogens degrade quickly in the environment and primarily affect the current generation, whereas others continue to be dangerous far into the future. Thus, the value we ascribe to current and future lives could determine which carcinogens we choose to regulate most strictly.

64 Horowitz & Carson (1990), Olsen (1993), and Cairns (1994) also elicited discount rates over life saving interventions. They found discount rates of 5-13%, 7-23%, and 16-38%, respectively. However, these studies all used intervals of twenty years or less, and are not as readily interpreted as intergenerational time preferences, which are the primary focus of this chapter.

65 The following is an example of a question in their study:

Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, 100 people will die this year from pollution, and 7000 people will die 100 years from now. The government has to choose between two new programs to control this pollution. The two programs cost the same, but there is only enough money for one.

Program A will save 100 lives now
Program B will save 7000 lives 100 years from now.

Which program would you choose? A B

66 A 1991 ruling by the U.S. Fifth Circuit Court of Appeals [See 947 F.2d (5th Cir. 1991)] overturned an asbestos regulation issued by the Environmental Protection Agency (EPA) in part because EPA did not discount the future lives that would be saved. On p. 1218 of that ruling, the judges commented: "... it would skew the results to discount only costs without according similar treatment to the benefits side of the equation ... Because the EPA must discount costs to perform its evaluations properly, the EPA should also discount benefits to preserve an apples-to-apples comparison, even if this entails discounting benefits of a non-monetary nature [the future lives which would be saved by the regulation].
If surveys of public preferences, such as those conducted by Cropper, Aydede, and Portney, are to be used as an input to such policy decisions, it is essential to determine the robustness of such results. A growing body of evidence has shown that elicited preferences are affected by the method of elicitation, the framing of the problem, and the context of the choice (Fischhoff, Slovic, & Lichtenstein, 1980; Tversky & Simonson, 1993). There is no a priori reason to suspect that measures of intergenerational preferences are immune to these effects. Indeed, Johanneson & Johansson (1997) found that implied intergenerational preferences are sensitive to minor changes in question format. However, their results were qualitatively comparable to Cropper, Aydede, and Portney's, as both studies concluded that the lives of future generations were valued much less than lives in this generation.67

The following sections describe a study that tests further the robustness of Cropper, Aydede, and Portney's results using several different elicitation procedures. Two of the formats tested whether preferences inferred from matching and rating response modes correspond with the preferences inferred from dichotomous choices. In other domains, researchers have found differences in implied preferences between choice procedures and matching procedures (see, e.g., Tversky, Sattath, and Slovic, 1988). Svenson and Karlsson (1989) found very low implicit discount rates when a ratings procedure was used.68

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67 Johanneson & Johansson's study, which was conducted in Sweden, was very similar to the study of Cropper, Aydede, & Portney. It was conducted by professional survey firm using telephone interviews, used a large sample (over 1500 respondents), and elicited preferences using choices between hypothetical programs which saved specified numbers of lives now or in a future year (by reducing risks from some unspecified source). However, Johanneson & Johansson found that the implied rate of substitution (of future lives for current lives) was reduced by a factor of about eight, when the choices were framed as 100 lives in the future vs. 100/k lives now than when framed as 100 lives now vs. k100 lives in the future (the format used by Cropper, Aydede, & Portney).

68 Svenson and Karlsson asked students at the University of Stockholm to compare the "seriousness" of a nuclear accident in the very distant future (ranging from 1000 to 2 million years from now) to an accident in the somewhat less distant future (in the year 2100). About 30% of the respondents thought that the waste leakage was equally serious, regardless of when it occurred. Most of the others rated the future accident to be less serious, though the ratings implied very low discount rates. For example, compared to an accident in the year 2100, whose seriousness was defined as "10," an accident in the
Three other formats tested the sensitivity of preferences to the "framing" of the choice problem. One explicitly mentioned the total of the lives saved across both periods, another highlighted equity between generations and a third involved a choice between two sequences of outcomes. Loewenstein & Prelec (1993) found that for intra-personal discounting, framing an outcome in terms of a sequence can affect the magnitude and even the valence of the implied discount rate. This has not, however, been replicated in an intergenerational context.

Finally, two formats tested the sensitivity of preferences between immediate and delayed life-saving programs to the context provided by the other alternatives in the choice set. In contrast to the standard theory of choice, which assumes stable utility surfaces in the face of different choice sets, many researchers have found that people commonly rely on the alternatives under consideration in order to assess the value of a particular option, so that the relative attractiveness of two options can depend on the presence or absence of other options in the choice set (Huber, Payne, & Puto, 1982; Huber & Puto, 1983; Ratneshwar, Shocker, & Stewart, 1987; Simonson & Tversky, 1992; Tversky & Simonson, 1993).

4.2 Measuring the value of future lives: a test of Cropper, Aydede, and Portney

4.2.1 Subjects

401 people participated in the study. I used two samples. The first was 158 registered voters selected for jury duty at the Pittsburgh Civil Courts (average age 43). The second was a convenience sample of 243 undergraduates at the University of Arizona and Carnegie Mellon University (average age 20). Respondents were given either a candy bar or a $1 lottery ticket for completing the questionnaire.


4.2.2 Procedure

Figure 4.1 shows the experimental design. Each respondent was randomly assigned one of four versions of the questionnaire. Each version contained three questions pertaining to the relative value of current and future lives. Questions were separated by distractor tasks so that respondents would be less likely to perceive relations between them or modify their answers to maintain consistency across questions. Two of the four versions included questions used by Cropper and colleagues, in order to test the comparability of my sample to theirs. Seven other questions tested the robustness of these results to manipulations of the elicitation procedure. The manipulations included changes in response mode (choice vs. matching vs. ratings), different question formats (which emphasized either the total number of lives saved, the sequence in saving over time, or the equity of the distribution of life-saving benefits), and manipulations of the choice set (including a relatively attractive or unattractive "decoy" choice to make the future-oriented program look good or bad by comparison). The procedures and results are described below. (The exact wording of each question is reported in Appendices 4.1a through 4.7b).

4.2.3 Replication of Cropper, Aydede, and Portney's results

Two of the questions on the survey were taken from Cropper et al. (1994), and were intended to test the comparability of my sample (which was a mixture of students and Pittsburgh residents) to theirs (which was a random sample of residents in Washington, D.C. and Maryland). The results were very similar. Cropper et al. (1994) found that 47% of the respondents preferred the hypothetical program that

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69 Although there were a total of 12 questions across the 4 versions (4 versions time 3 questions per version), only 9 different elicitation formats were tested, because three of the formats (sequence, total, and equity) appeared on two of the four versions (see Figure 4.1).
saved 100 lives now to one that saved 7000 lives one hundred years from now. I found 49%. Similarly, they found that 70% preferred a hypothetical program that saved 100 lives now to one that saved 200 lives twenty five years from now, whereas I found 78%. These results indicate that the sample I used was comparable to the one used by Cropper et al. in the sense that I obtained similar results using a similar elicitation procedure. Thus, my sample should be suitable for testing the robustness of their results to procedural variations. The following sections describe these alternate procedures.

4.2.4 Matching

This question used the same background scenario used by Cropper and colleagues, describing two hypothetical programs that prevented deaths from pollution. However, rather than choosing between two specified programs, respondents indicated how many lives Program B must save in 100 years to make it as good as Program A, which saved 100 lives now (i.e., 100 lives now = ____ lives in 100 years).

Results

The median matching response was 200, which implies a substitution rate of 2 to 1. This contrasts sharply with the results of Cropper, Aydede, and Portney, who

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70 Cropper, Aydede, & Portney do not report exactly which dichotomous questions they asked. I inferred the 70% from Figure 2 on p. 250 of their 1994 publication, which reports the percentage of respondents who preferred the immediate program at different rates of substitution between current lives and future lives.

71 In the matching format, the outcomes in both periods (including the zero outcome) were explicitly expressed, as shown below:

Program A will save 100 lives this year, but will save 0 lives 100 years from now.
Program B will save 0 lives this year, but will save ____ lives 100 years from now.
found a marginal rate of substitution of 44 to 1, and with the replication of their results reported above, which implied a substitution rate of approximately 70 to 1 (roughly half of the respondents preferred the program that saved 100 lives now to the one that saved 7000 lives in one hundred years). Furthermore, 43% of the respondents answered 100, which implies that current and future lives are considered equally important.72

4.2.5 Rating

This question asked respondents to rate the relative importance of a death 100 years from now with a death next year. Respondents first indicated whether they considered the outcomes to be equally bad. If they did not, they were asked to rate the relative badness of the less bad outcome on a scale ranging from 0 (insignificant by comparison) to 1 (equally bad).

Results

64% (60/92) of respondents judged the current death and the future death to be equally bad. Among the 28% (26/92) who thought that the future death was less bad, the median degree of severity was 3/10. Again, the results of this elicitation method

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72 Although the question was open ended, 95% of all responses were one of 4 values -- 100 (43%), 200 (10%), 1000 (22%), or 10,000 (20%).
contrast sharply with the results of Cropper, Aydede, and Portney, by suggesting that current and future lives are considered equally important by most subjects. Even for those subjects who did believe the current death was worse, the responses suggest rates of substitution of about 3 to 1, which is much lower than the 44 to 1 suggested by Cropper, Aydede, and Portney.

4.2.6 Total Framing

This question tested the effect of explicitly mentioning the total number of lives saved over both time periods. Respondents chose between Program A, which saved "55 lives now and 105 more lives 25 years from now, for a total of 160 lives" and Program B, which saved "100 lives now and 50 more lives 25 years from now, for a total of 150 lives." Indifference between these two programs would imply a marginal rate of substitution of about 1.2 to 1, because if 1 current life equal k lives in 25 years, Program A = Program B when $55k + 105 = 100k + 50$, which holds for $k = 1.2$.

Results

46% (93/200) of the respondents preferred Program A, which implies a substitution rate of less than 1.2 to 1. In contrast, for the 25 year time horizon, Cropper, Aydede, and Portney's results implied a substitution rate of 6 to 1, and Johanneson & Johansson (1997) found rates ranging from 12 to 1 to 25 to 1 (see Table 4.2). Explicitly mentioning the total may have cued some respondents to choose Program A, by giving them a compelling reason for doing so. (For the dichotomous choice questions used in earlier research, whose hypothetical programs saved lives in one period or the other, the total is obvious in one sense, but may not be a salient choice criterion because it is not explicitly mentioned.)
4.2.7 Sequence Framing

Respondents chose between two programs that saved 600 lives over the next three decades. Program A saved lives in an increasing sequence (100,200,300). Program B saved lives in a decreasing sequence (300,200,100).

Results

71% (139/196) of respondents preferred Program A, which saved lives in an increasing sequence. This implies that future lives are valued more highly than current lives. (Note that Program A can be created from Program B by delaying 200 units of life saving from the first to the third decade.) This result is consistent with earlier research of Loewenstein and colleagues (see, e.g., Loewenstein and Prelec, 1993), who found that negative discount rates may be induced by explicitly embedding a consequence into a sequence; that is, by making its temporal relation to other outcomes salient.\(^{73}\)

4.2.8 Equity Framing

Respondents chose between two programs that saved 300 lives over the next three generations. Program A saved all 300 lives in this generation and no lives in future generations (300,0,0), whereas Program B saved 100 lives in each generation (100,100,100).

Results

80% (157/196) of respondents preferred Program B, which saves an equal number of lives in each generation, to Program A, for which all of the life-saving benefits the

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\(^{73}\) An alternative explanation for this result is that respondents extrapolated the sequence beyond the specified three decades, in which case Program A would be superior in terms of total lives saved, because Program A would save 400 lives in the fourth decade, whereas Program B would save zero lives.
present generation. This result implies that future lives are valued more highly than current lives. Furthermore, it shows that preferences for intergenerational equity can trump preferences for temporal proximity. If so, intergenerational preferences cannot be simply characterized as a discount rate (or rate of substitution), because the desired tradeoff depends on the perceived distribution of the benefits across generations.74 The question formats used by Cropper, Aydede, and Portney (1991, 1992, 1994) or Johanneson & Johansson (1997) force respondents to choose between two inequitable programs -- one that saves all lives now and none in the future or another that saves all lives in the future and none now. Consequently, the choices to such questions (and the discount rates inferred from them) may not reflect concerns about equity that are clearly important.

4.2.9 Context effects

Two questions were designed to test whether preferences between two hypothetical life-saving programs could be manipulated by having respondents consider other alternatives. In one question, respondents first chose between Program A, which saves 100 lives now, and a "decoy" Program X, which saves 103 lives 24 years from now. They then made the "real" choice between Program A, which saves 100 lives now and Program B, which saves 200 lives 25 years from now (the same choice that Cropper et al. asked in isolation). I predicted that prior exposure to the relatively inferior future program, X, would increase the proportion of respondents

74 No substitution rate (or discount rate) could, by itself, explain the set of preferences (100,100,100) \(> (300,0,0) \rangle (0,0,300)\), which these results suggest. This result could be explained by invoking diminishing marginal utility of additional lives within a generation, which would penalize unequal distribution across generations. However, it does not typically make sense to suppose that someone's life has less value (to themselves or to society) because someone else's death is prevented. Furthermore, there is no good reason for isolating the effects of this particular project when calculating the marginal value of an additional life saved. The effects of the project could just as easily be subtracted from the 4 million or so deaths that occur annually in the U.S., such that the net effect of the alternate programs are (3,999,900, 3,999,900, 3,999,900) vs. (3,999,700, 4,000,000, 4,000,000). This formulation makes the claim of diminishing marginal utility far less compelling.
preferring Program B to Program A because saving an additional 100 lives at the "expense" of a 25 year delay would seem like a good deal in the context of another option that saves "only" 3 additional lives for a 24 year delay.75

Conversely, in the other question, respondents first chose between Program A, which saves 100 lives now and a "decoy" Program Y, which saves 7000 lives 26 years from now, before making the "real" choice between Program A and Program B. I expected that exposure to the relatively superior future program, Y, would decrease the proportion of respondents preferring Program B to Program A, because saving an additional 100 lives at the "expense" of a 25 year delay would seem like a bad deal in the context of another option that saves 6900 additional lives for a 26 year delay.

Results

Consistent with the predictions, the presence of a relatively inferior future program substantially increased the proportion of subjects who preferred the future-oriented Program B to the present-oriented Program A -- from 22% in the original condition to 43% in the positive contrast condition (p < 0.001). However, adding a relatively superior future alternative did not substantially reduce the proportion preferring Program B -- it was 22% in the original condition and 21% in the negative contrast condition. This may have resulted from a floor effect. A substantial minority of subjects may resolve the tradeoff by invoking the simple rule of choosing the program that saves more lives. Such subjects would be relatively immune to framing or context effects.

75 Simonson & Tversky (1992) note that salespeople commonly exploit such context effects by first presenting consumers with a much higher priced, only slightly better "decoy" product before showing them the real product they intend on selling, which then looks like a bargain by comparison.
4.2.10 differences between student pool and jury pool

Table 3.3 reports the results of the nine elicitation procedures, disaggregated by subject group. Overall, the results suggest that the younger, student sample cares more about future generations than the older, jury sample. The differences were statistically significant (at the 0.05 level) for three of the elicitation procedures. However, the differences between samples are small relative to the differences across procedures. For example, if the analysis is restricted to the jury sample (which was a random sample of adult Pittsburgh residents), the implied rates of substitution (of lives in 100 years for lives now) for the ratings, matching, or choice response modes was 1 to 1, 7.5 to 1, and 70 to 1, respectively.

4.3 General Discussion

Previous research on intergenerational discounting has concluded that the public values future lives much less than the lives of people in this generation. Cropper et al. (1994) concluded that the public would be willing to trade 44 lives in 100 years to save 1 life today. Johanneson and Johansson (1997) found marginal rates of substitution as high as 243 to 1. Cropper et al. (1994, p. 255 & 256) speculate that respondents may discount future lives because they "do not feel as close a kinship with future anonymous lives as with present anonymous lives" and that respondents' choices "presumably reflect ethical values." Similarly, Johanneson and Johansson

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76 The overall sample in this study consisted of about 60 percent college students. The remaining 40 percent were a sample of Pittsburgh residents awaiting jury duty who were randomly selected from the pool of registered voters. Thus, overall, my sample was likely younger and more educated than the sample used by Cropper, Aydede, & Portney (which was a random sample of households in Maryland and Washington D.C.). Nevertheless, using the combined sample, I obtained almost identical results as Cropper, Aydede, and Portney when I asked the questions they asked, as reported in section 4.2.3. For this reason, I have focused primarily on the combined results.

77 Johanneson and Johansson used two different framings. When the choices were framed as [100] lives now vs. [some multiple of 100] lives in 75 years, the implied substitution rate was 243 to 1. When the choices were framed as [100] lives in the future vs. [some fraction of 100] lives now, the implied rate of substitution was 32 to 1.
(1997, p.169) assume that the representative respondent "values the interests of the current generation higher than he values the interests of future generations."

The study presented here does not support these interpretations. As shown in Table 4.2, many of the elicitation procedures used in this study suggest that the public cares equally about present and future lives -- the implicit discount rates are approximately zero and the implied rates of substitution are approximately 1 to 1. Indeed, two procedures (the sequence and equity frames) imply negative discount rates.

Furthermore, there is little basis for believing that the discount rates implied by the dichotomous choice procedures do, in fact, reflect a diminished concern for future generations relative to current generations. Cropper et al. asked respondents who consistently preferred the present-oriented program to explain the reasons for their choices (see Table 1 on p. 250 of their 1994 publication). They coded the responses as follows:

- Technological progress provides means to save people in the future 31.3%
- One should live day by day 31.7%
- Future is uncertain 15.4%
- The life I save may be my own 6.5%
- Present-oriented program saves more lives 1.6%
- Saving lives now means more lives in the future 2.8%
- Other 7.7%
- Do not know 2.9%

Notably, there is no category labeled "I care less about future generations than this generation" or anything that suggests ethical values or kinship or a diminished concern for future people, per se. Respondents in the study presented here were not

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78 In the study for which these retrospective verbal protocols were elicited (which was conducted with 564 households in Washington D.C), Cropper, Aydede, & Portney used a "double-bounded" dichotomous choice procedure in which respondents were first given a choice between a program which saved lives now and a program which saved lives 50 years from now. If they chose the present oriented program, they were given a second choice in which the future program was made more attractive by reducing the time horizon from 50 to 25 years. The respondents who still preferred the present-oriented program were asked to state, in their own words, the reason for their choices.
requested to provide justifications, but were invited to comment on the questions or
their answers if they wished. Many of these comments suggest reasons similar to
those attributed to the respondents in the study by Cropper, Aydede, and Portney (see
Appendix 4.8 for a complete list of comments.) Many respondents refused to believe
that the future deaths would actually occur (e.g., "We'll figure out a way to save lives
in the future," "Technology will change and guarantee higher survival rates," "In
100 years, a solution might be found to save the life"). Another was dubious of the
long-term commitment by the government needed to ensure that the future programs
fulfilled their promise ("I don't trust long term projects in the hands of government
agencies which are subject to political whims."). None of the 29 people who offered
written justifications for their choice indicated that they felt less empathy toward, or
kinship with, or concern for future people.79

The large variability in implicit discount rates across procedures may partly
reflect differences in the degree to which the elicitation format encouraged or
permitted the respondent to express doubt about the premises of the scenario. In a
dichotomous choice procedure, it is easy for respondents to express their skepticism
that the future deaths would really occur -- by simply choosing the present-oriented
program. It is much less easy for them to adjust their matching or rating response to
incorporate such doubts. Thus, while the dichotomous choice questions are relatively
easy for respondents to understand and answer, they may be among the worst
elicitation formats in terms of confounding uncertainty about the occurrence of the
future outcome with diminished concern for the future outcome (conditional on its
occurrence).

79 It is also noteworthy that only five respondents who chose a future-oriented program (which saved
an equal or greater number of lives) felt any need to justify their answers, whereas eighteen
respondents who chose an immediate program did. (Six respondents made comments which did not
pertain to their choice, per se.)
The large variability across elicitation procedures also suggests that respondents lack preferences on which to base responses. As Tversky, Sattath, & Slovic (1988, p. 383) comment: "... if different elicitation procedures produce different orderings of options, how can preferences and values be defined? And in what sense do they exist?" If respondents lack stable preferences, they may simply choose the option that appears best along whatever dimension is made salient -- the program with the highest total when total is emphasized, the option with the most favorable sequence when sequence is emphasized, and the program that seems most equitable when intergenerational equity is emphasized.

In conclusion, the results of this study cast doubt on previous claims that people care less about future lives than present lives. The only procedure that implies substantial discounting of future lives was the dichotomous choice procedure used by prior researchers interpreted as though its terms were accepted as stated. The result was not robust to alternate response modes or framings of the question. Furthermore, an analysis of Cropper et al.'s evidence indicates that the preference for the present-oriented programs in these choices are not motivated by a diminished concern for future people, but by other considerations -- particularly a rejection of the premise that the future deaths will actually occur.80 Thus, there is no evidence that the

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80 Even if the responses did reflect the general public's "ethical values," it is unclear why Cropper and colleagues "find it comforting that the general public appears to agree with the discounting of future lives saved, and, furthermore, that its discount rate for life saving is, on average, equal to its discount rate for money." (1994, p. 260). First, the significance of this alleged equivalence is unclear, because, as the authors themselves note (1994, p. 256), there is no theoretical connection between the market interest rate and someone's degree of concern for future generations. Second, as discussed in Chapter 1 (see section 1.1.6), discounting future lives at the market interest rate is inappropriate if one is deciding between spending money now on a program which saves current lives and spending money now on a program which saves future lives (which is how the choice is expressed in the hypothetical scenarios used in their studies). If there is no investment of the money in either case, there is no compounding, and, thus, no basis for expressing the compounding via the discount factor. Third, if the choice was between spending money now on a program that would save future lives, or investing the cost of the program at the market interest rate, it would be appropriate to discount future benefits at the market interest rate even if we cared equally about future generations (as discounting for opportunity cost does not imply that the future benefit is less valuable but merely that its value is being expressed in a more highly valued currency). If, in fact, we care less about future people, this provides a different and additional reason for discounting.
implicit discount rates computed in earlier studies reflect ethical values or
generational weights, and it is wrong to use them to impute a "pure rate of social time
preference," that might be an input to actual policy choices.

There are many legitimate reasons to have less regard for outcomes that occur in
the more distant future. For example, the spill of a carcinogen one hundred years
from now may be less important than a spill five years from now, because a cure for
cancer is more likely to be found in the next hundred years than in the next five.
However, if one is interested in assessing rates of technological progress or the
probabilities that future events will actually occur, there are better ways to ask the
question -- not to mention better procedures for determining these figures than
surveying public beliefs. If one is interested in the importance or moral significance
of future people vs. current people, it seems better to simply ask about this directly.
When respondents in this study directly compared the severity of current and future
deaths (in the ratings format), most considered them to be equally important.
Chapter 5: CONCLUSIONS

An adequate understanding of intertemporal choice and the concept of "discounting" requires conceptual separation of several distinct concepts, including: the probability of future occurrence, objective changes in the consequence itself, changes in the utility function, utility from anticipation, utility from memory, opportunity costs, time preference, and, for distant consequences, intergenerational time preference. Chapter 1 proposes a framework for organizing these concepts.

Greater emphasis must be placed on articulating the basis for discounting in particular applications. Without knowing what the discount rate is supposed to represent, it is difficult to evaluate its normative legitimacy. For example, in a decision about circumcision, should the future benefits (a reduction in the risk of penile cancer) be discounted when being compared to the immediate costs (pain and possible infection)? Before one can begin to answer such questions, one must first ask what discounting is intended to represent. If discounting is supposed to account for opportunity costs, it cannot be justified in this case, because relief from the pain of circumcision cannot be invested at the market interest rate and later used to compensate for future cancer. If discounting is supposed to reflect time preference (preference in favor of immediate utility over future utility), then one must ask whether there is any rational basis for such a preference -- what reason there is for counting the future welfare of our child less than his more immediate welfare when making decisions on his behalf. Without first isolating the basis for discounting, such questions may not get asked, much less answered.

One of the most important distinctions that is often overlooked in discussions of discounting and intertemporal choice is the difference between discounting a consequence because it will confer less utility in the future and discounting future
utility, *per se*. The legitimacy of giving less weight to a future consequence if it is less likely to occur or if it will be less enjoyable if delayed seems indisputable -- it requires only the assumption that more utility is preferred to less. However, it is less clear whether there is any basis for giving a consequence less weight *merely* because it occurs in the future (whether there is any basis for discounting future utility, *per se*). Many philosophers have argued that there is no basis for discounting future utility; that all parts of a life are equally important and should receive equal consideration.

In chapter 2, however, I focus on a philosophical view of personal identity that may provide a rational basis for giving less weight to future utility -- a view which has roots back to Plato and Hume, but which is most recently associated with the contemporary British philosopher Derek Parfit. In briefest compass, Parfit argues that our future selves might rationally be treated as distinct individuals, because the differences between our current self and a future self are akin to the distinctions between ourselves and any other, distinct individual -- our future selves have different memories, different goals, different tastes, are composed of different molecules, and so forth.81 Thus, Parfit argues that if we believe that it is rational to discount the welfare of others relative to our own, then we must also conclude that it is rational to discount "our" own future utility.

Parfit's argument seems particularly compelling when we have reason to expect the "connectedness" between the stages of our life to be particularly weak (e.g., if we suffer from some neural disorder that will radically change our personality). However, his argument may hold to reduced degrees in more ordinary situations as

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81 The analogy is far from perfect however -- selves have identical genetic structure, whereas individuals do not (except for identical twins), selves are spatiotemporally continuous, whereas individuals are not (except for siamese twins), and (by some philosophical and religious views) selves have the same soul, whereas distinct individuals do not. Parfit, of course, denies this last alleged disanalogy.
In Chapter 3, I attempted to quantify the degree of discounting that might be justified by the philosophical perspective of diminishing connectedness, by stipulating a definition of connectedness in terms of similarity and asking people to judge how similar they are to various times in their past and future. The results of this study suggest that people believe that they have changed substantially over time and will continue to do so in the future. For example, looking just five years back, the mean reported degree of similarity on a 100 point scale ranged from 55 to 87 (depending on the age group). This implies that a substantial discount rate would be permissible if one weighted future utility by the degree of connectedness with future selves.

These results lend partial support to the normative legitimacy of the discounted utility model (DU), by suggesting that people do believe they change substantially along dimensions that (some philosophers contend) permit future utility to be discounted. The data do not, however, support DU’s assumption that the discount rate is constant over time. For example, teens report much higher rates of change than people in their 40's (see Table 3.1), which suggests that it may be rational for teens to discount future utility at higher rates (and to discount the near future at higher rates than the more distant future).

There was no evidence, however, that similarity judgments were valid predictors of respondents' (hypothetical) intertemporal choices. I found no significant correlation between judged similarity of future selves and implicit discount rates. There are several possible, non-exclusive explanations for this. First, similarity may

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82 In "Listening to Prozac," Peter Kramer marvels at Prozac's power to reshape a person's identity. Eight months after terminating the use of Prozac, his former patient "Tess" telephoned him to ask whether she could resume the medication. She said, "I am not myself." Kramer describes his reaction: "I found this statement remarkable. After all, Tess had existed in one mental state for twenty or thirty years; she then briefly felt different on medication. Now that the old mental state was threatening to re-emerge -- the one she had experienced almost all her adult life, her response was "I am not myself." But who had she been all those years if not herself? ... Suddenly those intimate and consistent traits are not-me, they are alien."
not be synonymous with connectedness. Second, there may be no *empirical, descriptive* relation between connectedness and concern for one's future. (Parfit contends only that people are rationally *permitted* to discount their future to reflect diminishing connectedness -- not that they actually will.) Third, the tasks used to measure implicit discount rates may not be good measures of concern for one's future.

In Chapter 4, I focused on inter-generational time preference, which pertains to the relative weight that individuals place on the welfare of future generations, relative to this generation. In contrast to the considerable literature that has attempted to measure individuals' implicit discount rates for consequences occurring later within their own life, comparatively few descriptive studies have sought to quantify intergenerational discount rates. By far, the most widely cited of these studies were conducted by Cropper, Aydede, and Portney (1991, 1992, 1994). From their studies, which involved choices between hypothetical life-saving policies, they concluded that the public cares much less about the welfare of future generations than about the welfare of the current generation. For example, they claimed that the average respondent is indifferent between saving 1 life in this generation and saving 44 lives one hundred years from now.

I present a study which contradicts these claims. I found that many alternate elicitation formats indicated that the public weights the welfare of future generations and current generation about equally. The particular elicitation format used by Cropper, Aydede, and Portney appears to conflate uncertainty that the future outcome will actually occur with diminished concern for the welfare of future people. Thus, I believe that the implicit discount rates they compute do not, in fact reflect generational weights, or a "*pure* rate of social time preference," as they claim.
In summary, I believe that more emphasis must be placed on maintaining distinctions among the various theoretical bases for discounting. This can help to clarify the legitimacy of particular practices (such as discounting future health benefits), improve elicitation procedures (such as those that attempt to measure generational weights) and refine normative models of intertemporal choice (by emphasizing the distinction between discounting consequences and discounting utility, and by focusing scrutiny on the justification for the discount factor, $\delta$, in the discounted utility model). As Sen (1982, p. 350-351) comments:

I do not doubt that different compromises can be reached about the relative importance attached to various considerations. But the least we should require is that attention be paid to the competing claims of these different influences and that the process of choosing discount rates ... be made more reasoned and more explicit. The search has to be more than an intellectual blindman's buff.
References:


Reid, T. 1785. Of Identity. in *The works of Thomas Reid*. Vol II. Samuel Ethridge, Jr., Charleston, South Carolina. pp. 338-344


U.S. Fifth Circuit Court of Appeals. 1991. [See 947 F.2d (5th Cir. 1991)]


Table 1.1 Modifications to DU to incorporate factors other than time preference

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SYMBOLIC FORMALIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DU (time preference only)</td>
<td>$V(x_0, x_1, \ldots) = u(x_0) + \delta^1 u(x_1) + \ldots$</td>
</tr>
<tr>
<td>DU + probability</td>
<td>$V(x_0, x_1, \ldots) = p(x_0) u(x_0) + p(x_1) \delta^1 u(x_1) + \ldots$</td>
</tr>
<tr>
<td>DU + changes in objective consequence</td>
<td>$V(x_0, x_1, \ldots) = u(x_0(t)) + \delta^1 u(x_1(t)) + \ldots$</td>
</tr>
<tr>
<td>DU + changes in utility function</td>
<td>$V(x_0, x_1, \ldots) = u_0(x_0) + \delta^1 u_1(x_1) + \ldots$</td>
</tr>
<tr>
<td>DU + utility from anticipation</td>
<td>$V(x_0, x_1, \ldots) = u(x_0, u(x_1), u(x_2), \ldots) + \delta^1 u(x_1, u(x_2), u(x_3), \ldots) + \ldots$</td>
</tr>
<tr>
<td>DU + utility from memory</td>
<td>$V(x_0, x_1, \ldots) = u(x_0) + \delta^1 u(x_1, u(x_0)) + \ldots$</td>
</tr>
<tr>
<td>DU + opportunity cost</td>
<td>$V(x_0, x_1, \ldots) = u(C_0) + \delta^1 u(C_1(\text{income}_1, \text{investment}_0)) + \ldots$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CORRESPONDING DESCRIPTION IN WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DU (time preference only)</td>
<td>Future utility should be discounted because we should care about the later parts of our life (for some, unexplained reason)</td>
</tr>
<tr>
<td>DU + probability</td>
<td>Future utility should be weighted by the probability that the consequence that gives rise to the utility will actually occur</td>
</tr>
<tr>
<td>DU + changes in objective consequence</td>
<td>The objective properties of some coarsely defined consequence may depend on the time at which it occurs</td>
</tr>
<tr>
<td>DU + changes in utility function</td>
<td>The subjective utility associated with a particular objective consequence may change over time</td>
</tr>
<tr>
<td>DU + utility from anticipation</td>
<td>The utility at a given moment may be influenced by the anticipation of future utility.</td>
</tr>
<tr>
<td>DU + utility from memory</td>
<td>The utility at a given moment may be influenced by the recollection of past utility.</td>
</tr>
<tr>
<td>DU + opportunity cost</td>
<td>Utility depends on the current consumption level, and the potential consumption level depends on current income &amp; past investment.</td>
</tr>
</tbody>
</table>
Table 3.1 Mean self-assessed similarity of current self to past and future selves

<table>
<thead>
<tr>
<th>Age group</th>
<th>40 years ago</th>
<th>30 years ago</th>
<th>20 years ago</th>
<th>10 years ago</th>
<th>NOW</th>
<th>5 years ahead</th>
<th>10 years ahead</th>
<th>20 years ahead</th>
<th>30 years ahead</th>
<th>40 years ahead</th>
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<tr>
<td>teens</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>thirties</td>
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<td></td>
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<tr>
<td>sixty+</td>
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<tr>
<td>overall</td>
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</table>

<table>
<thead>
<tr>
<th>significance level of group diff. (Kruskall - Wallis)</th>
</tr>
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<tr>
<td>0.13 0.31 0.00 0.00 0.00 -- 0.05 0.01 0.03 0.01 0.25</td>
</tr>
</tbody>
</table>

Table 3.2 Difference between predicted future similarity and reported past similarity of older matched age groups

<table>
<thead>
<tr>
<th>Predicting group</th>
<th>5 years ahead</th>
<th>10 years ahead</th>
<th>20 years ahead</th>
<th>30 years ahead</th>
<th>40 years ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>teens</td>
<td>3.4</td>
<td>8.2</td>
<td>8.3</td>
<td>-1.1</td>
<td>14.6</td>
</tr>
<tr>
<td>twenties</td>
<td>5.0</td>
<td>10.5</td>
<td>-0.2</td>
<td>15.9</td>
<td>12.7</td>
</tr>
<tr>
<td>thirties</td>
<td>-0.8</td>
<td>-1.7</td>
<td>22.2</td>
<td>16.7</td>
<td>18.4</td>
</tr>
<tr>
<td>forties</td>
<td>-6.2</td>
<td>6.5</td>
<td>3.0</td>
<td>28.4</td>
<td>17.0</td>
</tr>
<tr>
<td>fifties</td>
<td>2.5</td>
<td>-7.0</td>
<td>13.8</td>
<td>13.7</td>
<td></td>
</tr>
<tr>
<td>sixty+</td>
<td>-2.1</td>
<td>-13.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>0.4</td>
<td>2.4</td>
<td>8.9</td>
<td>14.7</td>
<td>14.9</td>
</tr>
</tbody>
</table>
Table 3.3 Median number of future dollars judged to be equally attractive to $100 tomorrow (implicit discount rates in parentheses)

<table>
<thead>
<tr>
<th>Age group</th>
<th>1 yr.</th>
<th>5yrs</th>
<th>10yrs</th>
<th>20yrs</th>
<th>30yrs</th>
<th>40yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>teens</td>
<td>$150 (50%)</td>
<td>$500 (38%)</td>
<td>$800 (23%)</td>
<td>$1,000 (12%)</td>
<td>$1,800 (10%)</td>
<td>$1,800 (7%)</td>
</tr>
<tr>
<td>twenties</td>
<td>$180 (50%)</td>
<td>$500 (38%)</td>
<td>$900 (25%)</td>
<td>$2,000 (16%)</td>
<td>$3,000 (12%)</td>
<td>$4,500 (10%)</td>
</tr>
<tr>
<td>thirties</td>
<td>$160 (60%)</td>
<td>$500 (38%)</td>
<td>$1,000 (26%)</td>
<td>$1,500 (15%)</td>
<td>$2,000 (11%)</td>
<td>$3,500 (9%)</td>
</tr>
<tr>
<td>forties</td>
<td>$150 (50%)</td>
<td>$500 (38%)</td>
<td>$1,000 (26%)</td>
<td>$2,000 (16%)</td>
<td>$2,500 (11%)</td>
<td>$3,500 (9%)</td>
</tr>
<tr>
<td>fifties</td>
<td>$150 (50%)</td>
<td>$400 (32%)</td>
<td>$1,000 (26%)</td>
<td>$2,000 (16%)</td>
<td>$7,500 (15%)</td>
<td></td>
</tr>
<tr>
<td>sixty+</td>
<td>$163 (63%)</td>
<td>$450 (35%)</td>
<td>$900 (25%)</td>
<td>$2,000 (16%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>$150 (50%)</td>
<td>$500 (38%)</td>
<td>$1,000 (26%)</td>
<td>$2,000 (16%)</td>
<td>$3,000 (12%)</td>
<td>$3,750 (9%)</td>
</tr>
</tbody>
</table>

Table 3.4 Median number of future extra "good days" judged equally attractive to 20 extra good days this year (implicit discount rates in parentheses)

<table>
<thead>
<tr>
<th>Age group</th>
<th>1 yr.</th>
<th>5yrs</th>
<th>10yrs</th>
<th>20yrs</th>
<th>30yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>teens</td>
<td>25 (25%)</td>
<td>35 (12%)</td>
<td>40 (7%)</td>
<td>60 (6%)</td>
<td>85 (5%)</td>
</tr>
<tr>
<td>twenties</td>
<td>21 (5%)</td>
<td>38 (14%)</td>
<td>50 (10%)</td>
<td>84 (7%)</td>
<td>100 (5%)</td>
</tr>
<tr>
<td>thirties</td>
<td>20 (0%)</td>
<td>33 (11%)</td>
<td>50 (10%)</td>
<td>50 (5%)</td>
<td>55 (3%)</td>
</tr>
<tr>
<td>forties</td>
<td>21 (5%)</td>
<td>50 (20%)</td>
<td>100 (17%)</td>
<td>183 (12%)</td>
<td></td>
</tr>
<tr>
<td>fifties</td>
<td>21 (5%)</td>
<td>80 (32%)</td>
<td>120 (20%)</td>
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</tr>
<tr>
<td>sixty+</td>
<td>25 (25%)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>21 (5%)</td>
<td>40 (15%)</td>
<td>56 (11%)</td>
<td>70 (6%)</td>
<td>80 (5%)</td>
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</table>
### TABLE 4.1 Experimental Design (time horizon in parentheses)

<table>
<thead>
<tr>
<th>Form A</th>
<th>Form B</th>
<th>Form C</th>
<th>Form D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) replication (100)</td>
<td>(1) matching (100)</td>
<td>(1) rating (100)</td>
<td>(1) total (25)</td>
</tr>
<tr>
<td>distractor</td>
<td>distractor</td>
<td>distractor</td>
<td>distractor</td>
</tr>
<tr>
<td>(2) sequence (≈20)</td>
<td>(2) sequence (≈20)</td>
<td>(2) equity (≈50)</td>
<td>(2) equity (≈50)</td>
</tr>
<tr>
<td>distractor</td>
<td>distractor</td>
<td>distractor</td>
<td>distractor</td>
</tr>
<tr>
<td>(3) total (25)</td>
<td>(3) replication (25)</td>
<td>(3) + contrast (25)</td>
<td>(3) - contrast (25)</td>
</tr>
</tbody>
</table>
Table 4.2 Concern for the Future Revealed by Different Procedures

<table>
<thead>
<tr>
<th>Elicitation Format</th>
<th>time horizon</th>
<th># future lives = 1 current life</th>
<th>implied disc. rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;conventional&quot; dichotomous choice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropper, Aydede, &amp; Portney (1994)</td>
<td>25</td>
<td>6</td>
<td>7.4</td>
</tr>
<tr>
<td>Cropper, Aydede, &amp; Portney (1994)</td>
<td>100</td>
<td>44</td>
<td>3.7</td>
</tr>
<tr>
<td>Johanneson &amp; Johansson (1997)(^a)</td>
<td>25</td>
<td>25</td>
<td>13.8</td>
</tr>
<tr>
<td>Johanneson &amp; Johansson (1997)(^b)</td>
<td>25</td>
<td>12</td>
<td>10.3</td>
</tr>
<tr>
<td>Johanneson &amp; Johansson (1997)(^a)</td>
<td>75</td>
<td>243</td>
<td>7.6</td>
</tr>
<tr>
<td>Johanneson &amp; Johansson (1997)(^b)</td>
<td>75</td>
<td>35</td>
<td>4.8</td>
</tr>
<tr>
<td>Replication of Cropper et al. (1994)(^c)</td>
<td>25</td>
<td>&gt;2</td>
<td>&gt;2.8</td>
</tr>
<tr>
<td>Replication of Cropper et al. (1994)</td>
<td>100</td>
<td>70</td>
<td>4.3</td>
</tr>
<tr>
<td>other procedures</td>
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</tr>
<tr>
<td>Matching</td>
<td>100</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>Rating</td>
<td>100</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Sequence(^d,e)</td>
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<td>&lt;1</td>
<td>&lt;0.0</td>
</tr>
<tr>
<td>Equity(^f,g)</td>
<td>50</td>
<td>&lt;1</td>
<td>&lt;0.0</td>
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<tr>
<td>Contrast(-)(^h)</td>
<td>25</td>
<td>&gt;2</td>
<td>&gt;2.8</td>
</tr>
<tr>
<td>Contrast(+)(^i)</td>
<td>25</td>
<td>&gt;2</td>
<td>&gt;2.8</td>
</tr>
</tbody>
</table>

\(a\)= For this version of their question, the choice was framed as X lives now vs. kX lives in the future.
\(b\)= For this version of their question, the choice was framed as X lives in the future vs. X/k lives now.
\(c\)= 78% of the respondents preferred the program that saved 100 lives now to one that saved 200 lives 25 years from now. This implies a rate of substitution (of future lives for current lives) of greater than 2 to 1, and an annual discount rate greater than 2.8%, but exact figures cannot be computed.
\(d\)= The exact time horizon is unclear. The alternate programs were described as saving different numbers of lives over the next three decades.
\(e\)= 71% preferred the program with the improving sequence (100, 200, 300) to the decreasing sequence (300, 200, 100). This implies a rate of substitution (of future lives for current lives) of less than 1 to 1, and a negative discount rate, but exact figures cannot be computed.
\(f\)= The exact time horizon is unclear. The alternate programs were described as saving different numbers of lives over the next three generations. I assumed a generation length of 25 years.
\(g\)= 80% preferred the program which saved an equal number of lives in each generation (100, 100, 100) to the program which saved all the lives in this generation (300, 0, 0). This implies a rate of substitution (of future lives for current lives) of less than 1 to 1, and a negative discount rate, but exact figures cannot be computed.
\(h\)= 57% of the respondents preferred the immediate program that saved 100 lives now to one that saved 200 lives 25 years from now. This implies a rate of substitution greater than 2 to 1, and an annual discount rate greater than 2.8%, but exact figures cannot be computed.
\(i\)= 79% of the respondents preferred the immediate program that saved 100 lives now to one that saved 200 lives 25 years from now. This implies a rate of substitution greater than 2 to 1, and an annual discount rate greater than 2.8%, but exact figures cannot be computed.
Table 4.3 Differences between jury sample and student sample

<table>
<thead>
<tr>
<th>Elicitation Format</th>
<th>Description</th>
<th>Result</th>
<th>pooled sample</th>
<th>jury sample</th>
<th>student sample</th>
<th>significance level (test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>100 now or 7000 in 100 yrs</td>
<td>% preferring 7000 in 100 yrs</td>
<td>51</td>
<td>36</td>
<td>60</td>
<td>&lt; 0.02 (χ²)</td>
</tr>
<tr>
<td>Replication</td>
<td>100 now or 200 in 25 yrs</td>
<td>% preferring 200 in 25 yrs</td>
<td>22</td>
<td>18</td>
<td>25</td>
<td>not sig. (χ²)</td>
</tr>
<tr>
<td>Matching</td>
<td>100 now = ____ in 100 yrs.</td>
<td>median value</td>
<td>200</td>
<td>750</td>
<td>150</td>
<td>not sig. (KW)</td>
</tr>
<tr>
<td>Rating</td>
<td>1 future life is ? as important</td>
<td>mean degree of importance</td>
<td>0.81</td>
<td>0.83</td>
<td>0.79</td>
<td>not sig. (t-test)</td>
</tr>
<tr>
<td>Total</td>
<td>(100 &amp; 50) = 150 or (55 &amp; 105) = 160</td>
<td>% preferring (55 &amp; 105) = 160</td>
<td>47</td>
<td>45</td>
<td>47</td>
<td>not sig. (χ²)</td>
</tr>
<tr>
<td>Sequence</td>
<td>(300, 200, 100) or (100, 200, 300)</td>
<td>% preferring (100, 200, 300)</td>
<td>71</td>
<td>65</td>
<td>75</td>
<td>not sig. (χ²)</td>
</tr>
<tr>
<td>Equity</td>
<td>(300, 0, 0) or (100, 100, 100)</td>
<td>% preferring (100, 100, 100)</td>
<td>80</td>
<td>72</td>
<td>85</td>
<td>&lt; 0.02 (χ²)</td>
</tr>
<tr>
<td>Contrast(-)</td>
<td>100 now or 200 in 25 yrs</td>
<td>% preferring 200 in 25 yrs</td>
<td>43</td>
<td>35</td>
<td>48</td>
<td>not sig. (χ²)</td>
</tr>
<tr>
<td>Contrast(+)</td>
<td>100 now or 200 in 25 yrs</td>
<td>% preferring 200 in 25 yrs</td>
<td>21</td>
<td>8</td>
<td>28</td>
<td>&lt; 0.05 (χ²)</td>
</tr>
</tbody>
</table>
FIGURE 1.1 Conceptual framework for organizing concepts relevant to intertemporal choice

<table>
<thead>
<tr>
<th>amount of future utility</th>
<th>weight given to future utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>δ Time Preference</td>
</tr>
<tr>
<td>Objective Changes</td>
<td></td>
</tr>
<tr>
<td>Changes in Utility Functions</td>
<td></td>
</tr>
<tr>
<td>Utility of Anticipation</td>
<td></td>
</tr>
<tr>
<td>Utility of Memory</td>
<td>η Intergenerational Time Preference</td>
</tr>
<tr>
<td>Opportunity Cost</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 1.2 Implicit discount rates in 36 studies
FIGURE 3.1  Self assessed similarity of past and future selves as judged by different age groups.
### APPENDIX 1.3a Implicit discount rates from studies using hypothetical & real monetary outcomes.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>GOOD (BAD)</th>
<th>RESPONSE VARIABLE</th>
<th>lower</th>
<th>upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maital &amp; Maital (1978)</td>
<td>Choice</td>
<td>--</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Thaler (1981)</td>
<td>Matching</td>
<td>$</td>
<td>7</td>
<td>345</td>
</tr>
<tr>
<td>Ainslie &amp; Haendel (1983)</td>
<td>Matching</td>
<td>Time</td>
<td>588</td>
<td>3614</td>
</tr>
<tr>
<td>Houston (1983)</td>
<td>Other</td>
<td>$</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Loewenstein (1987)</td>
<td>Valuation</td>
<td>$</td>
<td>4</td>
<td>212</td>
</tr>
<tr>
<td>Benzon et al. (1989)</td>
<td>Matching</td>
<td>$</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td>Shelley (1993)</td>
<td>Matching</td>
<td>$</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>Bohm (1994)</td>
<td>Choice</td>
<td>--</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Cairns (1994)</td>
<td>Choice</td>
<td>--</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>Shelley (1994)</td>
<td>Rating</td>
<td>--</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>Kirby &amp; Marakovic (1996)</td>
<td>Choice</td>
<td>--</td>
<td>26</td>
<td>280</td>
</tr>
<tr>
<td>Wahlund &amp; Gunnarson (1996)</td>
<td>Matching</td>
<td>$</td>
<td>18</td>
<td>158</td>
</tr>
<tr>
<td>Kirby (1997)</td>
<td>Valuation</td>
<td>$</td>
<td>700</td>
<td>700</td>
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</table>
APPENDIX 1.3b  Implicit discount rates from studies using hypothetical health outcomes.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>GOOD (BAD)</th>
<th>RESPONSE MODE</th>
<th>RESPONSE VARIABLE</th>
<th>lower</th>
<th>upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loewenstein (1987)</td>
<td>Electric shock</td>
<td>Valuation</td>
<td>$</td>
<td>-6</td>
<td>0</td>
</tr>
<tr>
<td>Svenson &amp; Karlsson. (1989)</td>
<td>Deaths</td>
<td>Rating</td>
<td>&quot;Seriousness&quot;</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Redelmeier &amp; Heller (1993)</td>
<td>Health</td>
<td>Rating</td>
<td>&quot;News disutility&quot;</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cairns (1994)</td>
<td>Lives</td>
<td>Choice</td>
<td>--</td>
<td>16</td>
<td>38</td>
</tr>
<tr>
<td>Dolan &amp; Gudex (1995)</td>
<td>Health</td>
<td>Time Tradeoff</td>
<td>--</td>
<td>-4</td>
<td>1</td>
</tr>
<tr>
<td>Cairns &amp; Van der Pol (1997)</td>
<td>Benefit</td>
<td>Matching</td>
<td>Benefit</td>
<td>42</td>
<td>42</td>
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</table>
APPENDIX 1.3c Implicit discount rates from field studies.

<table>
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<th>STUDY</th>
<th>DOMAIN</th>
<th>lower</th>
<th>upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hausman (1979)</td>
<td>energy-using durables</td>
<td>5</td>
<td>89</td>
</tr>
<tr>
<td>Gateley (1980)</td>
<td>refrigerator purchase</td>
<td>45</td>
<td>300</td>
</tr>
<tr>
<td>Moore and Viscusi (1988)</td>
<td>wages and health risk</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Viscusi and Moore (1989)</td>
<td>wages and health risk</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Moore and Viscusi (1990a)</td>
<td>wages and health risk</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Moore and Viscusi (1990b)</td>
<td>wages and health risk</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Dreyfus and Viscusi (1995)</td>
<td>auto price and safety</td>
<td>11</td>
<td>17</td>
</tr>
</tbody>
</table>
APPENDIX 3.1

Below, I would like you to rate how similar you expect to be in the future compared to how you are now, and how similar you were in the past compared to how you are now. By similar, I mean characteristics such as personality, temperament, likes and dislikes, beliefs, values, ambitions, goals, ideals, etc.

For each of the questions below, rate similarity by using a number from 0 to 100, where 0 means you [were / will be] completely different and 100 means you [were / will be] exactly the same. You may use decimals if you wish.

<table>
<thead>
<tr>
<th>Similarity Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>completely different</td>
</tr>
</tbody>
</table>

Compared to now, how similar will you be **5 years** from now? ____

Compared to now, how similar will you be **10 years** from now? ____

Compared to now, how similar will you be **20 years** from now? ____

Compared to now, how similar will you be **30 years** from now? ____

Compared to now, how similar will you be **40 years** from now? ____

Compared to now, how similar were you **5 years** ago? ____

Compared to now, how similar were you **10 years** ago? ____

Compared to now, how similar were you **20 years** ago? (If applicable) ____

Compared to now, how similar were you **30 years** ago? (If applicable) ____

Compared to now, how similar were you **40 years** ago? (If applicable) ____
APPENDIX 3.2

On each of the seven lines below, circle the option that you would prefer

1) $100 tomorrow or $500 in one year
2) $100 tomorrow or $25 in one year
3) $100 tomorrow or $250 in one year
4) $100 tomorrow or $50 in one year
5) $100 tomorrow or $125 in one year
6) $100 tomorrow or $75 in one year
7) $100 tomorrow or $100 in one year

Now, for each of the lines below, fill in the blank so that you would be indifferent between the immediate and the delayed payment -- i.e., so that you would have a very hard time deciding between them.

I would be indifferent between $100 tomorrow and $_____ in one year.
I would be indifferent between $100 tomorrow and $_____ in 5 years.
I would be indifferent between $100 tomorrow and $_____ in 10 years.
I would be indifferent between $100 tomorrow and $_____ in 20 years.
I would be indifferent between $100 tomorrow and $_____ in 30 years.
I would be indifferent between $100 tomorrow and $_____ in 40 years.
APPENDIX 3.3

Imagine that you will have the same job for the rest of your life. At this job, you get to spend about half of the days doing something that you love (good days). The other half of the days, you must spend doing something that you hate (bad days).

Suppose that you were given a chance to choose between having some extra good days (and, thus, fewer bad days) this year, or in a future year. For each of the six lines below, circle the option that you would prefer.

1) 20 extra good days this year or 100 extra good days next year
2) 20 extra good days this year or 5 extra good days next year
3) 20 extra good days this year or 50 extra good days next year
4) 20 extra good days this year or 10 extra good days next year
5) 20 extra good days this year or 25 extra good days next year
6) 20 extra good days this year or 15 extra good days next year
7) 20 extra good days this year or 20 extra good days next year

Now, complete the blank below so that you would be indifferent.

I would be indifferent between 20 extra good days this year and _____ extra good days next year.

I would be indifferent between 20 extra good days this year and _____ extra good days in 5 years.

I would be indifferent between 20 extra good days this year and _____ extra good days in 10 years.

I would be indifferent between 20 extra good days this year and _____ extra good days in 20 years.

I would be indifferent between 20 extra good days this year and _____ extra good days in 30 years.
APPENDIX 3.4

(1) "k" year perspective effect =

\[
\frac{\sum_{x=13}^{83} \frac{\sum_i \text{sim}_x(x+k, x)}{i} - \sum_j \text{sim}_{x+k}(x, x+k)}{100000}
\]

where:

- \(x\) = age
- \(k\) = length of interval being considered
- \(i\) = number of respondents of age \(x\) who made predictions
- \(j\) = number of respondents of age \(x+k\) who made reports
- \(\text{sim}_x(x+k, x)\) = similarity of age \(x+k\) to age \(x\), as judged from the perspective of age \(x\)
- \(\text{sim}_{x+k}(x, x+k)\) = similarity of age \(x\) to age \(x+k\) as judged from the perspective of age \(x+k\).
Appendix 3.5  Rank correlations between similarity judgments and [1 / 5 / 10 / 20 / 30, and 40] year monetary discount rates

<table>
<thead>
<tr>
<th>years until receipt of $</th>
<th>40 years ago</th>
<th>30 years ago</th>
<th>20 years ago</th>
<th>10 years ago</th>
<th>5 years ago</th>
<th>NOW</th>
<th>years ahead</th>
<th>5 years ahead</th>
<th>10 years ahead</th>
<th>20 years ahead</th>
<th>30 years ahead</th>
<th>40 years ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.13</td>
<td>0.03</td>
<td>-0.01</td>
<td>-0.05</td>
<td>-0.04</td>
<td>--</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.07</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.01</td>
</tr>
<tr>
<td>5</td>
<td>0.37</td>
<td>0.23</td>
<td>0.00</td>
<td>0.01</td>
<td>0.07</td>
<td>--</td>
<td>0.09</td>
<td>0.07</td>
<td>0.04</td>
<td>0.01</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.41</td>
<td>0.26</td>
<td>0.03</td>
<td>0.04</td>
<td>0.09</td>
<td>--</td>
<td>0.09</td>
<td>0.08</td>
<td>0.04</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>0.49</td>
<td>0.26</td>
<td>0.11</td>
<td>0.10</td>
<td>0.13</td>
<td>--</td>
<td>0.08</td>
<td>0.07</td>
<td>0.05</td>
<td>0.02</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.55</td>
<td>0.24</td>
<td>0.08</td>
<td>0.08</td>
<td>0.12</td>
<td>--</td>
<td>0.07</td>
<td>0.03</td>
<td>-0.00</td>
<td>-0.02</td>
<td>-0.04</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>-0.01</td>
<td>-0.08</td>
<td>-0.03</td>
<td>0.04</td>
<td>--</td>
<td>0.05</td>
<td>0.00</td>
<td>-0.04</td>
<td>-0.02</td>
<td>-0.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3.6  Rank correlations between similarity judgments and [1 / 5 / 10 / 20, and 30] year "good days" discount rates

<table>
<thead>
<tr>
<th>years until receipt of good days</th>
<th>40 years ago</th>
<th>30 years ago</th>
<th>20 years ago</th>
<th>10 years ago</th>
<th>5 years ago</th>
<th>NOW</th>
<th>5 years ahead</th>
<th>10 years ahead</th>
<th>20 years ahead</th>
<th>30 years ahead</th>
<th>40 years ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.12</td>
<td>-0.01</td>
<td>0.10</td>
<td>-0.08</td>
<td>0.02</td>
<td>--</td>
<td>-0.11</td>
<td>-0.13</td>
<td>-0.10</td>
<td>-0.08</td>
<td>-0.02</td>
</tr>
<tr>
<td>5</td>
<td>0.24</td>
<td>0.01</td>
<td>0.02</td>
<td>0.03</td>
<td>0.05</td>
<td>--</td>
<td>0.08</td>
<td>0.04</td>
<td>-0.05</td>
<td>-0.08</td>
<td>-0.07</td>
</tr>
<tr>
<td>10</td>
<td>0.44</td>
<td>0.02</td>
<td>0.12</td>
<td>0.16</td>
<td>0.15</td>
<td>--</td>
<td>0.10</td>
<td>0.07</td>
<td>-0.01</td>
<td>-0.04</td>
<td>-0.07</td>
</tr>
<tr>
<td>20</td>
<td>-0.31</td>
<td>0.00</td>
<td>0.12</td>
<td>0.14</td>
<td>--</td>
<td></td>
<td>0.03</td>
<td>0.01</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.06</td>
</tr>
<tr>
<td>30</td>
<td>-0.13</td>
<td>0.04</td>
<td>0.08</td>
<td>--</td>
<td></td>
<td></td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.03</td>
<td>-0.02</td>
</tr>
</tbody>
</table>
APPENDIX 4.1a

Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, 100 people will die this year from pollution, and 7000 people will die 100 years from now. The government has to choose between two new programs to control this pollution. The two programs cost the same, but there is only enough money for one.

Program A will save 100 lives now.
Program B will save 7000 lives 100 years from now.

Which program would you choose? (circle one)   A  B

APPENDIX 4.1b

Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, 100 people will die this year from pollution, and 200 people will die 25 years from now. The government has to choose between two new programs to control this pollution. The two programs cost the same, but there is only enough money for one.

Program A will save 100 lives now.
Program B will save 200 lives 25 years from now.

Which program would you choose? (circle one)   A  B
APPENDIX 4.2

Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, some will die this year from pollution, and some will die in the future. Consider Program A and Program B below, and then fill in the blank such that you would be indifferent between them -- so that you would judge them to be equally good.

Program A will save ___ lives this year, but will save ___ lives 100 years from now.

Program B will save ___ lives this year, but will save ____ lives 100 years from now.

(Please look back at the number you wrote in the blank to make sure that you consider Policy A and Policy B to be equally good. If you change your mind, feel free to change your answer.)
APPENDIX 4.3

Carefully consider each of the two outcomes listed below:

**Outcome A:** Next year, one person in the United States dies because of exposure to pollutants in the environment.

**Outcome B:** 100 years from now, one person in the United States dies because of exposure to pollutants in the environment.

Do you consider these two outcomes to be equally bad?  **YES**  **NO**

If **YES**, skip to question 2.
If **NO**, which outcome is worse? (Circle one)  **A**  **B**

If you circled A, answer question 1A (and skip question 1B)
If you circled B, answer question 1B (and skip question 1A)

**Question 1A:**

Compared to **Outcome A**, how bad is **Outcome B**? (Indicate on the scale below.)

**Question 1B:**

Compared to **Outcome B**, how bad is **Outcome A**? (Indicate on the scale below.)

---

1/10 as bad  3/10 as bad  5/10 as bad  7/10 as bad  9/10 as bad  

insignificant by comparison  2/10 as bad  4/10 as bad  6/10 as bad  8/10 as bad  equally bad
APPENDIX 4.4

The government is considering two different life saving programs:

**Program A** will save 55 lives now and 105 more lives 25 years from now, for a total of 160 lives.

**Program B** will save 100 lives now and 50 more lives 25 years from now, for a total of 150 lives.

Which program would you prefer? (circle one): A  B

APPENDIX 4.5

The government is considering two different life saving programs. Both programs will be in effect for 30 years.

**Program A** will become *more effective* over time. It will save 100 lives this decade, 200 lives next decade, and 300 lives in the decade after that.

**Program B** will become *less effective* over time. It will save 300 lives this decade; 200 lives next decade, and 100 lives in the decade after that.

Which program would you prefer? (circle one): A  B

APPENDIX 4.6

The government is considering two different life saving programs:

**Program A** will save 300 lives in your generation, 0 lives in your children's generation and 0 lives in your grandchildren's generation.*

**Program B** will save 100 lives in your generation; 100 lives in your children's generation, and 100 lives in your grandchilren's generation.

Which program would you prefer? (circle one): A  B

* Initial reviewers objected to the description of succeeding generations as your "your children's" and "your grandchildren's" on the grounds that such wording was too inflammatory and would disturb the respondents "true" intergenerational preferences. Though its hard to imagine who who will constitute the next two generations if not people's children and grandchildren, I changed the wording in a follow up study so that succeeding generations were described as "the next generation" and "the generation following that." The vast majority still preferred Program B.
APPENDIX 4.7a

Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, some will die this year from pollution, and some will die in the future. The government has to choose between three new programs to control this pollution. The three programs cost the same, but there is only enough money for one.

Program A will save 100 lives now
Program X will save 7000 lives 26 years from now
Program B will save 200 lives 25 years from now

Which program would you choose? A X
Which program would you choose? A B

APPENDIX 4.7b

Each year some people in the United States may die as a result of exposure to certain kinds of pollutants. Unless there are programs to control this pollution, some will die this year from pollution, and some will die in the future. The government has to choose between three new programs to control this pollution. The three programs cost the same, but there is only enough money for one.

Program A will save 100 lives now
Program Y will save 103 lives 24 years from now
Program B will save 200 lives 25 years from now

Which program would you choose? A Y
Which program would you choose? A B
APPENDIX 4.8 Justification for responses

Reasons for present orientation:

*If you save the 100 lives now, most likely, in time, you will have enough in the budget to save everyone else.*

*What are we waiting for, these are pollutants!*

*More programs may be developed in the next 100 years but not necessarily now.*

*Saving lives now, could possibly allow for these saved people to create bigger and better programs.*

*25 years from now they might figure out a way to save more!*

*[otherwise] Everyone will be dead, because there will be too much pollution.*

*Hopefully in 24 years from now there will be an administration in affect that will save millions of lives.*

*Because in 100 years a solution might be found to save the life.*

*With outcome A [the present oriented program], you have a person dying each year; with outcome B [the future oriented program], a person dies each day after 100 years.*

*If it took 100 years for someone to die, that would be 100 less people, but if people died right away that would be 99 more people.*

*If next year one person dies due to pollutants given the present concern for environmental controls, then in 100 years from now many more will be affected and possibly die.*

*Another program could and hopefully will be developed to save additional lives in future generations.*

*Simply because maybe one of the 200 more people saved in A will find some way of helping out people in future generations that is better. Plus the program might be revised in the years to come.*

*Within those 300 lives it is possible to have the needed information to make the program not necessary for future generations.*

*Program A is adequately effective and possibly training future generations to extend the benefits of its program that can potentially save more lives.*

*After time better plans may come about, but you do what you can now*

*I don’t trust long term projects in the hands of government agencies which are subject to political whims.*

*We'll figure out a way to save more lives over the next 25 years.*
APPENDIX 4.8 Justification for responses (continued)

Reasons for future orientation:

More information would be needed. The believability in program A is questionable knowing how long the programs take to be implemented and knowing that damage from the pollution would not be immediate in most cases.

100 years from now, we should know how to prevent this type of death.

Could indicate a certain amount of pollution control indicated by time period & # of deaths.

I've learned that events over time prove more fruitful in time as well.

On the face of it, it is unclear whether the additional lives saved in the future shows a long term strategy and a fundamental improvement of long lasting duration. I believe in long term, more permanent programs of substance, not [those that are] politically motivated.

Other:

Government responsibility is to save lives. Improper. Does not apply.

My current choice is B [to save the greater number of future lives], but if population control becomes a problem, then I'm not sure.

Again, more information is needed. Trust in the government to "control" this pollution is questionable. Certain standards must be met, but bigger government and more programs results in inefficiency.

Does the population change? Over time are there a lesser number of potential deaths or is it stable?

Not enough information to make a valid decision. Technology can change and guarantee higher survival rates.

Please give me a multiple choice question!