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EFFECTS OF CHOICE AND IMMEDIACY OF REINFORCEMENT ON SINGLE RESPONSE AND SWITCHING BEHAVIOR OF CHILDREN[1]

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Children responded on a single operandum to produce marbles or candy within a two-component multiple schedule and then were allowed to choose which component was in effect. Experiment I examined the effects of exchanging marbles after sessions for subject-selected or experimenter-selected candy. Rate of response to the single operandum was not affected. However, when the subjects could switch components, they spent the majority of time and responded at somewhat higher rates in a component where marbles were exchangable for subject-selected candy. Experiment II examined the effects of eliminating the immediate marble consequence for responses. Rate of response to the single operandum was not affected. However, when subjects could switch components they spent more time in a component where immediate marble consequences were available for responses, than where no immediate marble consequences were available.

In their short history of application, token systems have been used to modify and/or support a wide variety of human behaviors (*e.g.*, Ayllon and Azrin, 1965; Birnbrauer, Wolf, Kidder, and Tague, 1965; Phillips, 1968; Wolf, Giles, and Hall, 1968; Bushell and Brigham, 1971). Advocates of token systems often point to two basic characteristics that make them effective teaching and motivating systems: the immediacy of reinforcement for correct behavior in the form of a token, and the opportunity of the subject to choose from among a wide variety of terminal or backup reinforcers (*e.g.*, Ayllon and Azrin, 1968; Bijou, Birnbrauer, Kidder, and Tague, 1966; Whitlock and Bushell, 1967).

Although the application of token systems to the modification of human behavior has been successful, the contribution of immediacy of token reinforcement and choice of terminal reinforcers has not been analyzed. The present studies set up a laboratory analogue to a token system to investigate primarily some of the effects of two variables: subject's *versus* experimenter's choice of terminal reinforcers; and immediate token delivery *versus* no token delivery.

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EXPERIMENT I

The first part of the study examined the effects of several conditions upon the rate of response within a multiple schedule. In one component, responses produced candy. In the other component, responses produced marbles. Response rates were compared when: (1) marbles could not be exchanged for anything; (2) the experimenter praised a child for producing marbles; (3) marbles could be exchanged for candy selected by the experimenter; and (4) marbles could be exchanged for candy selected by the child. The second part of the study examined performance when the children could choose which component was in effect. The children's preference for each component of the multiple schedule and rate of responding was examined as a function of whether marbles could be exchanged for candy selected by the experimenter or candy selected by the child.

METHOD

Subjects

Two kindergarten boys of normal social and physical development, who attended a public kindergarten, served.

Apparatus

The apparatus consisted of a white box, 15 by 24 by 12 in. (38 by 61 by 30 cm). The face was an 11 by 24 in. (28 by 61 cm) screen of white translucent plastic and a 4 by 24 in. (10 by 61 cm) piece of plywood. Mounted on the plywood were two response buttons 1 by 2.75 in. (2.5 by 7 cm) one in the center and the second 4 in. (10 cm) from the right edge. The plastic screen could be illuminated either green or red by lamps mounted behind it. The apparatus was attached to a child's desk and placed in a three-sided cubicle. Two Gerbrands universal feeders, one for candy, the other for marbles, were bolted behind the partition. Candy and marbles were delivered to the child via a tube through a partition into a clear plastic tray mounted at the bottom of the face of the apparatus.

Scheduling, illumination of lights, and recording of the responses were controlled by standard electromechanical devices.

Procedure

Multiple schedule. Each child was initially brought into the room containing the apparatus and was told that by pressing the button in the center of the panel sometimes candy and sometimes marbles would drop into the tray. The child was then told that he could keep the candy or eat it immediately. The experimenter then demonstrated how the apparatus worked and watched the child respond. After the child had earned one piece of candy, the experimenter left and the session began.

Each session began with the green light on. Responses emitted when the screen was green always produced candy; responses emitted when the screen was red always produced marbles. The candy delivered was a random mixture of after-dinner mints, small gumdrops, small pieces of bubble gum, etc. A fixed number of responses (fixed-ratio schedule) was required to produce candy and marbles. The fixed ratios for each component of the multiple schedule were independently arranged and did not reset when the lights changed.

In the first condition (*no-trade* condition) each child was told that he had to give all of the marbles to the experimenter at the end of the session. Session 1 for Subject 1 and Sessions 1 through 3 for Subject 2 were 12 min in length (12 alternations between 30-sec periods of red and green). However, a combination of fairly high rates and low response requirements (FR 10) resulted in the children earning too many candies, and the session length was reduced to 6 min for the remainder of the study (six alternations between 30-sec periods of red and green). Initially in both the red and green components, 10 responses were required to produce reinforcement (FR 10). The fixed ratio in the green (candy) component was then slowly adjusted from FR 10 to FR 35. The value of FR 35 was selected because it appeared to produce fairly high, steady rates of response. The schedule in the red (marble) component was left at FR 10.

The next condition was a *praise, no-trade* condition. The experimenter told the child: "I like marbles very much and it would make me very happy if you earned a lot of marbles. You still will not be able to keep the marbles but it would make me very proud of you if you get a lot of marbles." If the child earned three or more marbles during the session, after the session the experimenter told the subject that he was proud of him and happy that he had earned so many marbles. The schedule of reinforcement in the red component was adjusted from FR 10 to FR 35 for Subject 1 but was left at FR 10 for Subject 2, since he emitted only a few responses in this component. The schedule in the green component remained at FR 35 for both subjects.

Next, a *trade, experimenter-selected candy* procedure was instituted. The child was told: "Now we are going to do something different; now you will be given one piece of candy for every marble that you earn." After the session, the experimenter counted the marbles and then gave the child the correct number of candies, selected blindly from the candy box.

Because Subject 2 did not respond in the red component, a special procedure was used. He was told that he would immediately receive a piece of candy for each marble that he earned. As soon as the child earned a marble, the experimenter stepped into the cubicle and said: "Good, here is a piece of candy." Once the child started responding, marbles were traded after the session and the ratio was raised to FR 35. For the remainder of the experiment, an FR 35 schedule was in effect for both subjects in both components.

In the next procedure (*trade, child-selected candy* condition) a single change was made;

after the marbles were counted, the child was shown the candy box and was told that he could pick out that many pieces of candy, of any type he wished.

Each condition was continued until the response rates in each component appeared to be stable. They were then repeated for each subject with an FR 35 schedule in effect during both components. The sequence of conditions in the multiple schedule and the number of sessions for each condition are shown in Figure 1.

Concurrent procedure. After the subject had been exposed to the various multiple schedule conditions, the procedure was changed to allow subjects to switch from one component to the other. This was done by activating the second (switching) key. By pressing this key once, the child could change at any time from the green component to the red component, or *vice versa*. In the absence of switching responses, the components alternated every 30 sec. The switching key was introduced by demonstration; the experimenter simply pressed the key several times, showing the child that pressing the key changed the stimulus condition. The child was then asked to press the key a number of times. No instructions were given as to when the subject should press the switching key. The sessions remained 6 min in length.

Within this concurrent schedule procedure, the effects of allowing marbles to be exchanged after a session for *child-selected* and *experimenter selected* candy were investigated. The schedule remained FR 35; in one component marbles were delivered and in the second, candy. In the *trade, experimenter-selected* conditions, each marble could be exchanged for one piece of candy selected by the experimenter. In the *trade, child-selected* conditions, each marble could be exchanged for one piece of candy selected by the child.

During the next-to-last concurrent condition (S1, Sessions 99 to 101; S2, Sessions 96 to 99) when marbles could be exchanged for child-selected candy, the experimenter recorded what type of candy was selected by each child. Then, the switching key was made inoperative. Responses during red produced marbles (which could be exchanged for child-selected candy) and responses during green produced candy selected systematically to match as closely as possible the candy previously selected by the children. Following this, the switching key again was made operative and, marbles could be exchanged for child-selected candy. In addition, the children were brought into the room before sessions and asked to sit down in a chair while the experimenter loaded the candy dispenser. The chair was situated in a position where the child had a clear view of the dispenser being loaded. Again, the experimenter loaded the dispenser with an assortment of candy that matched those selected by the child in the preceding conditions. The sequence of conditions in the concurrent procedure and the number of sessions for each are shown in Figure 2.

Results and Discussion

Multiple Schedule

The basic experimental manipulations in the multiple schedule phase of the study were carried out in the red component. Since conditions during green were basically the same after the schedule was adjusted to FR 35, rate in the green condition was used as a standard for evaluating possible effects during red.

The results of the multiple schedule phase are shown in Figure 1. Major differences between response rates in the green component (candy available on an FR 35 during the session) and the red component (marbles available during the session on an FR 35) occurred when the marbles could not be traded for candy (*no-trade* conditions). When the marbles could be traded for candy, there was little difference between the rates in the red and green components irrespective of the method of trade. That is, whether the child or the experimenter selected the candy, there were no consistent differences in response rates.

Concurrent Schedule

In the concurrent procedure, there were a number of possible dependent variables. In addition to response rate, there was total time spent in each component, total number of responses emitted in each component, and the number of switching responses from one component to the other. Upon analysis, three of these measures were redundant: total respones in a component, time in a component, and switching responses into a component. As a consequence, only time in a component is presented. The results of the switching procedures are presented in Figure 2.

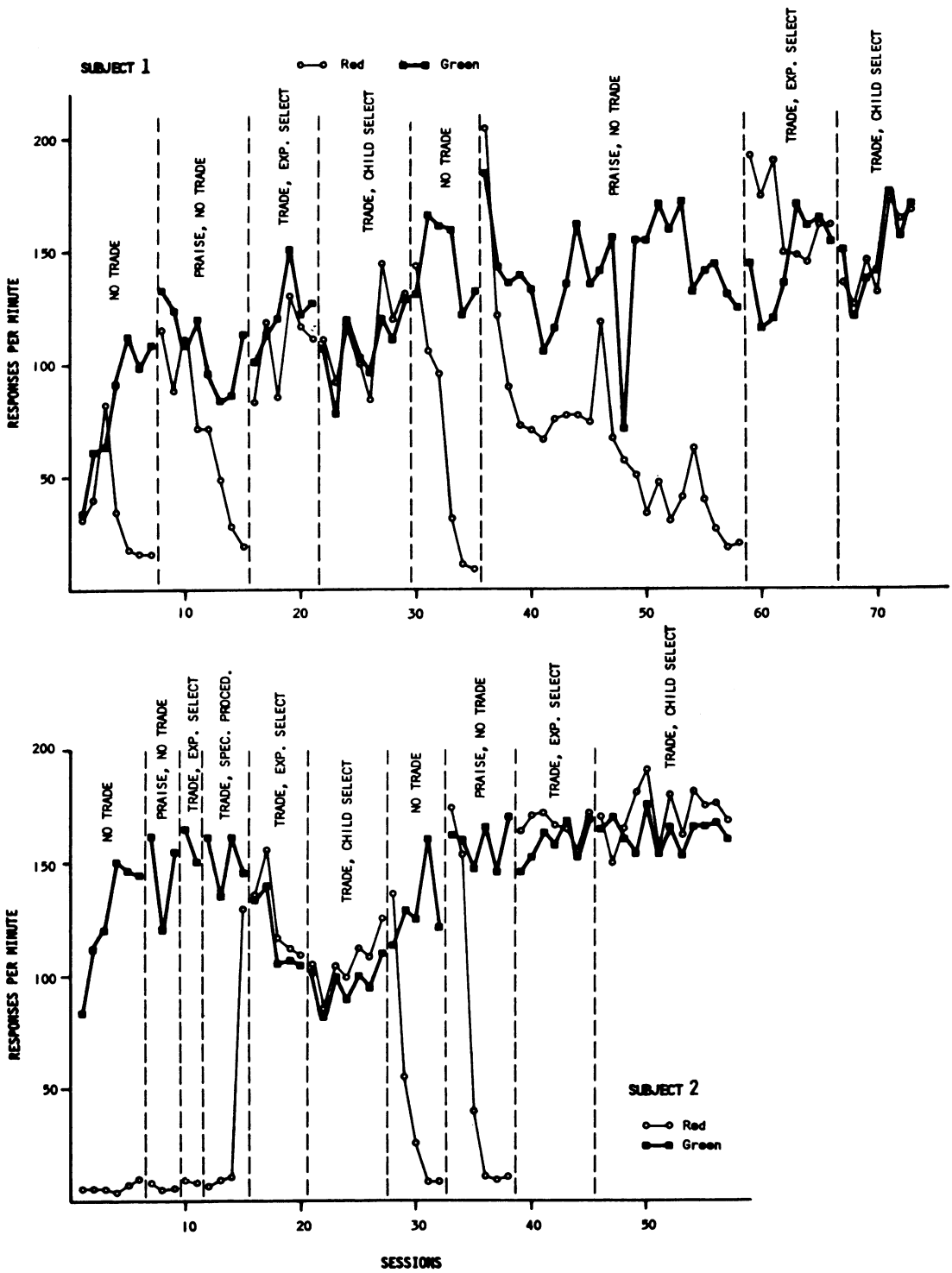

Fig. 1. Rate of response of Subject 1 and Subject 2 in the red and green components of the multiple schedule. In the green component, candy was delivered for responses. In the red component, marbles were delivered for responses. The labels denote the various trading conditions for marbles.

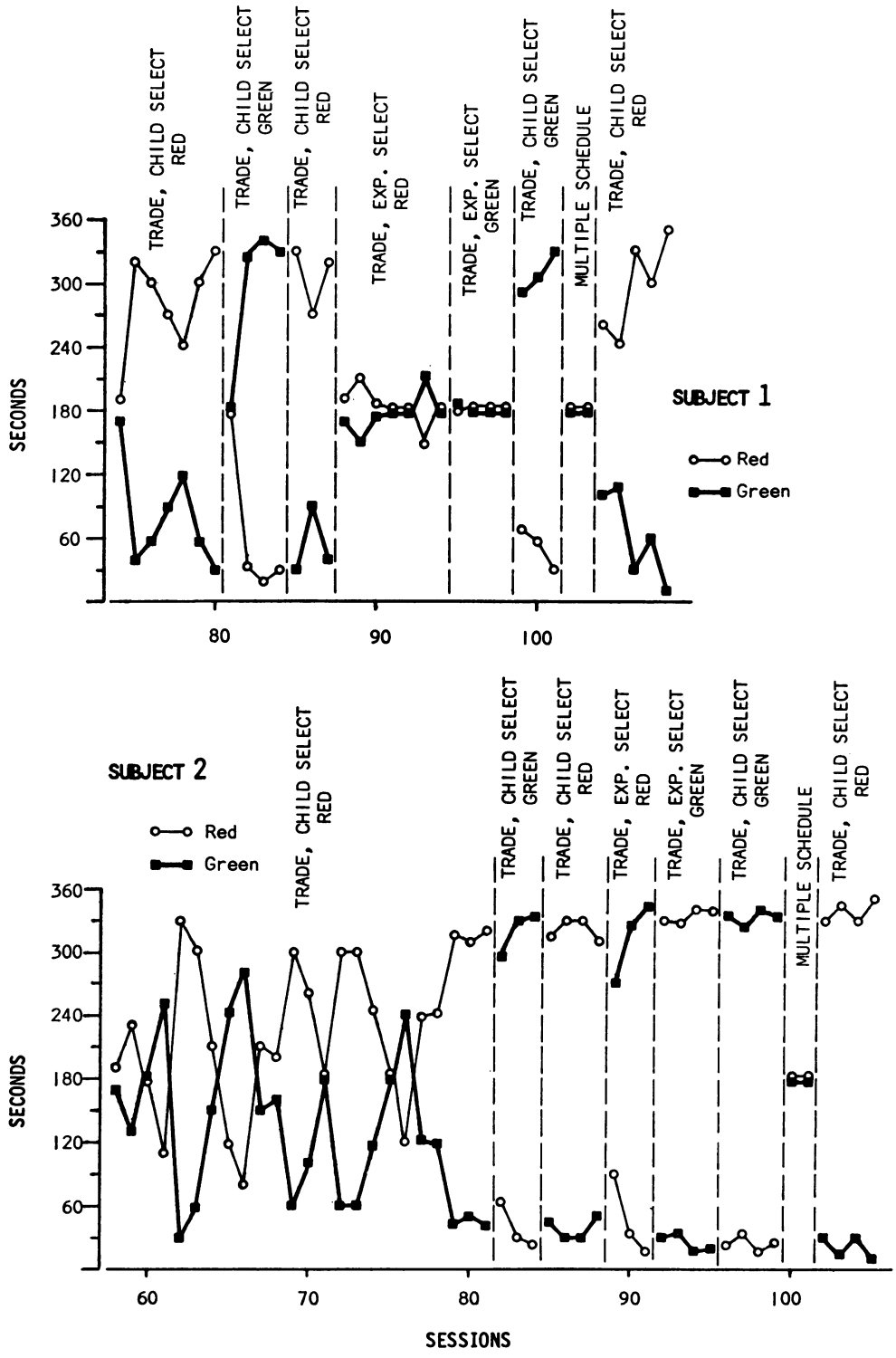

Fig. 2. Time spent in the red and green components of the multiple schedule by Subject 1 and Subject 2 when switching was allowed. Marbles were delivered for responses in either the red or green components and could be traded for child-selected or experimenter-selected candy as noted.

The introduction of the switching key had an immediate and consistent effect on Subject 1. When marbles available in the red component could be traded after the session for the child's choice of candy, he spent all of this time responding during red. When the marbles were moved to the green component, the subject reversed this component preference and spent most of his time responding during green. When marbles were again available during red, the subject again spent most of his time responding during red. In contrast, when the choice was between immediate candy and marbles traded for experimenter-selected candy, the child simply quit switching. During those two conditions (trade, experimenter-selected, red; and trade, experimenter-selected, green) he spent approximately equal amounts of time in each component. When the child-selected candy procedure was reinstated (Session 99) Subject 1 again showed a strong preference for earning marbles.

Two sessions where the switching key was inoperative (Sessions 102 and 103) were designed to bring the subject into contact with the information that the candy available during these sessions was approximately the same as he was choosing after the sessions. Nevertheless, when the switching option was reintroduced and marbles could be exchanged for child-selected candy (Sessions 104 to 108), the subject spent the majority of time working for the marbles.

Subject 2's performance under the initial switching conditions (trade, child-selected, red) was more variable than Subject 1's. Subject 2's performance vacillated between responding mainly during red and responding mainly during green, until after about 20 sessions he began showing a steady preference for responding that produced marbles (red component).

From that point on, Subject 2's performance was similar to that of Subject 1: when marbles could be exchanged for child-selected candy, the subject spent the majority of time in the component where responses produced marbles. The major exception was in the condition where the marbles were traded for experimenter-selected candy. Here, Subject 2 spent almost all of his time responding in the component where immediate candy was available. Subject 2's performance in the final two conditions was nearly identical to the performance of Subject 1.

During the concurrent procedure, children responded somewhat faster in components where marbles could be exchanged for child-selected candy *versus* experimenter-selected candy. The mean response rate over all child-selected candy conditions was 190 and 180 response per minute for S1 and S2 respectively, whereas the mean response rate over all experimenter-selected candy conditions was 105 and 132 responses per minute for S1 and S2 respectively. Thus, child choice of reinforcers appeared to affect positively both rate and preference within the concurrent format.

EXPERIMENT II

A feature of token systems that has been emphasized by many investigators is the immediate delivery of a token stimulus for desired behavior. The major argument is that a concrete stimulus will more effectively bridge the delay between the behavior and some consumatory response (Ayllon and Azrin, 1968; O'Leary and Drabman, 1971). Experiment II was designed to examine the effects of having or not having immediate token delivery.

METHOD

Subjects and Apparatus

The subjects were two kindergarten girls of normal social and physical development; both children attended a public kindergarten. The apparatus was the same as that used in Experiment I.

Procedure

Multiple schedule. In all conditions, exchanges were for experimenter-selected candy. The initial procedures were the same as in Experiment I with a session length of 6 min and an FR 35 schedule in both components. In the green component, responses produced immediate candy on an FR 35 schedule. All experimental manipulations were carried out in the red component. They were *no-trade;* the *praise, no-trade;* and the *trade* (experimenter-selected candy) conditions. In the *trade* condition, marbles were delivered on an FR 35 schedule during red, and marbles could be exchanged for experimenter-selected candy after a session.

Next, immediate marble consequences were eliminated in the *trade, no-marbles* condition. However, the child was given the number of

candies after a session that he would have earned had there been an FR 35 schedule. The subjects were told: "From now on, you will not get any marbles for working when the red light is on, but after we stop for the day, I will give you as many pieces of candy as you would have gotten for the marbles. You can still get candy for working during the green light." In the *no-trade, no-marbles* condition, marbles were not delivered for responses in the red component and in addition, responses in this component did not result in candy after a session. The sequence of conditions in the multiple schedule and the number of sessions for each condition are shown in Figure 3.

Concurrent schedule. Following the multiple schedule manipulations, a series of concurrent conditions were presented to determine the effect on preference of eliminating or maintaining the marbles as immediate consequences for responding in the red component. As in Experiment I, the switching option was instituted by activating the second key. By pressing this key, the subject could switch from one component of the multiple schedule to the other. If no switching responses occurred, the components automatically alternated every 30 sec. The subjects could press the switching key at any time during the 6-min session. Two conditions from the multiple schedule procedures were investigated: the *trade, no-marbles* condition and the *trade* condition. In the *trade, no-marbles* condition, candy was available immediately on an FR 35 schedule for responses in the green component. In the red component, responses did not produce marbles, but candy was given to subjects after a session as if marbles had been delivered on an FR 35 schedule. In the *trade* condition, immediate candy was delivered on an FR 35 schedule for responses in the green component. In the red component, responses produced marbles on an FR 35 schedule and these marbles could be exchanged after sessions for experimenter-selected candy. The sequence of conditions in the concurrent procedure and the number of sessions for each are shown in Figure 4.

Results and Discussion

Multiple Schedule

Figure 3 shows the rate of response in each component. When marbles earned in the red component could not be exchanged for candy (*no-trade* conditions), both subjects emitted few responses in this component as compared to the component in which candy followed responses. Allowing subjects to trade marbles after the session for candy (*trade* condition) substantially increased in the number of responses. These results were similar to those obtained in Experiment I.

Removing the immediate marble consequence while continuing to give candy after the session (*trade, no marbles*) had little effect on the performance of either subject, except for some instability in rate for Subject 4. Rate of responding during red (no immediate consequences for responses) was approximately equal to that during the green (immediate candy following responses).

Concurrent Schedule

When the switching key was introduced, candy was available during green and responding during red had no immediate consequences but resulted in candy after the session. Figure 4 shows that there was an immediate and increasing preference for green, the immediate candy component. When the marble consequence was reinstated during red (*trade* condition), Subject 3 eventually showed no preference for one component over another, while Subject 4 showed a reduced preference for green, the immediate candy component. Removing the marble consequence again produced a strong preference for green. Reinstatement of the immediate marble consequence resulted in Subject 3 showing little or no preference and Subject 4 a reduced preference for green.

Manipulations within the concurrent procedure did not appear to have consistent differential effects on response rates. Response rates during green were approximately the same as during red (approximately 180 responses per minute for both subjects) irrespective of whether or not marbles were delivered during red.

In summary, the rate of response was not affected by removing the immediate marble consequence in either the multiple or the concurrent schedules as long as candy was available after the session. In contrast, preference in the concurrent procedures did show effects of immediate marble consequences. The subjects spent more time in the component providing immediate candy than the component provid-

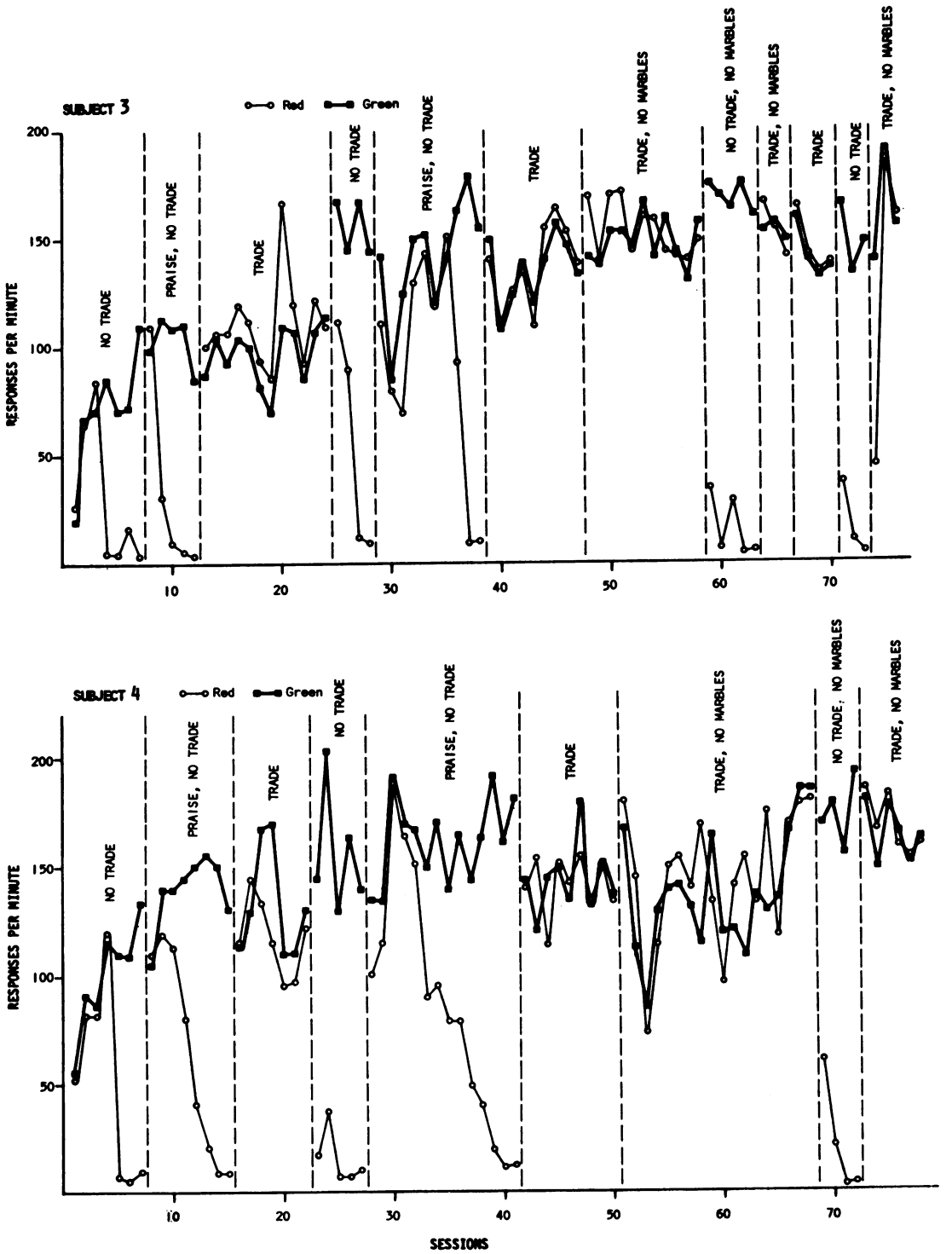

Fig. 3. Rate of response of Subject 3 and Subject 4 in the red and green components of the multiple schedule. In the green component, candy was delivered for responses. In the red component, marbles were delivered for responses. The labels denote the various trading conditions.

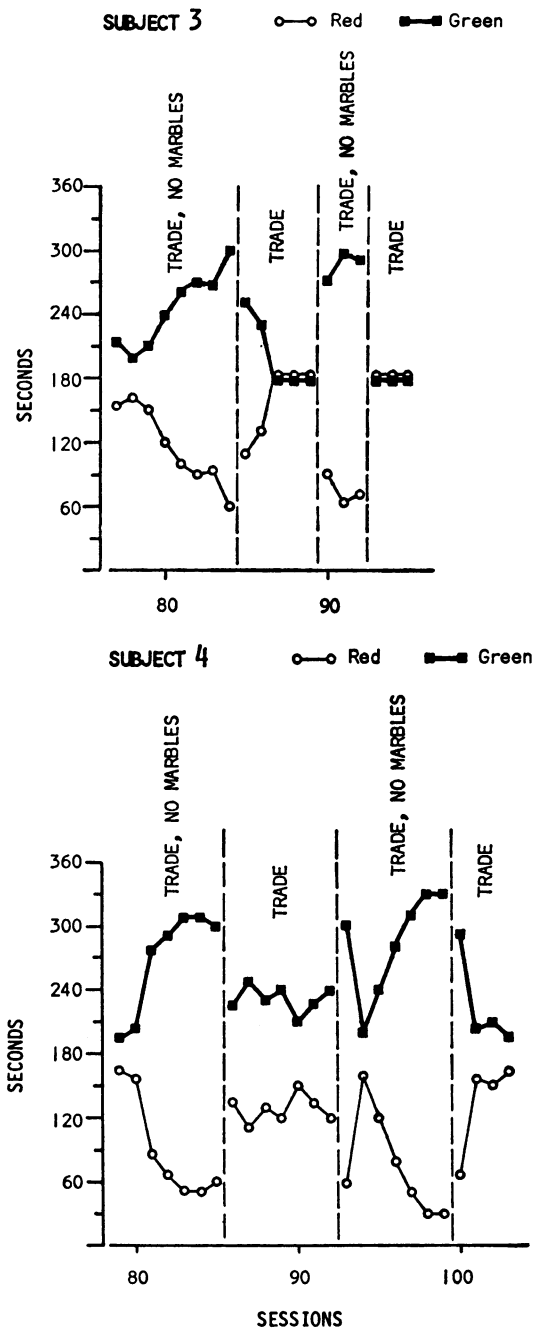

Fig. 4. Time spent in the red and green components of the multiple schedule by Subject 3 and Subject 4 when switching was allowed. In the green component, candy was delivered for responses. In the red component, at times marbles tradeable for candy were delivered (Trade), and at other times no marbles were delivered for responses but the child was given candy after the session as if marbles had been delivered (Trade, No Marbles).

ing delayed candy but no marbles during the session. However, when marbles followed responding during red, one subject showed no preference and the other a reduced preference for the immediate candy.

GENERAL DISCUSSION

Experiment I examined the effects of manipulating aspects of a token-exchange system. Most advocates of token systems or economies emphasize the subject's opportunity to select his own reinforcer as being an important factor in the system because it allows the subject the opportunity to respond to changes in motivation by a change in the selection of terminal reinforcers. However, in Experiment I, there were no major differences in rate of response to suggest that subject-selected reinforcers were any more effective than experimenter-selected reinforcers. When the multiple schedule was changed to a switching or concurrent procedure, the subjects showed a clear preference and a somewhat increased rate of responding for marbles that could be traded for subject-selected reinforcers.

In the concurrent procedure, moving the marbles from the red component to the green component and back, with subsequent changes in the subjects' preferences, indicated that the marbles and not a color preference controlled the subjects' behavior. Conditions in which marbles could be exchanged for experimenter-selected candy resulted in an immediate change in preference from marbles to candy, demonstrating that the opportunity to select the reinforcers was controlling the behavior and not a bias on the part of both subjects for earning marbles.

At this point, at least two distinct, if not mutually exclusive, interpretations were possible. First, it may have been that there was an important difference in the variety of candies selected by the experimenter and those selected by the subjects. Second, the opportunity to choose may have been a reinforcing event independent of the subsequent changes in stimuli that choices produced. It was possible that both factors contributed to the results to that point.

An attempt was made to separate these factors. The last two manipulations of Experiment I were designed to show the subjects that the immediate candy available during the ses-

sion was exactly the same as the candy the subjects had been consistently choosing in exchange for marbles after the last three or four sessions. Returning to the multiple schedule forced the subjects to come into extended contact with the contingencies in the immediate candy component; furthermore, the subjects were asked to watch the experimenter load the candy dispenser. Nevertheless, when the subjects were then given the opportunity to earn either immediate experimenter-selected candy during the session or marbles that they could trade after the session for their own choice of candy, they worked almost exclusively for marbles. After the experiment was terminated, the subjects were asked about the candy that was available during the session. They reported that it was the same as the candy they were choosing after the session. These results suggest that the opportunity to choose may itself have been as important as the backup reinforcers produced.

Voss and Homize (1970) presented somewhat analogous data indicating that rats prefer routes to a maze goal box that provided alternative paths over routes that provide only a single path. In a related area, Lovitt and Curtiss (1969) presented data indicating that self-imposed contingencies of reinforcement for one child produced higher rates of academic performance than contingencies imposed by the teacher. Thus, the results of these two studies also suggest that the opportunity for subjects to choose alternatives may play an important role in affecting their behavior.

In Experiment II, eliminating immediate marble consequences in the multiple schedule had little effect on responding. In the concurrent procedure, the subjects displayed a clear preference for the component in which there was immediate candy consequences as compared to the component in which there was no immediate consequences for responses but candy was delivered after the session. When marbles exchangeable for candy after the session were delivered immediately after responses, Subject 3 displayed no preference and Subject 4 displayed a slight preference for the component where immediate candy was delivered.

Compared to the immediate delivery of candy for responses in one component, there were two types of delay involved for responses in the other component: delay of any consequences when marbles were eliminated, and delay in trading the marbles for candy when marbles were delivered. That preference for immediate candy was reduced or eliminated when immediate marbles were delivered, suggests that the delay involved between the delivery and exchange of tokens is less disruptive than the delay between responding and the delivery of consequences afterwards. These results also suggest, in terms of preference, that tokens may function somewhat like immediate consumable reinforcers.

In recent years, several studies have indicated that preference situations may be more sensitive to the effects of independent variables than is rate of response to a single operandum (Catania, 1963; Favell, 1970; Neuringer, 1967; Schwartz, 1969; Weiner, 1966). These general findings were replicated in both Experiments I and II.

The analysis of the present results for the design of token systems must be interpreted in terms of the typical settings (*e.g.*, classrooms, hospital wards) where token systems have been employed. Which of our laboratory procedures, the multiple schedule or the concurrent schedule, is the appropriate analogue? In the multiple schedule, no reinforced alternative behaviors were available, while the concurrent procedure involved the direct comparison of alternative reinforced behaviors. Since in most situations where token systems have been employed there may be a variety of other behaviors maintained by uncontrolled reinforcers outside the token system (*e.g.*, peer-reinforced behaviors), the concurrent procedure would appear to be the more appropriate experimental analogue. If this is correct, providing subjects with the opportunity to choose their own reinforcers in exchange for tokens and providing immediate delivery of tokens for desired behavior may increase the relative amount of behavior controlled by the token system.

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