CHOICE OVER TIME #3

Edited by

GEORGE LOEWENSTEIN AND JON ELSTER

RUSSELL SAGE FOUNDATION 1992 NEW YORK

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Library of Congress Cataloging-in-Publication Data

Choice over time/[edited by] George Loewenstein, Jon Elster.
p. cm.
Includes bibliographical references and index.
ISBN 0-87154-558-6
1. Choice (Psychology) 2. Utility theory. 3. Self-control.
4. Time—Psychological aspects. I. Loewenstein, George.
II. Elster, Jon, 1940–
BF611.C48 1992
153.8'3—dc20 91-42816
CIP

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The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

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112 East 64th Street, New York, New York 10021

10 9 8 7 6 5 4 3 2 1

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Hyperbolic Discounting

GEORGE AINSLIE AND NICK HASLAM

OF THE MANY striking psychiatric syndromes known to man, the most dramatic is the multiple, or *split*, personality. Unrelated to coincidentally named schizophrenia, the *ego-splitting* of multiple-personality disorder confronts its sufferers with sudden shifts of values, plans, behaviors, ideas, and, indeed, everything that forms the human character (Putnam, 1989). Where some of these values and plans are incompatible with others, one set is apt to disappear from the patient's ken while he is under the influence of the incompatible set; alternatively, the patient seems to go about while under the influence of one set destroying the other—giving away valuable possessions, offending friends, even getting arrested—just so as to defeat the alternative plans.

At one time this condition was looked upon as exotic, and the report of a case guaranteed a book, and often a movie, about the patient. However, we are gradually becoming aware that multiple personality, while uncommon, is not rare (Bernstein and Putnam, 1986; Braun, 1986) and, furthermore, that lesser forms of ego splitting abound in the form of amnestic episodes (*blackouts* in the alcoholic, *flashbacks* in the posttraumatic stress patient, *fugues* in many people under stress) and binge disorders (bulimia, exhibitionism, some patterns of alcoholism, and similar episodes occurring sometimes in all of the dozens of addictions that have so far been described—Ainslie,

1992, Chapter 2). More important, there is growing evidence of self-defeating behavior traits in ordinary citizens, habits that make it seem as though the person at one time forgets or disregards earlier personal plans. "Bad habits" like nail biting, staying up too late, procrastinating, and failing to stick to a budget have long been familiar, but systematic research has recently revealed that people evaluate choices inconsistently even in dispassionate discussion of them (Benzion et al., 1989; Loewenstein, 1988, Thaler; 1987–1992; Tversky and Kahneman, 1981). Often this inconsistency is such that their conscious, deliberate preference is to choose the larger and later of two alternative cash prizes when both are distant, but to change to the smaller, earlier one as they draw nearer (Ainslie and Haendel, 1983). Such reversals of preference occur despite the constancy of environmental factors and the person's thorough familiarity with them.

The pervasiveness and robustness of such observations suggests that the problem may not come from some extraordinary condition that impairs the normal operation of intentionality, but rather from the process by which all people, perhaps all organisms, evaluate future goals. That is, the split ego may not be a freak of nature but the condition of nature itself, uncorrected, in these cases, by the learning process that comes to compensate for it at least partially in most people. There is now evidence that the basic temporal discount function of man and lower animals is such that elementary splits—reversals of preference between successive motivational states—can be expected to arise regularly in the absence of some influence to the contrary. The derivable consequences for an intelligent organism like man resemble many of the conflicting structures that have been proposed by Freud and other students of self-defeating behavior. But they also differ in that they can be parsimoniously integrated with existing motivational science. At least that is our argument in this chapter.

We briefly review how people have been described to devalue the future, then argue that such devaluation must occur in a curve that is more deeply bowed than economists' familiar exponential curve if it is to explain self-defeating behavior. We show that a well-documented discount function, Herrnstein's matching law, has the necessary shape. The matching law predicts temporary preferences for poorer, earlier alternatives when they are imminently available, a phenomenon that has been directly observed in both animals and man, and which provides a paradigm for self-defeating behavior. We deal with the counter-intuitive quality of such a model, then point out some of the long-standing puzzles it can explain, a task that will continue in Chapter 8 of this book. In this chapter, we show that

regularly recurring preferences interact somewhat like the interests in a legislature, and that depending on their duration, they may induce a variety of ambivalently valued activities such as (1) addictions; (2) briefer itchlike urges that include some psychiatric symptoms; (3) subjectively involuntary experiences, including pain and fear; and (4) at the other end of this scale of durations, more stable but still undesirable activities that are often ascribed to character flaws.

The Pervasive Devaluation of the Future

Major theories of self-defeating behavior include an extra choice-making center that is unconscious or otherwise autonomous, the classical conditioning of motives, and cognitive errors such as superstition, misinterpretation, and faulty logic. These theories, critically reviewed in Ainslie (1992, Chapter 2), can be shown to be inadequate explanations of self-defeating behavior because of faults in their internal logic and/or in their empirical foundations. That review also presents the conclusion of behavioral researchers that all bodily responses depend on differential reward or on events that are its functional equivalent. Such a conclusion does not imply that all behavior is deliberate, voluntary, or even conscious, but it does require that even self-defeating behavior be explained according to strict utilitarian logic. Freud's "economic" model attempted such an explanation, but no modern theorist has produced one.

It is significant that many diverse theorists have mentioned the incidental implication that their mechanism causes subjects to devalue the future: Freud's *Project for a Scientific Psychology* (1895) quite explicitly contends that repression defers the obligatory passage of painful stimuli through consciousness, thus trading an immediate discomfort for a later one; later Freud proposed that the pleasure principle (1911), which became the id (1920), is marked by the pursuit of "momentary pleasure" at the cost of better "pleasure at a later time" (1911, p. 223). The behaviorists' conditioned motives are, by their nature, the near-immediate consequences of the supposed conditioned stimulus and, thus, must differ from ordinary goal-directed motives, which can arise from distant expectations. Cognitive theories of self-defeating behavior propose that people fail to picture delayed consequences adequately (Mischel and Staub, 1965), underestimate the control exerted over later outcomes by their present behavior (Bialer, 1961; Strickland, 1972; Walls and Smith, 1970), or find waiting aversive (Mischel and Staub, 1965). Whatever their

mechanism, these assorted hypotheses all imply a devaluation of delayed events relative to more imminent ones.

However, these theorists have usually stopped short of saying that the human tendency to devalue future goods is fundamental. Although they often mention relative unresponsiveness to future contingencies as part of the problem, they portray it as exceptional and ascribe it to a more basic cause within their preferred theories, be it repression, conditioning, or illogical thinking. This is natural enough. We are used to thinking of ourselves as consistent, and we are often right. People do not radically devalue the future for most purposes, but preserve their interests over the years and save their money.

It is just as supportable, however, to say that living mostly for the present moment is our natural mode of functioning, and that consistent behavior is sometimes acquired, to a greater or lesser extent, as a skill. Both a general tendency to discount future events and a valuable but elusive trait countervailing this tendency have long been recognized. John Stuart Mill spoke of the conflict as commonplace:

> Many who are capable of the higher pleasures, occasionally, under the influence of temptation, postpone them to the lower. But this is quite compatible with a full appreciation of the intrinsic superiority of the higher. Men often, from infirmity of character, make their election for the nearer good, though they know it to be the less valuable; and this no less when the choice is between two bodily pleasures than when it is between bodily and mental. They pursue sensual indulgences to the injury of health, though perfectly aware that health is the greater good. (1871, p. 19)

The Victorian economist, Jevons, described the conflict similarly:

> To secure a maximum of benefit in life, all future events, all future pleasures or pains, should act upon us with the same force as if they were present, allowance being made for their uncertainty. The factor expressing the effect of remoteness should, in short, always be unity, so that time should have no influence. But no human mind is constituted in this perfect way: a future feeling is always less influential than a present one. (1871/1911, pp. 72–73)

In this century, Pigou perceived the same split between rationality and human nature:

> People distribute their resources between the present, the near future and the remote future on the basis of a wholly irrational preference. When they have a choice between two satisfactions, they will not necessarily choose the larger of the two, but will often devote themselves to producing or obtaining a small one now in preference to a much larger one some years hence. (1920, p. 25)

Systematic research on the discounting of delayed goals began with Thorndike's animal analogs of human choice situations. He found that "increasing the interval between the response and the satisfaction or discomfort . . . diminishes the rate of learning" (1911; quoted in Benjamin and Perloff, 1983). An army of subsequent investigators have found that even short delays cause profound declines in reward effectiveness, even when subjects are signaled immediately that the reward is sure to come (Ainslie, 1975; Kimble, 1961; Renner, 1964).

Empirical research on human devaluation of the future rewards has not been done until recently; perhaps the question of devaluation seemed adequately answered by economic statistics on how the delay of a good decreases its value in the free market. However, when the notion that market discount rates reflect spontaneous preference is tested systematically, it does not hold true, even in the realm of consumer economics. For instance, one study of actual air conditioner purchases showed that, in accepting higher operating costs in return for lower purchase prices, consumers devalued the future at annual rates as high as 89 percent (Hausman, 1979). Similar studies have sometimes found rates in the hundreds of percent (Gately, 1980; Ruderman, Levine, and McMahon, 1986).

The objection that economic realities may have compelled choices contrary to subjects' objective preferences in such research has been refuted in four studies where people were asked how they would trade off amount and delay of extra income that were hypothetical (Ainslie and Haendel, 1983; Benzion, Rapoport, and Yagil, 1989; Kurz, Spiegelman, and West, 1973; Lea, 1979). In the Ainslie and Haendel study, for instance, employees and patients in a substance abuse treatment unit were asked to imagine that they had won a certified check for $1,000 that could be cashed in a week, but that they had the option of getting a $2,000 certified check that could only be cashed after a greater delay. They were then asked to name the delay at which they would be indifferent between this check and the $1,000 one-week check. They were told to assume that the checks were entirely sound and that they could be sure of getting the money

at the stated time. The geometric mean time that patients would wait for the $2,000 was 31 days; the employees' answers were not significantly longer at 43 days. These groups were reporting that they would have to get annual interest rates on the order of 30,000–300,000 percent to make it worth leaving their prize money invested.

It might be objected that this was hypothetical money and that the subjects were more careless with it than they would have been with real money. To some extent this was probably true, although there is no reason to suppose the subjects were not frankly reporting what they felt. If they had wanted to impress the interviewer with how good their judgment was, they should have reported less discounting than they spontaneously performed, not more. In fact, given a situation where the patients could "invest" real money earned as subjects (from $2 to $10) for 3 days and collect 25 percent more, a third of them always chose not to do so, and another third sometimes chose not to. These patients were rejecting an annual interest rate of about one billion percent, even though they generally had little spending money, and their earnings were significant to them (Ainslie and Haendel, 1983).

Such a finding should not lead us to believe that these subjects never put money in the bank at 6 percent, or even that they do so less than most people. Rather, it supports the common observation that they are not *always* motivated to do so.

Crossing Curves Needed for Ambivalence

For some theorists, the simple discounting of delayed events explains all behaviors that are apparently imprudent or irrational. Logue (1988) suggests that organisms change their preferences over time because of a limited awareness of the future, or *time window*. Similarly, those of Cross and Guyer's (1980) *social traps* that are based on discounting are *time delay traps* attributed to simple discounting of the future. Economists Becker and Murphy (1988) invoke the same mechanism to assert that all addiction is rational, in that it must at every moment maximize the person's expected utility: They express the current utility of an alternative as the integral from the present moment through the person's expectable lifespan of $e^{\sigma t}$ times the momentary utility of that alternative at each delay, where σ is "a constant rate of time preference," and t is delay (their Formula 3). Because σ represents the steepness of exponential discounting, theirs is another time window hypothesis; ultimately they hold a person to

be impulsive because he simply discounts the future too much. The trouble with such theories is not that time windows are nonexistent—a *time horizon* has been noted in the plans of even economically sophisticated people (Friedman, 1963)—but that these theories cannot deal with the common case where a subject knows he will change preference in the future and is still at pains to prevent this.

The hypothesis that the "true" or innate discount rate for future events is extremely steep accounts for disregard of the future, but by itself it does not explain the persistently unresolved conflict between "higher" and "lower" behaviors that clinicians call ambivalence. A steep discounting rate per se should simply enfranchise Freud's pleasure principle. The person might intellectually appreciate that his preferences were costly in overall reward, but it is still not clear how such knowledge alone could weigh against the person's short-sighted motives. A high discount rate would mean by definition that the person does not care about this cost. Such carelessness might threaten the individual's survival as an organism, and an observer might wonder how this trait was ever selected for in evolution; but it cannot generate motivational conflict.

For a discount function to produce motivational conflict between alternatives, it must generate curves that either lie so close together as to prevent one from dominating the other, or that cross one another as time elapses. The former situation must indeed arise from time to time, but in any important choice, the value of reaching a resolution should add weight to an alternative that gets even a slight, temporary edge, permitting arbitrary choice.[1]

As for the latter situation, discount curves that cross as a function of time alone do not arise from the conventional, exponential form of discounting. Exponential curves decline by a constant proportion of the remaining balance per unit of time elapsed. Unless different events are discounted at different rates, this kind of curve will never predict vacillations in their relative values, much less a discrete period of temporary preference for an alternative that is otherwise less valued.

Of course, there is no reason that different kinds of events, for instance, drinking alcohol and eating, could not be discounted at different rates. Thus, if a person valued drinking alcohol more than

[1]Sometimes people hesitate long over what is simply a close choice, perhaps to learn more information, perhaps to change or escape the choice situation itself (e.g., which person to marry, or "Sophie's choice" of which child to save from the Nazis). Where this hesitation is not self-destructive per se, it need not be conflictual in any way that cannot be accounted for by conventional motivational theory.

eating when both were imminently available but discounted alcohol more steeply than food, we would expect him to prefer alcohol only temporarily, when it was available in the near future. This example seems true to life as far as it goes. It could be that rewards that are commonly the subject of impulses—addictive substances, "thrills," and escape from pain, for instance—are discounted in the familiar exponential curves, but more steeply than other rewards. However, many impulses seek the same rewards that are at stake in the long run, only on a schedule that delivers a smaller amount of them at a shorter delay. Thus, a person may temporarily prefer immediate but transitory social approval, sexual gratification, or relief of pain at the expense of greater long-term occurrence of the very same

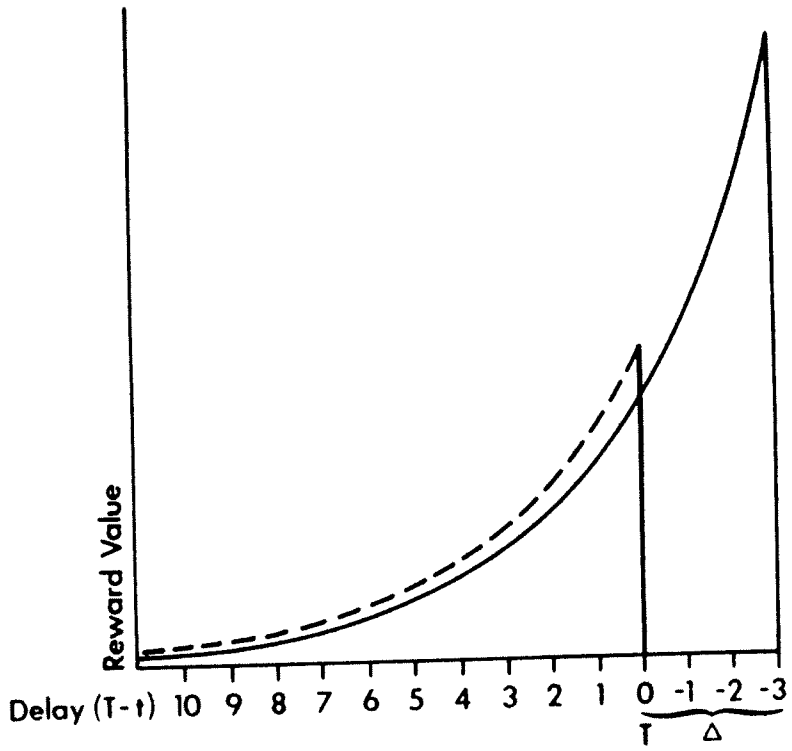

Figure 3.1. Exponential curves of the value of a reward expected at time T and an alternative that is objectively twice as great, expected 3 units of time later, as a function of decreasing delay ($D = T - t$) before they become available. Note that the X-axis in all figures is simple time, elapsing from left to right.

events. A person may be avaricious or not, but exponential curves give no reason why short-sighted avarice should conflict with far-sighted avarice.

Figure 3.1 shows two alternative amounts of the same good available at different times. The exponential curves drawn from them to show their discounted value at all times before they are due may decline sharply, but they remain proportional to one another. The only discount functions that can create conflicts between immediate and delayed consumption of the same good differ from conventional discount functions, not just in steepness but in their basic shape.

Herrnstein's Matching Law

For temporary preferences to form between rewards of the same type as a function of time, their discount curve must be more bowed than an exponential function. That is, it must decline steeply over small delays but level out into a long tail (Figure 3.2) that is higher at long delays than the tail of an exponential curve. In fact, a seemingly universal discount function that has just such a form has been observed in both people and animals.

Three decades ago, Herrnstein described a simple principle predicting subjects' relative valuation (V), as measured by frequence of choice, for each of two options in concurrent reward schedules, where behavior to obtain each option is rewarded unpredictably but at a set average rate (R) (Herrnstein, 1961), in a set amount (A) (Neuringer, 1967), and at a set average delay after the successful behavior ($T - t$, where T is the time each reward is due, and t the time of the behavior that obtains it) (Chung and Herrnstein, 1967). This principle, adapted from Killeen (1972), is as follows:

$$\frac{V}{V'} = \frac{R}{R'} \cdot \frac{A}{A'} \cdot \frac{T' - t}{T - t} \qquad (1)$$

was parsimonious in the extreme, containing no empirical constants. It described preference as simply proportional to reward rate and amount, and inversely proportional to delay. Shortly afterwards, Ainslie (1974) pointed out its relevance to the problem of ambivalence, because the simple proportions that comprise it become hyperbolic curves when they are shown as graphs; hyperbolas have the

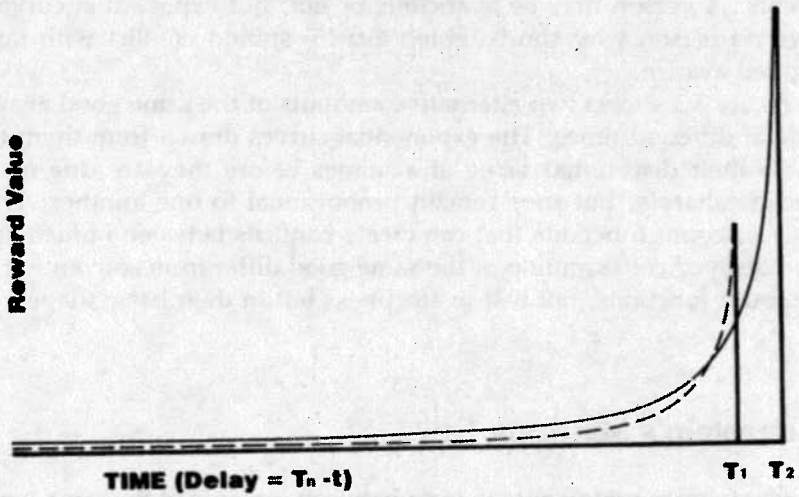

Figure 3.2. Hyperbolic curves of the value of the same expected alternative rewards as in Figure 3.1, drawn according to Equation (3).

curvature required to cross as a function of time, thus predicting temporary preferences in many cases.

Many subsequent experiments suggested small changes in the matching law's specific shape. Most significant for our present purposes was the finding that delay is not measured truly in concurrent variable interval schedules, and requires a more arduous discrete-trial "adjusting procedure" for literal accuracy (Mazur, 1987). The resulting formula for discounting the value of a single pair of rewards is:

$$\frac{V}{V'} = \frac{A}{A'} \cdot \frac{Z + \Gamma(T' - t)}{Z + \Gamma(T - t)} \qquad (2)$$

where Z is an empirical constant that limits maximum value at zero delay, and Γ determines the delay gradient, that is, the subject's sensitivity to delay. The discounted value of a single reward, taken as its ability to compete with alternatives, can be expressed as:

$$V = \frac{A}{Z + \Gamma(T - t)} \qquad (3)$$

We shall use this formula hereafter—setting Z and Γ at 1.0, following Mazur, because data about their proper value at long delays are

not available. Although derived empirically, this modification of the original matching formula has fortunate theoretical properties: Reward values are proportional to the size of the reward at long delays, rise sharply as delay approaches zero and yet never become infinite.

Consider two alternative rewards, one of which, A, will be available at time T, and a greater one, A', will be available at time $T + \Delta$. Equation (2) says that subjects will prefer them equally when:

$$\frac{V}{V'} = \frac{A}{A'} \cdot \frac{1 + (T + \Delta) - t}{1 + T - t} = 1$$

where t is the time the choice is made, and the "rates" of reward drop out because they are equal. Solving for t,

$$t_{\text{indifference}} = \frac{A(1 + T + \Delta) - A'(1 + T)}{A - A'} \qquad (4)$$

If A' were twice as great as A and Δ were 3 units of time, then $t_{\text{indifference}} = T - 2$; the delay at which the subject will be indifferent, $T - t_{\text{indifference}}$, is 2. At all choice points before $T - 2$ units, the alternative rewards should be preferred in the order of their amounts, which is to say that later, larger alternative rewards should be preferred. (At $t = T - 5$ units, e.g., the later reward should be preferred by 2/5 to 1/6, or 1.33). However, at all choice points after T − 2 units, the smaller alternative should be preferred over the larger one (e.g., at $t = T - 1$ units, by 1/2 to 2/5, or 1.25).

Direct Observations of Temporary Preference

The crucial aspect of any discount curve that is meant to explain impulsiveness is the degree to which it is bowed—whether rewards delayed by different times lose value in proportional curves or else in more concave curves that can cross, creating a conflict between present and future motives (Figure 3.2). Conventional concepts of motivation have assumed that the discount curve is exponential, probably *because* a more concave function produces intertemporal conflict and, hence, apparent irrationality.

Maximization of aggregate reward over time, discounted only in a shallow exponential curve, is still the basic valuation process in the

eyes of most economists, even those dealing with individual irrationality (e.g., Stigler and Becker, 1977). In fact, demonstration of any intrinsic discounting of future events (a "positive time preference") is still problematic for some (reviewed in Olson and Bailey, 1981). Even those economists who have dealt with cases like addiction, where a person seems to discount his or her future massively, regard the person's discount function as exponential (Becker and Murphy, 1988). Only recently have some economists begun to follow Strotz' (1956) suggestion that choice naturally changes over time, and to catalog behaviors that are paradoxical from the viewpoint of overall utility maximization (Loewenstein, 1988; Thaler, 1980, 1987–1992; Winston, 1980).

The ecological counterpart of economics, foraging theory, has assumed a choice principle that maximizes aggregate net energy gain as a necessary outcome of evolution (Krebs, 1978; Maynard Smith, 1978); accordingly it has not examined the discounting process until recently. When investigators have done so, they have found that animals will regularly choose poorer, imminently available prey over better, delayed alternatives to the detriment of overall foraging efficiency (Lea, 1979; Snyderman, 1983).

In behavioral psychology itself, theories that assume consistent maximization of reward or "molar maximization" are still advocated (Kagel, Battalio, and Green, 1983; Rachlin, 1983; Rachlin, Green, Kagel, and Battalio, 1976, 1981; Staddon and Motheral, 1978). However, behaviorists have been able to use the very property that makes molar maximization intuitively attractive to test it decisively: As we have seen, molar maximization implies an exponential discount curve and, thus, stable choice over time once an organism is familiar with the contingencies of reward (Figure 3.1). Conversely, the highly bowed curve generated by matching predicts that there will be some pairs of alternative rewards such that a larger, later reward is preferred when the choice is seen from a distance, but the smaller, earlier reward is preferred as it becomes imminent (Figure 3.2). Rather than waiting for the shape of the discount curve to be quantified precisely, some researchers have bypassed this question. Temporary change of preference is an empirical phenomenon in its own right and has been accessible to study.

The experimental paradigm to elicit temporary change of preference follows Equation (3): A reward is made available at time T, and a larger, alternative reward at time $T + \Delta$. The subject is offered the choice at some earlier time t. With Δ held constant, the delay ($T - t$) at which the choice is made is varied parametrically. A switch of

choice from the larger, later to the smaller, earlier reward as t approaches T represents a temporary change of preference.

A number of experiments have shown preference for the smaller-earlier reward when the delay $T - t$ is short, and for the larger-later reward when this delay is long. Such a switch has been obtained in animals choosing between two amounts of food at different delays (Ainslie and Herrnstein, 1981; Green, Fisher, Perlow, and Sherman, 1981; Navarick and Fantino, 1976; Rachlin and Green, 1972), in undergraduates choosing between longer or shorter periods of access to a video game (Millar and Navarick, 1984) or relief from noxious noise (Navarick, 1982; Solnick, Kannenberg, Eckerman, and Waller, 1980), in women deciding whether or not to have anesthesia for childbirth (Christensen-Szalanski, 1984), in substance-abuse patients choosing between different amounts of real money (Ainslie and Haendel, 1983), and even in the conscious self-reports of various human subjects choosing between hypothetical amounts of money (Ainslie and Haendel, 1983; Thaler, 1981). For instance, a majority of people say they would prefer to have a prize of a $100 certified check available immediately over a $200 certified check that could not be cashed for 2 years; the same people do not prefer a $100 certified check that could be cashed in 6 years to a $200 certified check that could be cashed in 8 years, even though this is the same choice seen at 6 years' greater delay ($T - t$). They generally do not notice that these choices differ only in the time they are made, and cannot give an economically consistent explanation of their reported intention to change their choice when this is pointed out to them.

These experiments provide evidence that a discount curve more deeply bowed than an exponential one governs the subjects' choices in the situations tested. Such findings do not establish a precise shape, and they do not rule out a curve that is deeply concave but not hyperboloid (e.g., that suggested by Logan, 1965). However, the differences among deeply bowed curves are not important for the model of motivational conflict proposed here. It is temporary preference per se that explains persistent self-defeating behavior.

Aside from the theoretical expectation that the matching law's hyperbolic discount curves would be maladaptive as the basic mechanism of choice, the main arguments against it have come from certain experimental findings: Human subjects often come to maximize aggregate reward, especially when they know the nature of reward schedule, and even lower animals sometimes move in the direction of maximization of reward after long experience. It has been proposed that the acknowledged examples of matching be relegated to

the status of special cases, either as derivable from maximization theory (Rachlin, Green, Kagel, and Battalio, 1976; Staddon and Motherall, 1978) or as one end of an evolutionary spectrum of sensitivity to "postreinforcer delay," with maximization at the other end (Logue, 1988).

However, the ability of adult humans to maximize income is not a surprise. People are known to be capable of great feats of gratification deferral. An organism that can spare next year's seed by rationing food over long periods of scarcity, and is known for resisting torture, is unlikely to be coerced by immediate reward in a laboratory experiment. The question is not whether people's choice pattern is limited to matching, but whether matching is the underlying mechanism of choice. If it is, it should remain detectable as a factor in decision making even after the person has largely achieved "rationality." How the person can achieve rationality within the constraints of the matching law will then be a large topic, somewhat overlapping the existing area of ego psychology.

To observe human matching directly, we have to observe situations where the subject is not challenged to exercise self-control and where the delays studied end in primary rewards or punishments, not tokens or warnings that these will come in the relatively distant future. Matching would not be expected in a procedure like that reported by Logue, Pena-Correal, Rodriguez, and Kabela (1986), where undergraduates chose between schedules of accumulating points that would later be converted to cash: Keeping cumulative scores challenges a subject to maximize these scores as a game in its own right, that is, as a rational task that "should" override current feelings of comfort or discomfort; differences in such feelings are minimized by rewarding with tokens exchangeable for money, which is in turn only a token exchangeable for still more delayed rewards. In the experiments just described where human subjects showed temporary preference, there was nothing inducing them to play a maximizing game; the rewards were either primary experiences, or money delayed by periods much longer than the time it would take to buy such experiences.

The human subjects in the latter experiments have undoubtedly shown better self-control at other times in their lives. However, in the experimental situations, they expressed a spontaneous preference for impulsive alternatives. We shall argue in Chapter 8 that a moderately small, one-time windfall like a prize or earnings as an experimental subject is exactly the situation where people do not apply their self-control. Here it is enough to note that people do not seem

to outgrow in any general sense their tendency to form temporary preferences, but rather selectively apply the impulse-avoiding skills that they have acquired.

As for the experiments showing an apparent shift toward maximizing in animals, some pigeons have learned to be slightly less impulsive than they were at first after long experience in an amount versus delay choice situation; but their gratification-delaying behavior is easily disrupted (Logue and Mazur, 1981) and never arrives at a pattern consistent with noncrossing discount curves (Todorov, de Oliveira Castro, Hanna, de Sa, and de Queiroz Barreto, 1983).

The universal report of temporary preference when it is looked for in animals, together with human subjects' similar behavior when expressing spontaneous preference, strongly suggests that deeply bowed discount functions and consequent temporary preferences for imminent rewards are fundamental properties of motivation.

The Counterintuitive Nature of Hyperbolic Discounting

The wisdom of the ages has held that future events should not be discounted (while recognizing a proneness to do so in the sin of usury). Pigou (1920) said

> Generally speaking, everybody prefers present pleasures or satisfactions of given magnitude to future pleasures or satisfactions of equal magnitude, even when the latter are perfectly certain to occur. But this preference for present pleasures does not—the idea is self-contradictory—imply that a present pleasure of given magnitude is any greater than a future pleasure of the same magnitude. It implies only that our telescopic faculty is defective. (pp. 24–25)

We have just seen modern theories in both economics and psychology that allow for steep discounting, but even they have mostly stuck to the conventional exponential discount curve that leaves temporary preference unexplained. Yet hyperbolic functions are commonplace in the perception of quantities that do not involve delay. According to a principle known since the nineteenth century, the Weber-Fechner law, a change in a physical stimulus is perceived not proportionately to its absolute amount but as a ratio of the change to the prior amount (Boring, 1950, p. 280). For the perception of value

specifically, recognition that it is based on a ratio dates back to Bernouilli: "Any increase in wealth, no matter how insignificant, will always result in an increase in utility which is inversely proportionate to the quantity of goods already possessed" (1738/1954, p. 25). Accordingly, Gibbon (1977) has suggested that the ratios described by the matching law simply represent the Weber-Fechner law as applied to the perception of delay. As applied to discounting, this law predicts that a delay from tomorrow to the day after tomorrow should be spontaneously perceived as 30 times as great as the delay from next month to next month plus a day.

But something seems wrong with this analysis. If we have reason to do so, we can correct for our human distortion of brightness, or loudness, or length, the dimension to which we analogize time (Benjamin, 1966; Kummel, 1966). The photographer can train his eye to estimate true light levels at least roughly, and a child soon learns to perceive automatically that the telephone pole down the street is as tall as the one nearby. Where an educated eye does not suffice, we easily believe the data of the light meter or tape measure. It becomes second nature to abstract a "real" object from our changing sensory impressions (Piaget, 1954). That is, we adjust our sensory impressions to agree with our best information, and we do so without the feeling that we are wrestling with some inner resistance.

Our norms call for the same adjustment when we are evaluating goods at various delays, but despite data from clock and calendar, such adjustment seems to occur irregularly, sometimes not at all. It typically takes some kind of effort, like "will power," to evaluate a present good as less desirable than a greater one in the future. This is where the analogy of delay to length breaks down: A person may move through time toward a goal just as he moves through space toward a building. The matching law formula describing the person's spontaneous valuation of a goal [Equation (2)] is close to the formula for the retinal height of the building ($Y = 1/X$, where Y is the magnitude in question, and X is the distance to the building or goal). The building does not seem to get larger as it gets closer, but the goal often seems to get more valuable. Insofar as the person fails to make the analogous correction, poorer goals that are close can loom larger than better, distant goals.

This is the heart of the temporary preference hypothesis. The original evaluation of delayed goods takes place in the same way as the perception of other magnitudes, but a person cannot learn to correct it as well, just as Pigou said. A larger image on the retina does not of itself motivate a person one way or another and, thus, does not

resist transformation by abstraction. *Satisfaction*, on the other hand, is the fundamental selective force of choice, and however the person perceives or categorizes it with his *telescopic faculty*, he is still acted upon by its direct influence. That is to say, there is a raw process of reward that constitutes the active determinant of value. While value can be perceived abstractly, it does not motivate differently because of this abstraction.[2] Abstraction occurs downstream, as it were, from where motivation occurs.

The inconstant valuation of events that results from this property of motivation causes preferences to change between a given pair of alternatives as time elapses. In ordinary speech, the process of establishing a stable preference, when acknowledged as an activity in its own right, is called *making* a decision. The term implies that this process is indeed not as automatic as the correction for retinal size, for it requires deliberate action from time to time. Still, once we have "made" a decision in a particular direction, we expect it to continue in that direction over time unless acted upon by new events, almost as if it obeyed Newton's first law of motion. Not to make decisions, that is, to undergo vacillation, is called weak, impulsive, or otherwise pathological, an extraordinary situation that needs explanation.

Because people sometimes stick to their original decisions and sometimes do not, it might seem arbitrary to say that sticking to them, rather than abandoning them, is what requires special explanation. But this could also have been said of the first law of motion: The objects of everyday experience tend to come to rest; why not see this behavior as the norm?

The answer is obvious. When Aristotelian philosophers looked for propellants rather than retardants, they actually found none and had to account for momentum with ad hoc constructs that lacked predictive power, such as streams of air doubling back from the front of a thrown stone to push it from behind (Andrade, 1954). When we have looked for factors that change preferences rather than maintain them, we seem to have been equally misled; existing theories of "irrational" or ambivalent behavior are a hodgepodge. Given experimen-

[2]Of course a person's expectations of his goals can be manipulated by intellectual processes, but the person's valuation of these expectations is strictly constrained by this application of the Weber-Fechner law. The person may, for instance, convince himself that giving in to a disproportionate urge this time will bode doing the same to similar future urges that he now sees in their true proportions and, thus, come to have additional motivation against the current urge (see Chapter 8). However, although the person may thus be able to find extra incentives, he cannot make any incentive bigger or smaller by force of intellect.

tal evidence that preference intrinsically tends to change as a function of time, it makes sense to look instead for what factors produce constancy.

Deeply bowed discount functions tell us that the shift of preferences in the absence of new incentives is not an exceptional event that attacks some naturally linear perspective on value through the intervention of repression conditioned motivation, or cognitive lapses. Rather, they predict that preference tends to be dominated by skewed momentary perspectives. Other things being equal, it will shift as our perspectives shift, even if we have experienced these same shifts until they are thoroughly familiar. It says in effect that what Eve did in the Garden of Eden was not to eat the fruit of knowledge but to swing on the universal discount curve from delayed rewards, bending it permanently from a shape that had always generated simple preferences to a shape that generates persistent motivational conflicts.

The Formation of Intrapsychic Interests

The conflicts created by highly bowed discount curves are unresolvable because each alternative is dominant at a different time. At most points in time, the person prefers a "rational" behavior, but when an opportunity to lapse is imminent, he changes to an equally sincere preference for its alternative. Objectively, the rewards for rationality are greater, but the highly bowed discount curve should make these rewards ineffective from some perspectives. People often report just such frank reversals of preference, but usually only in some areas of their lives, where they experience their wills as weak. It remains to be seen whether the matching law, which would seem to make the reversals the norm, can account for the controls that make impulses exceptional (see Chapter 8). It must be remembered that matching only describes the behavior to which a particular set of rewards will move an organism in the absence of additional motives, not what it will inevitably choose.

Given repeated choice of a temporarily preferred imminent reward, the person's motivation to seek a delayed, larger alternative will die away, because the person will have learned that he never actually waits for it. However, behaviors that include committing devices to forestall the change of preference (or its consequent behaviors) will result in delivery of the larger, later reward, and will be valued according to the original curve from the larger reward. If this

value has not been discounted too much at the time that these committing behaviors are available, they will be adopted; but if the person discovers a behavior that can evade this commitment at a time when the curve from the smaller reward is uppermost, the person will adopt this behavior in turn. The value of the committing behaviors will then decline, because they no longer guarantee the reward on which they are based. Thus, the effect created by successively dominant rewards is not simple turn taking, but a struggle for survival by the set of behaviors that tend to produce one reward against those that tend to produce its alternative. The turnings of this struggle can generate the whole range of behaviors that are seen in motivational conflict and that often seem paradoxical. The parties to the struggle are best described as "interests."

In political economy, an interest is an identified motive that acts on a group of people or would act on them if they were thoroughly familiar with the situation (e.g., "they have an interest in outcome *X*"). At the same time, it refers to the group that is defined by this motivation (e.g., "the votes of the *X* interest"). We propose that regularly recurring rewards create internal interests in the same way that economic opportunities create businesses to exploit them.

The reader may object to the idea of internal interests. They may seem to be another set of homunculi within the person, like the superego and id, or angels and devils. Such pairs of personifications of higher and lower motives have reemerged so often that they probably refer in some way to actual observation, but they have been defined only vaguely and have tended to deteriorate into allegory. However, the problem with such constructs has not been their personlike qualities, but the lack of a principle that could relate them to the whole person on one hand, and to the known elements of motivation on the other. We propose to supply such principles.

Interests are separated when the goods on which they are based are mutually incompatible. They may coalesce or divide over time, because they need not have an institutional life of their own. If I want to drink coffee, although it keeps me awake and I need sleep for an early appointment tomorrow, I have competing interests based on the rewards of coffee and sleep. If my appointment is changed so that I may sleep late tomorrow, they cease to support discrete interests. Thus, the term is one of convenience and implies nothing profound.

Furthermore, the concept of internal interests is convenient only because contradictory goals that are preferred at different times are not weighed against each other to produce a single, unambivalent purpose, but rather tend to produce conflicting sets of processes that

persist as long as they sometimes obtain their respective goals. When conflicts are not based upon the opposition of shorter- and longer-range goals, unambivalent and stable choices will result, and there is no more point in talking of interests.

Examples of the alternation of power between interests may be trivial. Take, for instance, a person who stays up too late at night, not particularly concerned about what he will feel in the morning when it is time to get up. The person's interest in staying up could be said to win out over his interest in feeling good in the morning. When the alarm rings in the morning, he regrets having stayed up so late and perhaps plans how to avoid staying up as late the following night—the balance of power between these interests has shifted. Now we also see an interest in going back to sleep, which may win out over one to get up and go to school or work; if the former interest prevails, the person will regret it in turn later on, when the latter regains its dominance. This alternation may be discerned on many successive nights and mornings, even though at each of those times, his motives will be different in some respects from each other time.

Thus, the case that is important for the problem of ambivalence entails a short-range interest based on the upward spike of the discount curve when the smaller reward is imminent, and a long-range interest based on the "objective" valuations described by the tail of the curve from a more delayed alternative reward. The long-range interest is based on heavily discounted motivation but has the advantage of foresight—it can take steps to forestall the temporary change of preference toward the poorer alternative, like the frequently cited example of Ulysses tying himself to the mast to nullify the influence of the Sirens (Elster, 1979). The short-range interest is powerfully motivated by the proximity of its reward and can be expected to prevail if it has not been previously forestalled.

Interests must be based strictly on increases in aggregate expectable discounted reward. A person has no interest in modifying future self-motives except when such modification will increase his present discounted expectation of reward. An interest based on getting chocolate ice cream for dessert does not increase expectable reward by forestalling an interest based on getting lemon meringue pie, even if the two rewards are alternative to one another. Neither interest includes a motive to interfere with the person's free choice between them. But an interest based on not gaining weight may increase overall discounted reward by adopting committing devices against a dessert interest.

The point of the temporary preference theory we are presenting

is that there are many incompatible interests that will not reach a stable resolution in which one of them simply wins, because they take turns being dominant. Any behavior in this situation must allow for the fact that the interest upon which it is based may not be dominant long enough to obtain the goal. Just as a currently dominant interest in a mature democracy must plan for the fate of its programs when a party that favors an opposing interest takes power, the person, in his present frame of mind, must take into account the tendency of currently unpreferred goals to become preferred at a later time if he is ever to see his current long-range plans realized.

We restate this theory: A person's motivation in general is divided into interests by the operation of the matching law. These interests are limited in their duration of dominance, but not necessarily in their access to any of the functions that comprise the *self* in any of its definitions. Like parties vying to rule a country, internal interests gain access to most of the person's resources when they prevail. The person who wants to stay up late at night, and the person who wants to rest in the morning, are indeed entire personalities, in the sense that they have the person's whole psychic apparatus at their disposal; yet they are clearly in conflict with one another. When an intelligent person is acting in his long-range interest not to smoke, he may use that intelligence to devise better stratagems to commit future behavior; but when he acts in his short-range interest to have a cigarette, that same intelligence can be marshaled to evade these devices.

The Effects of Temporary Preference Duration

Interests are apt to have a characteristic period of dominance, the length of time when their discount curves rise above those of competitors. This period depends on the kinds of rewards the interests have arisen to exploit, and on the intrinsic limitations of their particular modes of exploitation. It has in turn a major effect on what behaviors particular interests typically support. Duration of dominance affects not only how they defeat and are defeated by other interests, but also the affective quality of their motivation and whether behaviors based on them feel voluntary or not.

For example, conflictual sexual behaviors are temporarily preferred over various durations: Most obviously ambivalent are recurrent sexual rituals like exhibitionism, which are strongly preferred for the period in which they are executed (usually a matter of hours) but

disowned at other times. Other preferences are longer lasting: Driven, rather hollow behaviors such as satyriasis (the Don Juan syndrome) or nymphomania may be dominant for months or years at a time in someone who nevertheless believes the trait is harmful and sometimes tries to end it. Conversely, some preferences are brief, such as the surrender to a premature urge for ejaculation, which the person is motivated to avoid even a second before he gives in to it. Other processes like performance fears are experienced as lacking a preferred period altogether; yet they must compete with other emotions for dominance, which suggests, as we shall argue shortly, some form of preferability.

Differences in affective quality and perceived voluntariness serve to define five rough zones of preference duration, four of which are temporary (see Table 3.1). The fifth zone contains activities for which one never regularly changes preference.

Table 3.1 Zones of Temporary Preference Duration

Descriptor	Distinguishing Feature	Duration of Cycle	Time Until Recognized as a Problem	Examples
Optimal	Never aversive	No cycle	Never	Conflict-free satisfactions, "To love and to work"
Sellouts	Ambiguous feeling of aversion	Months to years	Decades	Constrictions of personality; seven deadly sins
Addictions	Clear periods of pleasure and aversion	Hours to days	Years	Substance abuse, destructive emotions
Itches	Ambiguous pleasurable phase but conscious participation	Seconds	Minutes	Physical itches, obsessions, tics, mannerisms, hypochondria
Pains	Never pleasurable, no sense of participation	Fractions of second	Fractions of second	Physical pain, panic

Addictions

The behaviors that best seem to fit the description "temporarily preferred" are often called addictions. They have a clear phase of conscious preference, plainly tied to the proximity of the addictive reward, followed by an equally clear period of regret. Many of these activities involve the consumption of drugs that produce physiological habituation as they are consumed and aversive withdrawal states when consumption is discontinued. But this is not true of thrill-seeking behaviors like pathological gambling, courting fights, runnings risks with the law, the ritualized sexual offenses (e.g., exhibitionism, voyeurism), or kleptomania. Some addictions do not involve a thrill but rather short-sighted relief from chronic unhappiness. For some people, that is the value of drugs, especially the opiates; it is also the basis for social withdrawal in schizophrenic, schizoid, and simply shy people (Baumeister and Scher, 1988), for self-laceration in some borderline characters (Asch, 1971; Bach-y-Rita, 1974; Pao, 1969), and the avoidance of stimulation in patients with chronic pain (Philips and Jahanshahi, 1985). Many addictive activities are seen as ordinary habits: bad habits, perhaps, but not badges of psychopathology. The "type A" person who tries to reform finds an overwhelming temptation to drive the car competitively, step on others' sentences, and otherwise indulge in impatience (Friedman and Rosenman, 1974). People may find themselves unable to give up a habitual stance in relationships or, more subtly, the "games" in Berne's perceptive taxonomy (1964), and there are many eating and sexual habits that people say they want to give up. Perhaps the most elementary addiction is procrastination—simply postponing the relatively unrewarding parts of an activity (Lachenicht, 1989).

Sellouts

Many behaviors are indulged in for years at a time despite the person's sense that they impair richer, still longer-term activities. Complaints based on this kind of conflict are the hardest to understand because they arise in an apparently healthy lifestyle: The person is successful at the job but undergoes a crisis because he is not getting the satisfaction that was expected; he is successful in romance but loses interest in his partners, and so on. Often these conflicts are seen in philosophical or religious rather than clinical terms. For instance, the seven deadly sins described in medieval times (lust, wrath, avarice, pride, envy, sloth, and gluttony) include activities

that can be highly stable and may never be renounced or even questioned but tend to become empty in the long run. These are major strategies for reward seeking, which often become stabilized as character traits—the Don Juan, the Narcissus, the embittered loser, the miser, etc. More complex but equally confining patterns are described in Berne's "scripts" (1972). Such strategies tend to be more narrow or concrete than other possible activities, and only some of their habitués come to identify them as unsatisfactory; for the others, of course, they are not conflictual but represent, however erroneously, their best guesses about how to obtain long-range satisfaction. Individuals may or may not ultimately reject them. The process of rejection is apt to involve long periods of reform alternating with surrender to the trait in question, during which the trait's character as a long but temporary preference is apparent. However, sometimes rejection comes decisively in a sudden "conversion" with no further changes of preference, and often the person expects to regret the trait years before he ever rejects it, making this category somewhat idiosyncratic among the temporary preferences. There is no accepted generic term for these slowly changing preferences with a clear-cut attractive phase and an ambiguous or variably experienced aversive phase, but they are sometimes called *sellouts*, and we shall adopt that term. We do not mean it to include those behaviors that an observer calls a sellout but that the subject himself does not expect to regret, for instance, the substitution of monetary gain for art as the goal of one's writing.

Itches

Some temporary preferences are briefer than the addictions. Unlike sellouts, which the person has at one time taken to heart and which may seem to be part of the self, preferences that are briefer than addictions are apt to seem external to the person. The individual is able to report participating in or "going along with" such activities but describes his motive not as pleasure but as an urge. The prototype of such activities is an itch, which the person wants to be rid of and which will abate if ignored, but which he usually maintains because of brief preference for the sensation of scratching. Many pathological forms of thought and behavior seem to follow this pattern, including hypochondria, persistent self-consciousness, obsessional doubts or worries, compulsive rituals, and the brief outbursts of social offensiveness called Tourette's syndrome, all of which are perceived by the person as undesirable, and all of which get worse with repetition,

but which nevertheless seem to be hard to give up. In everyday life, mannerisms of speech and behavior like teeth grinding, lip smacking, nail biting, hair pulling, psychogenic coughing, the use of "um," fidgeting, etc., are all patterns that produce some relief or satisfaction but that the person generally wants to be rid of (e.g., Azrin, Nunn, and Frantz-Renshaw, 1982; Gay, Blager, Bartsch, Emery, Rosenstiel-Gross, and Spears, 1987). Unlike literal itches, most of these activities lack a physiologically stereotyped need state and cannot be dismissed as pain avoidance.

Pains

As periods of preference get shorter, the motivation to participate in the activity is increasingly experienced as ego-alien. This relationship suggests that there is a fourth zone of temporary preference on the brief end of the scale that has the basic properties of pain: aversiveness combined with a great tendency to attract some kind of participation, a participation that is related to but not, as we shall see, identical with paying attention to the painful stimulus.

Like many of the implications of highly bowed discount curves, this concept of pain is counterintuitive. It has been developed at length elsewhere (Ainslie, 1987, 1992) but can be summarized as follows:

Aversive events—variously called punishments, pains, annoyers, or unpleasant stimuli—superficially appear to be the simple opposite of rewards. They were conceived in that way by philosophers of behavior until this century. Experimental psychology continued in this tradition. Rewards were held to simply deepen the pathway that led to them, while aversive events were thought to obliterate these pathways (e.g., Thorndike, 1935).

It has never been clear, however, what obliges the organism to pay attention to the aversive stimulus itself (Erdelyi, 1974; Smith, 1954). It may seem only common sense that pain is peremptory and has to be attended to. However, there is convincing evidence that pain is not an arbitrary reflex in an otherwise free market of behaviors but instead must compete for expression like any other alternative. Evidence from hypnosis research (Hilgard and Hilgard, 1975; Spiegel and Spiegel, 1978), neurophysiology (Melzack and Casey, 1970; Wall, 1977), and neurosurgery (Mark, Erwin, and Yakovlev, 1963) suggests that a motivational-affective, or aversive, aspect of pain can be separated from a sensory-discriminative, or informational, aspect, perhaps with the former representing a response to the latter (Sternbach,

1968). Aversive stimuli must compete, sometimes unsuccessfully, for the organism's attention and beyond that for its active generation of the emotion of aversion. They must then have a common dimension with behavioral rewards along which this competition can take place.

The subjective term that best captures the nature of this dimension is *urge*. An urge is clearly a motive and can be resisted, but it expresses an instinctive, demanding quality that a term like *temptation* does not. There is an urge to attend to aversive stimuli, or, more precisely, to generate motivational-affective pain or other negative emotions in response to aversive stimuli; but it probably does not differ in kind from the urge for one to shiver when cold, scratch what itches, or drink alcohol when tense.

An aversive stimulus cannot be simply rewarding, or it would not deter motor behavior; it cannot be simply nonrewarding, or it would fail to support attention and the motivational-affective pain response. However, the matching law predicts that a pattern of intense but brief reward followed by a longer inhibition of reward will be temporarily preferred during the time when it is imminently available. A brief spike of reward that undermines the effectiveness of other rewards for a relatively long time after it occurs will produce temporary preference for the event over ongoing alternative rewards during the period when it is imminently available, but nonpreference at all other times (Figure 3.3). If this aversive process produces rapidly regenerating reward spikes, it can reward a motivational-affective or attention-directing response, but it will punish motor behaviors. If these cycles occur rapidly enough, they may be experienced as a blend of aversion and attraction, just as a person who watches a spinning placard sees both sides of the placard superimposed on each other. For the whole pattern to appear as pain, the obligatory fall in reward will have to be long enough so that the aggregate, discounted value of this brief spike of reward is less than that of the ongoing alternative reward at all times except just before the spike is available.

The hypothesis that unpleasant stimuli lure us rather than attack us should not be hard to accept. There are many familiar behaviors that we find unpleasant and can withhold, but only with the greatest effort: biting a canker sore, reliving a bygone humiliation, or reacting with arousal when we hear a dripping faucet while trying to go to sleep. Indeed, the combination of attention-drawing and behavior-deterring characteristic of physical pain is shared by a number of other aversive processes. These hinge on behaviors as brief as the person's very notice. Phobias are the most important category; their participatory nature is shown by their responsiveness to behavior therapies that give patients practice in resisting the urge to panic

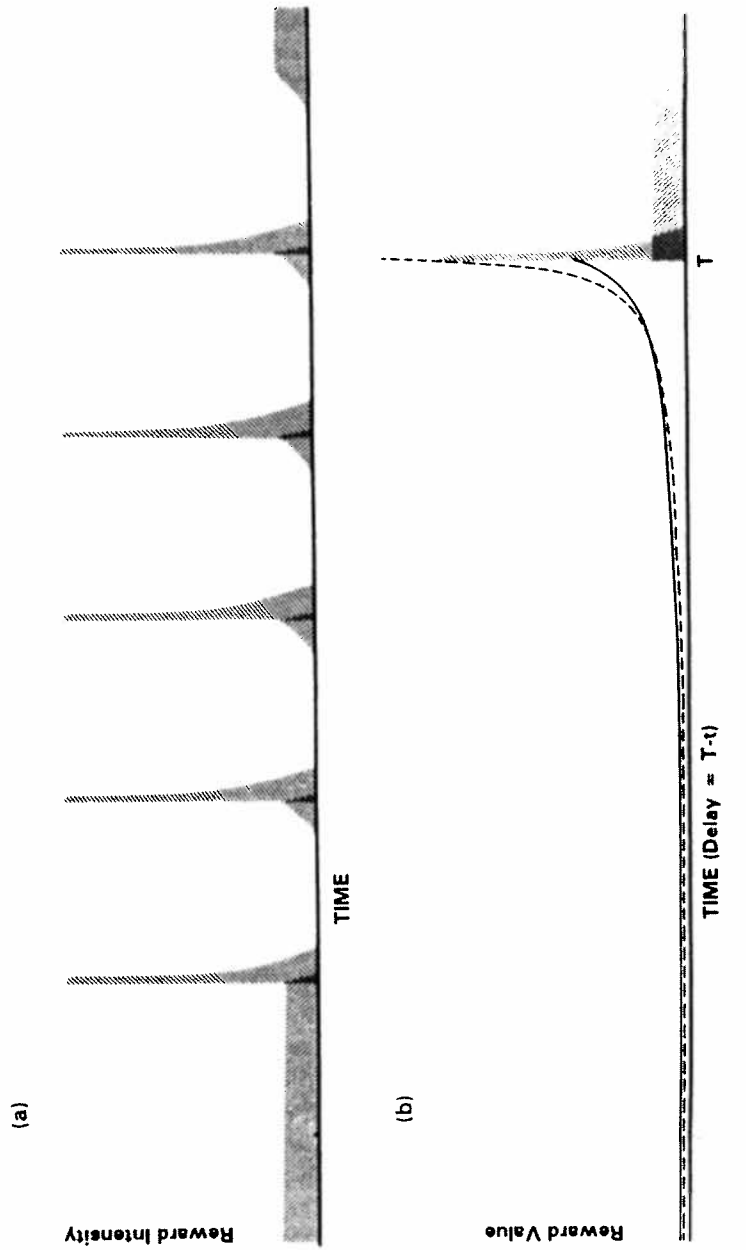

Figure 3.3. Amounts and hyperbolic value curves from five expected spikes of pain (Figures 3.3a) and from a small, constant reward that is alternative to a single spike (Figure 3.3b).

(reviewed in Clum, 1989). Tinnitus (ringing in the ears) seems to be another example of a perception that can be reduced by training in structuring attention (Ince, Greene, Alba, and Zaretsky, 1984). There are many other feelings that are experienced as "happening to" the person but that can be cultivated or, conversely, starved out by some kind of practice. If the person experiences them as happening without his participation and avoids them from their first appearance, they should be regarded as temporary preferences in the pain range of duration.

The Interaction of Interests

Deeply bowed discount functions suggest there should be a radical change in our traditional binary perception of motivation. As we have just seen, the sharpest division of incentives is not between pleasures and pains but between those rewards that are temporarily preferred and those that are preferred without conflict. Simple nonreward is probably neutral rather than aversive, a barren contingency that is avoided routinely and without much notice as a byproduct of the quest for reward. Aversive stimuli are at one end of the continuum of temporarily preferred incentives; they are not experienced as having a rewarding component because their duration of reward is so short. We must infer the rewarding aspect of aversive stimuli from their ability to reward attention. Activities preferred temporarily, but longer than pains, tend to be the subject of conscious ambivalence, which is felt differently depending largely on the duration of this preference. The classification of temporary preference for a given kind of activity according to the rough experiential benchmarks described earlier (Table 3.1) will often change from one situation to the next. For instance, the feelings called pain and fear are usually aversive throughout their duration. However, when the person seeks pain to prove virtue or bravery, or as an adjuvant to sexual pleasure, he may prefer it temporarily in the addiction or sell-out range (as in masochism) or may prefer it unambivalently. Similarly, a person may wholeheartedly cultivate an appetite for frightening movies, but when a child repeatedly seeks to watch them and suffers nightmares after each one, he is preferring them in the addiction range; if he experiences an unpleasant urge to rehearse scenes from them during the day, this activity (as opposed to the activity of going to these movies per se) will be an itch. The same person may be subject to related fears that never feel like he is bringing them on; these are [illegible] in the sense described earlier.

Some feelings have no characteristic zone of preference but play different roles depending on their use for the individual and the particular occasions that evoke them. Anger, for instance, may be felt unambivalently, or may be cultivated in the sellout range as self-righteous hatred, perhaps as one of the many cult hatreds (Ku Klux Klan, anarchism, etc.) in a person who "knows better." Explosive personalities who lose their tempers and feel remorse over a cycle of hours to days could be said to be addicted to anger, while for the obsessional patient, angry thoughts may be an itch, and for some schizophrenic or terribly inhibited patients, anger may be a pain that breaks through their consistent attempts to avoid it.

To complicate classification further, a given reward-getting process may have separable components that are preferred over different time courses. An exhibitionist is apt to prefer this sexual behavior for periods of time in the addiction range (a few hours at a time), but he also prefers generating fantasies about it in the itch range (seconds to minutes before suppressing them). An alcoholic not only prefers drinking in the addiction range but is apt to entertain cravings for alcohol in the itch range and also emit motivational-affective withdrawal symptoms in the pain range. Those vegetarians who classify the eating of meat as an addictive behavior may or may not suffer cravings for meat in the itch range. Where a behavior is not preferred temporarily, the appetite is not apt to be subject to ambivalence, either.

"Higher" Interests

There are many activities that are preferred consistently over time, that is, they are never regularly avoided or regretted. These may be trivial, routine tasks: a manner of walking, a particular job, combing one's hair. However, they also include the subtle "higher purposes" of life that tend to be spoken of rather mystically, in such terms as harmony with God or nature, self-actualization (Maslow, 1968), or ego autonomy (Loevinger, 1976).

The model proposed here differs from the many other hierarchies of maturity or ego function that have been proposed (reviewed in Loevinger, 1976) in that those hierarchies are nonconflictual; they depict the person as simply advancing upwards as he learns more about life, abandoning leaner activities as richer ones are discovered. The interests just described also form a hierarchy (Table 3.1), but the lower activities persist as temptations that threaten higher ones, and what is learned as the person matures are behaviors that can potentially join any of these interests in its competition with any other.

The other models predict that the person who has learned self-actualization should give up nail biting and overeating. In the model proposed here, the highest or richest activities stay in competitive equilibrium with bad habits, forestalling them when the person both knows how and is so motivated, succumbing to them when he knows how to evade such prior forestalling and is so motivated. In this model, too, many itches and pains that are usually counted as involuntary are brought into the hierarchy. If people are supposed to outgrow lower behaviors, reaction to a painful stimulus with pain behavior would be evidence of immaturity; but in a model that includes robust temporary preferences, there is no such implication.

Impulses as a Chain of Predation

While attaching a longer-range interest, a short-range interest must also guard against attacks by still shorter-range interests. This possibility makes sense of Jon Elster's paradoxical predicament: "I wish that I didn't wish that I didn't wish to eat cream cake. I wish to eat cream cake because I like it. I wish that I didn't like it, because, as a moderately vain person, I think it is more important to remain slim. But I wish I was less vain" (1989, p. 37 note).

His long-range wish is not to be vain, which defines vanity as a temporary preference in the sellout range. His vanity is in turn threatened by an appetite for cream cake, a temporary preference in the addiction range. Note that, given only what the example tells us, we would not call the appetite for cream cake a temporary preference if the vanity were not present.

In theory, there could be any number of different activities, each with slightly more immediate goals than the next and incompatible with it, which form something like a chain of predation within the person's repertoire of choices. However, it is hard to think of examples with more conflicting elements then there are in Table 3.1, that is, about five. An example with just that many elements might be a person with bulimia nervosa. This person's longest-range interest is to eat normally, that is, so that he is pleased when looking both forward and backward over periods of years. However, he derives shorter (sellout) range satisfaction from mortifying his appetite to the extent that no evidence of fat remains on his body—a preoccupying asceticism, called anorexia nervosa when pursued consistently, which interferes with richer satisfactions and which the person probably knows he will ultimately regret. This person does not pursue it consistently, but episodically has a food binge and then tries to undo

the damage by inducing vomiting. His preferences for a binge last a matter of an hour or two and, thus, are in the addiction range. Now say that he has read of injuries caused by self-induced vomiting, and develops a hypochondriacal preoccupation with having damaged his throat. When he is on a binge he repeatedly feels compelled to examine his swallowing sensations for evidence of damage, an urge in the itch range that interferes with the reward of eating. Finally, if he confronts evidence of injury, he may surrender to a panic that undermines even his ability to worry; this is experienced as happening without his participation and, thus, falls in the pain range.

Conflicts among interests in more than two ranges—that is, among short-, long-, and midrange interests—may underlie the pathological side effects of some kinds of impulse-controlling measures. This possibility will be described in Chapter 8.

Conclusion

The matching law and its hyperboloid discount function have broad implications. Without the nonexponential relation of motivational value to delay, we are at a loss to explain the inconsistency of preferences, the temporary dominance of inferior choices, and the apparent evidence of competing interests within the individual that have been widely reported. With the assumption of nonexponentiality, amply supported by behavioral research, we can account for "unwanted" behaviors ranging from character flaws to addictions to mannerisms to pain itself, the victim's participation in which has become increasingly evident in recent research. Although much previous writing on self-defeating behavior has contained intimations of a discounting theory, only a strict motivational accounting using these curves promises a comprehensive understanding of human irrationality.

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