Type of Reinforcer and Mode of Presentation

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Introduction

The area of concern of this study was the problem of facilitating learning in urban public schools, particularly in the inner city setting. The study's spcecific focus of interest was the use of reinforcers, to expedite learning by inner city children at the preschool level. Many such children begin school lacking the academic orientation which is commonly cultivated in a middle class environment. They are unfamiliar with the learning modes and content of the school setting and see little pragmatic use in the skills they are expected to acquire. These children often experience unusual difficulties with the academic curriculum from the outset, leading to cumulative deficits as they progress through the school years.

In order to redirect this trend, there has been an increasing emphasis on the use of primary reinforcers for these children, at the earliest possible stage of intervention. In most cases, however, the logistics of classroom management have resulted in the use of tokens which are exchangeable for a primary reinforcer following the learning period. When expanded over time and a selection of reinforcers, this system has often been referred to as a "token economy." The purpose of this study was to investigate possible differences in the reinforcement effects.

Two types of reinforcer (candy versus tokens) and two modes of presentation (presented-by-the-observer versus non-observer-presented) were compared for their effect on learning in a spatial task. One hundred (100) children, ages 5.5 to 6.5, were randomly assigned to the cells of 2 x 2

factorial design. The task was the repeated identification of a particular cup in a horizontal array of 15 cups. The task followed an initial trial in which the child discovered the correct location by trial and error.

The candies used as initial reinforcers were the same kind used as the immediate backup items for the tokens. In the observer-presented mode, the candy or token was given to the child by the observer, contingent on the child finding an X-mark under the correct cup; in the non-observer-presented mode, the candy or token was found under the cup directly. In either mode, the observer exhibited no behaviors of approval or disapproval other than presenting the candy or token.

Literature Review

Primary reinforcers such as food and water have long been standard reinforcers in experiments using animals as subjects (Thorndike, 1903; Pavlov, 1927; Skinner, 1938; Hull, 1943; Deese & Hulse, 1967; Bugelski, 1971). However, the customary deprivation procedures are not normally appropriate for use with children (Bijou & Sturges, 1959; Honig, 1966). As a substitute primary reinforcer, candy is known to be fairly universal, effective and durable, although subject to satiation as well as consequences to children's health when used extensively (Honig, 1966; Bijou and Baer, 1966). For these reasons, a large proportion of experimental and classroom procedures have introduced reinforcers in the form of tokens, exchangeable for either primary reinforcers (e.g., candy, cookies) or conditioned reinforcers (e.g., toys, trinkets, privileges).

The research on the use of tokens indicates a high effectiveness of this form of conditioned reinforcer (Wolfe, 1936; Cowles, 1937; Myers, 1960; Bijou and Baer, 1966; Staats, Finley, Minke, Wolfe and Brooks, 1964;

Bushnell, Wrobel and Michaelis, 1968; Wolf, Giles and Hall, 1968; O'leary, Becker, Evans and Saudergas, 1969; Heitzman, 1970; Chadwick and Day, 1971, Brigham, Grubard & Stans, 1972).

In appraising the above studies of token reinforcement, it should be noted that social approval may be an extraneous variable. Social approval has been well established by research as a powerful secondary reinforcer (Harris, Wolf & Baer, 1964; Hall, 1968). In many of the reported studies of token reinforcement the teacher's or administrator's social approval has been built into the treatments in such a way that the effect of tokens cannot be isolated from it, except as an increment, and in many cases not at all (Hanley, 1970). Thus it is possible that the effectiveness of tokens may in part derive from the way in which they appear to focus the social attention of the observer on the recipient (Mandelker, Brigham and Bushell, 1970).

In summary of the research on tokens, it appears that token reinforcement has demonstrated its effectiveness in altering behavior and in increasing academic performance under certain conditions. However, the effectiveness of tokens has not been compared directly with the effectiveness of a primary reinforcer such as candy. Indeed, the greater convenience and lesser distraction of a numerical point system appear to have led to its substitution even for tangible tokens in most academic settings, with little empirical investigation of its comparative effects (O'Leary & Drabman, 1971).

With regard to mode of delivery of the reinforcer, the literature tends to treat the mode of presentation as incidental to the reinforcer itself. As Lipe and Jung report in their review of "modes of incentive

delivery" (1971), "Most studies of direct, personal delivery of incentives involved teacher praise, attention, and approval." In contrast, "Mechanical modes of incentive delivery have usually emitted auditory or visual signals..." Plainly, some types of reinforcers determine their mode of delivery as either personal or mechanical. On the other hand, the development technology is erasing the clarity of the distinctions. The consoles used in computer assisted instruction "talk", and teachers in behavior modification programs are disciplining themselves to simulate computers (Homme, 1971, Packard, 1970). A number of reinforcers do lend themselves to manipulation of delivery mode, e.g., feedback (Geis & Chapman, 1971).

Of the studies reviewed in this chapter, only a few used an experimental design permitting statistical interpretation. As Birnbrauer (1971) points out, the designs generally used in the "experimental analysis of behavior" do not adhere to the group-statistical models of research: subjects are not randomly selected; the numbers of subjects are small (often less than ten); control groups are not used; data are not subjected to inferential statistical tests; conclusions are based on within-subject observations as treatment is applied, withdrawn, then reapplied. On the other hand, as Schutz and Baker (1968) point out, the difficulties of controlling experimental treatments in group research under natural classroom conditions frequently "washes out" differences. It is also often impractical or impossible, in a natural classroom setting, to match the sample or the treatment delivery to the requirements of the design. Furthermore, intergroup replication is regarded by experimental analysts (as practitioners of the experimental analysis of behavior have come to be

called) as inherently less generalizable than intrasubject replication (Sidman, 1960).

Regardless of methodological approach, however, there appears to be a lack of empirical data on the comparative effectiveness of primary versus token reinforcers. There also appears to be a lack of empirical data on the mode of presentation of reinforcers. It was in these areas that the present study was intended to add an increment of knowledge.

Procedures

The specifics of the experimental task were as follows: The experimenter hid a piece of candy, a token or an X-mark under one of fifteen cups. On being brought into the experimental area, the child was told that a candy, token or X-mark had been hidden and that on finding it, he or she might have it (in the case of candy), might exchange it for candy (in the case of a token), or would be given either a candy or an exchangeable token by the observer (in case of an X-mark). The child was told only about the one contingency to which he had been assigned. In all cases, the task of the child was to find the correct cup. In trials subsequent to the initial (purely chance) discovery, the child was told that the same cup was correct. He was asked if he could point to it. He then was instructed to lift that cup and see. If nothing was under the cup, he was told to go ahead and find the correct cup. The correct location was varied from subject to subject, being either the 6th, 7th, 9th, or 10th cup from the subject's left. These locations were determined by random drawing. The experimental model is shown below. The horizontal and vertical headings identify the independent variables. The operational definitions are stated within their respective cells.

	Type of Reinforcer	
	Primary (candy)	Conditioned (tokens)
Non-observer-presented	S finds candy under cup.	S finds token under cup. S puts token in box and takes candy.
Observer-presented	S finds X-mark under cup. E gives S a candy.	S finds X-mark under cup. E gives S a token. S puts token in box and takes candy.

Figure 1
Diagram of Experimental Variables and Operational Procedural Definitions

The dependent measure was the number of unsuccessful attempts prior to criterion. Criterion was established by two consecutive trials in which the correct cup was selected on the first attempt. Attempts, trials and criterion were defined as follows:

Attempt: Any cup lifted. A successful attempt was the lifting of the correct cup.

Trial: The sequence of cups lifted prior to and including the correct cup. Before each trial, the subject was sent away from the experimental area. The cups were again placed in line, and the candy, token or X-mark again placed under the correct cup. Thus, each trial represented a new start, and consisted of one or more attempts. A successful trial occurred when the first cup lifted was correct.

Criterion: Two consecutive trials in which the first cup lifted was the correct cup, that is, two consecutive successful trials. Thus, increments in the effectiveness of the reinforcer correspond to decrements in the dependent measure, the number of unsuccessful attempts.

Results

Analysis of variance was used to evaluate the data. Tokens were found to be significantly more effective than candy, in terms of fewer unsuccessful attempts, at the $< .05$ level. The difference between observer-presented and non-observer-presented modes was not significant, nor was the interaction between type and mode. The superiority of tokens over candy prevailed across sexes, age groups and counting-ability groups.

The analysis of variance of the number of unsuccessful attempts under reinforcement by the two types of reinforcer, candy and tokens, and the two modes of presentation, non-observer-presented and observer-presented, is presented in Table 1.

Analysis of Variance of Number of Unsuccessful Attempts under Reinforcement by Candy and Tokens when Non-observer-presented and Observer-presented

	Sum of Squares	d.f.	Mean Square	F ratio
Main Effects				
Type (candy vs. tokens)	1489.9543	1	1489.9543	6.5122*
Mode (non-observer-presented vs. observer-presented)	80.9999	1	80.9999	.3540
Interaction	190.4453	1	190.4453	.8324
Error	21966.1760	96	228.7935	

*p = .0123

The F ratio for the type of reinforcer was 6.5122, significant at $p = .0123$. The level selected for rejection of the null hypothesis in this study was .05. Therefore, the null hypothesis (that there exists no difference in the number of unsuccessful attempts under the two types of reinforcer) was rejected.

Rejection of the null hypothesis permitted a comparison of means in order to determine which type of reinforcer was more effective (in terms of fewer unsuccessful attempts). The mean number of unsuccessful attempts under the two types of reinforcer is shown in Figure 2. For each mean, n = 50.

As shown in Figure 2, the mean number of unsuccessful attempts under reinforcement by candy was 15.48, as compared with 7.76 unsuccessful attempts under reinforcement by tokens. Performance was superior when reinforced by tokens.

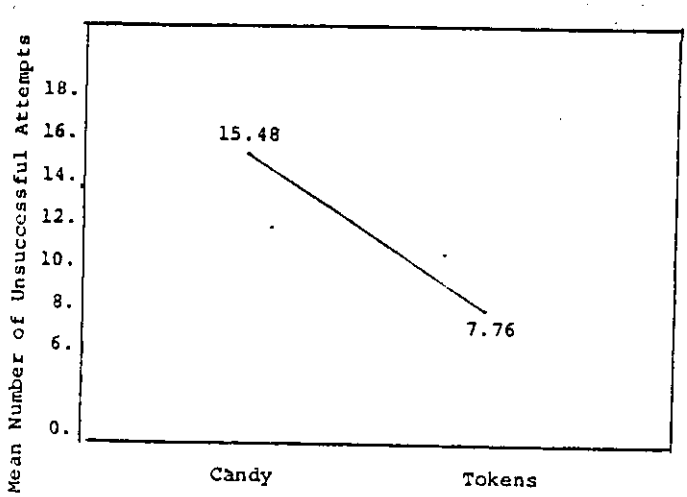

Figure 2
Mean Number of Unsuccessful Attempts under Reinforcement by Candy and Tokens

Discussion

The finding that use of tokens resulted in more efficient learning was interpreted in the context of the reinforcing power of environmental manipulation by the child (Harlow, 1950; Woodworth, 1958; White, 1959; Dwyer and Elligett, 1970). If the ultimate candy were the only reinforcer, the intermediate function of tokens would have constituted an interruption and delay of reinforcement and thus would have involved loss of effectiveness. That their effectiveness was in fact greater suggested that the process of exchanging the tokens for candy was reinforcing in itself.

This study therefore indicates that the logistical advantages of tokens over primary reinforcement may safely be utilized without reducing the effectiveness of the reinforcement, providing the following limitations of generalizability are kept in mind.

(1) The experimental task is not typical of school tasks. It was selected for its power to isolate the experimental variables rather than its similarity to the more academic tasks of the regular school curriculum.

(2) Every subject could be reinforced on every trial. Universal reinforcement was made possible by the selection of a task which every subject could accomplish, since each subject lifted cups until by design or accident, he lifted the correct one. This reinforcement contingency is not typical of school reinforcement contingencies.

(3) The exchange of tokens for candy was as immediate as possible, directly following each trial. This immediacy of exchange is not typical of "token economies." (It should be noted that the children were required to save the candy until the end of the school day under all contingencies.)

(4) The subjects of this study were engaged in isolated interaction with the observer, to a degree which is not typical of school interactions.

The extent to which these experimental characteristics deviate from normal school procedures, and the extent to which such deviations affect the generalizability of findings, is a question for professional judgment. Additional research may provide some relevant guidelines. Meanwhile, the present study strongly suggests that the expediency of the use of tokens does not reduce the effectiveness of the ultimate reinforcer, and under certain circumstances, may enhance it.

Implications and Suggestions for Classroom Use

In order to take into account the study's finding and limitations,

as well as the literature on token economies, the teacher of inner city children may wish to consider the following suggestions in initiating a system of token reinforcement.

1) At the outset, the teacher may wish to use candy as the reinforcer. Since continuous consumption of candy is undesirable, the teacher may provide containers in which the candy is to be kept until specified times.

2) The teacher may then wish to introduce tokens in place of candy, allowing pupils to exchange the tokens for candy immediately. (This is the condition of this study's findings.)

3) The exchange may be gradually deferred.

4) Other items may then be added as back-up items. Some of these may require the accumulation of several tokens.

5) Eventually back-up items may include a number of items which are made available only for temporary use. To these may be added privileges and valued activities.

6) The teacher should specify varying contingencies for the reinforcement of individual pupils. Each pupil is in a different stage of successive approximations of new behaviors, and each of these approximations must be reinforced if they are to culminate in the desired modification. That is, every pupil should be reinforced in his own successive approximations, however incomplete they may be.

7) The teacher may introduce a token economy for any aspect of the curriculum or for any part of the school day. The teacher may wish to select, as the initial tasks, those which are related to conduct.

8) The academic tasks most easily brought under the contingencies of reinforcement in a token economy are those related to rote learning.

9) The teacher may wish to avoid using a token reinforcement system for tasks which are intrinsically reinforcing. The introduction of reinforcement for such tasks may depress the desired behavior if reinforcement is withdrawn.

10) Research over the years has consistently demonstrated the effectiveness of novelty. In initiating a token economy, the universal, all-time strategy. At any time a teacher concludes that a token economy is losing its effectiveness, it should be terminated at least temporarily. The effectiveness of this system of reinforcement may be best sustained by using it selectively for limited tasks during limited intervals.

It is hoped that this study may have added an increment to the body of knowledge concerning the use of a token economy in contingency management.

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