DOCUMENT RESUME

ED 058 606 24 CG 007 025

AUTHOR Wolf, Montrose M.; And Others
TITLE Reinforcement: Applied Research. Applying Applied Reinforcement.
INSTITUTION Kansas Univ., Lawrence.; Pittsburgh Univ., Pa.
REPORT NO LRDC-1971-25
BUREAU NO BR-5-0253
PUB DATE 71
NOTE 26p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Behavioral Science Research; *Experimental Psychology; *Research Methodology; Social Influences; Social Organizations; *Social Psychology; *Social Reinforcement

ABSTRACT

These 2 papers examine the application of reinforcement principles in natural social settings. The first paper concentrates on the methodology of applied research, using an experimental as opposed to an observational strategy. That is, the experimenter intervenes with special "treatments" in a real-life social institution, much as he would in a laboratory experiment, and the behaviors studied are typically of real social concern. The 2nd paper considers a number of specific questions raised by the attempt to apply reinforcement principles in educational and therapeutic settings and suggests some lines of further research. Several concerns are: (1) the question of whether and how behavior can be maintained after special programs of reinforcement are terminated; (2) extensive, systematic study of the relationship between "programmed" and "natural" rewards is badly needed before reinforcement principles can be widely and well used in applied settings; and (3) developing effective training and maintenance programs for reinforcement agents. (Author/TA)

UNIVERSITY OF PITTSBURGH - LEARNING R & D CENTER

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MONTROSE M. WOLF AND TODD R. RISLEY

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LAUREN B. RESNICK

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Montrose M. Wolf and Todd R. Risley
University of Kansas

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Lauren B. Resnick
Learning Research and Development Center
University of Pittsburgh

1971

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Reprinted by the Learning Research and Development Center, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed do not necessarily reflect the position or policy of the Office of Education and no official endorsement should be inferred.

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REINFORCEMENT: APPLIED RESEARCH[1]

MONTROSE M. WOLF and TODD R. RISLEY
University of Kansas

Research in the practical application of reinforcement is a fairly recent phenomenon. About a decade ago, Ayllon and Michael (1959), using a straightforward application of reinforcement, reported dramatic modifications in the behavior of institutionalized psychotics. They described how powerful relationships, as regular and lawful as those found in the laboratory, existed between the abnormal behavior and the reinforcement even in the sometimes chaotic setting of a mental hospital ward. The implication was clear: Significant human behavior occurring in natural environments may not be sufficiently complex or capricious to preclude research in the practical application of reinforcement. The applied research which has resulted from this implication has exerted profound effects in a very brief period of time. These effects are most apparent in programs for children.

[1]The preparation of this manuscript was supported in part by Public Health Service grants MS 16609 from the Center for Studies of Crime and Delinquency of the National Institute of Mental Health and HD 03144 from the National Institute of Child Health and Human Development to the Bureau of Child Research and the Department of Human Development at the University of Kansas. The authors wish to thank Robert Hoyt for his valuable editorial assistance in the preparation of the manuscript.

The discipline of special education, for example, has incorporated reinforcement techniques as standard procedures in the management of the classroom behavior of severely retarded and disturbed children. This is reflected in the recent announcement by the U. S. Office of Education that funds are available to train special-education teachers in behavior modification. Also, numerous institutions for the retarded and the delinquent have incorporated reinforcement procedures in their regular programs, and dramatic results have been reported by therapists who train parents to apply reinforcement techniques to modify the behavior of their deviant children.

One result of the growing popularity of applied reinforcement research has been the appearance of a group of skeptics. They say that such research is discovering nothing really new — that effective teachers and parents have always known about reinforcement as common sense. And these critics are right, with one qualification. People have applied common-sense reinforcement just as they have applied common-sense physics. Sir Isaac Newton's grandmother no doubt unde .tood and used the principle of gravity before Newton precisely described its parameters. She probably applied her knowledge of trajectory if she had occasion to throw a spoon at young Newton when he was stealing a bite of pie before dinner. She most certainly could have told him that apples fall down and not up. Thus, the practical contribution of the early physicists was not in the discovery of the more obvious principles of physics — everyone applied them in a common-sense fashion already. Instead, the great practical impact came from the powerful experimental methodology that early physicists developed to produce precise descriptions of physical principles. This methodology was then applied to analyze the relative importance of these principles under specific practical conditions, and to exclude that part of the common-sense physics which was only superstition.

In the same manner, the initial contribution of researchers in applied reinforcement has not come from the discovery of genuinely new phenomena. Many grandmothers, teachers, and parents apply, as common sense, the reinforcement procedures that we are studying today. Instead, the greatest practical contribution of applied reinforcement research is coming from the experimental model which the researchers in this field have developed. It is a simple and elegant model that allows a researcher, practitioner, or parent to objectively measure and analyze the problem behaviors of an individual child.

The model incorporates accepted rules of measurement and experimental design. The measurement is usually carried out by a human observer, since in many instances human observation is the only feasible technique for recording significant behavior. This means that particular

attention must be devoted to the description of the response that is given to the observer. In order for the measurement of the behavior to be replicable, the response description must be sufficiently objective and detailed to allow an independent observer to record the same behavior with a high degree of agreement with the principal observer. Fortunately, there was a well-developed methodology of human observation already established which we could apply (Bijou, Peterson, and Ault, 1968). On the other hand, problems of experimental design for research with individual children have been more difficult. Our starting point was baseline logic for research with individual subjects, as described by Sidman (1960). Baseline logic comprises one question: Does a treatment condition substantially affect the baseline rate of a subject's behavior? Unfortunately, this is not a simple question. To "affect a behavior" means not only that a change in the behavior occurs but also that we have sufficient information to attribute that change in behavior to our treatment condition. Our thinking about this problem has evolved through several phases.

A-B Experimental Design

Originally, the most popular experimental design was the two-stage A-B design. We would measure a behavior during the baseline condition (A) and then watch for a change in the behavior during the treatment condition (B) as shown with hypothetical data in Fig. 9-1. Figure 9-2

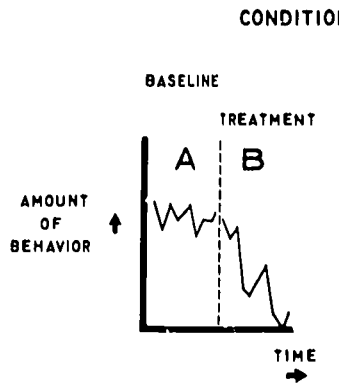

FIGURE 9-1. Hypothetical data presented in an A-B (baseline-treatment) experimental design.

represents the baseline and treatment measures of the actual crying behavior of a normal four-year-old nursery school child who was studied by our nursery-school-teacher colleagues Betty Hart, Eilleen Allen, Joan Buell, and Florence Harris (1964). Traditionally, nursery school teachers have depended upon internal variables such as fear, lack of confidence, or regression to explain excessive crying. These teachers decided to look at this child's social environment for an explanation of his behavior. The teachers attempted to analyze whether their attention was acting as a social reinforcer and thus maintaining the crying. They recorded the frequency of the child's cries. The crying response was defined as "(a) loud enough to be heard at least fifty feet away and (b) of five seconds or more duration." Each dot represented the number of crying episodes in one day. During baseline, the child averaged about eight episodes in one day. Each time the child cried, a teacher approached and comforted him. After ten days of baseline, the treatment (which involved extinction) was introduced and the teachers ignored the cries, "... neither going to him, speaking to him, nor looking at him while he was crying, except for an initial glance in order to assess the situation [Hart, Allen, Buell, Harris, and Wolf, p. 149]." As shown in Fig. 9-2, within five days after extinction was introduced, the crying decreased to between zero to two episodes.

While these results were dramatic, they were difficult for us to evaluate. What was the chance of coincidence? Did we really have sufficient information to indicate that the change in the crying behavior was due to our extinction condition and not the result of some unknown coincidental variable? After all, many preschool children cry excessively for awhile and

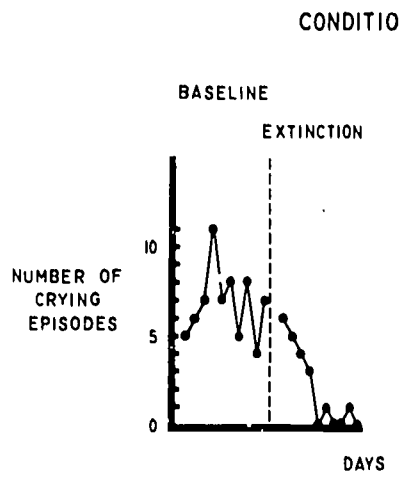

FIGURE 9-2. Number of crying episodes of a nursery school child which occurred each day during baseline and extinction. This is an example of an A-B design. (Hart, Allen, Buell, Harris, and Wolf, 1969.)

then seem to decrease their crying as they establish friendships or interests in play. It was true that the baseline behavior seemed stable. But could we afford to rely on the information given by the baseline as our only means of estimating what the natural course of the behavior would have been if we had not intervened? The same question applies to all research using an A-B design.

This problem also arose in the evolution of experimental medicine. Claude Bernard warned physicians a century ago of the danger of being misled by a coincidental change in a simple A-B analysis:

> A physician who tries a remedy and cures his patients, is inclined to believe that the cure is due to the treatment. Physicians often pride themselves on curing all their patients with a remedy that they use. But the first thing to ask them is whether they have tried doing nothing, i.e., not treating other patients; for how can they otherwise know whether the remedy or nature cured them"? Gall wrote a little known book on the question as to what is nature's share and what is the share of medicine in healing disease, and he very naturally concludes that their respective shares are quite hard to assign. We may be subject daily to the greatest illusions about the value of treatment, if we do not have recourse to comparative experiment. I shall recall only one recent example concerning the treatment of pneumonia. Comparative experiments showed, in fact, that treatment of pneumonia by bleeding, which was believed most efficacious, is a mere therapeutic illusion [quoted from pp. 194 and 195 of the 1957 edition of the English translation of the book originally published in 1865].

In applied reinforcement research, we can be misled as easily about the effectiveness of a reinforcement technique assessed in an A-B design. Bernard's solution for medicine was to use experimental-group control-group comparisons. In applied reinforcement research, however, we often do not have an opportunity to use group designs. We usually deal with a specific child or at most a few children. Until recently, no methodology existed for the scientific study of individual children. As recently as 1963, the same year as we were carrying out the study with the crying child, Mussen, Conger, and Kagan (1963, p. 24) concluded that ". . . methods for dealing with groups and group data are readily available, whereas methods for dealing with the individual case scientifically, are not." Thus, our aim has been to develop designs which will allow believable conclusions to be drawn from an analysis of the behavior of individual cases. In the case of the crier, he was the only child in our nursery school who cried so excessively that year. We conceded that the A-B analysis was incomplete. The analysis provided no information about what the natural course

of the behavior would have been had we not intervened with our treatment condition.

A-B-A-B Reversal Design

While we can never know what would have happened had we not altered the baseline conditions, two classes of designs have emerged which do give us sufficient information to make a believable estimate (Baer, Wolf, and Risley, 1968). One we have referred to as the *reversal* or the A-B-A-B design illustrated in Fig. 9-3. If the behavior "reverses" back to something approximating the baseline level when the treatment is withdrawn, we can make a reasonable estimate about what the natural course of the uninterrupted baseline behavior would have been. Once a reversal in behavior has occurred, the treatment condition is usually reinstated in order to replicate the original-treatment effect and also to leave the child in the improved state. The reversal design was actually employed (see Fig. 9-4) by the nursery school teachers when we carried out the research with the crier. "When continuous adult attention was again given to all cries and approximations to cries, the baseline rate of crying episodes was soon re-established. Then, four days after the reintroduction of extinction for operant crying, the behavior was practically eliminated [Hart et al., 1964]."

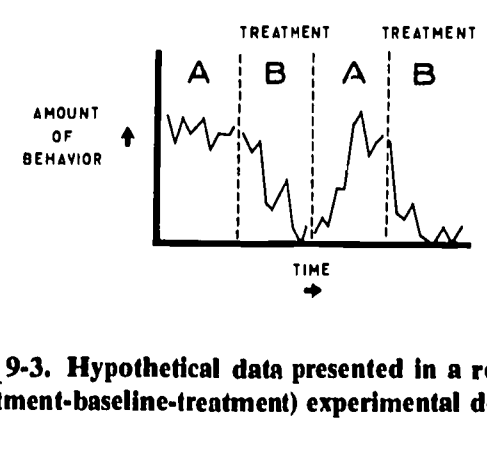

FIGURE 9-3. Hypothetical data presented in a reversal, A-B-A-B, (baseline-treatment-baseline-treatment) experimental design.

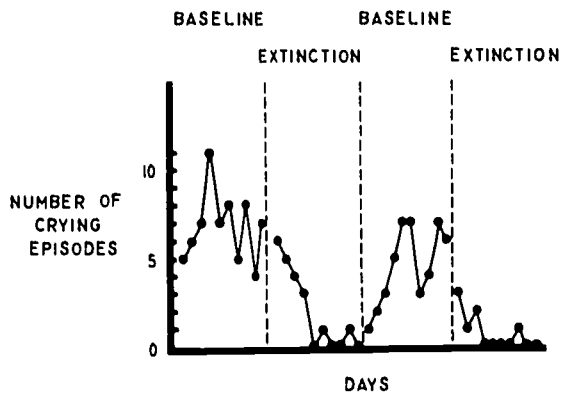

FIGURE 9-4. Number of daily crying episodes of a nursery school child during baseline, extinction, baseline, and extinction conditions. This represents an example of a reversal (A-B-A-B) design. (Hart, et. al., 1969.)

Multiple-Baseline Design

Reversal designs, on the other hand, can present problems. Sometimes the modified behaviors do not reverse in the "reversal" phase. Also, there are many occasions when reversals are undesirable, as when the target behavior is dangerous or self-destructive, or when the pleased parent or teacher does not want the undesirable behavior to return. In these instances, we employ a second strategy that we call a *multiple-baseline* design. Two or more behavioral baselines are recorded simultaneously as shown in Fig. 9-5. The treatment condition is then introduced for one of the behaviors but not for the second. The second behavior acts as a control for coincidence being responsible for any change in the first behavior. The second baseline allows us to estimate what the treated behavior might have looked like had we not intervened. A second replication of the effect with the second behavior also serves to increase our confidence in the reliability of the treatment effect. The greater the number of baselines used in a multiple-baseline analysis, the greater our confidence can be in the reliability of the relationship. While a study involving two baselines can be very suggestive, a set of replications across three or four baselines may be almost completely convincing.

There are several considerations in setting up a multiple-baseline study. One possibility is that there will be *induction* from one baseline to the next; that is, the change that a treatment condition seems to produce

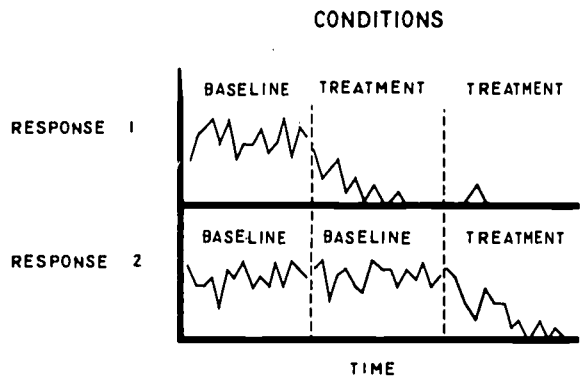

FIGURE 9-5. Hypothetical data presented in a multiple-baseline design. Two or more behavioral baselines are recorded simultaneously. Treatments are then introduced sequentially, first for one behavior and then for the second.

in the treated behavior may also appear in the second baseline that is intended to act as a control. The fact that change occurs across both behaviors diminishes the usefulness of the second baseline as a control. Another consideration is that multiple-baseline analysis may be quite convincing when carried out (1) across two or more different responses under the same environmental condition(s) and on the same subject(s), or (2) across two or more environmental conditions with the same response(s) and on the same subject(s), or (3) across two or more subjects with the same response(s) and under the same environmental condition(s).

A study involving multiple baselines across two different environmental conditions with the same responses and the same subjects was carried out by Barrish, Saunders, and Wolf (1969). This study is unusual in that the experimental design also involved a combination of reversal and multiple-baseline comparisons. Furthermore, the unit of analysis, rather than being an individual child, was an entire classroom of children. Out-of-seat and talking-out behaviors were studied in a regular fourth-grade classroom which included several "problem children" whom the teacher reportedly could not manage. Baseline rates of the inappropriate behaviors were recorded for a few weeks in math and reading periods. The reversal design was carried out in the math period. After baselines were obtained in math, the students were divided into two teams "to play a game." Each out-of-seat and talking-out response by an individual child resulted in a mark on the chalkboard which meant a possible loss of privileges by all the members of his team. If neither team obtained more than five marks, everyone received the privileges. If both teams received more

than five marks, the team with the fewest marks earned the privileges. The privileges included extra recess, being first to line up for lunch, time for special projects, stars and name tags, as well as winning the game.

As a matter of fact, both teams received fewer than five marks and thus won more than 85 per cent of the time. Figure 9-6 shows the suppressive effects of the game on out-of-seat and talking-out behaviors. When the conditions were reversed back to baseline, the inappropriate behaviors came back immediately, and when the game was reintroduced, order in the classroom was restored. Meanwhile, as a multiple-baseline control we had been recording concurrently the same behaviors in the reading period as shown in Fig. 9-7. If the reversal-design analysis had not worked properly, that is, if the behavior had not reversed when we returned to the baseline conditions, we could have relied on the multiple-baseline control condition and the second replication of the game condition that were carried out during the reading period to help us reach a conclusion about the effectiveness of the game treatment. On the other hand, while these data from the reading period show a change in the responses from the baseline condition to the game condition, by themselves they represent only an A-B demonstration. Thus, the data in Fig. 9-7 alone would have been insufficient to allow a proper conclusion about the role of the game. As it turned out, the game had a substantial and reliable influence on the two responses each time it was introduced. The results of the reversal condition

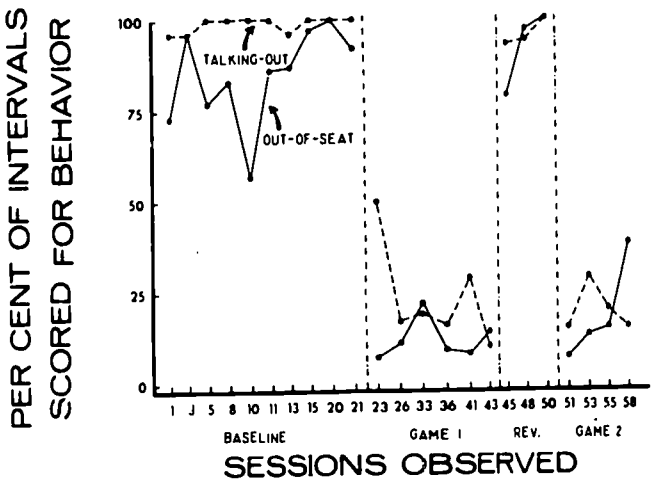

FIGURE 9-6. Per cent of 1-minute intervals scored by an observer as containing talking-out and out-of-seat behaviors occurring in a classroom of 24 fourth-grade school children during math period. During the game condition, out-of-seat and talking-out responses by a student resulted in a possible loss of privileges for the student and his team. The data were collected according to a reversal, A-B-A-B, design (baseline-treatment-baseline-treatment). (Barrish, Saunders, and Wolf, 1969.)

indicated that the game had a continuing role in the maintenance of order in the classroom.

As in the study just described, the subject-matter periods of the typical school day lend themselves to a multiple-baseline experimental design. Simultaneous baselines of the behavior of one student or of an entire class can be obtained in two or more subject-matter periods. The modification technique can then be introduced successively into each of the periods. If in each instance there is a change in behavior (and the behavior during the remaining baseline periods remains essentially unchanged), the investigator will have achieved a believable demonstration of the effectiveness of his technique. And he will have done so without depending upon or requiring a reversal of the behavior. A substantial increase in the number of behavior-modification studies using a multiple-baseline design can be expected in the future. Since we have only recently begun employing these designs, the other examples in this chapter will involve A-B-A-B (reversal) designs and their variations.

Token Reinforcement

Our next example of applied reinforcement research is a study carried out by our colleague Elery Phillips and his wife Elaine (Phillips, 1968; Phillips, Wolf, Bailey, and Fixsen, 1970). The Phillips are the houseparents at Achievement Place, a family-style treatment program for predelinquent boys who have been committed there by the county court. The treatment and research are administered by the houseparents who apply

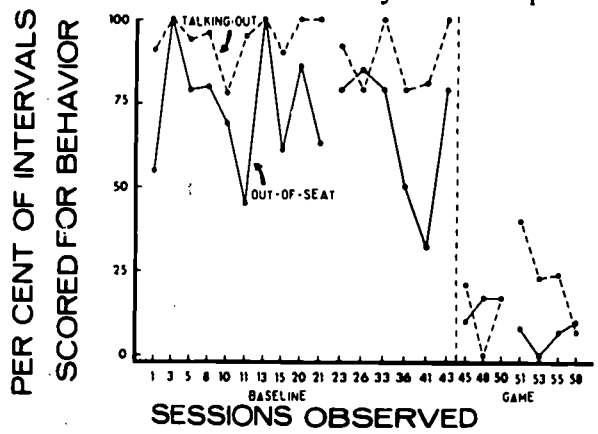

FIGURE 9-7. Per cent of 1-minute intervals scored by an observer as containing talking-out and out-of-seat behaviors occurring in a classroom of 24 fourth-grade school children during reading period. The baseline and game conditions were the same as during math period. The data represent a simple A-B analysis. (Barrish et al., 1969.)

and measure the effects of reinforcement procedures aimed at remedying a variety of the boys' social, self-care, and academic behavioral deficiencies. The six boys living at Achievement Place are thirteen to fifteen years old. Their records describe histories of aggression, thievery, truancy, and failure in school. They come from low-income families, some with long histories of criminal activity.

The treatment program of the Phillips', which incorporates relevant research as a major feature, is an example of the programmatic applied reinforcement research which should characterize more and more child-treatment programs. It also exemplifies a reinforcement technique now being broadly adopted: token reinforcement. The aim of a token economy is to arrange for immediate consequences, tokens, to bridge the delay between behavior and its scheduled reinforcer when the reinforcer cannot be made immediately contingent upon the behavior. The token economy at Achievement Place is similar in many respects to those designed by Ayllon and Azrin (1965), Staats, Staats, Schutz, and Wolf (1962), Cohen (1968), and others. The unit of the token-reinforcement system is the "point." The boys can earn points for appropriate behavior and lose points for inappropriate behavior. The points are traded for a variety of privileges. Almost everything that is important to the boys is incorporated into the system and is earned through points. At the end of each week, earned points are traded for privileges during the next week. Some of the privileges include the use of a bicycle, tools, games, TV, allowances, snacks, and freedom to go downtown or home for a visit.

The point system is arranged so that if a youth accomplishes certain tasks expected of him while losing a minimum of points in fines, he will obtain all the privileges without having to perform any extra jobs. Each boy needs about one thousand points a day to earn most of the privileges. Almost all of the boys earn more than one thousand points a day the majority of the time. Points are earned by engaging in designated social, self-care, and academic behaviors. A record of each reward or fine is made on a three-by-five "point card" which each boy carries. At the end of the day, the earned and lost points are tallied and recorded on a weekly point sheet. Most of the behaviors which earn or lose points are described and posted on the bulietin board. Rewards and fines range from ten to ten thousand points.

The daily routine at Achievement Place is similar to that of many conventional families. The boys get up about 7 A.M. They shower, dress, and clean their bedrooms and bathrooms. Following breakfast, some boys are assigned kitchen clean-up duties before leaving for school. After school, the boys come home immediately and prepare their homework. They are then free to do as they please depending, of course, on the

privileges that they have earned. After dinner and clean-up chores they again may engage in their privilege activities until bedtime.

Among the first behavior problems dealt with by Mr. and Mrs. Phillips was aggressive behavior. When the first three youths were admitted to Achievement Place, physical aggression was expected to be a problem; however, almost no physical aggression has occurred. There was, on the other hand, a great deal of aggressive *verbal* behavior. The youths frequently threatened damage to property or persons, and often made such statements as "I'm going to kick your butt" and "You better watch your mouth or you won't live 'til tomorrow." Inter-observer agreement regarding the measurement of aggressive statements averaged better than ninety per cent. The behavior was recorded for three hours each evening. Under the initial baseline condition, the behavior of each of the three boys was recorded without consequence. As shown in Fig. 9-8, Don had a high rate averaging about twenty-two responses per evening. Tom averaged about seventeen and Jack about five responses.

The first experimental condition involved correction. After each response, the boys were informed that they should not make aggressive statements. This seemed to reduce Tom's rate to about five per evening. But it appeared to have almost no effect on Don's or Jack's behavior.

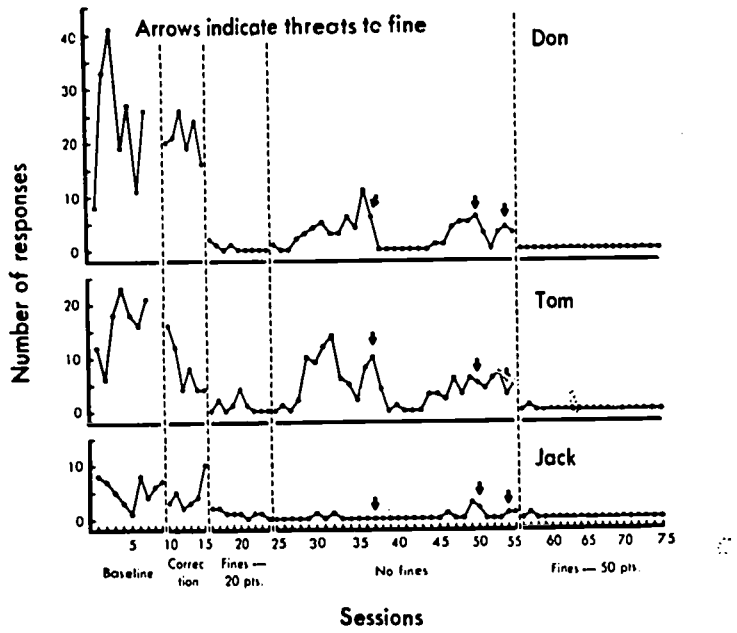

FIGURE 9-8. Number of aggressive statements per 3-hour observation session for each boy under each condition. If the correction condition is disregarded, the data represent an A-B-A-B analysis (baseline, fine, baseline, fine.) (Phillips, 1968.)

When correction did not eliminate the behavior, twenty-point fines were made contingent upon each response. In the fines condition, the response rates fell to near zero for each of the boys. After nine days, the no-fines condition was introduced unannounced. The boys no longer lost points for aggressive statements. During the third week of this condition, the houseparent threatened (designated by the arrows in Fig. 9-8) to reinstate the fines unless the aggressive statements were stopped. There was a significant reduction in the aggressive behavior, but it lasted only about a week. Then the rates again rose and the threat to fine was made a second time. There was a decrease in the behavior, but it was not as significant or as long-lasting as the previous reduction. A third threat appeared also to have very little effect. At the beginning of the fifty-sixth session, an announcement was made and the fines (fifty points this time) were reinstated. There were only two responses during the next twenty sessions. The A-B-A-B design clearly demonstrated the effectiveness of a point fine in controlling the aggressive verbal behavior.

Another problem concerned the boys' lack of cleanliness. Most of them arrived dirty at Achievement Place. Reports by probation officers suggested that in most cases the homes of these boys were extremely dirty and disarranged. Reports from teachers also contained comments about poor hygiene habits and dirty clothing. Token reinforcement contingencies were arranged for a variety of self-care behaviors and for maintenance of the home. While it was possible to arrange the reinforcement contingencies for aggressive verbal behavior to relate directly to the behavior of each individual boy, many maintenance behaviors were difficult to handle on an individual basis. Therefore, the Phillips investigated a number of systems involving individual and group reinforcement. These have been compared for their effectiveness in accomplishing the tasks as well as for their reinforcement value to the boys. The Phillips first tried arranging reinforcement contingencies for the group of boys as a whole; however, this arrangement proved to be less effective than others. A very effective system involved making a single boy responsible for the behavior of his peers. He had authority to give and take away points. In this manner, a *peer-managership system* was established. The manager's duties included seeing that a specified list of tasks such as taking showers and cleaning bathrooms, yard, and basement, were accomplished each day. The manager had the authority to give and take points depending on his judgment of the quality of the job completed. In turn, the manager earned or lost points according to whether the tasks were accomplished or not and, whenever possible, as a function of the quality of work.

Figure 9-9 shows the relative effectiveness of the manager system with its contingencies and consequences as compared to a group condition in

maintaining bathroom-cleaning behavior. Explicit criteria were established for each item in the bathroom. For example, no objects were to be left on the sink, the soap was to be in the soap dish, the toothbrush in the toothbrush holder, and all other objects in the medicine cabinet. Reliability of measurement between two independent observers averaged ninety-seven per cent. Under the baseline condition, when the boys were simply instructed to clean the bathrooms, very few of the items were completed. When the manager condition was introduced for the first time,

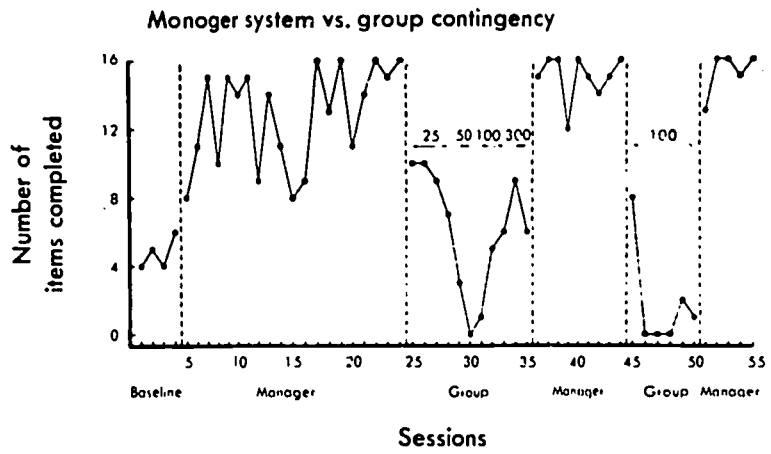

FIGURE 9-9. Number of bathroom-cleaning tasks accomplished per session for each condition. The numbers above the arrow indicate the number of points lost by each boy for the sessions indicated by the horizontal arrows. (Phillips, 1968.)

it took about two weeks for an acceptable level of bathroom cleanliness to occur. The manager condition was then discontinued and point contingencies were placed on the entire group. But the various point values which were applied did not produce a level of tidiness equal to that produced by the managership arrangement. When the manager condition was reintroduced, the cleaning behavior again improved. When the group condition was put back into effect, the behavior deteriorated. And again when the manager condition was reinstated, the cleanliness of the bathrooms increased significantly. Clearly in this instance, the group contingency and consequences were less effective than the peer-manager-arranged contingencies and consequences.

The Phillips have systematically exposed the boys to several systems involving individual or group consequences and individual or group tasks as well as variations in the manager system. The preliminary data indicate that when allowed to choose their own system, the boys will consistently

vote for a manager system when they elect the manager. This system is effective in accomplishing the chores, preferred by the boys, practical from the standpoint of the houseparents, and has other obvious attributes. Thus, through research, an excellent organizational system evolved that might not have occurred naturally and that does not usually occur in other institutions for predelinquents. Using similar measurement and design procedures, the Phillips have developed reinforcement techniques which have dramatically improved the social behavior, school achievement, promptness, communication skills, and manners of their boys. And in each case, the objectively obtained data and the experimental analysis have made possible a clear evaluation of the role of the treatment variables.

Conclusion

We are only beginning to apply reinforcement procedures to practical problems of child behavior; however, we already are able to depend upon a research methodology that can objectively and precisely measure and analyze significant behavior of individual children in natural settings. The methodology should allow us to design and to evaluate more effective and preferred treatment programs for all child and adult behavior problems. At the same time it will enable us to discontinue those aspects of commonsense reinforcement which are only superstitions. Clearly, an applied science and technology of reinforcement are at hand.

REFERENCES

Ayllon, T., and Azrin, N. H. The measurement and reinforcement of behavior of psychotics. *Journal of the Experimental Analysis of Behavior*, 1965, *8*, 357–383.

Ayllon T., and Michael, J. L. The psychiatric nurse as a behavioral engineer. *Journal of the Experimental Analysis of Behavior*, 1959, *2*, 323–334.

Baer, D. M., Wolf, M. M., and Risley, T. R. Some dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, 1968, *1*, 91–97.

Barrish, M., Saunders, M., and Wolf, M. M. Good behavior game: Effects of individual contingencies for group consequences on disruptive behavior in a regular classroom. *Journal of Applied Behavior Analysis*, 1969, *2*, 119–124.

Bernard, C. *An introduction to the study of experimental medicine.* New York: Dover Publications, 1957.

Bijou, S. W., Peterson, R. F., and Ault, M. H. A method of integrating descriptive and experimental field studies at the level of data and empirical concepts. *Journal of Applied Behavior Analysis*, 1968, *1*, 175–191.

Cohen, H. L. Educational therapy: The design of a learning environment. In J. M. Shlien (Ed.), *Research in psychotherapy*. Washington, D.C.: American Psychological Association, 1968, 21–53.

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.

Mussen, P. H., Conger, J. J., and Kagan, J. *Child development and personality.* New York: Harper & Row, 1963.

Phillips, E. L. Achievement Place: Token reinforcement procedures in a home-style rehabilitation setting for "pre-delinquent" boys. *Journal of Applied Behavior Analysis*, 1968, *1*, 213–224.

Phillips, E. L., Wolf, M. M., Bailey, J. S., and Fixsen, D. L. The Achievement Place model: A community-based family-style behavior modification program for pre-delinquents. Delinquency Prevention Strategy Conference, California Youth Authority, 1970.

Sidman, M. *Tactics of scientific research.* New York: Basic Books, 1960.

Staats, A. W., Staats, C. K., Schutz, R. E., and Wolf, M. M. The conditioning of textual responses using "extrinsic" reinforcers. *Journal of the Experimental Analysis of Behavior*, 1962, *5*, 33–40.

Discussion of Professors Wolf and Risley's Paper

APPLYING APPLIED REINFORCEMENT

LAUREN B. RESNICK
University of Pittsburgh

Wolf and Risley's paper is more an essay on applied research methodology than it is a report on a specific body of research on reinforcement. Its central point is that we now have at our disposal a research strategy that makes it possible to conduct scientific studies in relatively natural settings. The research strategy described is experimental rather than purely observational; that is, the experimenter intervenes with special "treatments" much as he does in the laboratory. However, the setting is usually a social institution of some kind, and the behaviors studied are typically of real social concern. The studies Wolf and Risley report are excellent exemplars of the kind of careful applied research advocated in their paper; the list of such exemplars is growing rapidly, and a new journal (*Journal of Applied Behavior Analysis)* is devoted almost exclusively to reports of applied reinforcement studies.

What is important about this growing body of research is that (1) it represents an application of basic psychological principles to socially relevant problems, and (2) in so doing, it carries research itself directly into the field. This approach contrasts with the more conventional relationship between basic psychological research and application, in which "basic" scientists run laboratory studies, extract a set of principles and write a prescription for their application, but leave all concern for actual imple-

mentation to a different group of people, who are often untrained in or uninterested in research. The studies reported by Wolf and Risley move scientific methodology directly into the natural setting. Research is built directly into an intervention program; manipulations of treatment conditions are planned so that the effects of different elements of the treatment program and their interactions can be assessed. At the same time, results of the research program can be fed back into the intervention program so that treatments are changed in accord with new findings.

The importance of reversal and multiple-baseline designs to this general effort is that they permit the isolation of elements of the treatment conditions without the use of control groups. A study by Madsen, Becker, and Thomas (1968) illustrates some of the possibilities for such experimental analysis. In this study, the effects of three elements of a classroom-control system were explored. Two classrooms were studied. In each, explicit rules for classroom behavior were first stated for the children. This condition had no effect on the rate of "inappropriate" behaviors (getting out of seat, making noise, grabbing, and so forth). In the next experimental period, the teacher stated the rules and also ignored all instances of inappropriate behavior; in one classroom, inappropriate behaviors increased; in the other there was no change. Next, a condition was introduced in which rules were stated, inappropriate behavior ignored, and appropriate behavior praised. Inappropriate behaviors dropped in both classrooms. A return to baseline conditions produced a return to baseline rates of inappropriate behavior, and reintroduction of the rules + ignorance + praise condition lowered the rate again. This study, by introducing the elements of treatment one at a time, permitted the inference that praise was the effective element in the treatment. However, a study in which praising is introduced first is needed to permit a clear conclusion.

A study by Reynolds and Risley (1968) used the reverse approach, first introducing a complex treatment and then withdrawing elements one at a time. In this study, the specified reinforcement — teacher attention and access to play materials contingent on verbalization by a preschool girl — was introduced, leading to an increase in talking by a child. One element of the reinforcing event — question-asking by the teacher prior to giving the child material she requested — was then withdrawn. Verbalization fell, but recovered when questioning was reintroduced. This result demonstrates that it was not general "attention" but specifically the teacher's questioning, together with contingent access to materials, that maintained the child's behavior.

Studies of this kind represent what may be called a "second generation" of applied behavioral research. Earlier studies were content to show

simply that reinforcement contingent on acceptable performance could increase the quality and frequency of that performance. Little attempt was made to isolate the effective components of the contingencies or to specify what types of contingent events were likely to be effective under what circumstances. Although their number is still small, a growing body of second-generation studies supports the Wolf and Risley claim that we now have at hand a sophisticated methodology for studying the effects of various reinforcement procedures. However, I am less convinced than Wolf and Risley appear to be that we now have a reinforcement technology suitable for immediate and widespread application. Certain crucial issues must be addressed before applied research in reinforcement can be expected to have major social impact.

A basic issue, for both theoretical and practical reasons, is the question of whether and how behavior can be maintained after special programs of reinforcement are terminated. Baer, Wolf, and Risley (1967) have called this the process of return to the "natural community of reinforcers." In addition, there is the practical problem of how to establish and maintain appropriate reinforcing behavior on the part of key personnel in natural social settings. I would like to elaborate on these two issues, considering, in the process, questions concerning the types of reinforcers and dependent variables studied, and the need for replication studies to determine the range of applicability of specific reinforcement programs.

Except in a few extreme cases, the ultimate goal of most behavior-modification programs is to prepare the individual to function in a "natural" setting, i.e., one in which external reinforcers are not systematically programmed. Reinforcers will still be present in the natural setting, but they may be of a different type, and much more "thinly" scheduled, than in the behavior-modification environment. In the natural environment, for example, the Phillips' boys would not lose points for verbal aggression, although subtle forms of reinforcement (perhaps simply the absence of negative consequences) would certainly be present in many settings. For other kinds of behavior — academic performance, for example — natural reinforcements are more visible, but they are often extremely delayed and symbolic, e.g., "grades." Systematic social and token-reward systems are designed to provide more immediate or tangible reinforcers for individuals who cannot maintain socially defined "appropriate" behavior under natural conditions. Must these special reinforcement systems remain in effect indefinitely, or can we find ways of fading out reinforcers while still maintaining the desired behaviors? Put another way, can systematic reinforcement programs be used as a means of shaping the ability to work for less favorably programmed external rewards?

Classic research on reinforcement suggests two mechanisms by which reinforcement contingencies can be modified while behavior is maintained. One is the process of gradually extending, or thinning, the reinforcement schedule. The quality of the reinforcer remains the same, but it comes less frequently, and, to be most effective in maintaining behavior, less predictably. The second process is the establishment of conditioned or secondary reinforcers. Here the schedule is not necessarily altered (although it may be), but the individual learns to work for a qualitatively different reinforcer. Examples of the application of secondary-reinforcement principles in an applied setting would be the pairing of verbal praise with a token, or the use of external praise and recognition for objectively successful academic performance. In the first case, the hope is that praise alone will eventually be sufficient to maintain the behavior originally reinforced by the token; in the second, the aim is to make the academic performance itself reinforcing enough to maintain the requisite study behaviors.

Extensive and systematic study of the relationship between "programmed" and "natural" rewards is badly needed before reinforcement principles can be widely and well used in applied settings. In conjunction with studies of methods of fading out tokens or other external reinforcers, there should be attention given to analyzing the whole range of reinforcers that may operate in an environment, how these interact with each other, and how new classes of events can become available and functional as reinforcers. In this research, it may be useful to consider reinforcers not as dichotomized into "intrinsic" and "extrinsic" classes, but as running along a continuum from reinforcers closely tied to a given task (i.e., "intrinsic to the task") to highly generalized reinforcers that have no inherent relationship to the task itself. Naturally available social reinforcers, such as attention, recognition, or winning an argument, would fall somewhere in the middle of such a continuum. Analysis in terms of such a continuum would lead to questions such as the extent to which more generalized reinforcers, which are usually easier to engineer in social settings, can be used to bring individuals into contact with task-specific reinforcers they might otherwise have missed, and how anticipation of favorable generalized consequences may help to maintain the reinforcing power of task-specific events.

Bandura's chapter reviewing research on self-reinforcement processes is extremely intriguing with regard to the latter question. If self-administered reinforcement can be shown to reliably maintain behavior, then it seems reasonable to consider the use of an overt self-reinforcement condition as a step in the process of fading out systematic external rein-

forcement in a substantially "thinned" external-reinforcement schedule. There is anecdotal evidence that something of this kind happens in many cases, particularly with young children. However, I know of no applied studies on processes of positive self-reinforcement.

Another possibility for fading out systematic reinforcement is to view the programmed contingencies as a means of shaping new behavior repertoires, which in turn make it possible for the individual to profit from reinforcements normally available in the environment. For example, if a teacher normally rewards only reading performance that is up to a certain arbitrary standard, and a particular child is unable to meet that standard, then he has no means of earning reinforcement in that environment. He may seek attention in disruptive ways. An intensive program in reading, together with powerful external reinforcers, at least initially, should have the effect of establishing a new repertoire which will bring him reinforcement in the classroom. Thomas et al. (1968) report precisely such an effect for an elementary school boy. In a study by Buell et al. (1968), teacher reinforcement of climbing on outdoor play apparatus served to increase time spent in contact with other children. The child thus was reinforced by other children for age-appropriate social behavior with a resultant decrease in certain collateral asocial and regressive behaviors. It is possible to interpret Wolf and Risley's example of the effectiveness of a "managership" system, as opposed to group contingencies, in these terms. The group-contingency condition required the boys to organize themselves — define what constituted "cleanliness," set up a system of policing, establish penalties for infractions. These functions required a set of social and organizational skills which the boys probably did not possess. The managership system essentially performed these functions for the boys. I wonder whether certain kinds of shaping procedures might not have succeeded in establishing skills which would have made it possible for them to perform effectively under the group condition.

With respect to actual social application of "applied" reinforcement research, it is important to emphasize that there is no simple dichotomy between laboratory and applied research. Rather, there is something like a continuum from more to less control over the range of variables that affect behavior. Each of the studies reported by Wolf and Risley was conducted in a natural social environment, and the experimenters committed themselves to study of behaviors that are educationally and socially relevant. On the other hand, in each of these studies, the reinforcement agent was committed to research and experimentation; in most of Wolf's and Risley's studies, the agents were graduate students rather than career teachers or youth workers. There is, therefore, another step from the laboratory yet to be made — to an environment in which ordinary

teachers, houseparents, therapists, or ward personnel are the agents of reinforcement.

To make this step, it will be necessary, first of all, to pay serious attention to the problems of how professional and sub-professional workers are to be trained in the use of reinforcement techniques and how their reinforcing behavior is to be maintained after the initial training period. I believe the same kind of experimental analysis can be applied to these questions as is now being applied to the design of treatment and management procedures for patients, schoolchildren, and delinquents. Even the most casual armchair analysis of skills needed by reinforcement agents suggests that verbal discussion however sophisticated and theoretically sound, is unlikely to produce the kind of behavior changes in the reinforcement agents that are needed if a systematic reinforcement program is to be effective. This suggestion is supported by informal reports of psychologists who have given courses or institutes on behavior modification for teachers and then checked on these teachers' classroom behavior a few weeks or months later.

Development of effective training and maintenance programs for reinforcement agents will require several steps. The first of these is analysis and specification of the components of effective reinforcement programs. Research of the kind reported by Wolf and Risley represents a major contribution to this effort. As a result of such studies, it should be possible to specify with increasing precision the critical components of applied reinforcement programs. However, it is important that in their enthusiasm for intra-individual experimental designs, applied reinforcement researchers not overlook the need for replication studies designed to explore the range of individuals and conditions across which generalizations concerning particular reinforcement effects can be made. A recent study in a Headstart classroom revealed four distinct patterns of response to the same classroom token economy (Wrobel and Resnick, 1970). Findings of this kind highlight the need for research specifying the effects of specific types of reinforcers and reinforcement schedules on individuals with histories of various kinds. Without a body of such research, we will need to begin anew with each individual subject to develop a reinforcement program suited to his needs, with relatively little learned from past experiences except a methodology of measurement and continuous evaluation.

This in fact seems to be the current "state of the art" in the field of applied reinforcement. We can state with assurance that a broad class of contingent events which we call reinforcers, administered systematically, will enhance (or suppress) target behaviors identified by experimenters. We have a methodology for monitoring the course of treatment in applied

settings. But the choice of precisely what contingencies — what reinforcers on what schedule — to apply in a given instance remains to a large degree a matter of hunch and intuition. In other words, we are in possession of a theory and methodology of behavior analysis which, when applied by sophisticated experimenters, can result in dramatic behavior changes in social settings. It is not at all clear, however, that the average "practitioner" in the field will be willing or able to use this method in its present form. A much more prescriptive approach to defining behavior-modification systems may be needed for widespread use.

A second step in training agents of reinforcement is the development of treatments designed to change adults' behavior in complex interactional settings. Again, the principles and techniques from the behavioral laboratory can be applied and systematically studied. What kinds of reinforcers are both effective and feasible in working with adults of various levels of education? Is it possible to shape behavior directly in a social environment through reinforcement of successive approximations to effective performance? If so, how can reinforcement and feedback be delivered to the treatment agent without disrupting the ongoing social interaction? How effective is "modeling" of appropriate performance in establishing complex skills? An initial study in our laboratory suggests that an expanded form of modeling that includes instances of poor performance as well as good, may allow subjects to learn to "edit" their own behavior, thus eliminating the need for direct feedback from a trainer or supervisor (Resnick and Kiss, 1970); but we need further research to determine the limits of such modeling and self-reinforcement procedures in training practitioners. All of these are critical questions for the future utility of applied reinforcement procedures. To date, there has been very little research in this direction.

Finally, for even the most careful training programs to prove of lasting social benefit, attention will have to be paid to the problem of maintaining the practitioners' reinforcing behavior over extended periods of time. Effective training programs will undoubtedly incorporate relatively dense reinforcement contingencies born of the need to shape new behaviors. Will these new behaviors on the part of teachers or other practitioners continue to be practiced when the training period is over? The problem is exactly analogous to the one raised earlier concerning the need to fade out formal reinforcement programs for children or patients and transfer control to natural contingencies in the environment. The solutions will probably be analogous as well. One hypothesis worthy of experimental investigation is that the practitioners' reinforcing behavior will maintain itself to the extent that children or patients exhibit visibly improved performance as a result of it. According to this hypothesis, reinforcement in

social environments is not a "one-way" affair in which teachers or therapists control the behavior of their charges. Instead, teachers and children, therapists and patients, mutually reinforce each other, with a consequent maintenance of the behavior of both participants. This interpretation is consonant with the "social-exchange" view of reinforcement espoused by many social psychologists (Gergen, 1969). Experiments on mutual reinforcement patterns may thus mark a fruitful point of contact between social and learning psychology.

REFERENCES

Baer, D., Wolf, M., and Risley, T. The entry into natural communities of reinforcement. Paper presented at the meeting of the American Psychological Association, Washington, D. C., 1967.

Buell, J., Stoddard, P., Harris, F., and Baer, D. M. Collateral social development accompanying reinforcement of outdoor play in a preschool child. *Journal of Applied Behavior Analysis*, 1968, *1*, 167–173.

Gergen, K. J. *The psychology of behavior exchange*. Reading, Mass.: Addison-Wesley, 1969.

Madsen, C., Jr., Becker, W., and Thomas, D. Rules, praise and ignoring: Elements of elementary classroom control. *Journal of Applied Behavior Analysis*, 1968, *1*, 139–150.

Resnick, L. B., and Kiss, L. E. Discrimination training and feedback in shaping teacher behavior. Paper presented at meetings of the American Educational Research Association, March, 1970.

Reynolds, N. J., and Risley, T. R. The role of social and material reinforcers in increasing talking of a disadvantaged preschool child. *Journal of Applied Behavior Analysis*, 1968, *1*, 253–262.

Thomas, D., Nielson, L., Kuypers, D., and Becker, W. Contributions of social reinforcement and remedial instruction in the elimination of a classroom behavior problem. Unpublished manuscript, University of Illinois, 1968.

Wrobel, P. A., and Resnick, L. B. An investigation of the effects of the application and removal of a token economy on the working behavior of sixteen Headstart children. Paper presented at meetings of the American Educational Research Association, March, 1970.