The effects of different methods of selecting and exchanging back-up reinforcers are examined, with two mentally retarded children participating in a token economy in a special education class. In separate experiments each child received tokens contingent upon attentive behavior. The different methods of selecting and exchanging back-up reinforcers consisted of preselecting back-up events that were to be purchased in advance of earning the tokens versus selecting back-up events only after the requisite number of tokens had been earned. The two methods of selecting and exchanging back-up events were compared in separate simultaneous-treatment designs for each child. The interventions were administered in the same phase, but balanced across the different time periods during which they were implemented. In each experiment preselecting back-up reinforcers prior to earning tokens led to higher levels of attentive behavior than did selecting back-up events after the tokens had been earned. Interpretations of the effects of preselecting back-up events that stressed the possible influence of making back-up events less remote in relation to the token-earning behaviors and the prompting function of the preselection procedure are discussed.

Enhancing Classroom Attentiveness by Preselection of Back-Up Reinforcers in a Token Economy

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Token economies have been very effective in altering the behavior of a wide range of clients in naturalistic, institutional, educational, and community settings (Kazdin, 1977b). The widespread

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application is greatly facilitated by the flexibility that token economies allow. Token programs can be varied in many ways to suit the demands of the populations and settings to which they are applied. The events that serve as tokens and back-up reinforcers, the type of contingencies, the manner in which tokens are administered, and many other variations provide options for implementing token economies without attenuating their efficacy.

Many program variations influence the efficacy of the contingencies. For example, reinforcement contingencies can be supplemented with response cost or time out, which usually enhances performance (Walker et al., 1976; Winkler, 1971); earning back-up events for one's peers rather than just for oneself often enhances performance (Kazdin & Geesey, 1977; Wolf et al., 1970); and receiving tokens from "peer-managers" enhances performance over the level achieved with staff-administered contingencies (Phillips et al., 1973). The above variations do not invariably improve performance, and exceptions to the stated relationships exist (Drabman, 1973; Rosenbaum et al., 1975).

Relatively little attention has been given to the manner in which back-up reinforcers are selected and exchanged in token economies, and whether variations in back-up reinforcer delivery differentially influence performance. In the usual program clients earn tokens and eventually select back-up reinforcers that can be purchased once their token earnings have accumulated to a sufficient number. As generalized conditioned reinforcers, tokens bridge the delay between performance and the exchange of tokens for back-up events. Possibly the manner in which tokens are usually exchanged can be improved by making the connection between tokens and back-up events more salient in some way, while the individual is earning tokens. Indeed, laboratory research has shown that the value of a conditioned reinforcer is increased the closer the proximity of the conditioned reinforcer and back-up event (Fantino, 1977). Procedures that increase the salience of the connection between tokens and back-up events and bridge the delay may increase the conditioned reinforcement value of tokens, and hence the effects that tokens exert over performance.

Token-earning behaviors can be viewed as initial steps in a chain of responses that terminate in receipt of back-up reinforcement. Reinforcers delivered at the end of a chain exert less in-

fluence on responses early in the sequence because the consequences are relatively remote (Kelleher, 1966). Tokens mediate the delay and sustain performance over periods until the back-up reinforcer is earned. Yet it may be possible to increase the salience of the final earned reinforcer while the individual engages in responses relatively remote from the consequence, i.e., works toward the back-up event. The net effect might enhance the performance over the level achieved by earning and spending tokens in the usual fashion where the back-up reinforcer may not be particularly salient while tokens are being earned.

The major purpose of this investigation was to compare two methods of selecting and exchanging tokens for back-up reinforcement. The first method consisted of the commonly used system in which back-up events to be purchased with tokens are selected by the client after tokens are earned; the other method consisted of preselecting or identifying the back-up reinforcer which the individual would receive in advance of actually earning the tokens. Preselecting the back-up event in advance was expected to enhance performance because it increases the salience of reinforcers for which the individual is presumably working.

METHOD

Overview of the Experimental Design

The effects of different methods of selecting back-up reinforcers were examined on the attentive behavior of two retarded children in a special education classroom. The interventions were evaluted in separate experiments, each of which was a variation of the simultaneous-treatment design. Discussions of this design have recently increased in the literature (Barlow & Hayes, 1979; Hersen & Barlow, 1976; Kazdin & Hartmann, 1978; Kratochwill, 1978), along with experimental demonstrations attesting to its utility (Foxx, 1977; Kazdin, 1977a; Kazdin & Geesey, 1977). Nevertheless, because the design is less commonly employed than other intrasubject-replication designs, it may be useful to highlight the design briefly.

The design begins with a baseline period. After baseline, two (or more) interventions are concurrently implemented to alter a single target response of one subject (or group of subjects). The interventions are implemented in the same experimental phase, but are balanced across the different conditions during which they are in effect. Hence, the effects of the interventions and the conditions of their administration can be distinguished. The intervention phase is continued until the response stabilizes under the separate interventions. In the final phase, the most effective intervention can be implemented across each of the different time periods, experimenters, and other conditions. Alternatively, all interventions can be withdrawn in the fashion characteristic of the ABAB design. The designs can vary in complexity depending upon the number of stimulus conditions across which the different interventions must be balanced (Kazdin, 1977a).

In this investigation, two separate single-case experiments were conducted. In each experiment, two interventions were evaluated, both of which consisted of different ways of selecting back-up reinforcers in a token economy. Daily observations were gathered for each child across two different time periods. After baseline, the two interventions were implemented each day but during different time periods. The interventions were counterbalanced across time periods so that the time period in which a given intervention was implemented alternated each day (Kazdin, 1977a; Kazdin & Geesey, 1977).

The two experiments differed in the third and final phase. For one child, the more effective method of selecting and exchanging back-up events in the initial intervention phase was implemented across each time period to determine whether performance improved further once the less effective intervention was replaced; for the other child, both interventions were withdrawn.

Subject and Teacher

Two boys were selected from a class of fourteen educably retarded children at the demonstration school of Pennsylvania State University. Mike was 6 years old and achieved a Stanford Binet IQ of 80; Ed was 7 years old and achieved a Stanford Binet IQ of 79. The boys were selected by the teacher because of their

low rates of attentive behavior during periods of assigned academic activity. The investigation was conducted in the classroom where the teacher administered the experimental conditions. The teacher was female and had experience with implementing classroom behavior modification programs.

Assessment

Observations of the children and teacher were made daily for two separate observation periods at approximately 11:00 a.m. and 11:30 a.m. During each observation period, and throughout the investigation, the children completed in-seat work in reading and arithmetic. Mike and Ed were both observed for 50 intervals during each observation period (total of 100 intervals daily) throughout the study. The teacher was observed concurrently with each child.

Each interval was divided into ten seconds of observation followed by two seconds for recording. To maintain the observation schedule, observers listened through earphone jacks to a prerecorded tape while they sat in the classroom observing the children. Nine undergraduate students (six females, three males) served as observers. Observer training consisted of learning the scoring system from videotaped samples of child behavior, as well as training in the classroom situation for more than two weeks prior to the inception of the study.

Teacher behavior. The behavior of the teacher was observed concurrently with the behavior of the two children. The behavior observed consisted of presenting reinforcing consequences that included the simultaneous delivery of a token (mark on a card on the child's desk) and approval. An instance of approval consisted of such statements as: "That's really good!"; "I like what you're doing!"; or "That's good working!" Approval and delivery of a token were always paired. The frequency with which the teacher delivered the reinforcing consequences was assessed by the observers. An observer recorded the delivery of consequences by marking a check on the child behavior scoring sheet next to the interval in which the consequences were delivered. Throughout the project, only those instances of token delivery and approval

that were planned as part of the contingencies transpired between the teacher and the children during the observation periods.

Child behavior. Each child was observed separately by different observers during each of the daily observation periods. A child's behavior was categorized as either attentive or inattentive (Kazdin, 1973). Attentive behavior was scored if the child sat in his seat and worked on his assignment. The child was required to be attentive for the entire ten-second interval for that interval to be scored as attentive behavior. Inattentive behavior was scored if the child did not work on his assignment, left his seat without permission, played with materials inappropriate to the task, or reclined on his desk. The in-seat assignment during the observations consisted of reading and arithmetic workbook materials. The level of materials did not vary for the individual subjects throughout the project.

Reliability of observations. Reliability checks were completed on 56.3% (n = 36) of the observation periods, distributed across each phase, child, and time period. Reliability was computed by dividing agreements between observers by agreements plus disagreements, and then multiplying by 100 to form a percentage. For teacher and child behavior, an agreement was defined as agreement on the occurrence of the behavior between two observers during the same interval. A disagreement was scored if one observer scored the occurrence of a behavior during an interval and the other did not. Interobserver agreement ranged from 80% to 100% for teacher behavior (median = 100%) and 82.5% to 100% for child behavior (median = 91.3%).

Reinforcement Program

During the intervention phases, each child participated in a token reinforcement program. The interventions consisted of two different methods of selecting back-up reinforcers for the tokens, as described below. During the reinforcement program, each child earned approval and tokens (marks on a card placed on his

desk) for attentive behavior. The teacher marked the appropriate card when a predetermined period of continuous attentive behavior had been achieved. The duration of continuous attentive behavior for each child was monitored by an experimenter in an observation booth and was communicated to the teacher who marked the child's card and delivered approval.

For each child the schedule of administering tokens and approval varied depending upon the level of attentive behavior during baseline observations. For Mike, whose attentive behavior was higher during baseline than that of Ed, the teacher provided approval and tokens contingent upon 40 seconds of continuous attentive behavior. As behavior improved, response requirements were increased (on day thirteen of the experiment) to 60 seconds of continuous attentive behavior. For Ed, approval and tokens initially were contingent upon 30 seconds of continuous attentive behavior, but this was quickly extended (on day twelve of the experiment) to 50 seconds as performance improved.

To ensure that the schedules of delivering tokens were adhered to consistently so that they would not vary across different intervention periods for a particular child, the teacher was cued by an experimenter through a "bug-in-the-ear" device. During an intervention phase, the teacher explained to the child that he would receive tokens for working and that the tokens could be exchanged for back-up events.

The manner in which the back-up events were selected by the child (i.e., in advance of earning points or after earning points) constituted the interventions. These interventions were administered each day and across each time period over the course of several days during a token reinforcement program. Several features of the reinforcement program were held constant across the different interventions, including the specific back-up events that a particular child could earn, the opportunity to choose the back-up event, and the response criteria for earning either tokens or back-up events. Thus any differences in attentive behavior across the interventions could not be attributed to differences in these other features of the program.

The number of tokens required to earn back-up events did not vary between the interventions. A back-up event was earned

whenever the subject accumulated a fixed number (fifteen) of tokens on the token-earning card. The criteria for earning tokens were made increasingly stringent as attentive behavior increased, in order to shape longer periods of sustained work. However, at no time were the criteria different for the interventions compared on a given day.

When the criterion number of tokens was earned, the child could earn one of four back-up events including: free time, a special recess, selection of a small toy from a treasure chest, or playing with a highly valued toy. The child was always free to choose the back-up event, each of which cost the same number of tokens. The separate interventions which were compared consisted of whether the child identified the specific back-up event to be purchased in advance of earning the tokens (preselected condition), or after the tokens were earned (postselected condition).

Experimental Conditions

Each child was studied in a separate experiment. Although both children were in the same class, the experimental interventions were begun at different points in time so that subjects did not receive the interventions at the same time. This helped minimize the work of the teacher, who administered the contingencies, and the possibility of generalized (vicarious) effects of treatment from one child to the other. The experiments began and ended at different times for each child. The conditions to which the subjects were exposed included the following phases.

Baseline and reversal phases. Attentive child behavior was recorded during each period without implementing specific contingencies to alter behavior. Baseline, the initial phase for Mike and Ed, was implemented for periods of seven and eight days, respectively. Only Ed was exposed to a reversal phase in which all interventions were withdrawn. This return-to-baseline condition lasted for eight days.

Token reinforcement phase. During this phase, a token reinforcement program was administered. The methods of admin-

istering tokens for a given child were the same for each of the two daily observation periods. During the different periods, however, the programs varied in the manner in which back-up reinforcers were selected. The programs differed in whether the child preselected the back-up event which the tokens would earn prior to earning them, or selected the back-up event only after a sufficient number of tokens had been earned. In the *preselected condition* the child was asked what back-up event he would want to purchase when the required number of tokens had been earned. At that point the child selected the back-up event he was working toward, even though points had not yet been earned. In the *postselected condition,* the child was asked what he wanted to purchase as a back-up event only after the required number of tokens had been earned. This latter selection method, of course, is the one commonly used in token economies, i.e., where individuals are not asked to decide what to purchase until they have earned sufficient tokens to exchange for back-up events.

The tokens were earned on each card during one of the daily observation periods while the intervention was in effect. Immediately prior to the observation period through the intervention, the teacher told the subject whether he was earning tokens for the preselected or postselected card. During the observation periods, only the specific card for which tokens were earned was marked by the teacher. To ensure that particular conditions were kept clear both to the child and teacher, the card used to earn tokens during a given observation period was framed by a yellow plastic disk.

When the predetermined token criterion had been accumulated on a particular card, the child was allowed to exchange the tokens for the back-up event. If the back-up event had been preselected, the child received this event. If the back-up event had not been preselected, the child selected what he wished to purchase at that point. Exchange of tokens for back-up events took place on the day the requisite number of tokens had been accumulated, but after the observation periods. It was possible for a child to earn slightly over the requisite number by the time the observation period ended if he had been close to the total prior to beginning that period. If more than fifteen tokens had been

earned, the extra tokens (e.g., not more than a few) were carried over to the next period of earning the criterion number.

For each child the two interventions were administered each day and alternated between the two daily time periods. After a pattern appeared to emerge suggesting the effects of the interventions, the first reinforcement phase was altered. The reinforcement phase lasted nine days for Mike and eight days for Ed.

Second token reinforcement phase. For Mike, the final phase was designed to implement the more effective intervention from the previous phase. The more effective exchange was the preselected back-up event procedure, which was implemented for Mike across both daily observation periods. This final phase lasted eight days for Mike. For Ed, the third and final phase of the design was a return to baseline conditions for an eight-day period.

RESULTS

Overall Effects

The effects of the reinforcement program and specific procedures for selecting back-up events were evaluated on the percentage of intervals in which the subjects were scored as attentive. The percentages for Mike and Ed are presented in Figures 1 and 2, respectively. The upper portion of each figure presents the combined data across daily observation periods and separate exchange procedures. These data indicate that during baseline, Mike was attentive for a mean of 24.6% of the intervals. Attentive behavior increased to a mean of 69.2% when the token reinforcement program was implemented. In the second reinforcement period (final phase), the more effective reinforcer selection procedure was implemented across both observation periods daily. During this phase, Mike's attentive behavior increased further to an overall mean of 85.4%.

For Ed, the pattern of the data (Figure 2) is similar. During baseline, Ed was scored as attentive for a mean of 14.5% of the intervals. Attentive behavior increased to a mean of 72.5% during

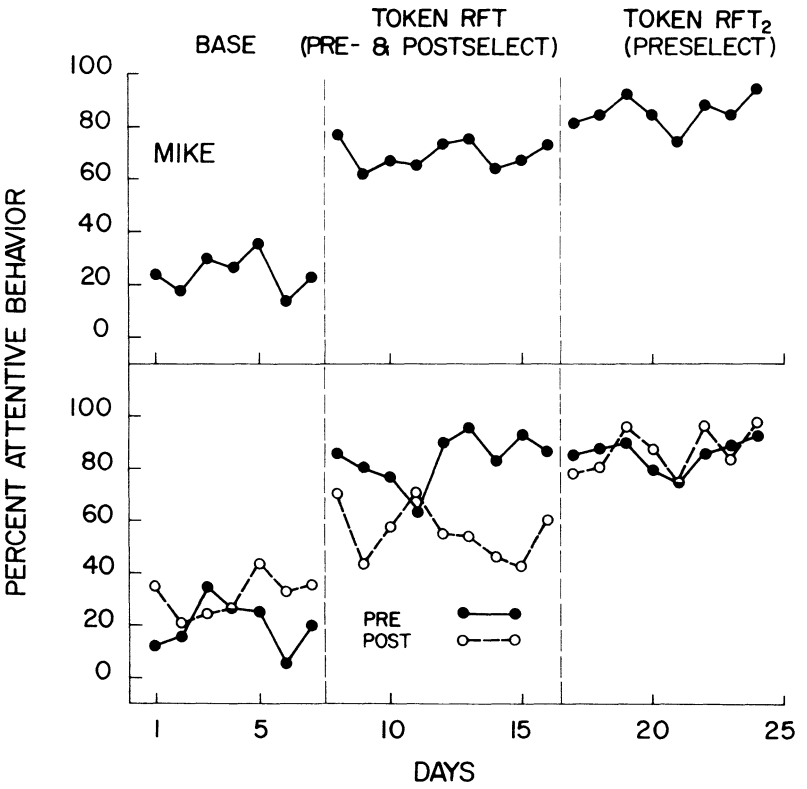

Figure 1: Attentive behavior for Mike across experimental conditions. Baseline—no experimental intervention. Token Reinforcement—implementation of the token program in which Mike either selected the back-up reinforcer for which he would use his tokens in advance (preselect), or selected the reinforcer only after he had earned sufficient tokens to purchase the event (postselect). These separate methods of selecting and exchanging back-up events were administered across different time periods each day. Token Reinforcement$_2$—implementation of the preselected method of identifying the back-up reinforcer across both daily time periods. The *upper* panel presents the overall data collapsed across time periods and interventions. The *lower* panel presents the data according to the time periods across which the interventions were balanced, although both interventions were presented only in the second phase.

the reinforcement program. Finally, attentive behavior decreased to a mean of 37.4% in the reversal phase when the reinforcement program was withdrawn.

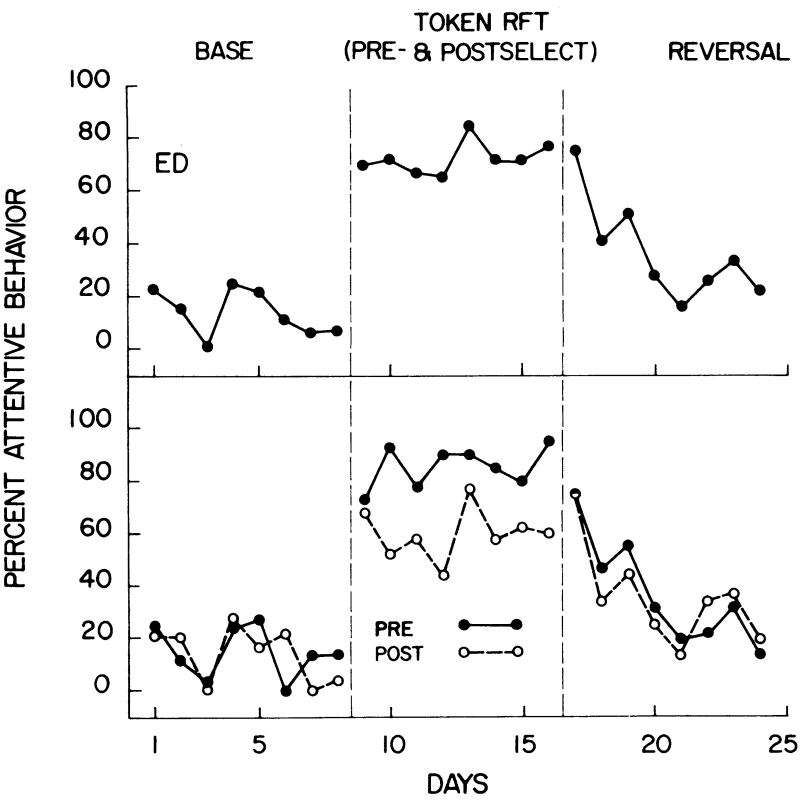

Figure 2: Attentive behavior for Ed across experimental conditions. Baseline—no experimental intervention. Token Reinforcement—implementation of the token program in which Ed either selected in the back-up reinforcer for which he would use his tokens in advance (preselect), or selected the reinforcer after he earned a sufficient number of tokens (postselect). Reversal—withdrawal of the token reinforcement program. The *upper* panel presents the overall data collapsed across time periods and interventions. The *lower* panel presents the data according to the time periods across which the interventions were balanced, although the interventions were presented only in the second phase.

Intervention Effects

The impetus for the investigation was to examine whether the two methods of selecting back-up reinforcers differentially altered student behavior. The effects of the different methods of selecting events for each subject can be seen in the lower

portion of each figure, where the data are collapsed across observational periods. The data are collapsed in an identical fashion across observation periods for all phases, although the two interventions were presented only during the reinforcement period. This manner of collapsing data permits examining the variability and means associated with the different observation periods before and after superimposing different interventions in the reinforcement phase.

The data for Mike (lower portion, Figure 1) during the token reinforcement period show that mean attentive behavior was 83.1% when Mike was allowed to preselect the reinforcer for which he was working. In contrast, his mean attentive behavior was only 55.3% for the periods in which he did not preselect the back-up event. Although the differences in effectiveness of the manner of selecting reinforcers is reasonably evident by visual inspection, statistical evaluation by a median test during the intervention phase corroborates the reliability of the differences. Preselecting back-up events led to significantly higher performance than did selecting back-up events after tokens were accumulated, $\chi^2(1) = 10.89$, $p < .01$.

The differential effects of the methods of selecting back-up events is also evident in the number of tokens earned under each condition during the reinforcement program. During the observation periods in which Mike earned for the preselected event, his daily mean earnings were higher (6.7 tokens) than when he earned for the event selected after tokens were earned (4.2 tokens). Since the schedules for administering tokens did not vary between the intervention methods, these results also attest to the greater performance under the preselection condition.

The effect of preselecting reinforcers can be seen in the second reinforcement phase for Mike. During this phase, Mike worked for preselected reinforcers for both of the daily observation periods, because preselection was the more effective intervention during the previous reinforcement phase. During this final phase, Mike attained a mean level of attentive behavior of 85.1% and 82.9% of the intervals for the observation periods that previously had been associated with different reinforcement selection methods. In other words, Mike's attentive behavior increased during those periods that previously would have been

associated with selecting reinforcers after earning tokens, but now had been shifted to the preselected condition.

The data for Ed (lower portion, Figure 2) during the reinforcement phase also show that attentive behavior was greater when he was earning for the preselected reinforcer (mean of 85%) than when he was earning for the postselected reinforcer (mean of 60%). These differences are relatively clear from visual inspection. In addition, evaluation of the different reinforcer selection methods, using a median test, revealed a statistically significant effect, $\chi^2(1) = 9$, $p < .01$. The different effects of the reinforcer selection procedures are also evident from the tokens earned during the reinforcement phase. Ed earned a daily mean of 9 tokens when working for the preselected reinforcer, but only 6.1 when earning for the reinforcer selected after earnings had been completed.

DISCUSSION

The results indicate that preselecting back-up events for earned tokens enhanced the performance of two retarded children in a special education classroom. Although the token economy was effective in improving attentive behavior, the effectiveness varied as a function of whether the back-up events were preselected in advance of actually earning tokens, or selected only after tokens had been earned. The different methods of selecting the back-up events would seem to have accounted for performance differences between the two interventions for each child, because other major variables in the token economy, such as the schedule of reinforcement, specific back-up events made available (and, in fact, ultimately selected), number of tokens required for back-up events, and amount of available contact with the teacher, did not differ between the interventions.

This study demonstrates that preselecting back-up reinforcers in advance of earning tokens leads to higher levels of performance than does selecting reinforcers after tokens are earned. The generality of this effect might be limited. Only two subjects were studied and each was drawn from the same class, although they were studied at different times. The results might be restricted

to subjects who are mentally retarded. Laboratory demonstrations occasionally have found that retardates may be less responsive than nonretarded individuals to select aspects of the contingencies, e.g., reinforcement schedules (Spradlin & Girardeau, 1966). Perhaps retardates are less responsive to ordinary token reinforcement contingencies and show enhanced performance when special techniques are implemented, such as preselecting reinforcers. Whether differences in performance would result when other subject populations or age groups are studied, remains to be assessed.

Although the findings indicate that preselecting back-up events in advance of earnings enhances performance, the precise reason for this was not evaluated. As suggested earlier, the increased efficacy of this procedure might be expected, insofar as preselection makes the back-up event that will eventually be earned more salient. Preselection may make earning the back-up event less remote and thereby increase responses early in the response chain leading to the event. If this interpretation is plausible, the preselection procedure bears some conceptual resemblance to response priming and reinforcer sampling, which also enhance performance and have been accorded an interpretation based upon chaining (Ayllon & Azrin, 1965).

Alternative interpretations of improved performance achieved by preselecting back-up events are available. For example, perhaps the reminders about the back-up event to be earned served a prompting function and would have accelerated performance even if the specific preselected event had not been identified to the child. That is, reminders of available back-up events per se may be the crucial ingredient influencing enhanced performance. Indeed, reminders about the contingencies in general and the availability of reinforcers (token or back-up) for improvements in performance may exert influence independently of the methods of selecting and exchanging back-up events. The purpose of this investigation was merely to explore procedural differences that might differentially affect performance. Subsequent research might examine which aspects of the preselection procedure account for improved performance.

A final consideration pertains to the simultaneous-treatment design and the potential implications its use may have for gen-

erality of results. The design was quite useful in comparing different methods of selecting back-up events for the individual subjects. Because two interventions were administered during the same phase, it is quite possible that the results for one intervention in part depend upon the implementing of two interventions during the same phase. The problem, referred to as multiple-treatment interference, usually results when the effects of one intervention can be influenced by one or more other treatments. As discussed in intrasubject-replication research, the problem arises as sequence effects in ABAB designs in which more than one treatment is evaluated. In such cases it is possible that the effects attained with the second treatment would not have been obtained without exposure to the prior intervention. Multiple-treatment interference does not threaten the internal validity of the experiment, but raises the possibility that intervention effects might be restricted to individuals with a particular history (sequence of interventions). Analogously, it is possible that the effects of the separate treatments compared in a simultaneous-treatment design are restricted to conditions in which the interventions are juxtaposed in the same treatment phase. Additional research would be required to evaluate this prospect in simultaneous-treatment designs, and, of course, more concretely with the present findings.

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