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ETIOLOGIC ASPECTS OF ALCOHOL AND DRUG ABUSE

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Clinicians, academicians and researchers in the field of alcohol and drug abuse have pooled their expertise in this examination of the etiology of substance abuse. The contributions are divided into three sections which present biological, psychological and sociocultural approaches to the subject. Articles discuss genetic factors, animal models, opiate addiction, ethanol metabolism, and the biological consequences of alcoholism; explain unconscious aspects of addiction and contemporary psychodynamic concepts, the behavioral approach, willpower, social-learning influences on alcoholism, the medical and multivariate models of alcoholism, and sensation seeking; and examine sociocultural factors, religious influence, family and familial factors, Alcoholics Anonymous, and social influences.

Chapter 9

THE MOTIVES OF THE WILL

GEORGE AINSLIE AND VARDA HALENDI

WHEN PEOPLE HAVE GIVEN UP a bad habit or addiction, they rarely report using one of the clever techniques that are popular in behavior-therapy manuals: keeping temptation out of sight, using imagery, finding ways to divert their minds, depositing money with a friend to be sent to some unappetizing cause if they fail, and so forth. People who have successfully renounced addictions usually say that they "just did it." On their own or with some kind of spiritual help, they simply resolved something, perhaps for a day, perhaps forever, but without any more conscious machination than it took to make the decision itself. They used what is commonly called *willpower*.

The will and the source of its power were much discussed in Victorian times. The following passage from Sully expresses the Victorian idea clearly:

> When the child begins to view each individual action in its bearing on some portion of his lasting welfare, his actions become united and consolidated into what we call conduct. Impulse as isolated prompting for this or that particular enjoyment becomes transformed into comprehensive aim and rational motive. Or to express the change otherwise, action becomes pervaded and regulated by principle. The child consciously or unconsciously begins to refer to a general precept or maxim of action, as "maintain health," "seek knowledge," "be good," and so forth. Particular actions are thus united under a common rule, they are viewed as members of a class of actions subserving one comprehensive end. In this way the will attains a measure of unity.[1]

This description of how willpower is generated seems like amateur psychologizing today. Unlike many of the topics that were current when modern psychology was being born, this one has not been the object of systematic research and theoretical development; it seems dated.

There are probably two reasons why the idea of "will" became

quaint among behavioral scientists. First, it operates entirely inside the subject's head and, thus, for many years was a forbidden topic for behaviorists; secondly, it seems to operate through logic and intellect and, thus, had little interest for authors studying the dynamics of the unconscious. Today, the average alcoholic knows more about the properties of the will than the behavioral scientist (e.g. the case reports in *Alcoholics Anonymous*), and if the latter even refers to it, he runs the paradoxical risk of *being thought both mystical and trite.*[2]

*However, some authors have again begun to describe a self-*control process not accounted for by either the classical defense mechanisms or standard behavioral theory.[3] Kanfer has described a process in the behavior therapy of self-destructive habits that he called "beta control," whereby a person makes a contract with himself to reward himself or not on the basis of self-observation.[4] Bandura and others have proposed similar kinds of self-reward.[5] Sjoberg has boldly reintroduced the term *will* and has made extensive clinical observations among various kinds of addicts on the experience of willing and the breakdown of the will.[6, 7] In his view, the will depends on an effort of logic, energy for which is withdrawn by any stressful activity, including social strain and the pressure of temptation itself.

These studies add substance to the common impression that the will is a motivated process that opposes other motivated processes, best called impulses, within the individual self. However, we still lack a clear idea of the rules for this conflict. How can a person reward himself, and why should he have to? If the person mostly wants to avoid an impulse, why is not this motivation itself enough to let him succeed? If he mostly wants to indulge the impulse, why does he not simply do so? Or, if the will is a lever whereby a minority faction inside the person's head can gain control over a stronger impulse, then where is its fulcrum, and how does the weaker side get hold of the handle? Impulsive motives have been thoroughly catalogued in this century, but we know little about the forces that work against them, the motives of the will.

One of us (G.A.) has shown that a highly concave discount function by which rewards lose value with delay would account

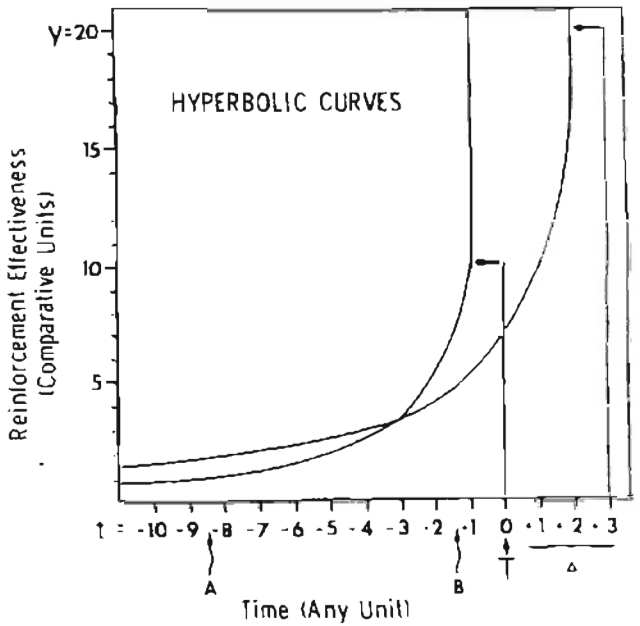

Figure 9-1. In this graph, the relative effectiveness of a small, early reward and a reward twice as large available three units of time later can be seen if the effectiveness of rewards is proportional to amount and inversely proportional to delay. (Just before the rewards are due, hyperbolic curves become infinitely high, though this portion is not depicted.)

for the conflicts between will and impulse (See Fig. 9-1).[3, 8] In a choice between a smaller, earlier and a larger, later reward, such a hyperbolic discount function describes the effectiveness of the rewards as roughly proportional to their absolute amounts when both are distant (e.g. point A), and a brief, temporary, but enormously strong tendency to choose the smaller reward when it becomes imminent (e.g. point B). Thus, the hyperbolic function allows us to define the person's short- and long-term interests in a given choice and explains why these interests do not average out to produce a simple, stable preference.

Furthermore, if the person's behavior in the current choice tells him how he is apt to make similar choices in the future (that is, if he sees his current choice as a precedent for a large category of future choices), then his current choice becomes governed not

by the single discount curve from the two current alternatives but by the summed curves depicting expected reward from the whole series of larger rewards versus the whole series of smaller rewards. That is, in Sully's words, if the person refers his current choice to a general maxim, his choice becomes governed by the aggregate benefit he expects for obeying or disobeying that maxim in the long run. It can be shown that the effect of adding together curves from a whole series of choices is to greatly reduce the amount and duration of the temporary preference for the smaller alternative in each current choice (See Fig. 9-2).[3] Thus, hyperbolic discount curves would provide us with an explicit mechanism for the generation of willpower.

Several experiments have now demonstrated that there is a hyperbolic discount in lower animals.[9] As we would predict from such a curve, these animals have also shown a curve of delayed reward and temporary change of choice as a function of the distance at which a pair of alternative rewards is seen and have even learned specific operants to forestall this temporary change of preference.[10-12] However, confirmation of these phenomena in human subjects has so far been lacking.

The idea of a discount curve that is both steep and highly concave may seem counterintuitive when applied to ourselves. Most people would probably name the prevailing interest rate if asked how much they or their friends discounted the future. Only people with addictive diseases (e.g. substance abusers, gamblers, compulsive spenders) are expected to discount the future at a higher rate and then only in specific circumstances. However, when this common intuition is tested systematically, it does not hold true, even in the realm of consumer economics. For instance, one study of actual air conditioner purchases (before the great inflation) showed that, in trading off purchase price and maintenance cost, consumers discounted the future at annual rates as high as 89 percent.[13]

It might be argued that in consumer-choice situations, people are forced away from their true preferences by various economic realities. In the air conditioner study, it was the poorest subjects who reported the highest discount rates, perhaps because they could simply not afford to buy the more efficient units.

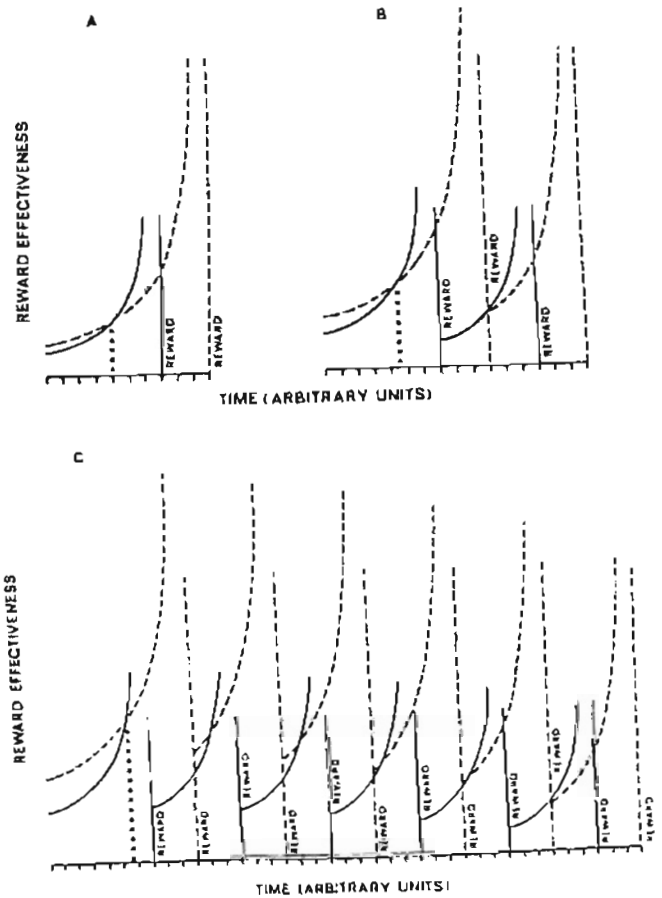

Figure 9-2. Shown here are the summed hyperbolic curves of the effectiveness of two alternative sets of rewards — small rewards are the solid lines, and rewards that are twice as great are the dashed lines: A equals sets of one reward each; B equals sets of two rewards each; and C equals sets of six rewards each (from 3). In A, the small reward becomes preferred three units of time before it is due; in B, the small rewards become preferred 2.4 units of time before the first one is due; in C, 1.6 units before it is due.

However, in two studies where people were asked how they would trade off amount and delay of extra income, which was entirely hypothetical, the subjects' answers did not move closer to the ordinary interest rate; in fact, they moved radically in the

other direction. Firstly, subjects with at least some financial means were asked how large a bonus they would demand immediately rather than collect a bonus of $100 in one year.[14] Their reported discount rates ranged from 36%-122%. Secondly, in another study, graduate students and staff at a university were asked how long they would wait for $10 rather than get $5 immediately. Their answers reflected a mean annual discount rate of 5,000 percent.[22]

CURRENT RESEARCH

We will review three of our own experiments that were designed to follow the leads in the economic literature and explore the slope and shape of the human discount function.

Self-Reports of Future Discount Rate

Procedure

Twenty employees and twenty-one voluntary patients in an elective drug and alcohol rehabilitation ward at a veterans hospital had roughly equal ages (patients = 36.1, staff = 41.3, N.S.) and years of schooling (patients = 12.5, staff = 13.7, N.S.).* They were asked to imagine that they had won a prize from a reliable company and could either get a certified check for a certain amount to be cashed in a week or a certified check for twice the amount but not be cashed until a later date.[23] They were asked to say how far off the larger check would have to be postdated for them to be indifferent between the two checks. We offered the subjects four of these two-way choices, with the smaller amounts being $10, $1, $1000, and $10 again for half the subjects and $10, $1000, $1, and $10 again for the other half.

Results

Subjects' answers varied from minutes to years. Since arithmetic means would overvalue the largest reported delays, the results were averaged using geometric means (See Table 9-I). The extent to which these answers exceed the bank discount rate is illustrated by converting them to annual interest rates,

* Rosemary Ewing provided assistance in this study.

TABLE 9-I

MEAN INDIFFERENCE POINTS AND THE EQUIVALENT ANNUAL INTEREST RATES

($= 2^{(\text{geom. mean } -7)} - 1) \times 100$

	Patients (N = 20)		*Staff (N = 21)*	
	Geom. Mean	*Annual Interest*	*Geom. Mean*	*Annual Interest*
$10 at 7 days vs. $20 at	11.4	212×10^{21}%	20.2	$15,200 \times 10^{6}$%
$1 at 7 days vs. $2 at	7.1	a	20.6	$8,400 \times 10^{6}$%
$1000 at 7 days vs. $2000 at	51.4	2,670,000%	43.1	96,000%
$10 at 7 days vs. $20 at (2d)	21.1	4240×10^{16}%	32.6	1,620,000%

although, as the subsequent experiments will show, the true discount function is probably more concave than the exponential function used by banks. The discounting rate is significantly lower the higher the hypothetical amounts offered, but even with the $1000 versus $2000, the $2000 alternative is greatly devalued.

These discounting curves might be so steep because the hypothetical prizes are a windfall, unexpected, and unearned. In such an event, subjects might not apply their usual rules about prudence with money.[17] Therefore, each subject was also asked how long he would hold onto a $10 savings bond that earned 50% annual interest, since such a choice was apt to be part of the subjects' ordinary experience, albeit at a lower interest rate. Subjects might thus describe a more prudent discount curve. This question indeed produced a lower self-reported discount rate, but one that was still markedly steeper than that observable in the money market (See Fig. 9-3).

It might be expected that the addicted patients would be less apt to wait for the larger amounts than the staff would, since they had a documented impulse-control problem and were poorer (i.e. mean income when last worked was $9200 for patients, $14,300 for staff, $p < 0.01$). However, the variation among individuals turned out to be greater than that between the groups, which was not significant. This is not just a case of too

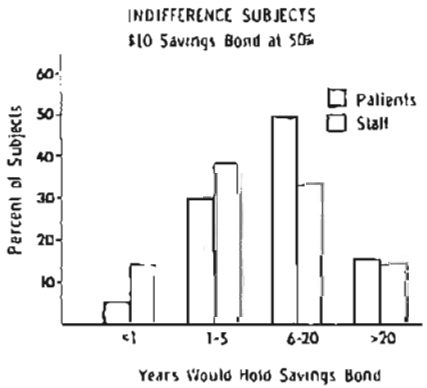

Figure 9-3. Years subject in the discount-rate study will hold a $10 savings bond yielding 50% interest.

small an N for significance — the trend in mean times to hold a savings bond was actually longer among patients than among staff.

In short, when both normal and addicted adults are simply asked how long they would wait to double various amounts of money, they report what could only be called *monumental impatience.*

Self-Reports of Temporary Preference

Procedure

To determine whether or not the steep, self-reported discount rates were more concave than simple percentage discount curves (i.e. exponential curves), we administered a questionnaire on hypothetical alternatives between various amounts of money at

TABLE 9-II

GRID OF POSSIBLE VALUES OF D AND Δ

	D = 0		D = 3 mos.		D = 1 yr.		D = 4 yrs.
Δ = 1 mo.	0 vs. 1 mo.	X	3 mos. vs. 4 mos.	X	1 yr vs. 1 yr + 1 mo.	X	4 yrs.* vs. 4 yrs. + 1 mo.
Δ = 6 mos.	0 vs. 1/2 yr.	X	3 mos. vs. 9 mos.	X	1 yr vs. 1-1/2 yrs.	X	4 yrs. vs. 4-1/2 yrs.
Δ = 2 yrs.	0 vs. 2 yrs.	X	3 mos. vs. 27 mos.	X	1 yr. vs 3 yrs.	X	4 yrs. vs. 6 yrs.
Δ = 4 yrs.	0 vs. 4 yrs.†	X	3 mos. vs. 4 yrs. + 3 mos.	X	1 yr. vs. 5 yrs.	X	4 yrs. vs. 8 yrs.

*Move to this point without change of preference scored as consistent preference for smaller amount.
†Move to this point without change of preference scored as consistent preference for larger amount.
NOTE. Xs mark possible changes of preference. Changes above the diagonal line represent less gratification delay; scores below, more gratification delay.

various delays.[24] We asked forty-two university students and twenty-eight substance abuse patients to imagine that they had won a prize from a reliable company and asked their preference in a number of choices between a smaller amount prize money at delay D and an amount twice as great at delay D + Δ (See Table 9-II). To avoid asking every comparison on the table, a contingent sequence was followed.

After each question, if the subject preferred the smaller amount, D was gradually raised from zero to three months, and then, if he still preferred the smaller amount, to one year and then to four years. If the subject chose the larger amount at the first delay D, then Δ, the lag between the rewards was gradually raised from one month to six months, to two years, and to four years; if a subject then changed his preference to the smaller amount, Δ was held constant and D was increased in steps as was just described. The questioning for each pair of alternatives stopped with one of three outcomes: (1) when the subject changes his preference as a function of D, that is, while going from one choice to another on a horizontal line; (2) when a subject showed consistent preference for either the larger or the smaller amount, ending up either in the lower left or upper right-hand corner respectively; or (3) when a subject changed his preference only with changes of Δ, moving in an endless loop around two of the lines.*

We followed this contingent sequence four times, offering different amounts each time: $50 versus $100, $10 versus $20, $250 versus $500, and finally $50 versus $100 again for half of the subjects and for the other half $50 versus $100, $250 versus $500, $10 versus $20, and $50 versus $100 again. An additional 48 students and 29 patients were given the initial $50 prize at

* For instance, the subject might consistently choose $50 over $100 at all the delays shown in line C but prefer $100 to $50 at all the delays shown in line D. In this case, the subject would probably have changed his preference as a function of D if the increments in Δ had been smaller. If the grid in Figure 9-7 lacked the middle two lines, most subjects' answers would probably go around in a circle; conversely, if Δ were increased more gradually (i.e. more horizontal lines), the subjects who changed their preferences only when Δ was changed would surely report changes of preferences while moving horizontally on one of these added lines. Nevertheless, we will report the data conservatively—not counting the endless loops as crossovers.

delay D versus $100 prize at delay D + Δ at the beginning of a different questionnaire.

Results

Figure 9-4 shows how students and patients responded to the first $50 versus $100 choice. Most subjects changed their preference as a function of D at some value of Δ. This was true of all the conditions and both groups of subjects as shown in Figure 9-5.

The students' curves are not significantly higher than the patients' by chi square. Furthermore, frequency of changing preference at low values of Δ and high values of D (i.e. X's above the diagonal band in Table 9-II) can be added to frequency of consistent preference for the small amount to form a rough

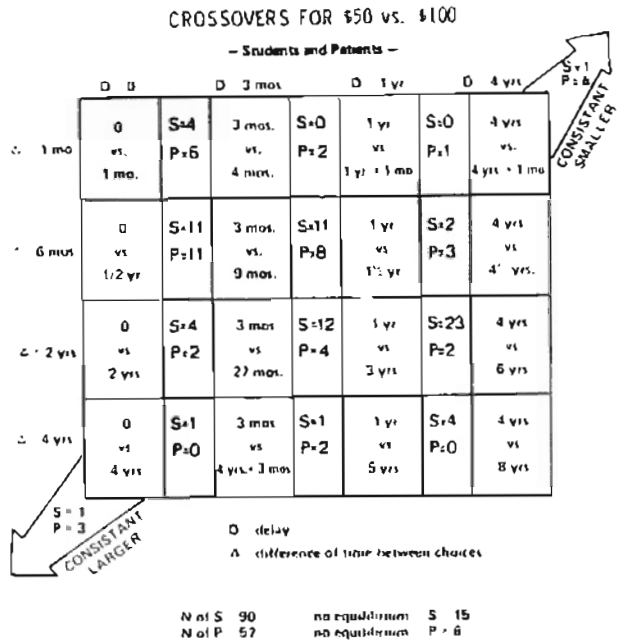

Figure 9-4. In this grid, the values of D and Δ used to elicit temporary preferences. The typical results are for a choice of $50 at D versus $100 at D + Δ: The numbers of students (S) and patients (P) who changed preferences with Δ constant are shown at each change of D. The numbers who did not change are shown in the upper right and lower left corners. Those who did not change at a constant Δ are shown below this.

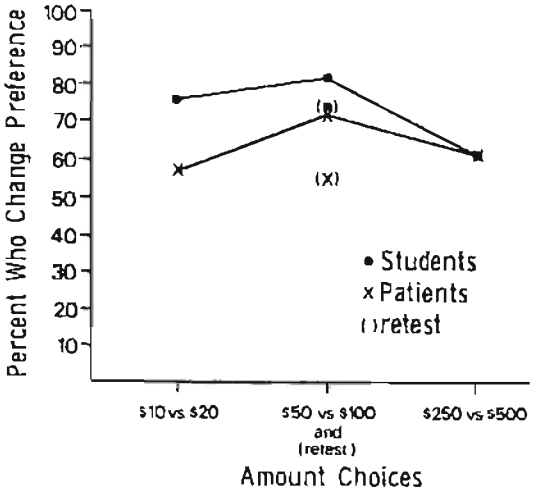

Figure 9-5. In this graph, the percent of students and patients who changed preference from larger, later to small, earlier amount as D was increased, with Δ held constant.

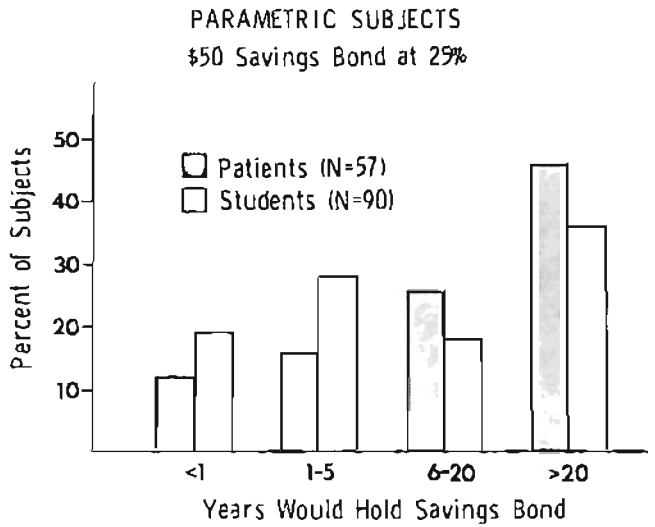

Figure 9-6. In this graph, the years subjects in the self-reported change-of-preference study would hold a $50 savings bond yielding 25% annual interest.

general measure of impatience, and this is almost identical in patients (57%) and students (55%). As in the previous questionnaire, there is no tendency for patients to report a shorter holding of a savings bond (this time yielding 25 percent interest) (See Fig. 9-6). The lack of differences between the groups is striking in light of their great differences in age (19.7 vs. 38.5 years) and estimated length of education when completed (11.5 vs. 17.9 years of school), as well as their obvious differences in symptomatology.

Temporary Preference for Smaller Amounts of Actual Money

Procedure

Subjects were patients in a substance abuse program who were being paid from $2-$10 per week for their participation in a different experiment.* On the Friday before the week that they earned this money, subjects were asked if they preferred being paid their money as soon as they had earned it, i.e. the next Friday (D = 7 days), or if they preferred being paid 25% more 3 days later (Δ = 3 days) (See Fig. 9-7). On the next Friday, when they had finished their work, they were asked again if they

* Betsy Snook provided assistance in this study.

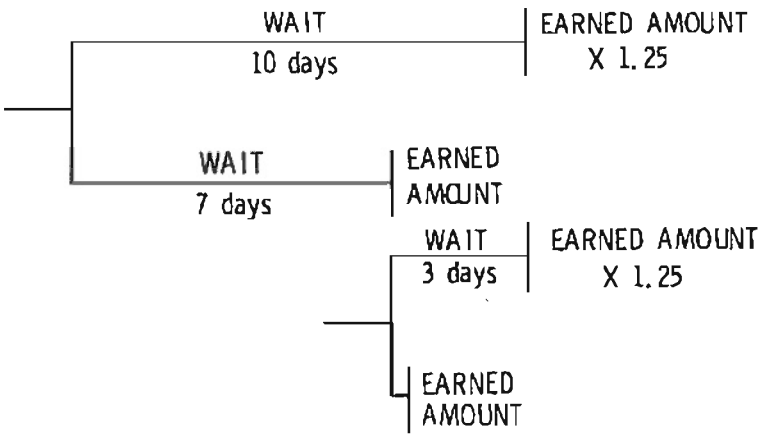

Figure 9-7. Shown here are the subjects' alternatives when choosing real money: First choice point, D = 7, Δ = 3 days; second choice point, D = 0, Δ = 3 days.

would prefer being paid immediately (D = 0) or get 25% more 3 days later (Δ still equals 3 days). This is, of course, the same choice seen at different distances.

Results

Thirteen of the eighteen subjects (i.e. 72%) crossed over at least once from the larger (later to the smaller), earlier amount.

The mean incidence of crossing over from delayed to immediate reward was 33 percent (See Table 9-III). Subjects preferred the immediate over the delayed pay both when D was 7 days and when it was zero 35 percent of the time; they consistently preferred the delayed over the immediate pay 27 percent of the time; and they crossed over from the immediate to the delayed pay 4 percent of the time.

These subjects were also given the hypothetical amount-versus-delay questionnaires described above. All but two of the subjects (i.e. 89%) crossed over on at least one question. The mean rate of crossovers was 69 percent as opposed to 1 percent mean rate of consistent preference for the immediate over the delayed, 11 percent mean rate of consistent preference for the delayed over the immediate, and a 19 percent mean rate of "endless looping," which, as we have just argued, probably represents a form of crossing over.

The mean rate of crossing over in choosing real money is

TABLE 9-III

MEAN PERCENT EACH SUBJECT CHOSE

	Consis Imed	Consis. Del	Cross Imed-Del	Cross Del-Imed	Round
Imagined money (38 ss,72 choices)	01	11	N.A	69	19
Real money (18 ss,66 choices)	35	27	04	33	N.A.
Real money (D = 2 weeks) (5 ss, 5 choices)	0	0	20	80	N.A.

correlated at R = 0.49, with the mean rate of crossing over in the hypothetical amount-versus-delay questionnaire ($p < 0.02$), showing at least some capacity of this questionnaire to predict real behavior. The crossover rate obtained in the real money choices was less than that reported on the questionnaire, but this difference may simply reflect the values of D and Δ used. Five subjects have been run once, with D starting at two weeks instead of one, and four out of the five changed their preference from the larger (later to the smaller), earlier reward when D was decreased to zero.

Discussion and Conclusions

These results show that under some circumstances people report much higher rates of discounting future rewards than most economists would call rational, and they will apply these steep discount rates to their actual behavior toward real money.[15, 16] Furthermore, this discounting does not occur in the traditional percentage discount curve, but in a more concave curve that frequently causes preferences to change simply as a function of elapsing time. These data are preliminary, but so far they confirm the generality of a discounting function that is both steep and highly concave, perhaps like the simple hyperbola that has been widely observed in animals.

Subjects in the first study who were asked about their indifference points reported an annual discount rate of at least several thousand percent per year. The subjects in the third study who did not wait three days to get a 25 percent increase in real money acted according to the astronomical discount rate of 5 billion percent per year.

The discount function evoked by experiments 2 and 3 is more concave than an exponential function. An exponential function would not permit any change of preference simply as a function of D. But almost all subjects reporting their preferences for amount versus delay, and 60%-80% of subjects choosing between actual amounts of money at real delays, shifted their preference as a function of D under at least one set of circumstances.

Furthermore, the highly concave discount function seems to

hold true for a wide range of absolute delays. The D's and deltas used in animal experiments have been only a few seconds. When our human subjects chose between actual amounts of money, the delays involved were in days, and when subjects reported their preferences between amounts and delays of hypothetical rewards, the delays were in months and years. Thus the short- and long-term interests that are defined by the concave shape of this curve do not depend on any particular range of delays but only on their relative amounts.

In one sense these studies have been too successful. The astronomical interest rates they have obtained (i.e. billions, trillions, quadrillions of percent per year) seem unreal, as if we had been lured into a line of reasoning that proved that one equals two or that the world is really upside down. In fact, banks manage to attract deposits by offering interest rates of only a few percent per year, and we do not see large numbers of people squandering tomorrow's food money for today's good time. The amounts of money involved in these studies are either small or entirely hypothetical, but in any case represent additional monies that would not ordinarily have been part of the subjects' usual income or expenditures. However, these features should not call the empirical findings into doubt. According to our original hypothesis about the motivational basis of will, only reward that is small, hypothetical, and/or one of a kind can elicit elementary preferences (i.e. preferences that are not influenced by the importance of the outcomes as precedents).

We have hypothesized that a highly concave discount function produces both the problem that makes the will necessary and the motivation that allows the will to overcome this problem. The problem is in the high spike of temptation that occurs as any reward becomes imminently available. The solution lies in the long tail of motivation from each reward, which is probably aggregated with the tails of other rewards, to create willpower when a series of choices is perceived to belong to a common category. If this hypothesis is correct, then categories that contain rewards vital to a person's interests will seem to act in a relatively even, linear fashion over time. However, we would expect to see subjects make exceptions when they can distinguish

individual choices from the larger category. Thus, it is just those activities that do not affect the subject's vital interests that are apt to elicit this spontaneous discount function. Insofar as a reward is small, hypothetical, or a one-of-a-kind windfall like the rewards used in this research, it is apt to elude the willpower he has marshalled to prevent the wasting of his substance. The effect of amount can be seen in our study or indifference points, where larger amounts produced less discounting. The effect of being hypothetical cannot be directly discerned in our data, but it is hard to believe that most people would be as impatient as they told us they would rather have a thousand real dollars now as opposed to two thousand real dollars later. The effect of being a windfall has been described in many common situations by the economist Thaler, who has shown that people are far less conservative in their decisions about "opportunity" costs (i.e. money they have not yet received) than in their decisions about "out-of-pocket" costs.[17]

Freud and the great religions before him have taught that man is basically impulsive. Not just addicts, or spendthrifts, or the mentally ill, but everyone has a pronounced tendency to discount the future. These experiments suggest that people indeed share this trait, but that there is a warp in our spontaneous perception of the future that contains the means to compensate for it if we can learn the skill. It seems likely that our relatively linear perception of value over time must be created and maintained by the continuous action of the will upon the highly curvilinear values that appear in spontaneous perception.

A Direction for Future Research

If it is true that the will operates by heaping the long low tails of a large number of expected rewards on top of each other until they form a bundle thick enough to oppose each individual impulse, then we can make many specific predictions about how it operates. This has been done elsewhere at some length.[25] Suffice it to say that extensive use of the will should lead very much to where the "compulsive" defenses are supposed to lead, that is, to lawyerly, systematic behavior and concern with choices more for their value as precedents than as events in their own

right. But if we want to test the truth of this model or do any systematic research on the will, what are we to do? Willing takes place entirely inside the person's head. A researcher cannot test the strength of a subject's will just by asking questions. If he tried to titrate a subject's will against a real temptation, assuming this was ethically justifiable and economically feasible, he would still find out little about the real strength of his subject's will; the mere intervention of the experimenter would allow the subject to distinguish this choice from the choices occurring naturally in his own experience, thus totally undermining its force as a precedent.

It may be that we will have to be content with introspective descriptions. However, in this laboratory we have been attempting to create an observable experimental model of the motives we have hypothesized to cause the phenomenon of will. This work is being done with the help of Ms. Shirley Raybin and Ms. Betsy Snook and has the following rationale.

The effect of the highly concave discount curve is to make the individual a series of partially independent choice makers; the motives governing the present choice maker can be expected to shift at future times as the present perspective is lost. Any choice maker who wants to count on the behavior of future choice makers must take steps to predict and influence these choice makers much as if they were separate people. The will can be seen as a tacit conspiracy among successive choice makers that each will choose the larger, later reward when his turn comes, provided that all the others have done so. The process is the same as that involved in tacit price-fixing conspiracies, where each firm privately adopts the price set by other firms so as not to start a price war. All the firms are apt to continue to make these private decisions unless they see that one firm has dropped its price, which removes the incentive for the others not to drop theirs.[18] The equivalent event for the will is the first lapse, which often leads to a spectacular "loss of control".[19, 20] As another Victorian psychologist said of the will, "It is necessary, above all things, never to lose a battle. Every gain on the wrong side undoes the effect of many conquests on the right."[21]

We reasoned that if we took some of the extraneous elements

out of the price-fixing conspiracy model, we would have an interpersonal game that had all the same motivational properties as the series of partially independent choice makers hypothesized to comprise the will. Groups of four or eight patient volunteers were recruited for a "voting game" in which their score depended both on their own behavior and that of their fellow players. They were given groups of eight trials, and in each trial the players took turns opting for a larger or smaller sum of hypothetical money. We began with the rule that if the player chose the larger amount (usually $8), he would get no further money from that choice, but if he chose the smaller amount say (e.g. $2), he would get that amount plus two dollars for every player who subsequently chose two dollars from then until the trial ended. Each trial had a 10 percent chance of ending after every turn, as determined by a random number generated on a pocket calculator. If this play went around the group more than once (as it often did), each player could make another independent choice under the same conditions, becoming like a bingo player tending additional cards. Each player who accumulated a previously announced amount of play money actually received a nominal prize of coupons he could use at the commissary. Thus both the theoretical and actual incentives encouraged cooperative play.

The data obtained with this design did not show any dramatic "conspiracies" or betrayals. However, it soon became apparent that we had not correctly followed the logic of our own hypothesis. A system in which a subject has to choose between a later larger amount and a series of smaller amounts is not quite a correct model of the will. When an alcoholic or a dieter has a lapse, he tries to see it as "just this once," a unique event that should not spoil his expectancy of getting the long-term benefits of sobriety or weight reduction. That is, he wants to have both the present pleasure and the aggregate long-term reward and is deterred from trying by the likelihood that future choice makers will see his behavior as a betrayal or will find similar loopholes so often that the long-term reward is impoverished. Thus, to model the will correctly, the rule should be that whether or not a player picks the smaller reward on his turn, he will accumulate smaller

rewards for each subsequent player who picks them. His only incentive for picking the smaller reward would then be to induce subsequent players to pick it as well, and he would be apt to pick it only if most previous players had also picked it. We are not testing whether, under these conditions, there will be tacit conspiracy behavior. If such behavior can be elicited in this bargaining format, hypotheses about the behavior of partially interdependent, serial choice makers will no longer have to be purely speculative.

Summary

A behavioral model of willpower depends on a steep, highly concave discount curve of delayed events, in contrast to the shallow exponential (percent per unit time) discount curve usually assumed to underlie rational behavior. There is ample evidence for the former curve in animals, but there has been little research on human subjects. Studies are reviewed which parametrically vary the lag (Δ) between the times two alternative rewards are available, and the delay (D) before the first of these rewards is available: (1) substance abuse patients and hospital employees who reported the lag (Δ) at which they would be indifferent between an amount of money at D = one week and a bigger amount at D + Δ revealed extremely steep discounting curves; (2) substance abuse patients and undergraduates given a hypothetical choice between an amount of money at various delays D and a larger amount at D + Δ reported a change of preference from the smaller to the larger amount as D was increased, with Δ held constant; and (3) substance abuse patients given a choice between actual money at delay D and a larger amount at delay D + Δ often changed preference as a function of D. These findings support the existence of a steep, highly concave discount curve. A multi-person game is described, which can be used to study the will as a relationship among partially independent, successive choice makers.

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