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EXCHANGE DELAYS AND IMPULSIVE CHOICE IN ADULT HUMANS

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Choice responding by adult humans in a discrete-trial task was examined as a function of conditions that manipulated either the delay to point delivery or the delay between points and their exchange for money. In point-delay conditions, subjects chose between an "impulsive" alternative that provided a small amount of points immediately and a "self-control" alternative that provided a larger amount of points delayed by 15, 30, or 60 s. Points were exchanged for money immediately following the session. Subjects preferred the self-control alternative. In exchange-delay conditions, subjects chose between a small amount of points exchangeable for money immediately following the session and a larger amount of points exchangeable for money after 1 day, 3 weeks, or 6 weeks. A self-control preference observed for all subjects in the 1-day exchange-delay condition reversed to exclusive impulsive preference for 4 of the 6 subjects when choice conditions involved exchange delays of 3 or 6 weeks. These results show that human choice is sensitive to the manipulation of exchange delays and that impulsive preference can be obtained with exchange delays on the order of weeks.

Key words: impulsive behavior, self-control, choice, conditioned reinforcers, delay of reinforcement, monetary reinforcers, button press, humans

In behavioral experiments, impulsive choice is most often defined as the choice of a smaller, less delayed reinforcer over the choice of a larger, more delayed reinforcer; self-control choice is the opposite (Ainslie, 1974, 1975; Logue, 1988; Rachlin, 1974). Pigeons often behave impulsively in these kinds of choice procedures employing positive primary reinforcers (e.g., Logue & Peña-Correal, 1984; Mazur & Logue, 1978). Adult humans, on the other hand, often exhibit a strong self-control preference when points and money are used as positive reinforcers (Logue, Peña-Correal, Rodriguez, & Kabela, 1986; Logue, King, Chavarro, & Volpe, 1990).

Strong impulsive preference has been observed only under certain conditions in the laboratory with normal adult humans. Impulsive preference has been obtained when noise reduction was used as a negative reinforcer (Navarick, 1982; Solnick, Kannenberg, Eckerman, & Waller, 1980). However, the findings are more complicated when experiments have used positive reinforcers. Studies that used a "consumable" reinforcer such as picture viewing (Navarick, 1986) or video-game playing (Millar & Navarick, 1984) have produced impulsive preferences on the part of only a minority of subjects (these studies used group-statistical methodologies). Studies that used conditioned reinforcers (points exchangeable for money) have obtained impulsive preferences only when procedures were arranged so that impulsivity produced a greater reinforcement density (Flora & Pavlik, 1992) or greater total amount of reinforcement (Logue et al., 1990, Experiment 1) than the self-control preference would have produced. Several researchers (Flora, Schieferecke, & Bremenkamp, 1992; Logue et al., 1986, 1990; Navarick, 1986) have questioned whether it even makes sense to call such behavior "impulsive" when choosing the smaller immediate reinforcer leads to more reinforcement overall than choosing the self-control option does. Logue et al. (1990) referred to this phenomenon as "molar self-control."

Several explanations have been offered to account for the persistent self-control preference exhibited by adult humans in studies using positive reinforcement in light of the impulsive preference exhibited by pigeons. Logue and her colleagues (1986, 1990) and Belke, Pierce, and Powell (1989) have suggested that adult humans show self-control because they are sensitive to events integrated over long periods of time (perhaps because of verbal abilities) and thus show a pervasive tendency to maximize total reinforcement. These same researchers also considered an alternative expla-

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nation that differences attributable to the use of conditioned reinforcers with humans and primary reinforcers with pigeons may account for the different preferences. Specifically, because points must be exchanged for money after the session, there is no advantage to obtaining them quickly, as there might be with obtaining food that can be consumed immediately. Indeed, Ragotzy, Blakely, and Poling (1988) obtained strong impulsive preferences in their subjects using primary food reinforcers, but the use of mentally retarded adolescent subjects makes direct comparisons to the other studies difficult. Belke et al. (1989) suggested that the differences between primary and conditioned reinforcers in time from choice response to consumption may account for the relative insensitivity of human subjects to delay as a parameter of choice, a finding in their study as well as in that by Logue et al. (1986). These observations suggested to us a closer examination of conditioned reinforcers and the various delays they involve.

Conditioned reinforcers of the token type (such as points exchangeable for money) necessarily involve at least three delays: delay to receipt of the points (point delay), delay to exchange of points for money (exchange delay), and delay to spend the money to acquire or consume a commodity (consumption delay). The consumption delay may consist of several additional delays, depending on the particular commodity. If points serve as reinforcers because of their relation to backup reinforcers, then the delays between point delivery and backup reinforcer (exchange and consumption delays) might be powerful determinants of choice. Previous self-control studies using points/money reinforcers have directly manipulated only point delays. Perhaps impulsive preference would be more probable if exchange or consumption delays were varied instead of point delays. The purpose of this experiment was to examine the effects of manipulating exchange delays on the impulsive choice of adult human subjects. Subjects were also exposed to a conventional point-delay choice procedure to provide a point of reference with previous studies.

METHOD

Subjects

Six undergraduate students, 5 female and 1 male (S2), were recruited from an introductory behavior analysis course at the University of North Texas. During recruiting, subjects were informed that they could earn money for participating in an experiment about choice and human decision making; no course credit was offered, nor was participation a course requirement.

Apparatus

Sessions were conducted in a small room (2.1 m by 3 m) in which there was a chair and a table with an IBM-compatible PC XT microcomputer and monitor on it. Two windows, one of which was a one-way mirror, were covered by miniblinds. All keys on the keyboard were covered by a cardboard overlay except the space bar and the two keys on the left and right edge of the bottom row (the "z" and the "/" keys). The left key was covered by a green sticker, and the right key was covered by a blue sticker. These keys were used as the choice keys, and their colors matched the colors of each corresponding half of the screen during choice trials.

Procedure

A discrete-trials procedure was used, with four forced-choice trials and 20 choice trials. Details of the trial structure are presented in the Session Structure section below, following a general description of the two major delay conditions. Prior to each session, the experimenter programmed one of the two choice keys to provide the larger quantity of points that would be involved in the delayed choice; the other choice key would then provide the immediate, smaller quantity of points. The delayed choice key was alternated between the left (green) key and the right (blue) key across sessions.

Point-delay condition. In this condition, the self-control choice delivered 10 points after either 15, 30, or 60 s; the impulsive choice delivered 5 points immediately after the choice was made. Points were exchanged for cash (1 point was worth 2 cents) immediately following the session. This is the conventional type of delay procedure used in discrete-trials formats with humans (e.g., see Logue et al., 1986, Experiment 1).

Exchange-delay condition. In this condition, both the impulsive choice and the self-control choice provided their corresponding points immediately after a choice; however, the points for the self-control choice were exchangeable

for money after either 1 day, 3 weeks, or 6 weeks from that session date. Points for the impulsive choice were exchangeable for money at the end of that session. Subjects were given this information at the beginning of the session (as described below). If money was owed to the subject from that session, it was paid in cash immediately after the session. If money was owed at a later exchange date, the subject was told the amount owed, the length of the delay, and the precise date it would be payable. If money was owed from that session, and money was owed that same day from a previous session, the subject was reminded that x amount was from today's session and that y amount was from a particular previous session.

Efforts were made to reduce the likelihood that the exchange delays would produce an impulsive bias because of some associated aspect other than the delay itself. First, none of the delayed dates was later than the end of the semester. This was intended to reduce the probability that subjects might avoid choosing delayed money because of the ambiguity of next semester's personal schedules. Second, Rachlin, Raineri, and Cross (1991) showed that humans may treat delayed reinforcers as if they were probabilistic. Therefore, subjects were told that the senior experimenter had the money in his possession so the delayed payments were guaranteed. This was intended to convey to subjects that despite the delay in payoff, the probability of payoff was certain.

Session structure. Before each session, subjects were required to remove their watches and any other wrist jewelry and leave them with their personal belongings in another room. The watches were removed so that subjects would not use them to time the delays in the choice trials. Before the first session began in the experimental room, subjects were handed a copy of the following instructions, which were read aloud to them:

> On the keyboard you will see a green key and a blue key. You will use these keys to indicate your choices during the experiment. Points will be delivered for each choice, and you will see the points add up on the screen. Each point is worth 2 cents. Therefore, if 100 points appear on the screen, we will exchange these points for 2 dollars.
>
> The first four times that you have the opportunity to press one of the colored keys you will notice that the computer forces you to choose either the green key or the blue key in an alternating fashion. These first four chances allow you to see what happens when you make one choice or the other. These sample choices are not instructions about how you should respond and they won't count as part of the experiment. [This last statement was designed to prevent subjects from alternating choices due to misinterpreting the forced trials sequence as an instruction.] In each of the next 20 choice opportunities, you are free to choose the green key or the blue key. Points for these choices will be exchanged for money.
>
> You have as long as you wish to choose between the green and blue alternatives, but when the screen reads, "Press space bar to collect points" you have only 4 seconds to press the space bar. If the space bar is pressed in time, points will add up in the box on the screen that has the same color as the key you chose. If you fail to press the space bar within 4 seconds, the points will be lost.
>
> Instructions will appear at the beginning of each session telling you when the points you collect in that session will be exchanged for money. Make sure you read these instructions carefully each day. Please don't press any other keys on the keyboard. Please don't adjust any of the window blinds.
>
> When you are done, the computer will tell you how many points you have. Leave the computer as it is and go get the experimenter. Please don't discuss anything about the experiment with anyone else until it is over. They may be subjects and you may influence their behavior.

The instruction sheet was left next to the computer for all subsequent sessions. The experimenter answered any questions by reading the relevant portion of the instructions again. The experimenter also remained in the room throughout the forced-trials portion of the first session to answer any questions about the procedures.

A subject initiated each daily session by pressing the space bar, which presented one of the following sets of instructions on the screen depending on the experimental condition. During the point-delay condition, the on-screen instruction read, "Points for all choices will be exchanged for money at the end of today's session." During the exchange-delay condition, the instructions read, "Points for one choice will be exchanged for money at the end of today's session. Money for choosing the other key will be __." The blank was filled in with the words "paid in 1 day," "paid in 3 weeks," or "paid in 6 weeks," depending on the value of the exchange delay. These phrases were

highlighted on the screen to enhance their salience. The subject pressed the space bar to proceed to the four forced-choice trials.

Only one of the choice keys was operative during a forced-choice trial. A green or blue box (14 cm by 11.5 cm) was displayed on the left or right half of the screen corresponding to the operative choice key. Within that box was a black space (3 cm by 5 cm) that functioned as a cumulative point counter, continuously displaying the point totals for that choice. During exchange-delay conditions, it had the words "paid today" or "paid in __" (1 day, 3 weeks, or 6 weeks) displayed below the point total. Outside and below the box was a small (2 cm by 1.5 cm) box of the same color that blinked continuously as a visual prompt to press the choice key. At the bottom center of the screen was a brown box (2 cm by 7.5 cm) with the words "choose now" in it. The forced-choice trials alternated between the blue and the green choices. When the subject pressed the colored key designated by the forced choice, the computer beeped and a point delay ensued if one was programmed for that choice. Keys were inoperative during point delays. If no point delay was programmed, the trial proceeded immediately to the point-delivery portion. The words "choice made" appeared in the brown box until the point-delivery portion of the trial.

In the point-delivery portion of the trial, the screen displayed the large colored boxes for each choice (green on the left and blue on the right), and the brown box was replaced by a red box that instructed subjects to "Press space bar to collect points." A 4-s limited hold required the subjects to press the spacebar or the point delivery would not occur. After the first session, subjects never failed to collect points because of the limited hold. When the subject pressed the space bar, the point counter in the appropriate on-screen box was incremented by either 5 points for the impulsive choice or 10 points for the self-control choice. To make the point magnitude more salient, digits appeared above the point counter counting from 1 to 5 or 1 to 10 stacking on top of each other up the screen within the large colored box at the rate of one digit per 500 ms; this was accompanied by a beep as each digit appeared. After point delivery, the large boxes disappeared and the centered brown box reappeared and displayed "please wait." This was present for the duration of a compensating intertrial interval (ITI) that adjusted for the length of any point delay to hold the time between trials to 75 s regardless of which choice was made. The ITI also ensured that session length was not affected by point delays.

Following the forced-choice trials, an on-screen instruction told subjects, "Those were the practice choices, now let's start the experiment. When you are ready to begin, press the space bar." The cumulative point counters in each box were reset to zero, and the 20 free-choice trials ensued. Choice data and point/money totals were taken from these 20 trials. The only difference between the forced-choice trials and the free-choice trials was that both large colored boxes were simultaneously displayed on the screen during the choice portion of the free-choice trial. Session duration was approximately one-half hour. Sessions were held each weekday except for rare absences by subjects. Exclusive impulsive preference would yield $2.00 per session; exclusive self-control would yield $4.00 per session.

Sequence of conditions. All of the subjects experienced a zero-delay condition first. During this condition, subjects chose between 5 points presented immediately versus 10 points presented immediately. The purpose of this condition was to assess whether the larger amount of points/money was preferred over the smaller amount given equal delays, and to insure that subjects were discriminating between the different point amounts associated with each choice. There was some concern about this latter point, because some pilot subjects had shown indifference between the choices in an earlier version of the procedure that did not include the salience-enhancing digit presentation during point delivery described above.

The zero-delay condition ended when a stability criterion, used for all conditions, was met. The stability criterion required that an experimental condition remain in effect until the overall percentages of impulsive choices in consecutive sessions were within 15% of each other. In addition, the last three session halves were examined for trends and variability (a session half was either the first or last 10 trials of the 20 choice trials). The percentage of impulsive choices in each session half was calculated, and conditions were not changed if any two of the three percentages differed by

more than 10%. A condition with a particular delay value sometimes remained in effect for additional sessions after the stability criterion had been met just to confirm the stability.

Half of the subjects were then exposed to the exchange-delay conditions before the point-delay conditions, and the other half were exposed to the reverse sequence. The sequence of these conditions and delay magnitudes for each subject are presented in Table 1. Only the delay magnitudes for the self-control choice are shown, because the delay for the impulsive choice was held constant at the minimum value (0 s for point delays, end of session for exchange delays). The delay magnitude of the first exchange delay the subject experienced was repeated as the last exchange delay for each subject except S6, for whom this was not possible because the exchange period would have been after the semester. The order of exposure to the different delay magnitudes within a delay condition was also varied among subjects.

An additional manipulation was used with 2 subjects (S2 and S6) who showed no change in preference under the maximum exchange-delay value. Unfortunately, the time remaining in the semester prohibited any substantial enlargements of the exchange delays; instead, the point magnitude for the impulsive choice was increased until the subject's preference reversed. This increased point magnitude was then used in a subsequent point-delay condition for comparison. Because investigating different point magnitudes was not the focus of this experiment, this manipulation was strictly of an exploratory nature.

Table 1

Sequence of delay conditions, delay magnitudes, and number of sessions for each subject.

Subject	Order of conditions (number of sessions)
S1	X: 3W (3), 1D (2), 6W (2), 3W (2) P: 30 (2), 15 (2), 60 (2) X: 3W (7)
S2	X: 6W (6; i = 5, 5, 8, 9, 10, 9), 3W (2), 1D (3), 6W (4) P: 15 (2), 30 (2), 60 (3; i = 5, 9, 9)
S3	X: 1D (2), 3W (3), 6W (2), 1D (4) P: 60 (2), 30 (2), 15 (2)
S4	P: 30 (2), 15 (2), 60 (2) X: 3W (3), 1D (2), 6W (3), 3W (4)
S5	P: 60 (2), 30 (2), 15 (2) X: 1D (2), 3W (4), 6W (2), 1D (2)
S6	P: 15 (2), 30 (2), 60 (2) X: 6W (8; i = 5, 5, 8, 9, 9, 9, 9, 8), 3W (2), 1D (2) P: 60 (2; i = 9, 9)

Note. X = exchange delay (D = day, W = weeks). P = point delay (values in seconds). Delay magnitude is the value of the delay for the self-control choice. When point values for the impulsive choice were changed, the point value in each session is indicated following the letter i.

RESULTS

The data analyzed were the percentage of impulsive choices; that is, choices for the smaller amount of points/money that had either no point delay in the point-delay condition or the minimum end-of-session exchange delay in the exchange-delay condition. Figure 1 shows that the behavior of all subjects stabilized after two or three sessions, with a preference for the larger amount of points in the zero-delay condition used to assess sensitivity to the procedure and its points/money reinforcer. They preferred 10 points to 5 points given no point delay and only the end-of-session exchange delay.

All subjects showed exclusive preference for the self-control choice (0% impulsivity) in the point-delay conditions, with the exception of a single impulsive choice in S4's first session. Under the exchange-delay conditions, responding of all subjects stabilized with 0% impulsive preference when the delay to the self-control choice was 1 day; they preferred to wait a day to collect $4.00 rather than collect $2.00 immediately or split their choices to collect some money now and some later. Four of the 6 subjects (S1, S3, S4, and S5) showed stable responding with 100% impulsive preference at the 3-week delay, although in two cases (S1 and S4) this occurred only in the second exposure to the 3-week delay after an intervening exposure to the 1-day and 6-week delays. S1 was reexposed to the 3-week delay a third time as her last phase, and her responding stabilized at 100% impulsive preference even though she had oscillated between exclusive self-control and exclusive impulsive preference for the first four sessions of that phase. The same 4 subjects also showed 100% impulsive preference when exposed to the 6-week exchange delay for the self-control choice; they chose to earn $2.00 that day rather than wait 6 weeks for $4.00 or split their choices.

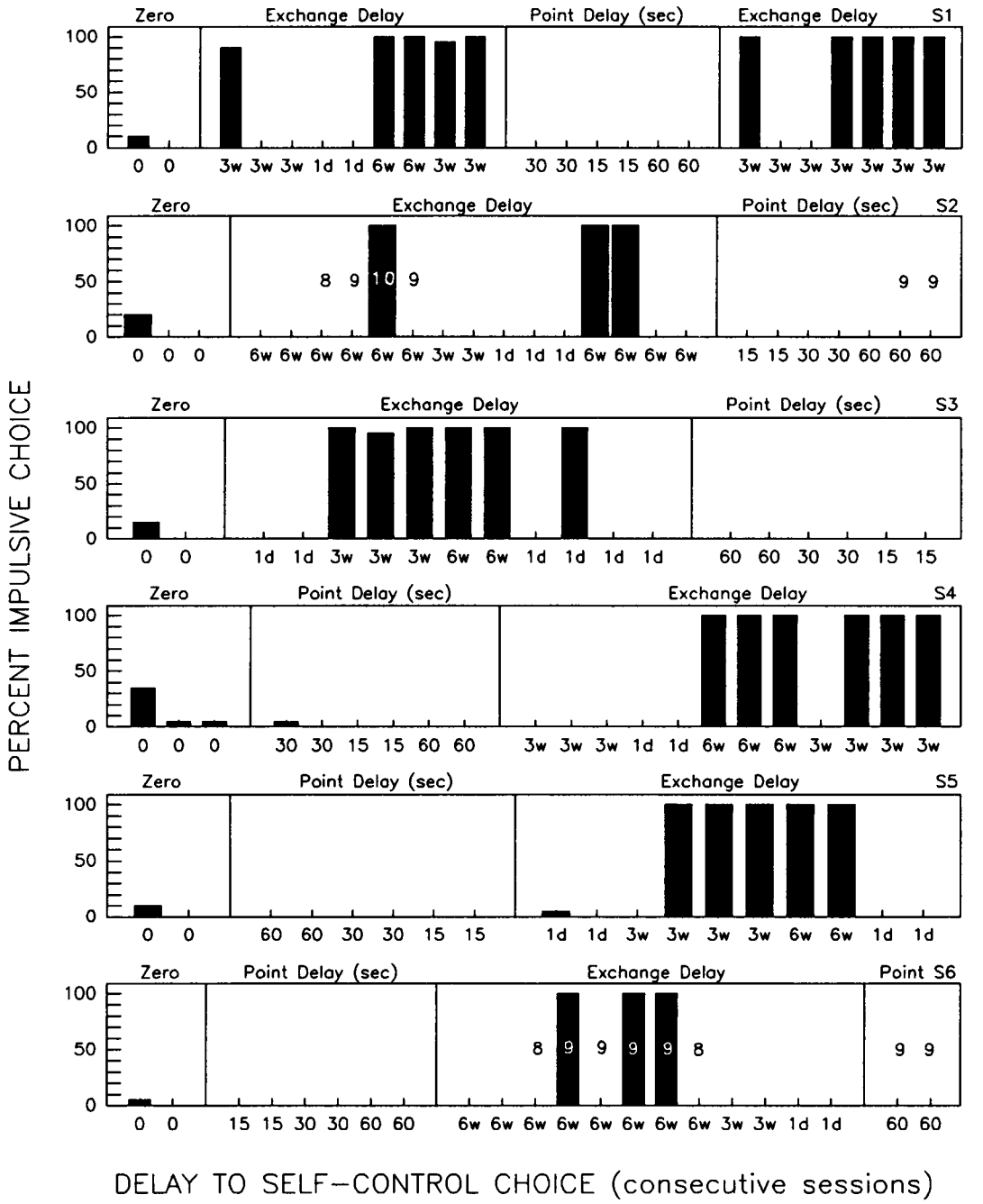

Fig. 1. The percentage of impulsive choices (choices of the immediate, smaller amount of points and money out of 20 choice trials) for each subject in consecutive sessions. The type of delay condition in effect is indicated above each graph box. The magnitude of the delay to the self-control choice in each session is indicated on the *x* axis. Point delays are in seconds; exchange delays are in days (d) or weeks (w). Numbers in midgraph for S2 and S6 are point amounts for the impulsive choice when these were increased above the standard 5 points.

Two subjects (S2 and S6) made no impulsive choices at the 3-week exchange delay or at the first exposure to the 6-week exchange delay with the standard point amounts (5 for each impulsive choice, 10 for each self-control choice). Point amounts for the impulsive choice were increased for each subject until they reversed their preferences under the 6-week exchange-delay condition. Preference reversal occurred and stabilized for S6 after four sessions when 9 points were available for each impulsive choice, but not when impulsive choices produced 8 points. For S2, preference reversal did not occur until point amounts for the two choices were the same (10 for each choice). With equal points for both choices, the designated impulsive choice does not conform to the definition used for impulsive choice in the rest of the experiment, but the preference for that choice showed that the subject was not making choices just to "bank" money for later. A second exposure to the 6-week delay at standard point amounts for this subject produced two sessions of 100% impulsive preference followed by two sessions with no impulsive choices. Neither S2 nor S6 made any impulsive choices when these choices produced 9 points in a point-delay format (the last phase for each subject).

DISCUSSION

This experiment has shown that manipulating exchange delays can alter preference in a self-control choice procedure using points/money reinforcers. Preference was reversed from exclusive self-control to exclusive impulsivity in the majority of subjects by varying the length of the exchange delay. Such strong impulsive preferences have been observed with adult humans only when negative reinforcers have been used or when procedural variations permitted impulsive preference to result in greater overall reinforcement amount or density with points/money reinforcers (and then it is questionable whether choice with that outcome should be called impulsive). The impulsive preference seen in the exchange-delay conditions of the present study always resulted in less total points/money reinforcement than would have resulted from a self-control preference. Point-delay conditions, in which points were differentially delayed but exchange delays were equal and relatively brief for each choice, produced an unchanging self-control preference that has been so often observed in similar choice procedures.

Exchange delays may be useful as adjustable parameters in choice procedures because they can produce impulsive or self-control preferences, but they bring additional complexities to the procedures. Several aspects of the findings merit discussion in this regard. There was some suggestion in subjects' performances and in debriefing comments that fluctuations in subjects' total monetary income or expenditures outside the experiment influenced their preference in the experiment. Because monetary payments are arrayed over a lengthy time period beyond the experimental sessions, exchange-delay procedures may be more susceptible to extraexperimental variables of that nature than are procedures that manipulate only within-session variables.

There was no discernible effect of exposure to the point-delay conditions prior to the exchange-delay condition or vice versa. However, within the exchange-delay condition, there may have been effects of the order of exposure to the different delay magnitudes. Because subjects exposed to the 3-week and 6-week delays as their first exchange delay exhibited either no impulsivity or impulsivity in their second exposure to these values, it may be that exposure to the 1-day exchange delay alters subsequent reaction to longer exchange delays. The 1-day delay value may help to establish, by contrast, 3 or 6 weeks as "a long time," making impulsive behavior more likely with those values of exchange delay. A more systematic examination of order effects would shed light on this possibility.

The fact that preference was typically binary (either exclusive impulsivity or self-control) in the exchange-delay condition is also worth noting. This may be a property of choice with this type of delay, or it may be due to procedural details of the present experiment. The size of the exchange delays and the monetary amounts used may have contributed to the exclusivity of the preferences in lieu of splitting choices between the alternatives. Perhaps longer or shorter exchange delays, or monetary amounts differing in proportion or absolute quantity, would have produced mixed preferences. The forced-choice portion of the sessions probably facilitated any tendencies toward exclusive preference, because it allowed

subjects to see what the choice outcomes were for the rest of the session and decide between the alternatives beforehand.

The preference reversal that occurred at long exchange delays is consistent with that predicted by certain mathematical formulations relating the value of a reinforcer to its delay. Based on experiments with pigeons, Mazur (1987) argued that the value of a reinforcer is discounted with increasing delay according to a hyperbolic decay function:

$$V = \frac{A}{1 + KD}, \quad (1)$$

where V is the discounted value of a reinforcer, A is monotonically related to the amount (the undiscounted value) of the reinforcer, D is the reinforcer delay, and K is a constant proportional to the degree of discounting. Assuming that money is the reinforcer of interest, Equation 1 shows that the discounted value of the \$4.00 delayed by 1 day for exclusive self-control preference still would be greater than that of the \$2.00 delivered at the end of the session for exclusive impulsive preference, so subjects should prefer the self-control choice. All of our subjects did. Specifically, if K is set to 0.01, \$2.00 delayed until the end the session (0.5 hr) would have a value of \$1.99, whereas \$4.00 delayed by 24 hr would have a discounted value of \$3.23. On the other hand, the discounted value of \$4.00 delayed by 3 or 6 weeks would be less than the discounted value of the \$2.00 for impulsive preference, so subjects should prefer the impulsive choice. Most of our subjects did. The discounted value of \$4.00 delayed by 6 weeks (1,008 hr), for example, would be \$0.36. The same relative reinforcer values would be predicted with values of K as large as 0.043.

In a study designed to quantify delay discounting, Rachlin et al. (1991, Experiment 1) found that the hyperbolic discount function described the choice data of their human subjects as well. However, subjects in the Rachlin et al. study were asked to indicate their preference between imaginary choices. That is, subjects were asked to choose between cards that indicated hypothetical monetary amounts payable after hypothetical delays. One advantage of the hypothetical scenario was that it allowed the researchers to study choices involving delays (months and years) that were as long as those that people might encounter in everyday life. A disadvantage of the procedure was that subjects did not actually experience any real delays or receive real payoffs, so their choices might not have been the same as those they would make if they faced choices with real outcomes.

In our experiment, the longest delay was 1.5 months and the monetary amounts were not as large as in Rachlin et al., but the delays and payoffs were real. Our study was not designed to evaluate Mazur's (1987) delay discount function, so there were not enough variations in amount and delay examined to generate the indifference points necessary to test the formula adequately. However, the data are consistent with its predictions, and that lends some support to Rachlin et al.'s suggestion that the same form of delay discount function holds for humans as well as pigeons.

Several studies (e.g., Belke et al., 1989; Logue et al., 1986, 1990) have reported that human subjects show a tendency to maximize reinforcer amount and are relatively insensitive to reinforcement delay as a parameter of choice in many choice procedures. In self-control choice studies, this may occur because most procedures manipulate brief point delays (on the order of seconds) as the reinforcement delay, while exchange delays remain constant for each choice at the end of the session. Subjects are paid at the same time regardless of which choice they make, so choice is reduced to one between earning a smaller or larger amount of money per time spent in the session. Varying the point delays is then a relatively insignificant manipulation in this context, and subjects always choose the larger amount, thus producing maximization or self-control. In the present experiment, choice proved to be very sensitive to exchange delays because they affected when money, not points, was obtained. If the delay to money is a major determinant of choice (perhaps only because it sets a lower limit on when the money can be spent), it is possible that point delays on the order of days or weeks in conjunction with exchange delays of a few seconds would produce similar results. This suggests that the treatment of points in self-control studies needs to be reevaluated.

Self-control studies that have used points/money reinforcers have treated points or point delivery as *the* reinforcer (e.g., Flora & Pavlik, 1992). Delay to reinforcement is equated with

delay to points. However, points are only part of the reinforcement system when using points exchangeable for money; the other components include the money and its exchange delays, and what is later purchased with the money and the associated consumption delays. No single thing is *the* reinforcer in these systems. Treating the points as the reinforcer makes these procedures appear to be analogous to procedures using primary reinforcers such as food, but it does so at the risk of oversimplifying the complexity of the conditioned-reinforcement system. The same could be said of procedures using tokens other than points. Our findings show that different arrangements of the relation between the components of the reinforcement system can produce different preferences. It is therefore important to consider all of the components of the reinforcement system in any analysis of choice using token-based conditioned reinforcers.

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