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Choice in the Classroom: Human Impulsivity and Self-Control

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CHOICE IN THE CLASSROOM: HUMAN IMPULSIVITY AND SELF-CONTROL

by

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A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Philosophy
Department of Psychology

Western Michigan University
Kalamazoo, Michigan
April 1989

Order Number 9000838

Choice in the classroom: Human impulsivity and self-control

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Western Michigan University, 1989

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ACKNOWLEDGEMENTS

I wish to express my appreciation to those who enabled me to conduct this study. I would like to thank Dr. William Redmon for his invaluable support and guidance through my entire doctoral program. Thanks must go to my dissertation committee, Drs. William Redmon, Jack Michael, Paul Mountjoy, Abraham Nicolaou, and Howard Farris, for their advice and support in bringing this dissertation to conclusion.

Finally, a special thanks to Barb and Alex Esch who stood by and encouraged me throughout.

John W. Esch

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CHAPTER I

INTRODUCTION

Self-control has been defined as the choice of a larger, more delayed reinforcer over a smaller, less delayed reinforcer while impulsiveness is the choice for the smaller less delayed reinforcer. These definitions seem to adequately describe many human dilemmas. Persons who spend all their weekly paycheck on non-essentials finding themselves unable to pay their bills are said to spend their money impulsively. Students who postpone writing a major paper until the last few days before it is due may be reprimanded for not having more self-control. Behavioral studies have accepted the reifications of impulsivity and self-control and identified environmental variables that account for such choice patterns.

Two procedures have been used in studying choice: concurrent chains and discrete trial. Fantino and Logan (1979) describe the concurrent chains procedure as a choice between two equal and concurrently available schedules in which the first link, called the choice phase, leads to two different scheduled outcomes in the second link. Preference for one chain schedule over the other is measured in the choice phase (initial link) by the relative rate of responding on the choice key correlated with the scheduled reinforcement in the second link. The independent variable is the scheduled reinforcement schedule of the second link. The dependent variable is relative rate of responding that is often defined as the

number of responses on one alternative divided by the total number of responses on both alternatives. These data are typically presented as choice proportions.

Concurrent Chains Procedures

A study by Rachlin and Green (1972) provides a typical example of concurrent chains procedures for studying choice. Figure 1 displays the relevant aspects of this model. To the left of the page is a single line with FR25 which indicates that the first link (the choice phase) of the chain is the same on both choice manipulanda (two white key lights) represented by the two "Ws" in the box. At the 25th response on either key, one of the final links in the chain becomes operative and the other inoperative. Thus, if the 25th response occurred on the upper key, then the top half schedule representing the final link would become operative and the lower schedule would become inoperative. Once the 25th response is made, then a single response to either the green ("G") key or the red ("R") key would activate the programmed immediate small or delayed larger reinforcement correlated with that key. Choice proportions are assumed to indicate a pattern of self-control if they favor the terminal link correlated with the green key leading to larger but delayed reinforcement. Impulsiveness is indicated if responding favors the terminal link leading to smaller but immediate reinforcement.

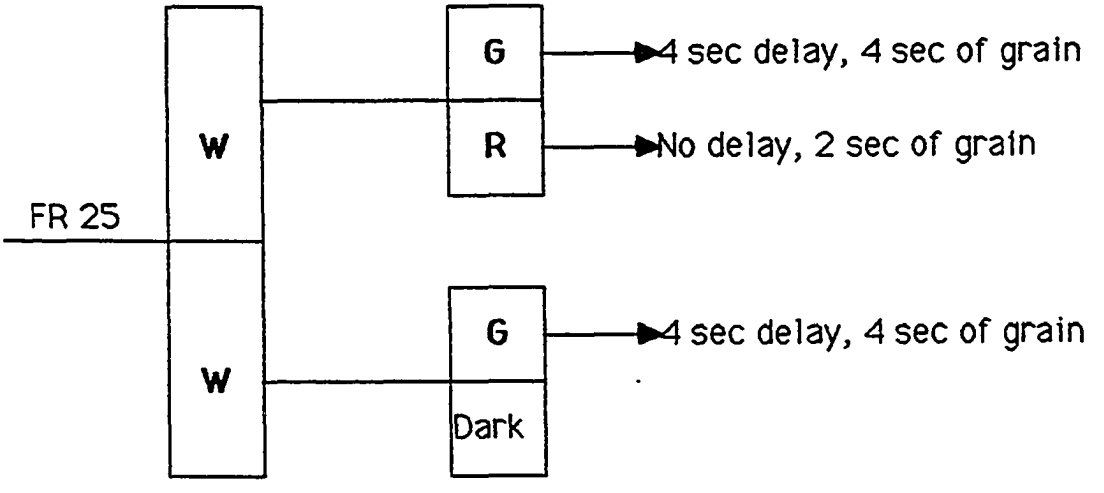

Figure 1. Choice and Commitment Procedures From Rachlin and Green (1972).

Ainslie (1974) demonstrated that pigeons prefer immediate access to 1 second of food compared to delayed access to 3 seconds of food. However, a few pigeons learned to peck a key that removed the key stimulus associated with the shorter food access and subsequently shifted their preference to the delayed alternative. The latter behavior was called a demonstration of commitment. Green and Snyderman (1980) studied choice behavior under conditions in which absolute and relative delays to reinforcement and amount of

reinforcement were manipulated. Pigeons were given 6 or 2 seconds' access to food which were delayed by 6:1 (12 versus 2 seconds), 3:1 and 3:2 ratios with the larger delay associated with longer access to food. Results showed that pigeons preferred the smaller immediate food consequence when relative delays were small (e.g., 12 versus 2 seconds). However, preference reversed as the delay ratio increased the absolute time to reinforcement (120 versus 20 seconds).

Discrete-Trials Procedures

Choice behavior also has been studied by a discrete-trials procedure. In this procedure subjects select one of two different schedules which include various planned arrangements of reinforcer magnitude and delays to reinforcement. Once one schedule is selected the other becomes inoperative. When the chosen schedule is completed, both choices are again made available. The dependent variable in a discrete-trials procedure is the number of choices made for one schedule divided by the total number of choices for both and is usually expressed as a choice proportion in favor of one of the two schedules.

Ainslie and Herrnstein's (1981) study exemplifies a discrete trials procedure. Pigeons chose between two keys, one leading to 2 seconds of grain access and the other to 4 seconds of grain access delayed by .01, 2, 4, 5, 6, or 12 seconds. The results indicated that pigeons preferred the small immediate grain access when delays to both schedules were short, i.e., .01 and 2 seconds. As schedule

delays increased to 6, 8, and 12 seconds, preference shifted to the larger delayed food award. Interestingly, two pigeons continued to choose the larger delayed grain access even when scheduled delays were again shortened to .01 seconds.

Using a discrete trials procedure, Mazur and Logue (1978) demonstrated that pigeons could learn to choose a larger delayed food reinforcer even in the presence of a smaller immediate food reinforcer after undergoing a lengthy fading procedure. Initially, pigeons always chose the longer duration reinforcer when presented with a choice between a 2- or a 6-second access to food, both delayed by 6 seconds. Pigeons continued to choose the larger delayed food consequence as the 6-second delay to the 2 seconds of food access was gradually faded to 0 seconds. Some pigeons thus learned to choose the larger delayed food consequence in the presence of a smaller immediate food reinforcer. Logue, Rodriquez, Pena-Correal, and Mauro (1984) replicated the Mazur and Logue (1978) results and demonstrated that individual histories are important in determining choice behavior. Groups of pigeons with varying degrees of fading history were presented choices between immediate smaller and delayed larger reinforcers. Pigeons performed differentially as a function of their fading history. Pigeons with a lengthy history in which preference for a smaller immediate food reinforcer was gradually faded out in the presence of a larger delayed reinforcer made more choices for the larger delayed reinforcer than pigeons with less extensive fading history or none at all.

Along with relative and absolute delays to reinforcement and amount of reinforcement, Hall-Johnson and Poling (1984) have demonstrated that the initial link of concurrent fixed-ratio chain schedules also affects preference. Pigeons initially preferred the schedule with the smaller initial requirement in a concurrent fixed ratio (FR) choice paradigm: FR10, FR90 versus FR50, FR50. Even though each choice has an average of two reinforcements per 100 responses, pigeons preferred the FR10, FR90 schedule because of the shorter delay to initial reinforcement. This preference persisted for the chain with the shorter initial link despite: (a) increases in ratio requirements of the second FR from FR10, FR90 to FR10, FR170; (b) increases in the duration of food in the non-preferred FR50, FR50 schedule from 3 to 9 seconds; (c) decreasing the duration of food access in the preferred (FR10, FR90) schedule from 3 to 1.5 seconds; and (d) shortening the second ratio requirement of the FR50, FR50 to FR50, FR30. The only manipulation that altered preference for the FR10, FR90 schedule was to shorten the duration of food access to the point that the pigeon could not eat. Poling, Blakely, Pellettiere, and Picker (1987) replicated the above results showing preference for the FR chain with the smaller initial link. The study extended the findings to show that this preference continued as the probability of reinforcement in the initial or final link decreased from 1.0 to .5. Preference for the smaller requirement initial link reversed only when the probability of reinforcement in that link approached zero.

Human Operant Studies

Basic research has demonstrated that the critical controlling variables in choice responding are absolute and relative delays toreinforcement, amount of reinforcement, probability of reinforcement, the length of response requirement of the initial link in an FR, FR chain schedule, and individual histories of reinforcement, such as the fading procedures of Mazur and Logue (1978). Human choice studies have attempted to establish the generality of these variables and procedures across species and responses.

In an early replication of the Rachlin and Green (1972) model of choice, Burns and Powers (1975) presented two school-aged children with choices between two chain schedules. One lever response led to a choice of earning two immediate tokens or four tokens delayed 6 seconds. They could also choose a "commitment" lever leading only to the larger delayed consequence. Students chose each alternative equally as often as time before the second link was delayed from 0 to 8 seconds. They generally chose the smaller immediate consequence in the second link if they made the non-commitment choice in the initial link. As the choice point was delayed 12 to 64 seconds, the students displayed an increased preference for the non-commitment schedule and continued choosing the immediate points. Thus, human impulsivity was demonstrated, but preference reversal as a function of delay in choice point did not replicate earlier findings.

More recently, Millar and Navarick (1984) used access to a video game and found a "limited" amount of impulsiveness. In a group design, subjects were given choices between various "play-wait" or "wait-play" contingencies. Both the "play" and "wait" durations were manipulated. Results indicated that subjects (college students) preferred immediate over delayed reinforcers, and larger over smaller; 40% of the subjects preferred an immediate smaller reinforcement compared to 33% who preferred a larger delayed reinforcer. In a second experiment, preferences for immediate smaller reinforcers decreased as equal intervals were added to both choices, increasing absolute delays to reinforcement. Navarick (1986) observed a similar weak pattern of impulsivity in subjects choosing between two schedules of viewing slides of entertainment and sports personalities. The only time that impulsivity reliably occurred was when the immediate short viewing time was followed by no delay and subjects could thereby increase total viewing time by selecting the immediate consequence versus the delayed consequence.

However, Logue, Pena-Correal, Rodriguez, and Kabela (1986) failed to find impulsivity using both a discrete trials and concurrent chains procedure in a series of experiments with human adults. Human choice behavior was consistently affected by the amount of reinforcement than delay of reinforcement. These authors suggested that the type of reinforcer, points exchangeable for money after the session, may account for the difference in human and nonhuman findings. The investigators observe that there is no advantage for humans to obtain points before the end of the session.

On the other hand, there is advantage for a food-deprived animal to obtain food before the end of the session.

Ragotzy, Blakely, and Poling (1988) conducted the only single subject human choice experiment using access to food as a positive reinforcement procedure. The study investigated the effects of amount of reinforcement and relative and absolute delays to reinforcement. Severely mentally impaired subjects were given a choice between schedules of smaller immediate or larger delayed food awards. In the absence of delays, the larger food award was chosen. But with delays to the larger reinforcer, preference switched to the smaller immediate food award. When delays were added to both schedules, preference again changed for the larger reinforcer. Thus, with this population, traditional variables affecting choice (amount of reinforcement and relative and absolute delays to reinforcement) demonstrated generality of variables across species.

Two experiments (Navarick, 1982; Solnick, Kannenberg, Eckerman, & Waller, 1980) have found human impulsivity with negative reinforcement procedures. Humans were given a choice between two schedules of an aversive white noise and escape from the noise. Subjects exhibited impulsive behavior in choosing to escape the noise for a short period rather than enduring it and obtaining access to a longer period of escape. Only when equal delays were added to both choices did preference shift to the schedule with the immediate noise but longer delayed period of silence.

Navarick (1987) suggested that probability of reinforcement is a variable affecting human choice. In a group design using a

discrete trial procedure, subjects chose between various immediate smaller versus delayed larger durations of viewing slides of entertainment figures in which the probability of reinforcement was also varied. The results indicated that the subjects preferred a schedule of slide viewing that had a probability of 1.0 versus .5. They also preferred longer duration viewing time when the probability of both was 1.0, but as the probability for the longer duration decreased from 1.0 to .22 the choice proportion for the immediate consequence increased. Also, delays to viewing time interacted with probability of reinforcement so that subjects preferred a certain short immediate reinforcer to a less certain, larger delayed one.

For basic and human research to be of more than academic interest, relevance to solving socially important problems must be shown. Dziadosz and Tustin (1982) is the only applied study involving choice of food reward in vocational activities of severely mentally impaired persons. They demonstrated that subjects in a free-choice situation acted impulsively, showing preference for immediate food reinforcers but showed self-control, preference for a delayed larger food reward, under a commitment procedure. Five mentally retarded adolescents worked on 10 tasks each session. Task materials were colored either red or green, and each color was correlated with different amounts of a food reinforcer. Completion of a task using red was followed immediately by the delivery of one potato chip, while completion of tasks using green materials was followed by four chips per task given 30 minutes after the session ended. During

free choice conditions, subjects selected a task color an immediately began working. During commitment conditions, subjects chose the task color 24 hours prior to the session. In this ABAB design, subjects generally demonstrated preference for the larger delayed food reinforcement during the commitment procedure.

Purpose of the Present Study

Educational settings contain a variety of concurrently available reinforcers and incentives for studying choice. With respect to grades, some students prefer immediate knowledge of their academic performance while others prefer to delay such consequences for as long as possible. Both choice patterns may indicate "impulsiveness." Good students who constantly want to know about their good grades act as impulsively as poor students who consistently avoid bad grades. Both may be maladaptive in educational settings, the dependent good student requires excessive teacher time and performs only if given extreme support. The poor student avoids immediate educational contingencies programmed to alter academic behavior and may experience large delayed aversive outcomes as a result (e.g., failing grades).

The purpose of the present study was to apply basic and human research findings on choice in an educational setting using grades as rewards. Specifically, the study investigated student choice responding for immediate versus delayed points for grades as a function of changes in amount of points within naturally occurring delays to reinforcement. Student reinforcement histories were

examined and evaluated in defining impulsive and controlled choice patterns.

CHAPTER II

METHOD

Subjects

Seven subjects were selected from English classes at an alternative high school. Their ages ranged from 14 to 18 years. The students were enrolled in an alternative school because of a history of academic, behavioral, or attendance difficulties.

Setting

The experiment was conducted in a large classroom, formerly a library of an elementary school that was used to house the city's alternative school programs. Students were allowed to sit where and with whom they wished. Academic work was individually contracted with the teacher on a daily basis.

Contract Criteria

Grades were given daily in the form of points earned for meeting classroom management and academic criteria according to the following schedule (see Table 1).

The points were converted into grades according to the following scale: 10 = A+, 9 = A, 8 = B, 7 = C, 6 = D, 5 (and below) = E. The grade/point relationship and criteria were posted in the classroom and periodically reviewed.

Table 1

Schedule of Points and Criteria for Classroom Behavior

Points	Criterion
1	- Contract written and approved before first choice bell
1	- Started work immediately
1	- Stayed on task to end of hour
1	- Did not bother others
1	- Got work checked by teacher
1	- Engaged in reading of magazine, book tape, etc. only
1	- Wrote summary of reading material
1	- Wrote summary and opinion
1	- Wrote summary, opinion, and gave reasons
1	- Wrote summary, opinion, reasons, and criticized opinion and reasons
10	

Grade Choice Form

All data were coded on the Grade Choice Form (see Appendix A). At four choice points during the class period, students chose between getting one-fourth of their contracted points immediately by circling "YES" on the Grade Choice Form or delaying the grade point award until the end of class by circling "NO" each time. Thus, students who contracted for 9 points and chose to receive immediate grade points could potentially receive 2.25 points at each choice point.

Educational Choice Patterns

A pre-experimental assessment of choice for immediate/delayed grade and performance was done to determine existing educational choice patterns. Four patterns of choice behavior were observed (see Table 2). A traditional self-control pattern was indicated by

Table 2

Possible Impulsive and Self-Control Patterns of Choice Behavior in an Applied Educational Setting

		Choice	
		Immediate Grade/Points	Delayed Grade/Points
PERFORMANCE	Bad	Adaptive Self-Control	Avoidance-Impulsive
	Good	Dependent-Impulsive	Traditional Self-Control

the students who performed well on contracted work and preferred delayed grade points by circling "NO" on the Grade Choice Form. Delay of immediate reinforcement is a typical definition of self-control patterns (Rachlin & Green, 1972). Skinner (1968) speaks of creative and original student behavior controlled by idiosyncratic and delayed consequences rather than the immediate consequences of attention and approval. An adaptive self-control pattern was suggested by students who performed poorly on contracted work but chose to receive immediate grade points by circling "YES." In this case students endured an immediate small amount of punishment in the form of fewer grade points and brought their behavior more quickly under the control of contingencies leading to larger but delayed reinforcement, a better grade. This seems similar to Skinner's (1974) explanation of persons exhibiting self-control by making an earlier "controlling" response that will bring their subsequent behavior under the control of later contingencies.

Two patterns of maladaptive impulsivity were also identified. A dependent-impulsive pattern was observed when students performed well and chose to receive immediate grade points by circling "YES" on the Grade Choice Form. This pattern is analogous to previously mentioned animal and human studies in which subjects chose an immediate reinforcer over a larger but delayed reinforcer (Rachlin & Green, 1972). Students who perform well but require frequent information or reassurance put an unnecessary strain on the teaching situation and may become dependent on assistance from others. Moreover, Skinner (1968) points out that students controlled by such

contingencies are not free to develop original and creative repertoires minimally controlled by the practical contingencies of the subject being studied.

An avoidance-impulsive pattern was indicated by students whose performance was poor and who chose delayed grade points by circling "NO" on the Grade Choice Form. This case is similar to Solnick, Kannenberg, Eckerman, & Waller's (1980) and Navarick's (1982) human choice studies that used the removal of aversive noise as a form of negative reinforcement. In both examples, subjects chose to avoid a small-magnitude aversive stimulus for a short period of time immediately, rather than enduring it for a short period to gain access to a longer period of reduced aversiveness. Students exhibiting such behavior act maladaptively in that they avoid immediate consequences that might alter behavior which leads otherwise to delayed aversive consequences (i.e., failing grades and deficit repertoire).

The present applied study differs procedurally from laboratory animal and human operant studies of impulsivity and self-control. Laboratory studies involve scheduled responses that produce unavoidable consequences. For example, in a commitment procedure the impulsive behaving pigeon needs to make only one controlling response to produce the contingencies for a controlled response leading to a delayed but larger food award. This situation is analogous to Skinner's (1953) explanation of self-control by "changing the stimulus" (p. 233). For example, the closing of a door while studying eliminates distracting discriminative stimuli associated with immediate consequences that would obviate stimuli associated with the

delayed consequences of studying.

Skinner (1953) presents other examples in which the controlling response is not a single response producing an unavoidable contingency but a continuous response that maintains a second contingency. A person may talk about something else (the controlling response) in order to avoid talking about a painful subject (the controlled response). Or a person may count to ten (the controlling response) to avoid saying angry things (the controlled response) in a heated conversation. The critical procedural difference between these applied and laboratory examples is that the delayed controlled contingency occurs only with the continued occurrence of the controlling response.

In the present study students with dependent-impulsive choice patterns must continue to perform well without immediate information on performance to contact delayed contingencies associated with creative and original behavior, as well as an improved classroom setting. Likewise, students with avoidance-impulsive choice patterns must continue to perform well while receiving immediate information on performance to avoid contact with delayed aversive contingencies associated with failing grades.

Dependent Variable

Choice Proportions

The main dependent variable of interest was the proportion of "YES" and "NO" choices that individual students made on the Grade

Choice Form for immediate grade points during each class session. Individual choice proportions for immediate points were determined by dividing the number of "YES" choices on the form by the total number of "YES" plus "NO" choices. Three "YES" choices and one "NO" choice would yield a choice proportion of .75 (3 / 3 + 1 = .75). A choice proportion of .5 indicates a preference for immediate grade points; and below .5 a preference for delayed grade point award.

On-Task Performance

On-task performance was measured at each choice point. When the choice bell rang (about every 7 minutes), the teacher noted if each student was on-task or off-task. On-task behavior was defined according to Marholin, II and Steinman (1987). The student's actions or orientations indicate appropriate

> engagement in the assigned tasks. Specific examples include: getting out appropriate materials, looking at books or other materials, turning to appropriate page or assignment, shifting activities, writing answers to questions or working problems, following teacher's general instructions, appropriately looking at aa person talking with teacher, waiting with hand raised, and waiting in response to a teacher's prompt (p. 468).

On-task behavior was represented as the percent of total opportunities for on-task behavior. Thus, a student who was on-task one out of four times during a session obtained an on-task score of 25%.

Outcome Performance

The number of daily grade points earned by students was used as a measure of outcome performance. Daily grade points were based on

the presence or absence of items previously listed on the daily contract criteria. Bonus points were not included in the daily total.

Phase Choice Proportions

The number of "YES" choices for immediate points was averaged for each phase of the experiment. Phase choice proportions were calculated by dividing the number of "YES" choices at each choice point per phase by the total number of "YES" plus "NO" choices at each choice point per phase (10 baseline "YES" choices at Choice Point 1 divided by 10 baseline "YES" + 10 baseline "NO" choices at Choice Point 1 = .5).

Independent Variable

Criteria for Impulsive Choice Patterns

Table 3 depicts the guidelines for identifying the two impulsive choice patterns during the experiment. An on-task percentage of 75% was arbitrarily set as a minimum standard for good performance. A choice pattern was considered dependent-impulsive when a student's choice proportion for immediate points was greater than .5 and on-task performance was also high, 75% and above. An avoidance-impulsive choice pattern was indicated when a student's choice proportion for immediate points was less than .5 and on-task performance was below 75%.

Table 3

Identification of Impulsiveness Patterns by Proportion of Choices for Immediate Points and the Percent of On-task Performance

	Dependent-Impulsive	Avoidance-Impulsive
Proportion of Choice for Immediate Points (*1)	Greater than .5	Less than .5
Percent of On-task on Performance (*2)	75% and above	Below 75%

(*1) Choice proportions are calculated by dividing the number of "YES" choices on the Grade Choice Form by the number of "YES" plus "NO" choices per session.

(*2) On-task percentages are calculated by dividing the number of on-task observations by the number of on-task plus off-task observations per session.

Note: .5 indicates an indifferent choice pattern.

Bonus Points

Students exhibiting impulsive choice behavior during baseline were given bonus points contingent on demonstrating self-control choice patterns at each choice point. Students showing dependent-impulsive choice patterns were given bonus points for circling "NO" on their Grade Choice Form and receiving all points at the end of the class, a traditional self-control pattern. Students exhibiting avoidance-impulsive choice patterns were given bonus points for circling "YES" to get immediate grade point awards, an adaptive self-control pattern. Bonus points were always given at the end off the class.

Experimental Design

An ABA multiple baseline across subjects and classes was used. Each phase continued until students' choice proportions were stable. Stability was defined by the occurrence of choice patterns in four of five sessions or in three consecutive sessions.

Procedures

Phase 1: Baseline 1

All students had folders that contained the Grade Choice Form (Appendix A) that was replaced daily and a weekly work contract (Appendix B). At the beginning of each class, the teacher set the choice timer for about seven minutes and reminded all students to fill out their daily contracts. As students filled out their contracts, the teacher circled the room and signed completed contracts, circling the total number of points the contract was worth on the Grade Choice Form.

Each time the choice timer rang, the teacher noted which students were on-task and off-task, reset the choice timer for about seven minutes, and told students to circle "YES" if they wanted part of their points now or "NO" if they wanted those points at the end of class. After students had circled "YES" or "NO" on the form, the teacher went to each student and did one of the following:

1. The teacher awarded one-fourth of the total daily points to students who circled "YES" and were on-task when the timer rang. Points were awarded by circling the corresponding number at the

given choice point, e.g., 2.25 is 1/4 for a 9-point contract. The teacher then initialed the form. Teacher comments were minimal; frequently, none were made.

2. The teacher deducted points from students' one-fourth total if they circled "yes" but were off-task when the timer rang. One point was deducted at the first choice point if the contract was not complete. One-half point was deducted if the student was off-task. The teacher then initialed the form. If students asked why they got a lower point total, the teacher recited the part of the contract criteria that they failed to meet (e.g., "You have to complete your contract on time," "...start on time," "...stay on task.").

3. If the student circled "NO," the teacher only initialed the form and covertly coded whether the student was on-task or off-task so that points could be calculated at the end of the session. The teacher made no comments to students.

During baseline the teacher made forced choices for students who exhibited invariant response patterns by pre-circling the "YES" or "NO" choices on the Grade Choice Form. An invariant response pattern was defined as five or more identical choice proportions during Phase 1. This was done to insure that students made contact with both choice contingencies during Phase 1.

Phase 2: Experimental Condition

The Experimental phase differed from baseline only by the offer of bonus points for exhibiting self-control choice patterns. Number 4 on the Grade Choice Form was altered as follows:

"4. AT EACH BELL YOU WILL GET ONE-HALF (.5) bonus point AT THE END OF CLASS FOR:

A. CHOOSING YES - Give me PART of my daily points NOW

B. CHOOSING NO - Give me my daily points LATER."

Before the first choice bell, the teacher circled and read Number "4-A" to students exhibiting dependent-impulsive choice patterns, while "4-B" was circled and read to students displaying avoidance-impulsive choice patterns.

At the end of class, the teacher verbally added up the number of bonus points the student earned and wrote that number in the space provided on the Grade Choice Form. Total daily points were determined by adding points earned to the bonus points earned.

Phase 3: Baseline

Students were verbally told that there would be no offer of bonus points and returned to Baseline 1 conditions.

CHAPTER III

RESULTS

Reliability

Choice and On-Task Computations

An independent observer recalculated all the computations of choice proportions and on-task percentages from data on the Grade Choice Form for each student. Reliability was calculated by dividing the number of agreements by the number of disagreements plus the number of agreements and the result was multiplied by 100. The reliability of individual choice proportion computations ranged from 97% to 100%. The reliability of individual on-task computations ranged from 95% to 100%.

On-Task Performance

Independent observers coded the on-task performance of subjects for 20% of the sessions. These data were compared to those collected on the Grade Choice Form. The number of agreements between the two observers was divided by the number of disagreements plus the number of agreements and the result was multiplied by 100. The range of reliability scores was 82% to 100%.

Outcome Performance

The reliability of outcome performance assessments was determined by an independent observer who recalculated the point values for 20% of each student's contracts according to the Daily Contract criteria. Session reliability was calculated by dividing the number of criteria agreements between observers by the number of disagreements plus the number of agreements and the result was multiplied by 100. The range of reliability scores for each student was 88% to 100%.

Dependent-Impulsive Choice Patterns

Six subjects (2S7, 2S4, 1S2, 2S12, 2S2, and 2S3) were identified as displaying dependent-impulsive choice patterns. All students showed on-task performances above 75% and all but two (1S1 and 2S12) met choice proportion criterion for immediate points of more than .5 (see Figures 2 through 7). Subjects 1S1 and 2S12 (see Figures 4 and 5) were included in this group because of baseline data indicating a choice preference above .5 and good on-task performance. However, the last five choices points of Baseline 1, Sessions 30, 32, 33, 34, and 36 indicated a choice pattern of indifference to self-control, the inclusion of these data gives information about subjects with weaker impulsive choice patterns.

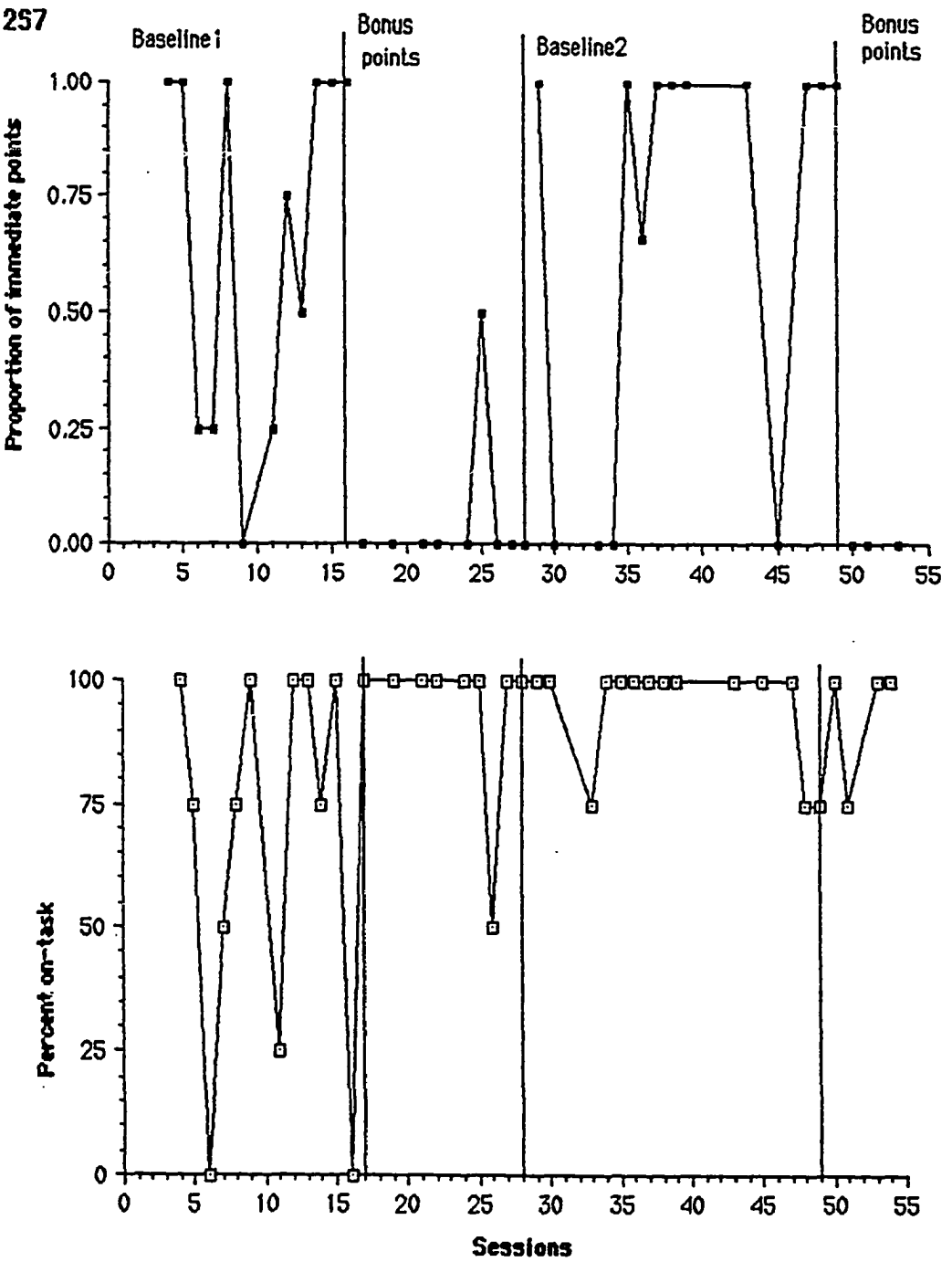

Figure 2. Dependent-Impulsive Choice Patterns of Subject 2S7. Proportion of choices for immediation points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

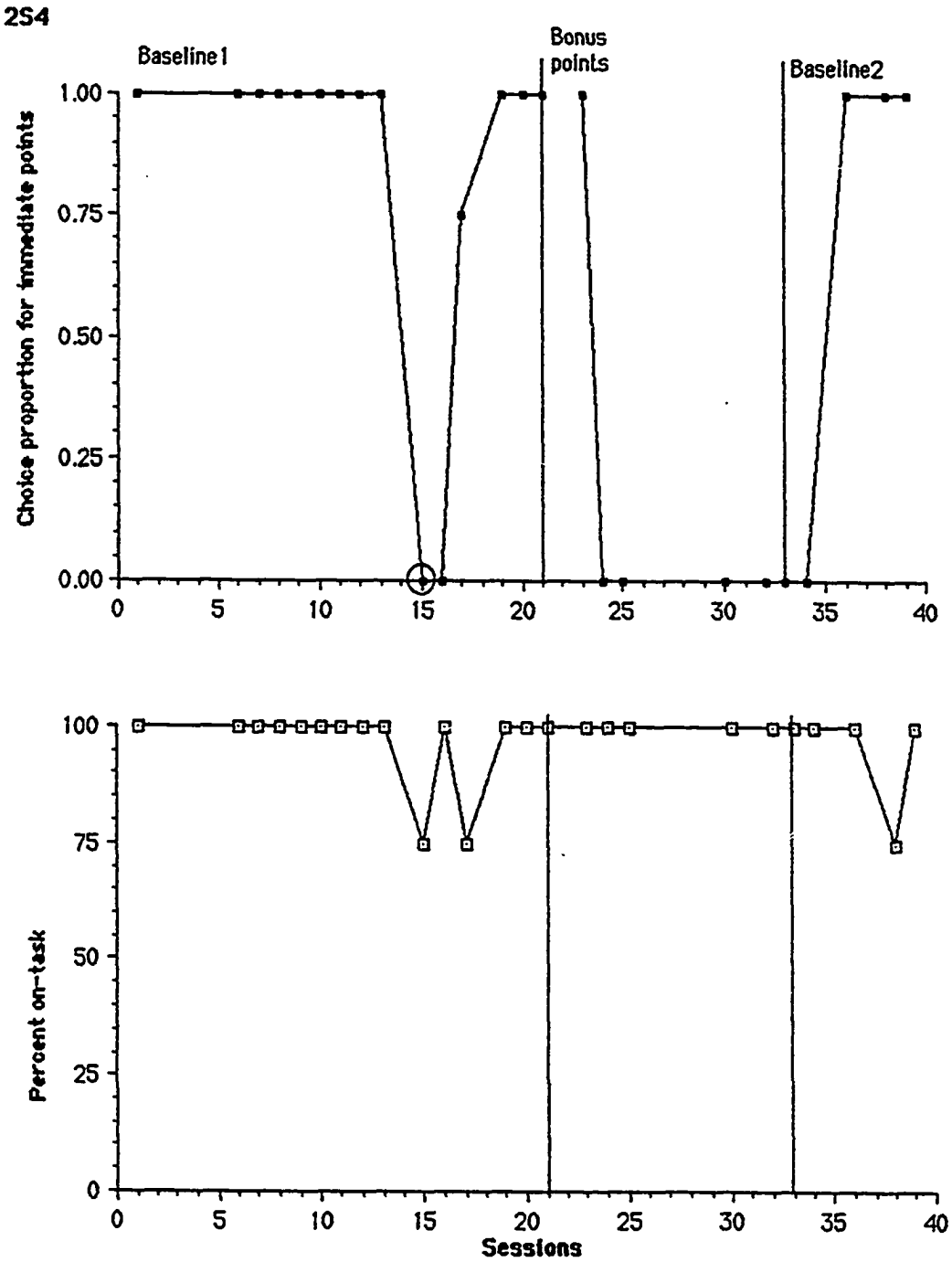

Figure 3. Dependent-Impulsive Choice Patterns of Subject 2S4. Proportion of choices for immediation points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

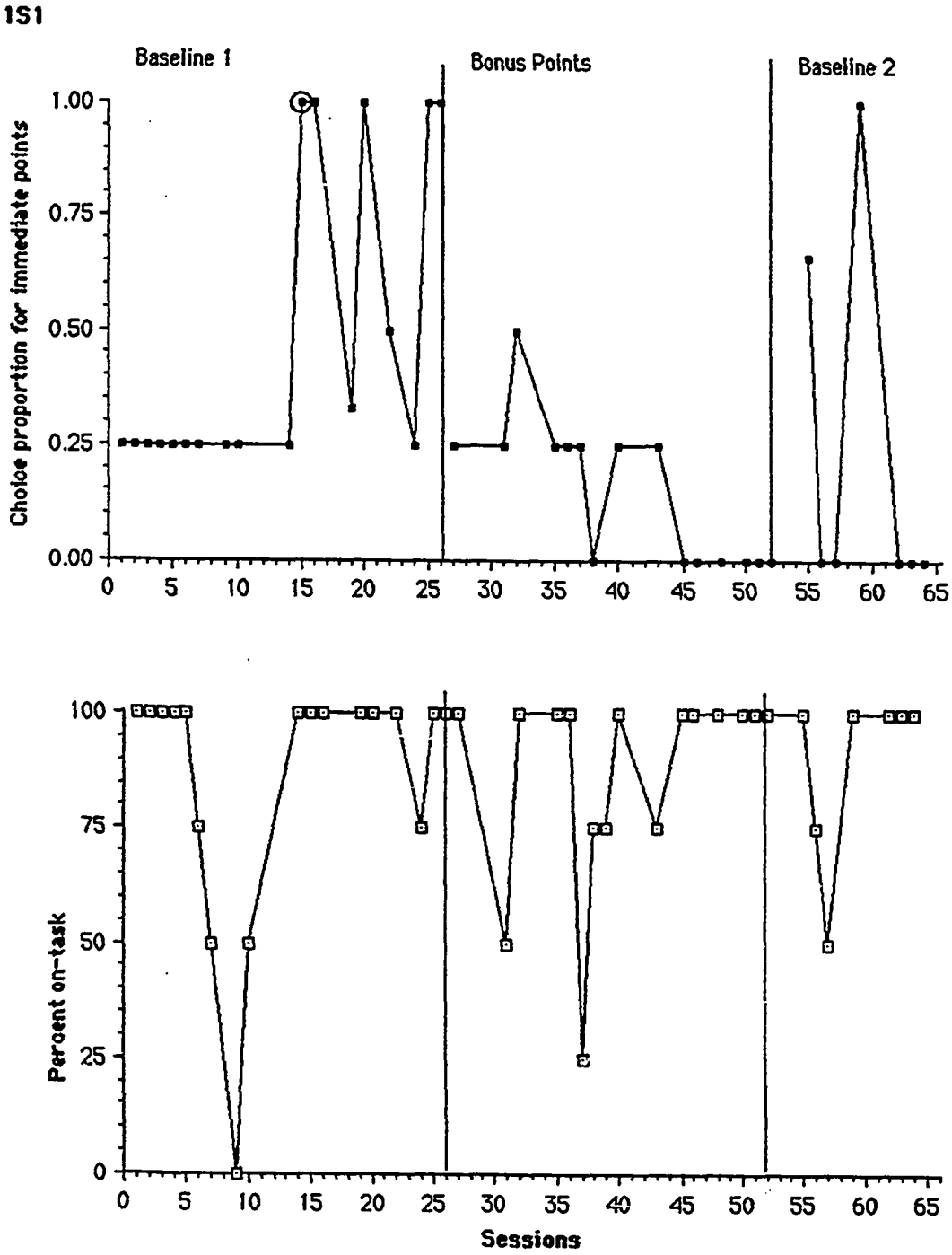

Figure 4. Dependent-Impulsive Choice Patterns of Subject 1S1. Proportion of choices for immediation points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

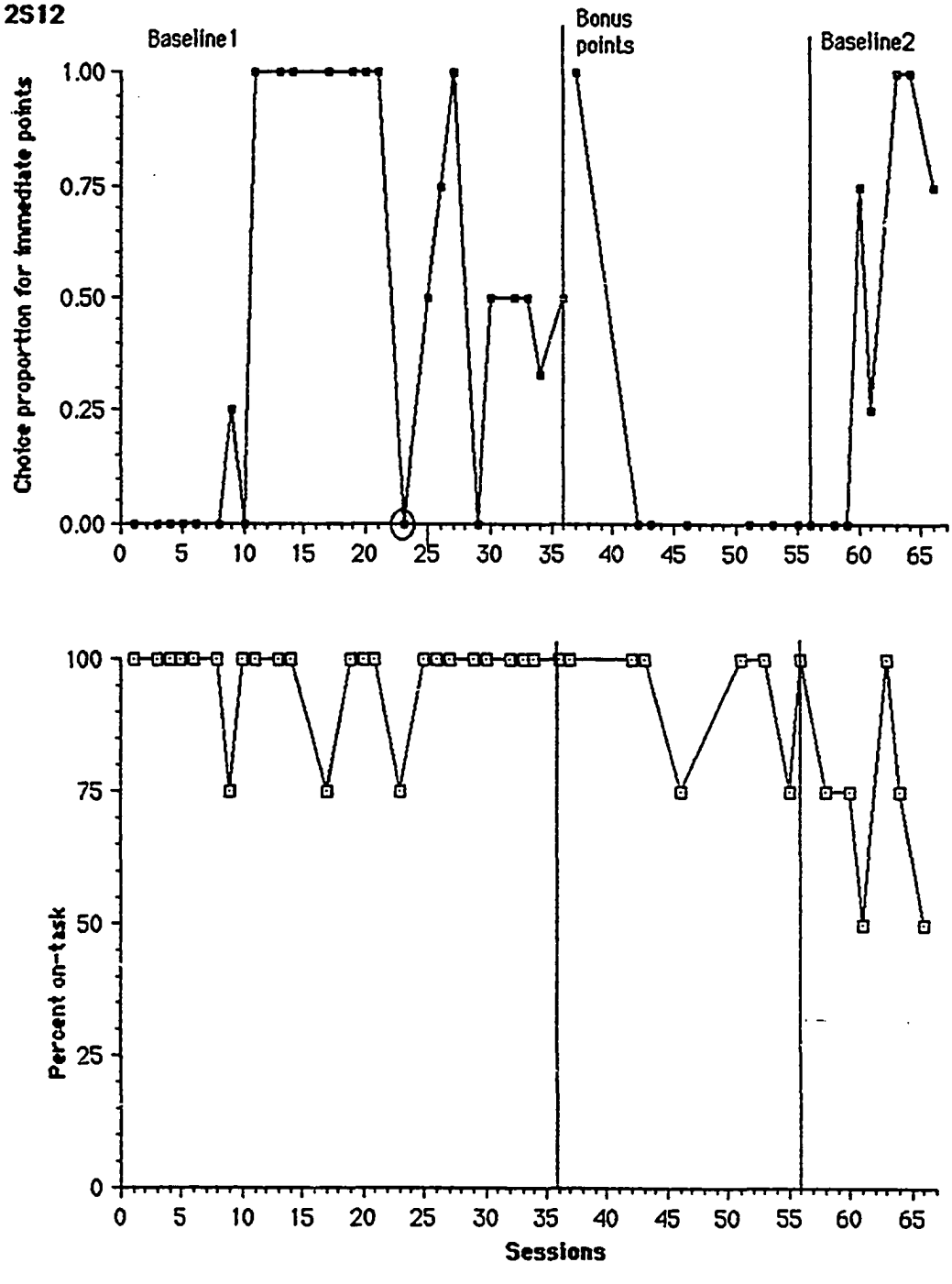

Figure 5. Dependent-Impulsive Choice Patterns of Subject 2S12. Proportion of choices for immediation points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

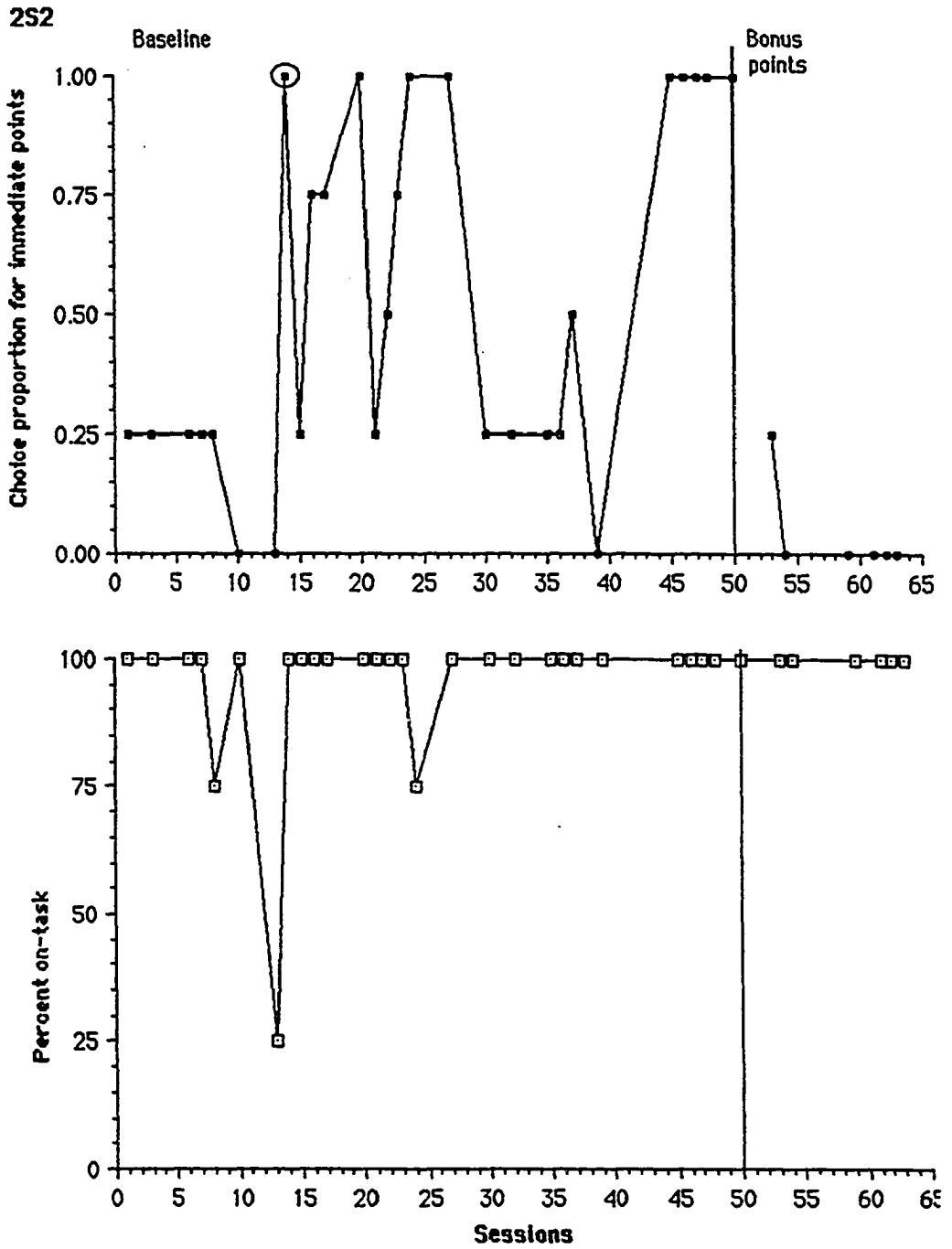

Figure 6. Dependent-Impulsive Choice Patterns of Subject 2S2. Proportion of choices for immediation points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

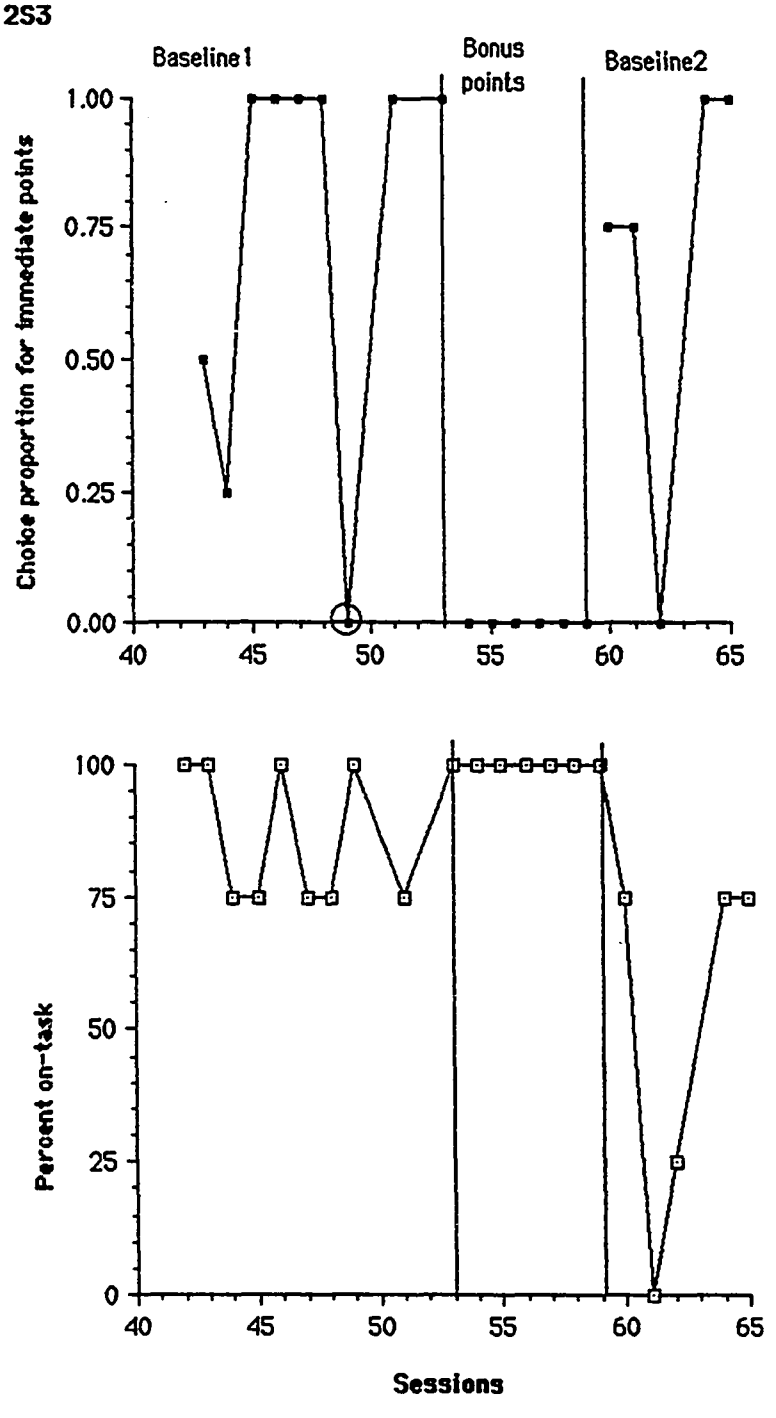

Figure 7. Dependent-Impulsive Choice Patterns of Subject 2S3. Proportion of choices for immediation points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

On-Task Performance

Figures 2 through 7 show choice proportions (top half) and on-task percentages (bottom half) for each of the subjects during the experiment. On-task percentages were quite stable during all Experimental phases. Figures 3, 4, 6, and 7 showed, with few deviations, that most students were on-task 75% to 100% of the time. Only two students showed much variability below these limits: 2S7 and 1S1. Subject 2S7 (Figure 2) displayed less than 75% on-task behavior early during Baseline 1 (Sessions 6, 7, and 11). Subject 1S1 displayed a similar pattern during Baseline 1 but occasionally showed on-task behavior below 75% throughout other phases, including Sessions 7, 9, 10, 24, 31, 37, and 57. Sessions 61 to 65 correspond to the last few days before summer vacation which may have contributed to the decline in on-task performance in Students 1S1, 2S12, and 2S3 (see Figures 4, 5, and 7).

On-task performance improved and became less variable during the Experimental phase for some students. Figures 3, 6, and 7 showed that the on-task behavior of Subjects 2S4, 2S2, and 2S6 was between 75% and 100% during baseline, but became invariant at 100% during the Experimental phase. This pattern was similar to a lesser degree for Subjects 1S1 and 2S7.

Improved on-task performance continued despite a return to baseline conditions for several students (2S7, 1S1, and 2S2) (see Figures 2, 4, and 6). The improvement of on-task percentages during the Experimental phase is noteworthy for two reasons. First, the

improved performance occurred in the absence of direct manipulation of on-task performance; bonus points were given for "YES" and "NO" choices on the Grade Choice Form. Second, the higher on-task percentages maintained by some students following a return to baseline suggest that this improved on-task performance was maintained by contingencies external to the experimental conditions.

Choice Proportions

An overview of students' choice behavior (Figures 2 through 8) demonstrated that all students reached the stability criterion during baseline with choice proportions above .5 for three consecutive sessions or four of the last five sessions. During the experimental phase, bonus points were given for choosing to delay grade points until the end of class. All students displayed a choice reversal within one session of the introduction of the experimental condition. With the exception of Subject 1S1, impulsive choice proportions were 0.0 after one session and remained so until baseline conditions returned. Even 1S1 displayed the reversal during the experimental phase with a lowered choice proportion from an impulsive 1.0 to .25. During Baseline 2 all but 1S1 reversed choice proportions to Baseline 1 levels within five sessions. Figure 3, (Subject 2S4) presents a good example of choice reversals observed with most students.

Some students displayed very stable within-phase choice proportions. For example, 2S4 and 2S3 (depicted in Figures 3 and 7) chose to receive immediate points (1.0) almost exclusively during baseline,

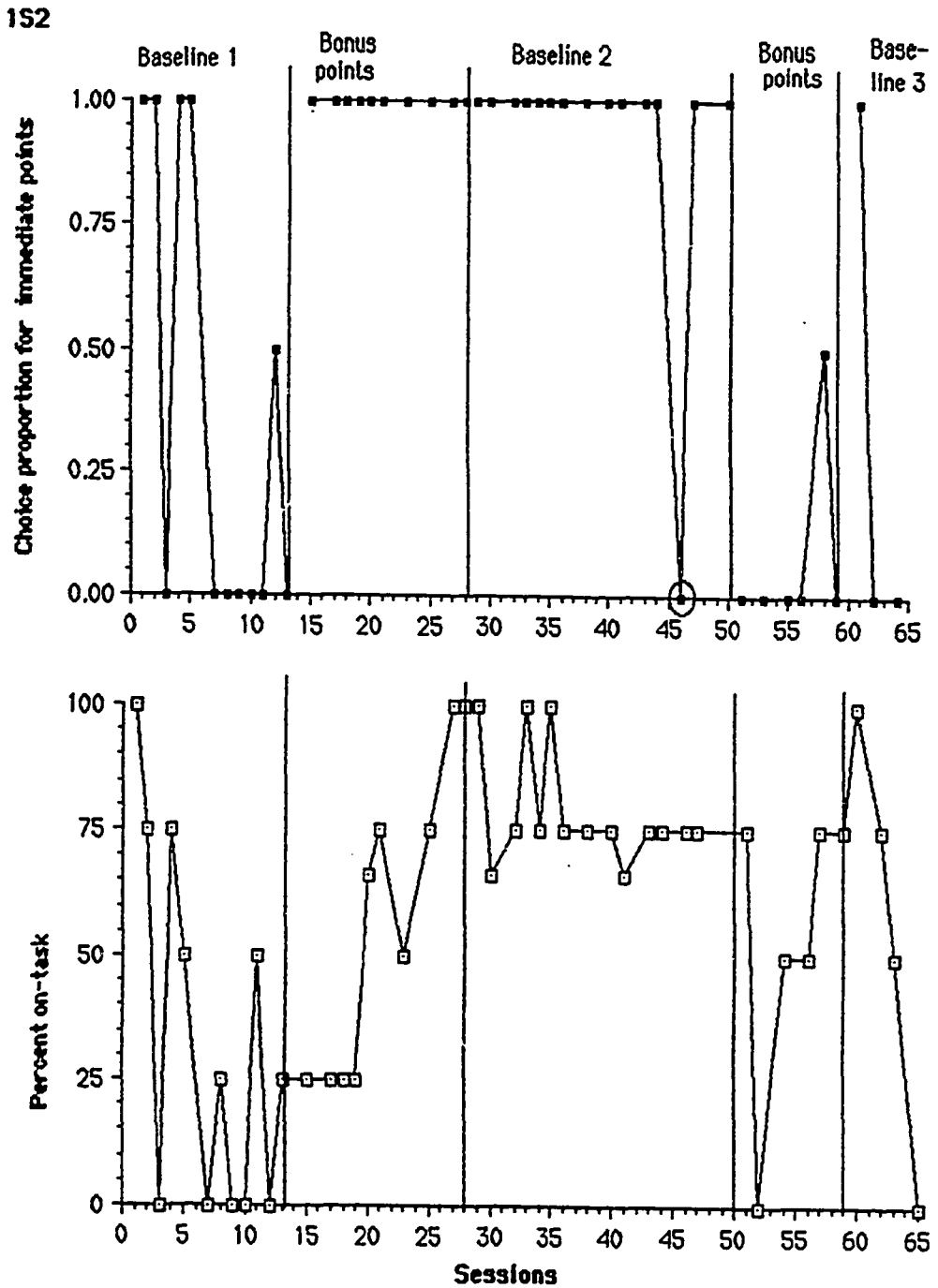

Figure 8. Avoidance-Impulsive Choice Patterns of Subject 1S2. Proportion of choices for immediate points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

and then, within one session, chose to delay grade points (0.0) during the experimental phase; their performance returned to baseline or near baseline levels (.75 to 1.0) during Baseline 2.

Other students displayed greater within-phase variability. Subject 2S7 (see Figure 2) exhibited choice variability throughout baseline. During three sessions (6, 7, and 11), 2S7 showed a brief avoidance-impulsive choice pattern (choice proportion below .5 and on-task percentage below 75%). Similar brief avoidance-impulsive patterns were observed with other students throughout the experiment: 1S1 (Figure 4) in Sessions 7, 9, 10, 24, 31, 37, and 57; 2S12 (Figure 5) in Session 61; and 2S3 (Figure 7) in Session 62.

Outcome Performance

Student grade point outcome performance for each phase is displayed as outcome performance average in Table 4. The average

Table 4

Average Outcome Performance for All Students Based on Mean Daily Points*

Student	(Range)	Base 1	Exper.+	Base 2	Exper.2+	Base 3
Dependent-Impulsive						
2S7	(4-7.5)	6.5	7.7	7.6	9.0 (4 sessions)	
2S4	(7-10)	8.2	8.3	8.5 (2 sessions)		
1S2	(3-10)	6.7	7.9	8.2		
2S12	(7-10)	9.4	8.0	8.0		
2S2	(5-10)	8.2	9.0			

Table 4--Continued

Student	(Range)	Base 1	Exper.+	Base 2	Exper.2+	Base 3
2S3	(8-10)	9.5	8.6	7.3 (4 sessions)		
Avoidance-Impulsive						
1S2	(1-6)	3.8	7.7	7.6	8.0	
1S8	(3-9)	6.2	6.8	7.1	7.0	7.6 (3 sessions)

* 10 = A+, 9 = A, 8 = B, 7 = C, 6 = D. 5 and below = E.
+ Average grade excludes bonus points.

grade point earned is the mean of all daily grade points during each phase.

The experimental phase only reinforced choice patterns regarding the receipt of grade points and was not expected to affect grade outcome. Nevertheless, the data indicate a grade point performance improvement of more than 1.0 per day by some students. For example, 2S7's grade improved from a 6.5 in Baseline 1 to a 7.7 during the Experimental phase. The improvement maintained despite a return to baseline conditions, and improved again with a reintroduction of the experimental conditions. Similar patterns were observed in 1S1 who demonstrated grade improvements from 6.7, to 7.9, and then 8.2 during Baseline 1, Experimental, and Baseline 2 phases, respectively. Student 2S2's performance also increased slightly, although the increase was less than one grade point. Grade performance was stable for one student (2S4), but declined by more than 1.0 grade

point for two others (2S12 and 2S3). However, 2S3's last baseline average includes only four data points and that average was significantly lowered by one grade of four points, his lowest grade of the semester.

In letter grade terms, it appears that students with Baseline 1 grades of D+ improved their grades over the phases to grades of C+ and B's. The Phase 1 grade performance of other students with grades of B or better either maintained or slightly declined.

Phase Choice Proportions

Table 5 displays the average impulsive choice proportions for immediate points (choosing "YES") at each of four choices per session for each student during all phases of the experiment. The average was calculated by dividing the number of impulsive choices by the total number of impulsive and non-impulsive choices. Proportions above .5 are considered impulsive choices, those less than .5 are self-control choices, and a proportion of exactly .5 is classified as indifference.

During Baseline 1 the average choice proportions varied considerably among subjects during Choice Points 1, 2, and 3. However, during the same period within-subject variability was minimal. In general, students seemed to display consistent choice patterns across the first three choice points. Students 1S1, 2S12, and 2S2 showed a tendency toward self-control patterns ranging from .27 to .48. Subjects 1S7, 2S4, and 2S3 displayed a tendency toward impulsive choice patterns with choice proportions ranging from .66 to .87.

Table 5

Proportion of Choices for Immediate Grade Points as a Function of Time Between Choice Point and the Award of Final Daily Grade

Dependent-Impulsive Group	Choice Points* 1 (35 min)		2 (25 min)		3 (15 min)		4 (5 min)	
Student	[f/N]**		[f/N]		[f/N]		[f/N]	
2S7								
Base 1	[6/12]	.50	[8/12]	.66	[8/12]	.66	[11/12]	.92
Exp 1	[1/9]	.11	[1/9]	.11	[0/9]	0.00	[1/9]	.11
Base 2	[9/11]	.81	[8/12]	.66	[9/12]	.75	[9/12]	.75
Exp 2	[0/4]	0.00	[0/4]	0.00	[0/4]	0.00	[0/4]	0.00
2S4								
Base 1	[12/14]	.86	[13/14]	.93	[13/14]	.93	[13/14]	.93
Exp 1	[1/6]	.17	[1/6]	.17	[1/6]	.17	[1/6]	.17
Base 2	[3/4]	.75	[3/4]	.75	[3/4]	.75	[3/4]	.75
1S1								
Base 1	[5/6]	.31	[4/17]	.24	[4/17]	.24	[17/17]	1.00
Exp 1	[0/14]	0.00	[0/15]	0.00	[1/15]	.07	[8/15]	.53
Base 2	[1/7]	.14	[2/8]	.25	[1/8]	.13	[2/8]	.25
2S12								
Base 1	[13/23]	.57	[8/23]	.34	[9/23]	.39	[14/23]	.61
Exp 1	[1/8]	.13	[1/8]	.13	[1/8]	.13	[1/8]	.13
Base 2	[3/6]	.50	[5/6]	.83	[3/6]	.50	[4/6]	.66
2S2								
Base 1	[8/27]	.30	[11/27]	.41	[12/26]	.46	[24/27]	.89
Exp 1	[0/6]	0.00	[0/6]	0.00	[0/6]	0.00	[1/6]	.17
2S3								
Base 1	[8/9]	.89	[8/9]	.89	[8/9]	.89	[7/9]	.78
Exp 1	[1/7]	.14	[1/7]	.14	[1/7]	.14	[07]	0.00
Base 2	[2/4]	.50	[3/4]	.75	[3/4]	.75	[3/4]	.75

Table 5--Continued

Avoidance-Impulsive Group	Choice Points* 1 (35 min)		2 (25 min)		3 (15 min)		4 (5 min)	
Student	[f/N]**		[f/N]		[f/N]		[f/N]	
1S2								
Base 1	[5/12]	.42	[4/11]	.36	[5/12]	.42	[4/12]	.33
Exp 1	[9/9]	1.00	[10/10]	1.00	[9/9]	1.00	[10/10]	1.00
Base 2	[14/14]	1.00	[14/14]	1.00	[13/13]	1.00	[13/13]	1.00
1S2								
Exp 2	[0/6]	0.00	[0/6]	0.00	[1/6]	.17	[1/6]	.17
Base 3	[1/3]	.33	[1/3]	.33	[1/3]	.33	[1/3]	.33
1S8								
Base 1	[0/9]	0.00	[0/10]	0.00	[0/10]	0.00	[5/9]	.56
Exp 1	[4/4]	1.00	[5/5]	1.00	[5/5]	1.00	[4/5]	.80
Base 2	[10/10]	1.00	[11/11]	1.00	[11/11]	1.00	[11/11]	1.00
Exp 2	[0/7]	0.00	[0/7]	0.00	[0/7]	0.00	[1/7]	.14
Base 3	[0/6]	0.00	[0/6]	0.00	[0/6]	0.00	[0/6]	0.00

* Proportions were calculated by dividing the number of choices for immediate grade points by the total number of choices made.

** f = number of choices for immediate grade points.
N = the total number of choice made.

A large increase in "YES" choice proportions occurred at Choice Point 4, which is about 5 minutes before total daily points were presented. Students 1S7, 1S1, and 2S2 displayed choice proportion in- creases of .26, .73, and .41 over previous choice points. However, these increases in impulsive choice patterns were eliminated during the Experimental phase with the introduction of bonus points for choosing to receive points at the end of the class, a self-control choice pattern. Choice proportions during the Experimental phase ranged from 0.00 to .17 during all choice points

for all but Subject 1S1. That subject demonstrated self-control choice proportions of 0.00, 0.00, and .07 during the first three choice points and then exhibited an increase to .53 at Choice Point 4. With this single exception, the Experimental phase produced little within- or between-subject variability.

Average choice proportions for immediate grade points increased following a return to baseline conditions during Baseline 2. However, there were two main differences between Baseline 1 and Baseline 2. First, Baseline 2 proportions contain less within-subject variability (0.0 to .33) across all four choice points than Baseline 1 (.07 to .65). A second difference between Baseline 1 and Baseline 2 is that Baseline 2 did not show the Baseline 1 increase of "YES" choice proportions at Choice Point 4. To the contrary, Baseline 2 choice proportions appear rather flat across all choice points.

Avoidance-Impulsive Choice Patterns

Two students (1S2 and 1S8) were identified as displaying avoidance-impulsive choice patterns by exhibiting on-task percentages below .75 and choice proportions below .5. Student 1S8 is included in this group based on pre-experimental data despite increasing on-task percentages during baseline. It appears that 1S8's choice pattern was unstable during baseline. It was included, however, to represent a weak avoidance-impulsive pattern on a continuum from impulsive through indifference to self-control.

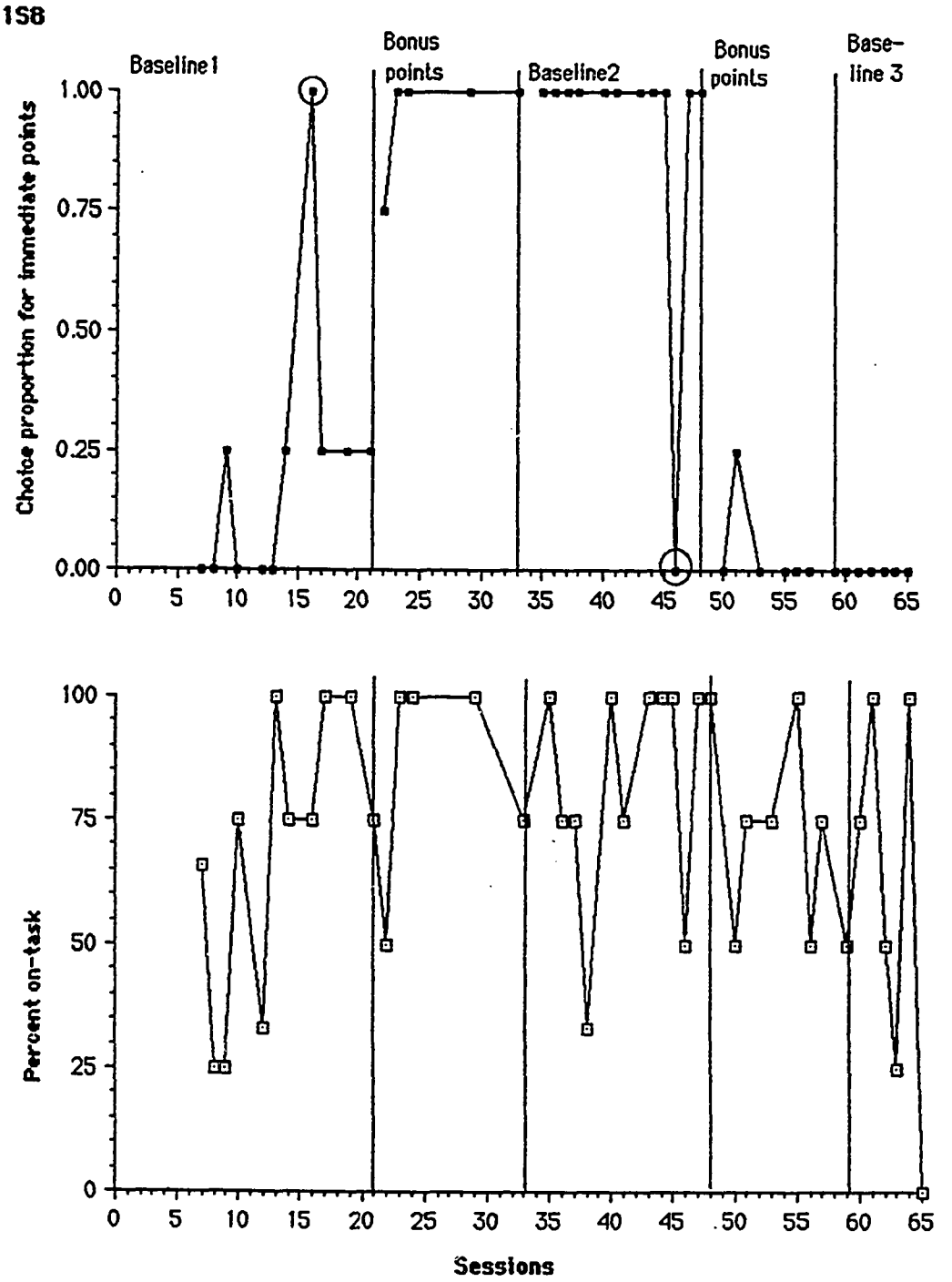

Figure 9. Avoidance-Impulsive Choice Patterns of Subject 1S8. Proportion of choices for immediate points (upper graph) and collateral on-task percentages (lower graph). Forced choices are circled.

On-Task Performance

The bottom half of Figures 8 and 9 show on-task percentages for Students 1S2 and 1S8. With the exception of a baseline increase for for 1S8 discussed above, the two on-task percentages followed similar patterns across all phases of the experiment. Figure 8 shows that on-task percentages for 1S2 were low during Baseline 1, frequently at 0% and 25% (Sessions 3, 7 through 10, 12, and 13). On-task percentages improved with the Experimental phase during which students were given bonus points for choosing to receive immediate grade points. The improvement occurred within one session for 1S8, but was more gradual with 1S2 who took nine sessions before demonstrating consistent on-task percentages at 75%. These improved percentages continued with few deviations through an unsuccessful return to baseline conditions.

Figures 8 and 9 (Sessions 49 to 60) show that on-task performance began to decrease with the start of a new experimental phase during which students were given bonus points for choosing to delay grade points until the end of class. On-task percentages dropped immediately below 75% for both students and generally remained low throughout this phase and a subsequent baseline return. The last few data points are suspect since they correspond with the last few days of school, a time during which many high school students exert less effort.

Choice Proportions

The top half of Figures 8 and 9 show that choice patterns were very similar across experimental phases for the two students. During Baseline 1, both students displayed an avoidance-impulsive choice pattern (a preference for delayed grade points) below the indifference proportion of .5. Subject 1S2 demonstrated the strongest avoidance-impulsive choice pattern with a complete avoidance of immediate grade points during six of the last seven baseline sessions (Figure 8, Sessions 7-13). Figure 9 shows that Subject 1S8 displayed a similar but weaker choice pattern.

These choice patterns changed abruptly during Phase 2 with the introduction of bonus points for choosing to receive immediate grade points. Within one session, preference changed from delaying to receiving immediate points. This choice pattern continued despite a removal of bonus points during Baseline 2 conditions.

Preference changed only with the introduction of Phase 2 during which students received bonus points for choosing to delay grade points. Both students changed choice proportions from 1.0 to 0.0, or in favor of immediate grade points. Both students continued this pattern with the exception of a single session. A return to baseline conditions did not reverse choice proportions for Subject 1S8, although 1S2 displayed a single session reversal at Session 61 (see Figure 8).

Outcome Performance

Table 4 displays the average grade point outcome for Subjects 1S2 and 1S8 across all experimental phases. The mean grade points earned per session are displayed. Subject 1S2 showed a substantial mean grade increase from Baseline 1 to the first experimental phase. The increase, 3.8 to 7.7, continued during Baseline 2 and slightly increased again during the introduction of the second experimental phase. A similar but weaker improvement pattern is observed with Student 1S8. Again, it is interesting to note the improvement in on-task performance and grade point average without directly programming for them.

Phase Choice Proportions

Table 5 displays the average impulsive choice proportions for each phase by time of award within sessions for students displaying avoidance-impulsive choice patterns (1S2 and 1S8). Averages were calculated by dividing the total number of avoidance-impulsive choices (delaying grade points) by the total number of impulsive plus nonimpulsive choices. The choice proportion averages of 1S2 across the four choice points range from .33 to .42 indicating a tendency toward an avoidance-impulsive choice pattern. Subject 1S8 showed a similar impulsive choice pattern with choice proportions around .10 during Choice Points 1 to 3. Subject 1S8 also displayed an increased choice proportion for immediate grade points at Choice Point 4 that was noted in the dependent-impulsive group.

The introduction of bonus points during Phase 2 for choosing immediate grade points increased choice proportions from .09 to 1.00 during all choice points. A withdrawal of bonus points during Baseline 2 decreased these proportions only slightly. When bonus points were offered contingent on choosing to delay points (Experimental Phase 2), Subjects 1S2 and 1S8 again reversed preference dropping choice proportions from .93 to .17 and less across all choice points. This pattern continued for 1S8 through a third return to baseline. Subject 1S2's Baseline 3 data were incomplete but suggested a similar pattern during three sessions.

CHAPTER IV

DISCUSSION

The present study demonstrated that two types of impulsive choice patterns of responding defined in an educational context can be altered. Dependent-impulsive and avoidance-impulsive choice patterns were changed by awarding bonus points following self-control choice patterns. Avoidance-impulsive subjects continued exhibiting self-control behavior despite removal of the bonus-point contingency (i.e., a return to baseline). Additionally, collateral benefits occurred with changes in choice patterns: students not only exhibited choice patterns of self-control, but also displayed improved grades and on-task performance. These collateral improvements occurred without programming for them, and for students exhibiting avoidance-impulsive patterns, continued long after the removal of experimental conditions. Furthermore, all students in the dependent-impulsive group preferred immediate points at Choice Point 4. This preference shifted in four of the six students as a function of choice point delays for total daily points. Choice point delays affected the preference of one of two students in the avoidance-impulsive group. Finally, choice behavior evidenced substantial within-subject and between-subject variability during baseline which was reduced during the bonus-point phase and subsequent baselines.

Several previous studies have failed to observe human impulsive choice patterns. Logue et al. (1986) failed to find impulsivity using points exchangeable for money after each session in an adult population. Millar and Navarick (1984) observed that only 409% of their subjects behaved impulsively while Navarick (1986) found impulsivity only when choosing the small reinforcer actually allowed subjects to increase total reinforcement. Only Ragotzy et al. (1988) found human impulsivity with mentally impaired subjects using breakfast cereal as a reinforcer. Their subjects consistently preferred three pieces of cereal to one piece of cereal when neither alternative was delayed. However, this preference shifted to the smaller immediate food award as the delivery of the larger food reinforcement was delayed. Similarly, the results of the present student demonstrate human choice for points associated with academic grades shifts as a function of delays to total daily points. All choice points were delayed by at least five minutes from award of total daily points. Students preferred immediate partial points to delayed total points during baseline sessions. However, data from Table 5 indicate that three of six students in the dependent-impulsive group reversed preference from the immediate small point award at five minutes before total point delivery to the delayed large point award as choice points to total daily point award were delayed further by 15, 25, and 30 minutes.

The results of this study suggest that points exchangeable for money produce different effects than points exchangeable for grades. Logue et al. (1986) observe that there is no value in obtaining

immediate points that can later be exchanged for money. Thus, the subjects in their study adopted choice strategies that maximized the amount of money to be received later. On the other hand, there was no advantage in the present study for adopting a maximization strategy for points exchangeable for grades since the maximum grade was established before any choices were made and produced no more points than the cumulative points from each choice point. In contrast to the subjects of Logue et al. (1986), the students in the present study indicated by their comments ("It doesn't matter, you get the same number of points") that neither immediate nor delayed choices held any advantage with regard to total amount of points possible. Thus, the presence or absence of impulsive behavior may be an artifact of the positive reinforcement procedure used. One procedure differentially reinforces choice strategies that maximize reinforcer amount; the other emphasizes delays to reinforcement while keeping constant the amount of total reinforcement available.

Self-control patterns of choice behavior can be viewed as a preference for a delayed larger reinforcer. Several animal studies have demonstrated that pigeons are generally more sensitive to delays of reinforcement than amount of reinforcement (Ainslie & Herrnstein, 1981; Green & Snyderman, 1980; Rachlin & Green, 1972) and thus more likely to display impulsive choice patterns. The demonstration of self-control patterns of behavior in pigeons has been a topic of experimental interest. Commitment procedures that add delays to both choice alternatives have produced self-control choice patterns (Rachlin & Green, 1972). Ainslie and Herrnstein

(1981) observed that two pigeons continued to choose the larger delayed reinforcer after exposure to a commitment procedure was discontinued. This "sensitivity" to the amount of reinforcement in the presence of an immediate reinforcer was investigated in several studies using a fading procedure (Logue et al., 1984; Mazur & Logue, 1978). Pigeons learned to continue to choose the larger delayed reinforcer even in the presence of the smaller immediate reinforcer but only after an extensive fading procedure.

Some histories of exposure to the larger delayed alternative in a choice paradigm seem to strengthen the probability of that choice. Data from the avoidance-impulsive group of students suggest a comparable conclusion. During Phase 1, both students (see Figures 7 and 8) preferred to receive delayed points, an impulsive choice for poor performing students. Preference shifted to a self-controlled choice pattern with the addition of contingent bonus points. This preference persisted with the removal of bonus points during Phase 3 (return to baseline). Thus, it might be argued that a history of exposure to a larger delayed reinforcer using contingent bonus points altered impulsive choice patterns.

The present study supports previous research on human impulsivity with negative reinforcement procedures (Navarick, 1982; Solnick et al., 1980). Students exhibiting poor on-task performance and avoidance-impulsive choice patterns preferred the offset of a small aversive stimulus (a partial bad grade) even though the avoidance of such contingencies led to a larger aversive stimulus (a failing grade for the day/semester). Thus, using points correlated with

grades, students behaved impulsively preferring smaller immediate offsets of an aversive stimulus to the offset of larger delayed ones.

The choice conflict as expressed above (one between immediate offset of a small aversive event versus delayed offset of a larger aversive event) is not the only analysis of human impulsivity and self-control using aversive stimuli. Epstein (1984) studied choice in a mixed schedule of immediate food reinforcement followed by delayed shock. Pigeons continued to peck a key for food, although with greater latencies, even though reinforcement was always followed by delayed shock. This view seems to match many human conditions including the present one. For example, in the presence of a cake, the overeater will indulge even though increased weight is a delayed aversive outcome. A smoker will smoke in the presence of a cigarette though terminal illness may be the delayed consequence. Likewise, the poor performing student will avoid poor grades and other grade-related aversive stimuli even though an unavoidable failing grade is the delayed outcome.

The improvement in on-task performance and grades without specifically programming for them is an interesting phenomenon with potential applied benefits. It appeared that avoidance-impulsive subjects' choice patterns reversed as a function of bonus points for choosing immediate points. In addition, that choice brought these subjects into contact with contingencies that altered their future behavior as evidenced by their increased grades and on-task performances. Furthermore, once these behaviors were brought under the

control of these contingencies, the collateral behaviors persisted even when bonus points were no longer given. In this context, the choice procedure may be a simple way to program for the generality of variables and processes across contrived and natural settings (Ferster, 1972; Johnston, 1979; Stokes & Baer, 1977). For example, bonuses might be given to a worker for choosing to privately observe a comparison of his/her productivity and rate of absenteeism to other workers or exemplary workers. To the extent that knowledge of other workers' productivity and rates of absenteeism affect the individual worker's performance, the response of choosing to observe the comparison might affect the individual worker's future productivity and absenteeism rate. Bonuses are not provided for increased productivity and attendance but for choosing to observe a comparison of individual and group or exemplar performances.

The present study contains weaknesses that may have affected the results and should thus be considered. First, one subject in each group barely met criteria for inclusion in a group. Subject 1S12 was included in the dependent-impulsive group even though the student's choice proportions indicated near indifference. Subject 1S8 was included in the avoidance-impulsive group though on-task percentages were about 75% (others were 50% or lower). The reasons for including these students were given previously and need not be repeated. However, it is not clear whether a choice pattern of indifference represents a transitional choice pattern that is the mid-point on a continuum between preference for immediate and preference for delayed consequences or a separate group in which the

consequence has no value regardless of other contingent arrangements. For example, tokens that cannot be exchanged may have little value for a person and will not effect much behavior whether presented with or without delays. Efforts should be made to make groups as homogeneous as possible so that the variables affecting choice can be accurately observed. Second, conclusions regarding subjects with avoidance-impulsive choice patterns are tenuous considering that the group contained only two subjects. A larger number of students would make the generalizations about this group stronger. Finally, there is some evidence that students did not discriminate between the last choice point for immediate grades and the award of total points. The last choice point occurred about five minutes before the delivery of the day's total points. Students generally wanted to know their daily grade. Some of the choice proportion data may be artifacts of students confusing the last choice point with receiving their daily grade. Thus, care should be taken to insure that choice proportions area function of a single discriminated choice point.

A next step for future studies using this choice model in educational settings might be the use of a commitment procedure in which students make choices between immediate and delayed grades 24 hours in advance. Animal studies reveal the development of self-control patterns of behavior while human studies are equivocal. Part of the ambiguity of human choice responding may lie in reinforcer type, another area for research. Logue et al. (1986) suggest that use of points exchangeable for money encourages the

development of self-control choice patterns by making maximization strategies advantageous. Studies in this area would have to separate at least four variables: type of reinforcer, the verbal behavior of the subject, the reinforcement procedure, and the opportunity to maximize reinforcement. It is possible that points exchangeable for money is a unique class of reinforcer that produces self-control effects in some people due to a special social and verbal history. The present study indicated the points exchangeable for grades did not necessarily produce self-control behavior. On the other hand, it is not clear whether points exchangeable for increased access to unstructured time such as recess would produce impulsive or self-control choice patterns. It is also possible that self-control choice patterns are more likely to occur when there is an opportunity to maximize reinforcement. It was noted that there was no opportunity to maximize points for grades since there was a preset reinforcer limit. The question remains whether such reinforcer limits contribute to choice behavior in humans. Solnick's et al. (1982) negative reinforcement procedure produced human impulsivity. Perhaps impulsivity is an artifact of the procedure itself. Given this possibility it might be of interest to use a negative reinforcement procedure where the offset of loss of points, exchangeable for money, is the reinforcer. One might expect subjects in the Logue et al. (1984) study to lose a few points immediately to save more points later on, while Solnick's subjects might be expected to offset the loss of immediate points even though they would lose more points in the long run. Finally, the verbal

histories of human subjects must be taken into consideration. Buskist and Miller (1986) note that much human behavior is the result of contingencies and rules about the contingencies. If the contingencies contradict the rules, the rules will be dropped. However, rules will continue to exert an influence on behavior as long as they match the contingencies in some way, even when total reinforcement is less than that arranged by the actual contingencies. A choice paradigm of instructed versus uninstructed choices may help to clarify the role of verbal behavior in human choice.

Grade outcome and on-task performance were changed by providing bonus points to students for contacting the contingencies that would alter their behavior. It would be important to find out if a choice procedure that provides incentives for contacting other natural contingencies could affect other collateral behaviors. For example, hyperactive children might be given the choice of leaving their seat for one minute immediately or waiting five more minutes and leaving their seat for three minutes. Delays to reinforcement might be added to both alternatives in a commitment procedure or bonuses might be added for self-control choices. The dependent variables of interest might include time out of seat, work accomplished in seat prior to and during self-control and impulsive choices, the rate of other collateral behavior such as pencil chewing, rocking, etc.

Conclusion

Human choice behavior was studied in an applied educational setting. Students' choice behavior was defined and divided into two

groups by choice patterns for grade points and academic on-task performance. Dependent-impulsive students chose immediate points even though their on-task performance was good. Avoidance-impulsive students chose delayed points (avoidance) when their on-task performance was poor. Bonus points reversed choice preference from an impulsive pattern to a self-control pattern in both groups. Students in the avoidance-impulsive group continued self-control patterns even with the return to baseline. This suggests that choice behavior came under different contingencies. In support of this conclusion, on-task performance and grade outcome improved with changes in choice patterns for this group and continued even though bonus points were removed. Choice behavior was orderly within subjects across delays, but did not follow established patterns predicted by various animal studies and the Rachlin and Green (1972) formulation of choice behavior. Some students reversed preference as a function of delay to reinforcement but in an unpredicted direction. Human choice behavior seems to be a function of more than delay to reinforcement and amount of reinforcement. The verbal behavior of subjects, reinforcer type, and opportunity to maximize reinforcement may be additional variables affecting human choice behavior.

APPENDICES

Appendix A

Grade Choice Form

GRADE CHOICE FORM

NAME_____ HOUR_____ DATE_____

1. THE BELL WILL RING 4 TIMES DURING THE HOUR.

2. EACH TIME THE BELL RINGS YOU WILL HAVE A CHOICE:
   a. get part (about 1/4) of your daily points OR
   b. wait and get your points at the end of the hour.

3. THE MOST DAILY POINTS YOU CAN GET FROM YOUR STUDY CONTRACT IS

(the circled number and grade)	10	9	8	7	6	5
	A+	A	B	C	D	E

4. WHEN EACH BELL RINGS CIRCLE "YES" OR "NO". (Total daily points and grades are not affected by your choice)

YES - Give me PART of my daily points NOW.

NO - Give me my daily points LATER.

BELL NUMBER	CIRCLE ONLY ONE											TEACHER INITIAL
1	YES					NO						_____
	2.5 A+	2.25 A	2.0 B	1.75 C	1.5 D	1.25 E	1.0 --	.75 --	.5 --	.25 --	0 --	
2	YES					NO						_____
	2.5 A+	2.25 A	2.0 B	1.75 C	1.5 D	1.25 E	1.0 --	.75 --	.5 --	.25 --	0 --	
3	YES					NO						_____
	2.5 A+	2.25 A	2.0 B	1.75 C	1.5 D	1.25 E	1.0 --	.75 --	.5 --	.25 --	0 -	
4	YES					NO						_____
	2.5 A+	2.25 A	2.0 B	1.75 C	1.5 D	1.25 E	1.0 --	.75 --	.5 --	.25 --	0 -	

TOTAL DAILY POINTS_____

Appendix B

Student Contract Form

STUDENT CONTRACT FORM

STUDENT NAME_____ CLASS_____

Date	Contract (decription & criterion)	Time Needed	OK'ed	Results
_____	1._____			inc
	_____	_____	_____	Com
_____	2._____			Inc
	_____	_____	_____	Com
_____	3._____			Inc
	_____	_____	_____	Com
_____	4._____			Inc
	_____	_____	_____	Com
_____	5._____			Inc
	_____	_____	_____	Com
_____	6._____			Inc
	_____	_____	_____	Com
_____	7._____			Inc
	_____	_____	_____	Com
_____	8._____			Inc
	_____	_____	_____	Com
_____	9._____			Inc
	_____	_____	_____	Com

STUDENT REVIEW INFORMATION

	M	T	W	TH	F
1. Fill out contract & had it signed (5m)					
2. Began work immediately					
3. Stayed on task (end of hour)					
4. Didn't bother others					
5. Got feedback & review of contract					

Appendix C

Human Subjects Institutional Review Board Approval

WMU

Western Michigan University
Kalamazoo, Michigan 49008-3899

Human Subjects
Institutional Review Board

TO: John Esch

FROM: Ellen Page-Robin, Chair EP-R

RE: Research Protocol

DATE: May 13, 1988

This letter will serve as confirmation that your research protocol, "Impulsivity and Self-Control in a Classroom Grading System," has been approved as exempt by the HSIRB.

If you have any further questions, please contact me at 387-2647.

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