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THE REINFORCEMENT OF COOPERATION BETWEEN CHILDREN[1]

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Most methods for the development and experimental analysis of cooperation between humans require specific instructions concerning the cooperative relationship between the individual responses. Peters and Murphree have developed one of the most recent of these methods (1). Skinner has suggested (2), and shown with lower organisms (3), that cooperation between individuals can be developed, maintained, and eliminated solely by manipulating the contingency between reinforcing stimuli and the cooperative response.

The advantages of eliminating instructions concerning cooperation are that (*a*) the initial acquisition of cooperation can be studied, (*b*) subjects (*S*s) that learn by demonstration and instruction with difficulty (i.e., infants, certain classes of psychotics, and lower organisms) can be studied, and (*c*) no problems involving the effects of instructions upon the behavior of the *S*s are involved.

Some more general advantages of operant conditioning techniques are (*a*) a more continuous record of the cooperative process is obtained, (*b*) extraneous environmental variables are minimized, and (*c*) relatively long periods of experimental observation are possible.

PROBLEM

Can cooperation between children be developed, maintained, and eliminated solely by the presentation or nonpresentation of a single reinforcing stimulus, available to each member of the cooperative team, following each cooperative response?

Cooperative Teams

Twenty children, seven to twelve years of age, were formed into ten cooperative teams of two children. The children in each team were matched as to age and sex. Seven teams were boys and three were girls.[2] Selection was made via the request, "Who wants to play a game?" The first two volunteers of the same age and sex were chosen for each team. The age given by the children was verified against available community center records. No information concerning the game was given during the selection. No teams were rejected.

Cooperative Response

Cooperation was assured by designing an apparatus that (*a*) could not be operated by one individual alone (assuring group behavior), and (*b*) demanded that one individual respond to the behavior of the other individual in order to produce reinforcement (assuring cooperation).

Procedure

The two children of each cooperative team were placed at opposite sides of a table with three holes and a stylus in front of each child (see Fig. 1). A wire screen down the center of the table prevented each child from manipulating the other child's stylus, which was on the other side of the table.

The following instructions were given: "This is a game. You can play the game any way you want to or do anything else that you want to do. This is how the game works: Put both sticks (styli) into all three of the holes." (This sentence was repeated until both styli had been placed in the three available holes.) "While you are in this room some of these" (the experimenter (*E*) held out several jelly beans) "will drop into this cup. You can eat them here if you want to or you can take them home with you." The instructions were then repeated without reply to any questions, after which *E* said: "I am leaving the room now; you can play any game that you want to while I am gone." Then *E* left the room until the end of the experimental session.

If the styli were placed in opposite holes within 0.04 seconds of each other (a cooperative response), a red light flashed on the table (conditioned reinforcing stimulus) and a single jelly bean (reinforcing stimulus) fell into the cup that was accessible to both children.[3] Cooperative responses were recorded on counters and a cumulative response recorder in an adjoining room.

Experimental Design

Each team was studied for one continuous experimental session divided into the following three consecutive periods without experimental interruption:

1. *First reinforcement period.* Every cooperative response was reinforced for over 15 min. If the rate of response was not steady at this time, the reinforcement was continued until five minutes passed with no noticeable change in the rate of cooperation.

2. *Extinction period.* The cooperative responses were not reinforced for a period of at least 15 minutes and until a steady rate of response for at least five minutes was observed.

3. *Second reinforcement period.* The cooperative responses were again reinforced until at least three min-

[1] This paper was read at a meeting of the Eastern Psychological Association on April 10, 1954, New York City.

[2] We wish to thank the Harriet Tubman House and the South Bay Union of Boston, Mass., for providing the subjects and the use of their facilities.

[3] Skinner (3) presented two reinforcing stimuli (one to each pigeon) following each cooperative response.

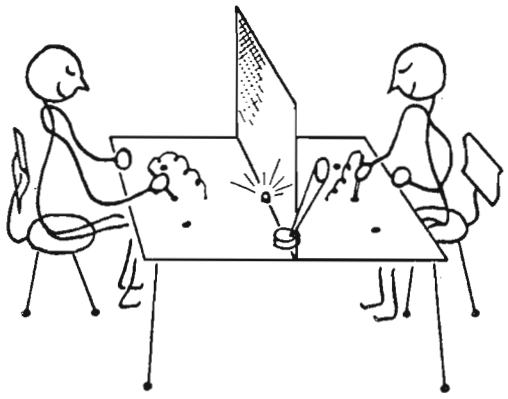

FIG. 1. APPARATUS USED FOR THE REINFORCEMENT OF COOPERATION BETWEEN CHILDREN

utes of a stable rate occurred. This was done to determine whether a reduction in rate during the extinction period was due to extinction, satiation, or fatigue.

RESULTS

All teams learned to cooperate without specific instructions in the first 10 min. of experimentation. Observation through a one-way vision screen disclosed that leader-follower relationships were developed and maintained in most cases. Almost immediately eight teams divided the candy in some manner. With two teams, one member at first took all the candy until the other member refused to cooperate. When verbal agreement was reached in these two teams, the members then cooperated and divided the candy. Most vocalization occurred during the initial acquisition period and throughout the extinction period. This vocalization was correlated with a higher variability in rate during these periods. (See below.)

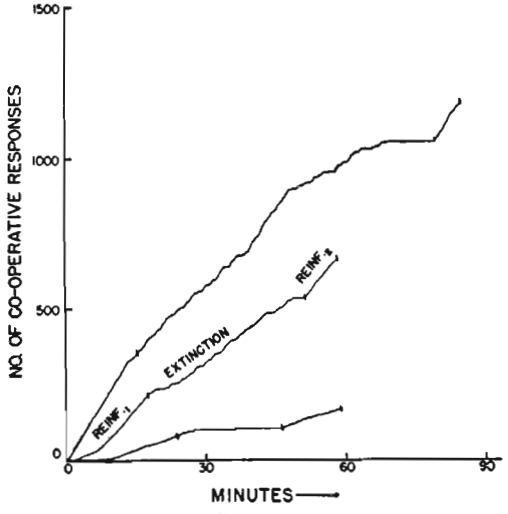

FIG. 2. CUMULATIVE RESPONSE RECORDS FOR THE TEAMS WITH THE HIGHEST, MEDIAN, AND LOWEST RATES OF COOPERATION

TABLE 1

THE MEDIAN AND RANGE OF THE NUMBER OF COOPERATIVE RESPONSES PER MINUTE FOR THE CRITICAL EXPERIMENTAL PERIODS

N 10	Number of cooperative responses per minute			
	First three mins. of first reinf. period.	Last three mins. of first reinf. period.	Last three mins. of extinction period.	Last three mins. of second reinf. period.
Median	5.5	17.5	1.5	17.5
Range	1–26	6–26	0–7	6–27

Figure 2 contains cumulative records of the cooperative responses of the three teams with the highest, the median, and the lowest number of cooperative responses for the experimental session. These curves show a large difference in the rate of acquisition of cooperation. One team took almost 10 minutes to acquire a high cooperative response rate. Stable rates of cooperation can be observed during the latter parts of the first reinforcement period. The gradual, rather than immediate, decline in cooperation during extinction suggests an orderly extinction of cooperative behavior as is found with individual extinction curves. In all cases the variability of rate was greater during extinction than during reinforcement. Skinner has found this increased variability in rate during extinction with lower organisms and has described it as emotional behavior (2, p. 69). The high rate of response following the first reinforcement of the second reinforcement period shows that reacquisition is almost immediate.

Table 1 contains a quantification of the records for statistical analysis. The median and range of the number of cooperative responses per minute for all 10 teams during the critical periods of the experiment are given. The number of cooperative responses per minute for the first three minutes of the first reinforcement period was significantly lower than the rate during the last three minutes of the first reinforcement period ($p < .02$).[4] This shows that

[4] Wilcoxon's nonparametric T for paired associates was used in all statistical treatments (4).

the rate of cooperation was significantly lower during initial acquisition than during maintenance of cooperation. The number of cooperative responses per minute during the last three minutes of extinction was significantly lower than the rate during the last three minutes of the first reinforcement period ($p < .001$). This shows that the removal of reinforcement during extinction significantly lowered the rate of cooperation between these children.

The number of cooperative responses per minute during the last three minutes of the second reinforcement period was significantly above the rate during the last three minutes of the extinction period ($p < .001$). This shows that the rate of cooperation was significantly increased during the second reinforcement period and that the drop in rate during extinction was due to the absence of the reinforcing stimulus rather than satiation or fatigue. The rates of cooperation during the second reinforcement period and the last three minutes of the first reinforcement period were not significantly different and show that the rate was almost immediately restored to its pre-extinction value upon the presentation of reinforcement for the second time. The rate of cooperative responding during the first three minutes of the second reinforcement period was significantly higher than during the first three minutes of the first reinforcement period ($p < .02$). This again shows that the reacquisition of cooperation was not gradual, as was initial acquisition, but occurred almost immediately.

CONCLUSIONS

Operant conditioning techniques can be used to develop, maintain, and eliminate cooperation between children without the use of specific instructions concerning cooperation. The rate of a cooperative response changes in much the same way as a function of single reinforcements as does an individual response. In the reinforcement of cooperative responses, a reinforcing stimulus need not be delivered to each member of the cooperative team following each cooperative response. The presentation of a single reinforcing stimulus, available to each member of the cooperative team, is sufficient to increase the rate of cooperation. The cooperative response gradually increases in frequency when reinforced and gradually decreases in frequency when no longer reinforced (extinction). Cooperative responses are maintained at a stable rate during reinforcement but occur in sporadic bursts during extinction. Reinforcement following extinction results in an almost immediate restoration of the rate of cooperation to its pre-extinction value.

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