THE USE OF CONTINUOUS REINFORCEMENT SCHEDULES AS A BEHAVIORAL TOOL

by

Eva Ellis Conrad

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STATEMENT OF AUTHOR

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SIGNED Eva Ellis Conrad

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Ralph J. Wetzel
Professor of Psychology

7-27-73
Date

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ABSTRACT

This study is a laboratory test of a proposed behavior modification technique of switching reinforcement to a continuous schedule to decrease resistance to extinction. Twenty-four first graders were reinforced with candy for bar-pressing on one of four acquisition reinforcement schedules: CRF, VR5/CRF, CRF/VR5, or VR5. The dependent variable was the number of responses during extinction. Extinction was defined as complete whenever a child indicated he wanted to stop playing the game or at the end of 15 minutes in the extinction phase, whichever came first. There were no significant differences among the four groups. A logarithmic transformation of the data also yielded no significant differences in the number of responses to extinction across the four groups. The trend of the data, however, does support the investigation of this technique in the natural environment.

INTRODUCTION

Control of human operant behavior, in part, entails knowledge and control of the schedule of reinforcement by which behavior is maintained. Every reinforcer is delivered according to some schedule, although vast differences exist in schedules' complexity and obtrusiveness. Knowledge of the schedule of reinforcement is an important variable in controlling the rate of operant responding.

The fact that various schedules produce typical and predictable patterns of acquisition and extinction of operant behavior with infrahuman subjects has been well established experimentally (Ferster and Skinner, 1957; Catania and Reynolds, 1968). Various studies with different species and tasks generally produce similar results for the five simple reinforcement schedules. A continuous reinforcement schedule is one in which every occurrence of a response is followed by reinforcement. With positive reinforcement, this schedule typically produces a regular pattern of responding and a rapid return to operant level of responding during extinction. On a ratio schedule, the first response after a certain number of responses is reinforced. With positive reinforcement, both fixed and variable ratio schedules generate a

high rate of responding. However, the extinction rate of responding is much higher after a variable ratio schedule than after a fixed ratio or a continuous reinforcement schedule. In an interval schedule, the first response after a certain number of minutes or seconds is reinforced. With positive reinforcement, both fixed and variable interval schedules of reinforcement produce moderate but stable rates of responding and can maintain operant behavior for long periods of time with relatively few reinforcers. Variable interval schedules result in extremely durable response patterns which are very resistant to extinction. Investigations of children's response patterns to various reinforcement schedules have been neither as extensive nor as conclusive as the research with infrahuman subjects.

The classic study in the area of control of children's acquisition of a free operant task by manipulation of reinforcement schedules was done by Long, Hammack, May, and Campbell (1958). Approximately 200 children ranging in age from 4 to 8 years participated in this research. In brief, the results indicate that fixed ratio (FR) schedule control is possible and patterns of responding resemble those of infrahumans. The initial ratio must be neither too low (2 to 10) nor too high (above 60) to achieve a ratio-like pattern of responding with children. The establishment of typical

fixed interval (FI) responding is difficult and entails either the initial use of a variable interval (VI) .05 minute schedule followed by a shift to FI 1 minute, or the initial use of FI 1 minute with no previous experience of intermittent reinforcement. Like the FR patterns, children acquiring an operant behavior on VI schedules of .05 or 1 minute performed in a way similar to other organisms.

Laboratory studies of reinforcement schedules with retarded children (Spradlin, Girardeau and Corte, 1965; Orlando and Bijou, 1960) generally agree with the infrahuman response data. Children's responding on the fixed interval schedule appears to be the major exception. Spradlin, et al. (1965) noted some difficulty in attaining control over children's behavior with this schedule and Long, et al. (1958) found that some children's response rates were never controlled by the FI schedule. A fixed or variable ratio schedule generated a high rate of responding as long as the ratio was not in excess of 650 (Spradlin, et al., 1965). Variable ratio schedules result in fairly high and constant rates of responding in both retardates (Orlando and Bijou, 1960) and normals (Long, et al., 1958). These laboratory studies of schedule control of a free operant task indicate that behavior control through schedule manipulation is an effective technique of behavior change.

The importance of the schedule by which behavior is maintained and/or by which behavior is to be reinforced is frequently stressed in applied literature (Ayllon and Azrin, 1968; Gardner and Stamm, 1971). Manipulation of the ratio of a fixed ratio reinforcement schedule (Winkler, 1970) or of the interval of a variable interval schedule (Henderson, 1968) are frequently used techniques in token economy systems.

In conjunction with the positive reinforcement of incompatible behavior, two techniques for the modification of inappropriate behavior are punishment and extinction. Punishment may involve either the presentation of a negatively reinforcing stimulus contingent on the inappropriate behavior or the removal of a positive reinforcer contingent on the inappropriate behavior. Punishment has been found to result in only temporary suppression of behavior (Reynolds, 1968), and may produce interfering emotional responses (Solomon, 1964). Although punishment has been used successfully in therapeutic settings to control self-destructive behavior (Bucher and Lovaas, 1970), it is generally not the recommended technique to control inappropriate behavior (Tharp and Wetzel, 1969).

Extinction involves the cessation of the reinforcement that is maintaining the inappropriate behavior and has proven to be a more desirable behavioral tool for the modification of inappropriate behavior. Williams

(1959) determined that an infant's crying was maintained by parental attention. The procedure of ignoring the crying resulted in rapid extinction. Hart, Allen, Buell, Harris, and Wolf (1964) successfully eliminated operant crying in two preschool males. During baseline, the crying appeared to be reinforced by teacher attention. The treatment of ignoring the crying and positively reinforcing constructive behavior resulted in extinction of the crying response. A third experimental phase in which the teacher returned to her baseline behavior confirmed that crying was maintained by teacher attention. Boer and Sipprelle (1970) used extinction procedures to modify the avoidance behavior of a four-year-old female. Treatment consisted of ignoring the child's anxiety in the presence of M.D.'s and positive reinforcement of her cooperative behavior with M.D.'s. Conger (1970) determined that the soiling behavior of an otherwise normal nine-year-old encopretic male was maintained by the mother's attention. Extinction procedures of consistently ignoring the soiling behavior were rapid and successful in modifying this inappropriate behavior. A three-month follow-up revealed that no symptom substitution or relapse had occurred. Extinction procedures have also proven successful with mentally retarded (Wolf, Birnbrauer, Williams and Lawler, 1965) and psychotic children (Wolf, Risley, and Mees, 1964).

A laboratory-established pattern of behavior with potential application in applied settings is the greater resistance to extinction evidenced after the organism has been maintained on an intermittent reinforcement schedule. This partial reinforcement effect (PRE) is strongest if the intermittent schedule is a variable ratio or a variable interval schedule (Reynolds, 1968).

The PRE is not consistently found in relatively primitive subhuman species, such as turtles and fish. Comparing earlier, conflicting studies, Gonzales, Eskin, and Bitterman (1962) conclude that the PRE can be found in fish if the number of reinforcers rather than the number of trials were equated. Studies which equate the number of trials across groups (Wodinsky and Bitterman, 1960) did not find that the resistance to extinction was increased following an intermittent schedule.

Jenkins and Rigby (1950) rewarded rats with water for responding on a bar-press according to a fixed interval 1 minute, or a fixed interval 2 minutes, or a continuous reinforcement schedule. During the three-hour extinction period there was an average of 40% more responding by the rats who had acquired the behavior on one of the intermittent schedules. In an extensive literature review, Jenkins and Stanley (1950) did find evidence of the PRE in various species and with such varying tasks as

eyelid conditioning, bar-press, escape-avoidance learning mazes, and verbal responses. They concluded: "All other things equal, resistance to extinction after partial reinforcement is greater than after continuous reinforcement when behavior strength is measured in terms of single responses" (p. 222). A more recent literature review (Lewis, 1960) provides further support for this conclusion.

In general, research with adult humans does provide evidence of a partial reinforcement effect. Fattu and Mech (1955) found that college students extinguished saying numbers more slowly after an intermittent schedule than after continuous reinforcement. Hekmat (1971) used a quasi-therapeutic interview situation with adult subjects. The number of affective self references was the dependent variable and the extinction data reveals a partial reinforcement effect. Kerpelman and Himmelfarb (1971) investigated partial reinforcement effects in attitude acquisition and subsequent counterconditioning. Subjects were presented with evaluative traits and asked if the trait was characteristic of "a recently discovered group of primitive people". Subjects were divided into four groups and received either 100%, 80%, 70%, or 50% reinforcement. The dependent variable was the number of positive traits the subjects attributed to the primitive people and reinforcement was positive feedback. For example, in the 100% reinforcement group, for every

positive trait they assigned to the primitive people, they were told by the examiner that they were correct. The three groups were significantly more resistant to counter-conditioning than was the continuously reinforced group. Hargrave (1971) used both verbalized expectancy of success and task performance during 30 extinction trials over 100% and 50% reinforcement to study partial reinforcement effects. By both extinction measures on chance tasks (guessing numbers) subjects were more resistant to extinction after partial reinforcement than after continuous reinforcement. However, on skill tasks (solving anagrams) subjects were more resistant to extinction after 100% reinforcement.

Partial reinforcement effects have also been demonstrated in vicarious learning situations (Hamilton, 1970; Borden, in press). Subjects who observed a model rewarded on a partial reinforcement schedule showed greater resistance to extinction than subjects who observed a model reinforced on a continuous basis.

The partial reinforcement effect has not been consistently found with children. Warren and Brown (1943) found that extinction of a lever-pressing response was more rapid following intermittent reinforcement than following continuous reinforcement. A within-subjects design was used and each subject experienced four extinction phases. The extinction phases following intermittent

reinforcement were the third and fourth extinction experienced by the subjects, whereas the extinctions following continuous reinforcement were the first and second. Pumroy and Pumroy (1961) support this finding that CRF during acquisition leads to greater resistance to extinction. A ball-dropping task and a repeated measures, within-subjects design were employed. Reinforcement and extinction periods followed one another until each child was reinforced three times under four schedules: 16-2/3, 33-1/3, 50 and 100 percent reinforced. The difference in the number of responses during extinction among the four acquisition schedules was statistically significant. Of the four reinforcement schedules, the CRF schedule resulted in the greatest number of responses during extinction and the 16-2/3% intermittent reinforcement resulted in the least number of extinction responses.

Both Warren and Brown, and Pumroy and Pumroy present data on extinction responses which differ from the previously cited studies in the infrahuman and adult human subjects. Methodological issues may account for this incongruity. The use of multiple extinction sessions have been found to result in increasingly faster extinction sessions (Pumroy and Pumroy, 1961; Baumeister and Forehand, 1971). This constitutes a major shortcoming in the Warren and Brown study. In the Pumroy and Pumroy study, the extinction period was only two minutes long.

Different results may have been obtained with a longer extinction period, or by allowing the subjects to respond until they stopped voluntarily.

Several experiments using between-subjects designs present evidence of a partial reinforcement effect. Brackbill (1958) reinforced smiling in eight infants according to either a continuous or a variable ratio schedule of reinforcement. Subjects were matched for the total number of trials during the conditioning phase of the experiment. Subjects who had been reinforced on an intermittent schedule of reinforcement were significantly more resistant to extinction than were the continuously reinforced subjects. Comparing the effects of CRF schedules with intermittent schedules on extinction, Bijou (1957) found that with a free operant task, preschoolers on a 20% VR schedule made significantly more extinction responses than did subjects who were on a 100% reinforcement schedule. The total number of reinforcements were equated in this experiment. Kass (1962) equated the number of trials in a study of the effects of chronological age of 216 preschoolers and five percentages of reinforcement during acquisition on resistance to extinction. There was a significant and consistent decrease in the number of responses to extinction as the percentage of reinforcement during acquisition increased. The interaction between age and percentage of reinforcement was insignificant. Kass and

Wilson (1966), comparing VR and CRF schedule effects on extinction, also equated for the number of trials. A 2 x 2 x 5 factorial design was employed analyzing two percentages of reinforcement (100% and 33-1/3%), the presence and absence of secondary reinforcement (a light), and five amounts of training trials (3, 9, 21, 45, and 60). Neither the equation of number of trials nor the presence of the light had significant effect on extinction performance. Resistance to extinction was inversely related to the number of acquisition trials for both continuous and intermittent training. Extinction was more rapid in the 100% group than in the 33-1/3% group regardless of the number of training trials. Similar results were obtained in Cowan and Walter's (1963) comparison of the effects of CRF and FR schedules on resistance to extinction.

In the natural environment behavior is frequently under the control of aperiodic schedules of reinforcement. Theoretically, the shifting of the schedule of reinforcement of undesirable behavior to a continuous reinforcement schedule should reduce the number of responses to extinction.

Animal data on shifting schedules of reinforcement are inconclusive. Likely (1958) established bar-press responding in four groups of rats under one of the following reinforcement schedules: CRF; VI 1 second; CRF then VI 1 second; and VI 1 second then CRF. The mean number of

responses during the four-hour extinction period did not differ significantly among the groups. The data was re-analyzed using a ratio of initial extinction pattern of responding to later extinction pattern of responding. This analysis procedure revealed that aperiodic reinforcement either early or late in training resulted in greater resistance to extinction than did CRF alone. Hotherall (1966) found a significant reduction in resistance to extinction when large numbers of continuous reinforcements are used prior to a partial reinforcement schedule. This suggests that pretraining on CRF may confound effects of schedules of reinforcement given during training on resistance to extinction. The typical animal training procedure includes the initial use of CRF.

LeBlanc (1970) compared four rats on a bar-press task. The subjects received primary reinforcement according to one of the following schedules:

CRF, VI, Extinction, VI, CRF, Extinction
CRF, VI, Extinction, VI, Extinction
VI, CRF, Extinction, CRF, VI, Extinction
VI, CRF, Extinction, VI, Extinction.

She found that the first two subjects had greater resistance to extinction than did the last two subjects. This pattern, however, did not hold up across successive extinction sessions.

Only a single study on shifts in reinforcement schedules with children was revealed in a literature

search. Spradlin (1959), working with severely mentally-retarded children ranging in age from 8 to 18 years, did not find that a series of CRF trials, following partial reinforcement schedules, reduced resistance to extinction. The 20 subjects were divided into groups and equal number (24) of training trials on the Lindsley manipulandum were administered according to one of the following schedules:

100% reinforcement
75% reinforcement
50% reinforcement
50% reinforcement, then 100% reinforcement
100% reinforcement, then 50% reinforcement.

Extinction was considered to be complete at the end of 30 seconds of nonresponding, or after a total extinction time of 10 minutes. There were no significant differences between the groups on the number of responses to extinction. This lack of significant differences may be attributable to the age range of the subject, to the small number of subjects in each group and/or to the mental ability of the subjects. Responding on other operant tasks by institutionalized retarded children (e.g., Barrett and Lindsley, 1965) has been found to be deviant from response patterns of normal children. Spradlin's failure to find a PRE with severely mentally retarded children is not supported by more recent evidence (Baumeister and Hawkins, 1966).

In the study described here, a comparison of four groups (CRF: VR: VR then CRF; and CRF then VR) was a test of the hypothesis that continuous reinforcement of

children prior to extinction will reduce resistance to extinction. It was predicted that the subjects' detection of a change in reinforcement contingencies would be facilitated by a prior continuous reinforcement schedule and would be debilitated by a prior intermittent reinforcement schedule. It was expected that continuous reinforcement immediately prior to extinction would reduce resistance to extinction.

METHOD

Subjects: The subjects were 24 experimentally naive first grade children who ranged in age from 5.5 to 6.5 years.

Apparatus: The apparatus was a brightly colored wooden box, measuring approximately 60 x 40 x 20 centimeters. A small silver bar press and cup were mounted on the front of the box. The apparatus automatically dispensed M & M candies in accordance with the programmed schedule of reinforcement. Responses on the bar were automatically recorded. This equipment and the control panel for the reinforcement dispenser were located out of the subject's sight beneath a nearby table.

Procedure: The subjects were brought individually to a small room adjacent to the school library. The teacher had told the children that each of them would be going to play a game. After the child was shown the apparatus, the following instructions were given:

> In this game you try to get as many candies out of the machine as you can. Sometimes when you press this bar, candies will fall into this cup. You can play the game as long as you like. You don't have to hurry. Just tell me when you want to stop. Remember, try to get as many candies as you can.

After giving the instructions, the experimenter sat quietly in a corner of the room reading. Questions were answered by repeating all or part of the instructions. There was no distinction between the acquisition and extinction phases of the experiment except for the cessation of reinforcers.

The four acquisition schedules of reinforcement were: CRF; VR5; VR5 then CRF; and CRF then VR5. A total of twenty reinforcers were administered to each subject in each group. Subjects in the first group received a candy each time they pressed the bar until twenty reinforcers had been delivered. The second group received a candy on a VR5 schedule until twenty reinforcers had been delivered. The two shifting-schedule groups received half of their total number of reinforcers on each schedule. Subjects in the third group experienced a VR5 schedule until ten reinforcers had been delivered. The remaining ten reinforcers were delivered on a 100% schedule. The fourth group received ten reinforcers on a CRF schedule followed by ten reinforcers on a VR5 schedule.

In order to equate the amount of reinforcement across groups, the number of training trials across groups differed: the CRF group had 20 acquisition trials, the VR5 group had 100 trials, and the two shifting-schedule groups had 60 trials.

For all groups, extinction was defined as complete whenever a child indicated he wanted to stop playing the game or at the end of 15 minutes in the extinction phase, whichever came first.

RESULTS

Table 1 presents the number of responses to extinction, group means, and group means by sex of subjects for the four groups. An analysis of variance was performed with schedules of reinforcement during acquisition and sex of subjects as the independent variables and number of responses to extinction as the dependent variable. The sex effect was significant ($p < .05$) with the males emitting more extinction responses than the females.

Table 1. Number of extinction responses following four acquisition reinforcement schedules.

	Acquisition Reinforcement Schedule:			
	VR5	CRF/VR5	VR5/CRF	CRF
	1252	551	146	20
	1634	523	267	14
	15	418	272	7
	283	223	50	12
	38	26	42	695
	3	184	46	5
Means:				
Group	537.50	320.83	137.17	125.50
Males	967.00	497.33	228.33	10.33
Females	108.00	144.33	46.00	237.33

An F_{max} test (Kirk, 1969) was done to determine if the homogenity of variance assumption of the analysis of

variance had been violated. The results of this test (F_{max} = 477,472.67) clearly indicated that the scores did not exhibit homogeneity of variance.

Consequently, a logarithmic transformation of the data was performed. The transformed data is presented in Table 2, and Figure 1 graphically presents the means for males and females by the four reinforcement schedules. The results of the analysis of variance with the transformed data are presented in Table 3. None of the analyzed effects were significant. A homogeneity of variance test with the transformed data (F_{max} = 871.70) indicated that the logarithmic transformation did reduce the heterogeneity of variance of the scores.

Table 2. Logarithmic transformation of the number of extinction responses.

	Acquisition Reinforcement Schedule:			
	VR5	CRF/VR5	VR5/CRF	CRF
	3.0976	2.7412	2.1644	1.3010
	3.2133	2.7185	2.4265	1.1461
	1.1761	2.6212	2.5705	.8451
	.4771	2.2648	1.6990	1.0792
	2.4518	2.3483	1.6232	2.8420
	1.5798	1.4150	1.6628	.6990
Means:				
Males	2.4956	2.6936	2.3418	1.0974
Females	1.5029	2.0094	1.6617	1.5400

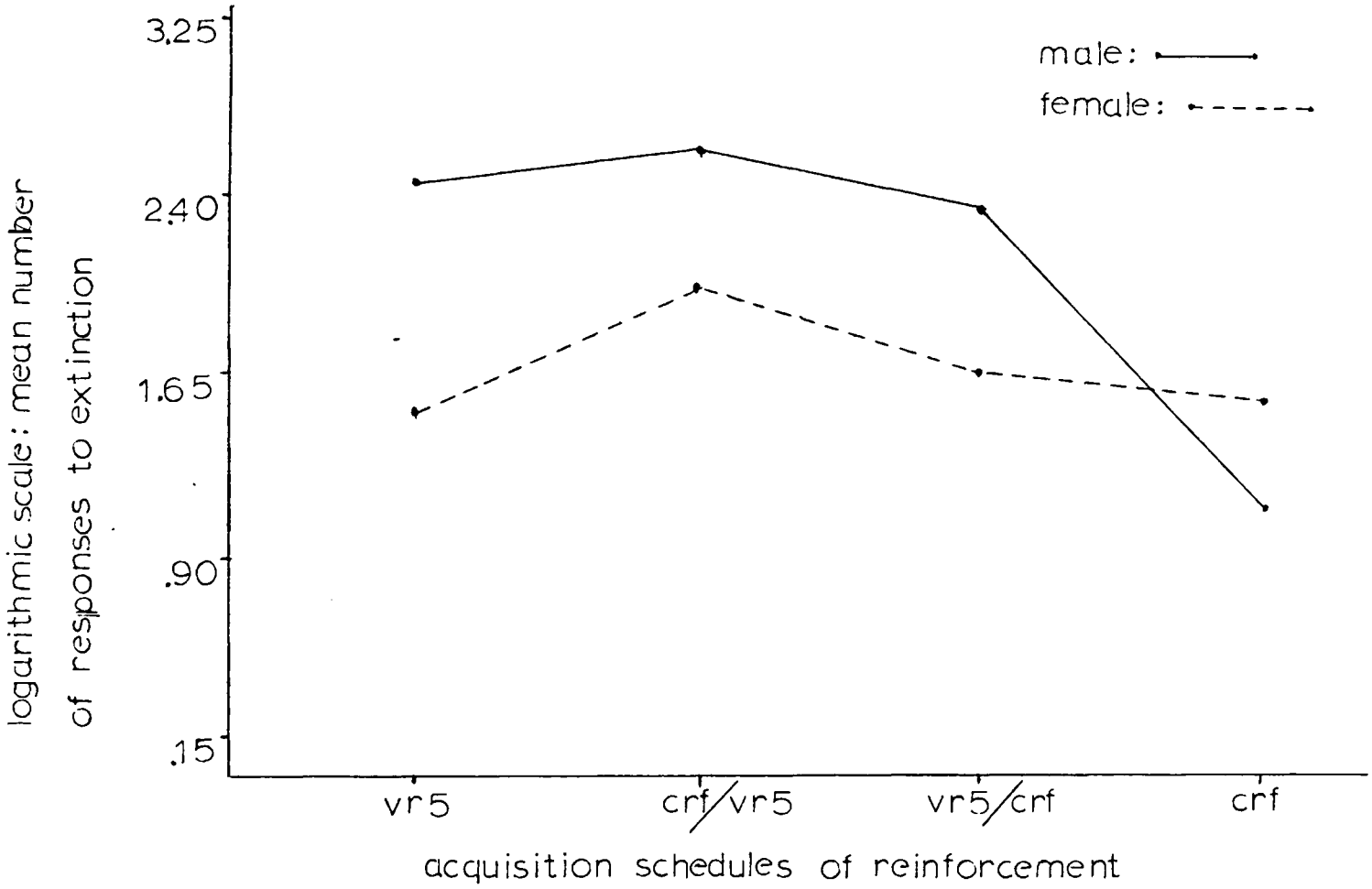

Figure 1. Mean number of extinction responses by sex and by four acquisition schedules of reinforcement.

Table 3. Analysis of variance summary table on the logarithmic data.

Source	Degrees of Freedom	Mean Square	F	P
Schedules of Reinforcement	3	1.1277	1.86	N.S.
Sex of Subject	1	1.3936	2.30	N.S.
Interaction of Schedules with Sex of Subject	3	.5916	.98	N.S.
Error Term	16	.6059		

Results of the Duncan New Multiple Range Test (Kirk, 1969) revealed one significant ($p < .05$) cell mean comparison. Male subjects under a CRF/VR5 acquisition schedule made significantly more extinction responses than did males who experienced a CRF acquisition schedule.

Of the 24 subjects, 21 terminated the extinction phase by indicating they were ready to stop before the end of the maximum time of 15 minutes. Of the three subjects who did respond during the entire 15 minutes, two had experienced acquisition under the variable ratio schedule.

DISCUSSION

Analysis of behavior problems frequently indicates that inappropriate behavior is maintained on an intermittent reinforcement schedule. This study proposed switching to a continuous reinforcement schedule as a behavioral technique to lessen the strength of partial reinforcement effects and consequently shorten the length of extinction.

The number of extinction responses across the four groups who had experienced different acquisition reinforcement schedules was not significant. Evidence of a partial reinforcement effect can be seen in the result that of the three subjects who responded during the entire fifteen minute extinction period, two had experienced an intermittent acquisition reinforcement schedule.

Some support for the use of switching reinforcement schedules as a behavioral technique to facilitate extinction was revealed in the Duncan New Multiple Range Test. There was a significant difference between extinction response cell means, with male subjects in the CRF/VR5 group making significantly more extinction responses than did males in the CRF group. This between-group comparison indicates that extinction is shorter when a CRF schedule precedes extinction.

Reinforcement in this study served as a motivator since none of the subjects were actually learning a new motor behavior. It was noted anecdotically that the male subjects were much more interested in the mechanics of the apparatus than were the female subjects. This anecdotal but not quantified difference in behavior may largely account for the response differences evidenced by the sexes.

The trend of the data lends support to the hypothesis that switching schedules to continuous reinforcement can reduce resistance to extinction. This study provides preliminary support for the investigation of this technique in the natural environment.

REFERENCES

Ayllon, T., and Azrin, N. The token economy: A motivational system for therapy and rehabilitation. New York: Appleton-Century-Crofts, 1968.

Barrett, B. H., and Lindsley, O. R. Deficits in acquisition of operant discrimination and differentiation shown by institutionalized retarded children. In L. P. Ullmann and L. Krasner (Eds.), Case studies in behavior modification. New York: Holt, Rinehart & Winston, 1965. Pp. 348-357.

Baumeister, A. A., and Forehand, R. Effects of extinction of an instrumental response on stereotyped body rocking in severe retardates. The Psychological Record, 1971, 21, 235-240.

Baumeister, A. A., and Hawkins, W. F. Extinction and disinhibition as a function of reinforcement schedule with severely retarded children. Journal of Experimental Child Psychology, 1966, 3, 343-347.

Bijou, S. W. Patterns of reinforcement and resistance to extinction in young children. Child Development, 1957, 28, 47-55.

Boer, A. P., and Sipprelle, C. N. Elimination of avoidance behavior in the clinic and its transfer to the normal environment. Journal of Behavior Therapy and Experimental Psychiatry, 1970, 1, 169-174.

Borden, B. L. Some effects of schedules of vicarious reinforcement and rate of responding by a model upon extinction in an observer. Journal of Experimental Psychology, in press.

Brackbill, Y. Extinction of the smiling response in infants as a function of reinforcement schedule. Child Development, 1958, 29, 115-124.

Bucher, B. and Lovaas, O. I. Operant procedures in behavior modification with children. In D. J. Levis (Ed.) Learning approaches to therapeutic behavior change. Chicago: Aldine Publishing Co., 1970, Pp. 36-64.

Catania, A. C., and Reynolds, G. S. A quantitative analysis of the responding maintained by interval schedules of reinforcement. Journal of Experimental Analysis of Behavior, supp., May, 1968.

Conger, J. C. The treatment of encopresis by the management of social consequences. Behavior Therapy, 1970, 1, 386-390.

Cowan, P. A. and Walters, R. H. Studies of reinforcement on aggression: I. Effects of scheduling. Child Development, 1963, 34, 543-551.

Fattu, N., and Mech, E. V. Resistance to extinction of verbal responses following two patterns of reinforcement. Journal of General Psychology, 1955, 53, 193-198.

Ferster, C. B., and Skinner, B. F. Schedules of Reinforcement. New York: Appleton, 1957.

Gardner, W. I., and Stamm, J. M. Counseling the mentally retarded: A behavioral approach. Rehabilitation Counseling Bulletin, 1971, 15, 46-57.

Gonzalez, R. C., Eskin, R. M., and Bitterman, M. E. Extinction in the fish after partial and consistent reinforcement with number of reinforcements equated. Journal of Comparative and Physiological Psychology, 1962, 55, 381-386.

Hamilton, M. L. Vicarious reinforcement effects on extinction. Journal of Experimental Child Psychology, 1970, 9, 108-113.

Hargrave, G. A comparison of verbal and non-verbal measures of extinction for skill and chance tasks acquired under partial and continuous reinforcement. Dissertation Abstracts International, 32, 3004-B. 1971.

Hart, B. M., Allen, K. E., Buell, J. S., Harris, F. R., and Wolf, M. M. Effects of social reinforcement on operant crying. Journal of Experimental Child Psychology, 1964, 1, 145-153.

Hekmat, H. Reinforcing values of interpretations and reflections in a quasi-therapeutic interview. Journal of Abnormal Psychology, 1971, 77, 25-31.

Henderson, J. D. The use of dual reinforcement in an intensive treatment system. In R. D. Rubin, and C. M. Franks (Eds.), Advances in behavior therapy. New York: Academic Press, 1968. Pp. 201-210.

Hotherall, D. Resistance to extinction when continuous reinforcement is followed by partial reinforcement. Journal of Experimental Psychology, 1966, 72, 109-112.

Jenkins, W. O., and Rigby, M. K. Partial (periodic) versus continuous reinforcement in resistance to extinction. Journal of Comparative and Physiological Psychology, 1950, 43, 30-40.

Jenkins, W. O., and Stanley, J. O. Partial reinforcement: A review and critique. Psychological Bulletin, 1950, 47, 193-234.

Kass, N. Resistance to extinction as a function of age and schedule of reinforcement. Journal of Experimental Psychology, 1962, 64, 249-252.

Kass, N., and Wilson, H. Resistance to extinction as a function of percentage of reinforcement, number of training trials upon the development of a secondary reinforcer with children. Journal of Experimental Psychology, 1966, 71, 355-357.

Kerpelman, J. P., and Himmelfarb, S. Partial reinforcement effects in attitude acquisition and counterconditioning. Journal of Personality and Social Psychology, 1971, 19, 301-305.

Kirk, R. E. Experimental design: Procedures for the behavioral sciences. Belmont, Calif.: Brooks/Cole, 1969.

LeBlanc, J. M. Continuous reinforcement: A possible behavior modification procedure for decreasing resistance to extinction. Dissertation Abstracts International, 31, 3731, 1970.

Lewis, D. J. Partial reinforcement: A selective review of the literature since 1950. Psychological Bulletin, 1960, 57, 1-28.

Likely, F. A. Relative resistance to extinction of a periodic and continuous reinforcement separately and in combination. Journal of General Psychology, 1958, 58, 165-187.

Long, E. R., Hammack, J. T., May, F., and Campbell, B. J. Intermittent reinforcement of operant behavior in children. Journal of the Experimental Analysis of Behavior, 1958, 1, 315-340.

Orlando, R., and Bijou, S. W. Single and multiple schedules of reinforcement in developmentally retarded children. Journal of Experimental Analysis of Behavior, 1960, 4, 339-348.

Pumroy, D. K., and Pumroy, S. S. Effect of amount and percentage of reinforcement on resistance to extinction in preschool children. Journal of Genetic Psychology, 1961, 58, 55-62.

Reynolds, G. S. A primer of operant conditioning. Dallas: Scott, Foresman, 1968.

Solomon, R. L. Punishment. American Psychologist, 1964, 19, 239-253.

Spradlin, J. E. Effects of reinforcement schedules on extinction in severely retarded children. Dissertation Abstracts International, 20, 2404, 1959.

Spradlin, J. E., Girardeau, F. L., and Corte, E. Fixed ratio and fixed interval behavior of severely and profoundly retarded subjects. Journal of Experimental Child Psychology, 1965, 2, 340-353.

Tharp, R. G., and Wetzel, R. J. Behavior modification in the natural environment. New York: Academic Press, 1969.

Warren, A. B., and Brown, R. H. Conditioned operant response phenomena in children. Journal of Genetic Psychology, 1943, 38, 181-207.

Williams, C. D. The elimination of tantrum behavior by extinction procedures. Journal of Abnormal and Social Psychology, 1959, 59, 269.

Winkler, R. C. Management of chronic psychiatric patients by a token reinforcement system. Journal of Applied Behavior Analysis, 1970, 3, 47-55.

Wodinsky, J., and Bitterman, M. E. Resistance to extinction in the fish after extensive training with partial reinforcement. American Journal of Psychology, 1960, 73, 429-434.

Wolf, M. M., Birnbrauer, J. S., Williams, T., and Lawler, J. A note on apparent extinction of the vomiting behavior of a retarded child. In L. P. Ullmann, and L. J. Krasner (Eds.), Case studies in behavior modification. New York: Holt, Rinehart and Winston, 1965.

Wolf, M., Risley, T., and Mees, H. Application of operant conditioning procedures to the behavior problems of an autistic child. Behavior Research and Therapy, 1964, 1, 305-312.