1982

Effects of intermittent reinforcement and reward-associated messages on response maintenance : a thesis ...

Paul Vinciguerra
University of the Pacific

EFFECTS OF INTERMITTENT REINFORCEMENT AND REWARD-ASSOCIATED MESSAGES ON RESPONSE MAINTENANCE

A Thesis

Presented to

The Graduate Faculty of The

University of the Pacific

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Paul Vinciguerra

May 1982

This thesis, written and submitted by

Paul Joseph Vinciguerra

is approved for recommendation to the Committee on Graduate Studies, University of the Pacific.

Department Chairman or Dean:

Thesis Committee:

Chairman

Dated March 26, 1982

ACKNOWLEDGEMENTS

Several wonderful people helped me at various stages of this research. First, I was fortunate to have a scholarly and cooperative thesis committee consisting of Roger Katz (Chairperson), Esther Cohen, and Gary Howells. Each made valuable contributions in terms of research design, implementation, data interpretation, and especially writing up the final product. Each was also very flexible and available at a short notice. For all of these attributes I am very grateful. I would especially like to thank Roger Katz and Esther Cohen for personal encouragement and friendship which they incorporated into my graduate training. Second, I would like to thank Arthea Larson and Colleen Allivado for serving as research assistants. It was fortunate for me that these two were so well organized; their foresight and assistance was an invaluable contribution. I am also grateful for the friendships which developed during this time. Third, I would like to thank Don Hartmann for his suggestions concerning data analysis, Lynne Zarbatany for her comments on early drafts of my thesis, and Jean Hansen for doing a wonderful job of typing many revisions.

A final, big thanks, goes to my parents for their never ending encouragement and support during this time.

Abstract

The effects of thinning to intermittent reinforcement with various reward-associated messages were investigated using an alternating treatments design. Three children who displayed high rates of disruptive classroom behavior were encouraged to be on-task using a FI 30" schedule of token reinforcement. Once the children reached a preset criterion of on-task behavior, the tokens were thinned to a leaner FI 5' schedule and different reward-associated messages concerning the reinforcement reduction were simultaneously interspersed. Three conditions were compared and alternated from one session to the next. One condition attributed the reinforcement reduction to increased competence (e.g., "You're doing so well you don't need tokens"); a second attributed reductions to factors extraneous to behavior (e.g. therapist forgetfulness); in the third condition no information was given about the schedule change. In a final extinction phase tokens were completely withdrawn. Results indicated that for two subjects the reward-associated messages affected rates of on-task behavior differentially during both thinning and extinction sessions. Better shortterm maintenance was obtained during thinning and extinction phases when the reward messages stressed personal competence rather than extraneous reasons for the reduction in reinforcers. The results are interpreted in terms of reward communication theory. Practical implications are also discussed.

Effects of Intermittent Reinforcement And Reward-Associated Messages on Response Maintenance

A major goal of most reinforcement programs is to produce durable behavior change--change that maintains after reinforcement contingencies are withdrawn. Because withdrawing reinforcers too quickly may result in a rapid return to baseline, the procedure of thinning to intermittent schedules of reinforcement is often prescribed (Marholin & Siegel, 1978; Stokes & Baer, 1977).

Studies with retarded and autistic clients have shown that thinning to intermittent reinforcement can prolong treatment effects (Kazdin & Polster, 1973; Koegel & Rincover, 1977). For example, in Kazdin and Polster's study two retarded adults received token reinforcement on a continuous schedule for increasing their social interactions in a workshop setting. Following a brief reversal which demonstrated the effectiveness of the reinforcement procedure, continuous reinforcement was reinstated for one client and an intermittent schedule was introduced for the second. In a final extinction phase, only the client previously given intermittent reinforcement maintained his social interactions at a high level. This finding is consistent with laboratory research showing that intermittent reinforcement produces greater resistance to extinction than continuous reinforcement, presumably because the schedule change is less discernable.

Aside from these two studies, the issue of reinforcer thinning has received little attention in the applied research literature. Much remains to be discovered about how the procedure is best carried out and variables that influence its effectiveness. For example, an important but infrequently addressed question concerns the meaning or interpretation client's attach to reductions in reinforcers during the thinning process. In this respect it may be that thinning affects different client populations differentially. Much would seem to depend on the client's cognitive-perceptual capacity to detect schedule changes, and the meaning they attach to those changes.

One facet of this problem that has received some attention is the meaning or significance that clients attach to receiving reinforcers in general. In this regard, Feingold and Mahoney (1975) suggest that the manner in which rewards are delivered influences the significance they may hold for the client. The reason for this is that inherent in each gesture or act of reinforcement there is a message or communication to the recipient. For example, administering a token with the message, "Here's a token for being such a good boy/girl," indicates that the child has earned one more token toward a prize or valued item; in addition, it conveys competence and self-efficacy information (e.g. I'm a good boy/girl). Messages of this sort are believed to mediate the effects of rewards.

A recent study by Dollinger (1979) helps to clarify this point. Preschool children received tokens for playing with puzzles. In one manipulation the experimenter explicitly varied the type of statement

or message made when delivering the token. For one group of children the experimenter said "You must really like earning tokens," while in a second group the experimenter said "You must really like solving puzzles." Later the tokens were withdrawn and the children's interest and performance on the puzzle activity were assessed in a free choice situation, i.e. in the presence of other activities. Results indicated that children receiving the 'solving puzzles' message showed more interest and persistence at the puzzle activity than children receiving the 'earning tokens' message. The same reward had different effects depending on the communication which accompanied it. In commenting on these results Dollinger says:

> "From a clinical standpoint, the use of reward/messages might be an effective strategy as termination approaches. Particularly with children, unexpected symbolic rewards with appropriate messages (e.g. "good player awards" or "certificates of competence") might be used to engender maintenance-enhancing attributions of competence and self-efficacy" (pg 366).

A recent study by Katz and Vinciguerra (1982) provides some support for this.

A twelve-year-old boy of normal intelligence who displayed high baseline rates of disruptive classroom behavior was encouraged to be on-task using a dense (FI 30") schedule of token reinforcement. Once a high criterion of on-task behavior was reached, the tokens were abruptly thinned to an intermittent (FI 5') schedule while simultaneously

providing different explanations for the schedule change. Three conditions which reflected different reward communications were compared using an alternating treatments design. These included: (1) a competence set which stressed increased competence as the explanation for the change to intermittent reinforcement (e.g. "You are doing so well at this task that you don't need as many tokens"); (2) an informational set which attributed reinforcement reductions to factors extraneous to the child's behavior such as therapist forgetfulness (e.g. "I did not remember to bring the tokens so I can't give you as many"); and (3) a no information condition in which the child was told nothing about the change. The results indicated that the reward-associated messages affected rates of on-task behavior differentially despite the fact that equal amounts of reinforcement were actually earned under each condition. Higher response rates were obtained with the competence and no informational sets (the latter was slightly less effective than the former) than with the message stressing extraneous factors.

The results are interesting. On the one hand they suggest that in some contexts thinning may adversely affect behavior; yet in a quite different context reduced schedules can be as effective as rich schedules. An influential variable seems to be the meaning attached to the reinforcement reduction via the reward associated message.

Further research is needed to examine the effects of reward messages on the thinning process, especially since certain difficulties with the Katz and Vinceguerra (1982) study limit the conclusions that can be drawn. In particular, since only one subject was used it would

be premature to make any generalizations about the results obtained. Second, while the child's behavior was continually observed, the experimenter's was not. Although the experimenter attempted to be consistent across each condition, he may have inadvertently influenced the child's behavior by increasing his use of praise or attention. To assess these potential influences the experimenter's behavior would also have to be observed and recorded. Last and perhaps most important, it would be interesting to know what would happen if the rewards were withdrawn totally. Would reward messages continue to govern behavior in the absence of any tangible consequences?

The purpose of the present study was to address these issues by replicating the procedures used by Katz and Vinciguerra (1982) with three children who displayed disruptive behavior in the classroom. A coding schema was used to record the experimenter's behavior throughout. In addition, an extinction phase was included in which shortterm maintenance was assessed in the absence of tangible rewards but in the presence of different reward-associasted messages. Based on Katz and Vinciguerra findings, it was predicted that reward-associated messages would differentially affect children's on-task behavior during thinning and extinction, and that best results would be obtained with the competence condition, relative to the extraneous and no information conditions.

METHOD

Participants

Three children who displayed high rates of disruptive classroom

behavior (e.g. talking out, wandering around the class, etc.) were selected to participate. Subject #1 was a twelve year old boy from a special education class for speech handicapped children. Subjects #2 and #3 were both from the day program of a residential treatment center. Subject #2 was a twelve year old emotionally disturbed boy with a slight learning disability. Subject #3 was a nine year old emotionally disturbed boy, and like the other two children, he engaged in little on-task behavior. The behavior problems of all three children interferred with their academic work and achievement.

Setting and Materials

The children were each asked if they would like to have the opportunity to work with a tutor in an area in which they were having difficulty (e.g. math, reading, etc.). All children agreed to meet individually with the experimenter (the author) for twenty minute tutorial sessions. Subject #1 met twice a day with the experimenter, and Subjects #2 and #3 met once a day. All sessions took place in rooms adjacent to the classroom. The experimenter and child sat next to each other at a table and an observer usually looked on from the opposite end of the room.

During the tutorial sessions children worked on academic materials that had been prepared by their teachers. Subject #1 worked on a standard math text (adding and subtracting two digit numbers); Subject #2 worked in a task sequencing book which required him to copy a model series of numbers in backwards order; Subject #3 read short stories and answered related questions in a workbook. The children

used the same materials throghout the study. Midway through the study Subject #2 was moved to a detention hall and the study was completed at that site.

Behavioral Observations

An interval recording system was used to score the childrens' on-task behavior during each session. Experimenter behaviors were also recorded. Observations were made on a ten second observe and ten second record basis. For an interval to be counted as on-task, the child had to be reading or writing in his materials the entire ten seconds. Behaviors such as fidgeting, looking around, and so on were scored as off-task. The experimenter behaviors included: 1) no interaction, the experimenter did not initiate or respond to the child; 2) positive interaction, the experimenter praised or delivered physical attention to the child (e.g. pat on the back); 3) negative interaction, the experimenter reprimanded the child (e.g., "You need to work if you want to earn a token"); 4) requests, the experimenter made task relevant demands or prompted on the child; 5) tutoring, when the child requested that the experimenter assist with an assignment. These observations helped to determine whether the experimenter was consistent throughout each phase or alternating condition of the study. Observations were collected by two main observers and by the experimenter. Reliability was assessed weekly between pairs of observers.

Overview of the Design

As in the Katz and Vinciguerra study (1982), an alternating

treatments design was used. The design allows comparisons to be made between two or more treatments using a single subject (Barlow & Hayes, 1978). In this case three reward messages were compared for their effectiveness in facilitating maintenance of on-task behavior during thinning and extinction phases. In the first phase of the design, baseline observations were collected to obtain an initial estimate of how frequently each child was on-task. After baseline observations, token reinforcement procedures were used to bring rates of on-task behavior up to a prearranged criteria (on-task 80% of the time for three consecutive sessions). During the time that on-task behavior was being shaped, tokens were delivered on an FI 30" schedule. After the shaping phase, the reinforcement schedule was thinned to an FI 5' (tokens every five minutes), while simultaneously introducing various explanations for the reduction in rewards (see procedure section). The FI 5' was chosen in order to make the schedule change obvious to the child. The order of the conditions was random and children received identical amounts of reinforcement in each condition throughout this phase of the study. In a final phase of the study (Extinction), which also consisted of an alternating treatments design arrangement, all tokens were withdrawn and the experimenter again provided the children with one of three justifications for the change. The messages used during extinction were similar to those used during the thinning phase (e.g. emphasizing competence, extraneous factors or providing no information) but the phrasing was changed to incorporate the new information that there would be no further tokens given.

Procedure

For all children the study proceeded as follows:

Baseline. During baseline the children were taken individually to the experimental room where they were asked to work on their assignments for approximately twenty minutes. The experimenter pretended to be working on his own materials and interacted minimally with the children. On-task behavior was recorded for four sessions in this manner.

Shaping. Following baseline, token reinforcement procedures were introduced to encourage on-task behavior. The children were told that working would be rewarded with pennies which could be traded in for various back-up reinforcers. Reinforcers such as candy, crackers, cookies, and so on were priced and made available at the end of each session. Initially tokens were delivered on a FI 30" schedule. If after thirty seconds the experimenter observed a child to be on-task, a token was placed in front of him. No praise accompanied the tokens. If the child was off task, he was reminded about the contingencies and missed the opportunity to earn a token. On-task behavior occurred often enough that reprimands were unnecessary through most of the study. Token reinforcement was delivered in this manner until each child was on-task 80% of the time for three consecutive sessions

Thinning. During the alternating treatments phase the schedule was thinned to a more intermittant FI 5' schedule (tokens every five minutes instead of every thirty seconds). At the same time the reward

messages were introduced in random order. To randomize their order of appearance each condition was put on a slip of paper and drawn from a hat. The conditions consisted of the following instructions: 1) Competence message, the experimenter told the child "You're doing such a good job you don't need as many tokens today"; 2) Extraneous message, the experimenter told the child "I'm running low on tokens so I can't give you as many today"; 3) No information, the child was given no information about the change from high to low density reinforcement. Prior to stating these instructions and thinning, children were briefly exposed (about five minutes) to the FI 30" schedule. The purpose of starting each session with the denser schedule was to control for carry over effects from previous sessions as well as the gradual deterioration of behavior with time. With brief exposure to the FI 30' schedule and the frequent opportunity to receive tokens, the initial rates of on-task behavior were similar from session to session. After five minutes of responding on the FI 30" schedule, the experimental instructions were stated and the tokens were thinned. Instructions were stated once and the experimenter asked the child if he had heard the statements. If not, the instructions were repeated. Thinning procedures continued in this manner until each condition had occurred for five sessions (for a total of fifteen thinning sessions).

Extinction. Following the thinning phase, rewards were discontinued altogether for two additional sessions per condition. The experimenter administered messages consistent with earlier themes

but with the slight modification that denoted the discontinuation of rewards. For the competence message the experimenter said "You are doing such a good job you no longer need tokens"; for the Extraneous message, the child was told "I am out of tokens and I can't give you any more;" and again during the No Information condition, no message was given to the child. In order to assess response maintenance uncontaminated by previous reinforcement, extinction sessions were not begun by priming on the FI 30" schedule. The extinction procedures were continued until each treatment had occurred for two sessions.

Results

Reliability

Reliability was assessed weekly for a total of eighteen reliability checks. At least one check occurred during each phase of the study, with most occurring during the alternating treatments phase. Interobserver agreement was calculated using the percentage agreement formula (agreements/agreements plus disagreements x 100). Agreement for on-task behavior averaged 87% (range 72% to 100%); agreement for experimenter behaviors averaged 88% (range 76% to 100%).

On-Task Behavior

Figures 1-3 show the percentage of intervals on-task during each session for the three subjects. Data are shown for baseline, shaping, thinning and extinction sessions. The headings Competence, Extraneous and No Information refer to the alternating treatments during thinning and extinction sessions.

Subject #1. As can be seen in Figure 1, in the first baseline session, Subject #1 was on-task 40% of the time. Over the next three sessions, however, on-task behavior deteriorated to a level close to zero. Subject #1 grew uncooperative when he was confronted with work which had been difficult for him in the past. While he continued attending the tutorial sessions, he was resistive and accomplished very little. The mean level of on-task behavior during baseline was 18%.

When token incentives were introduced in Session 5, Subject #1's on-task behavior improved rapidly. During this shaping phase (Sessions 5-10) his performance was consistently high, ranging from 80-90% time on task. Ten to twelve tokens were earned during each session. Within six sessions the criteria of being on-task 80% of the time for three consecutive sessions had been met. The mean level of on-task behavior during shaping was 89%.

Beginning with Session 11 the reinforcement schedule was thinned and reward messages were introduced. Subject #1's earnings were reduced to three to five tokens per session. During thinning, the competence and no information reward conditions produced approximately equal rates of on-task behavior, with means equal to 80% and 87%, respectively. For both of these conditions, the rate of on-task behavior was only slightly lower than that of the shaping phase. In contrast, the extraneous reward messsage resulted in a highly variable pattern of on-task behavior which was insufficient to maintain the high rate of on-task behavior obtained during shaping. The mean level of on-task behavior with the extraneous condition was 50%.

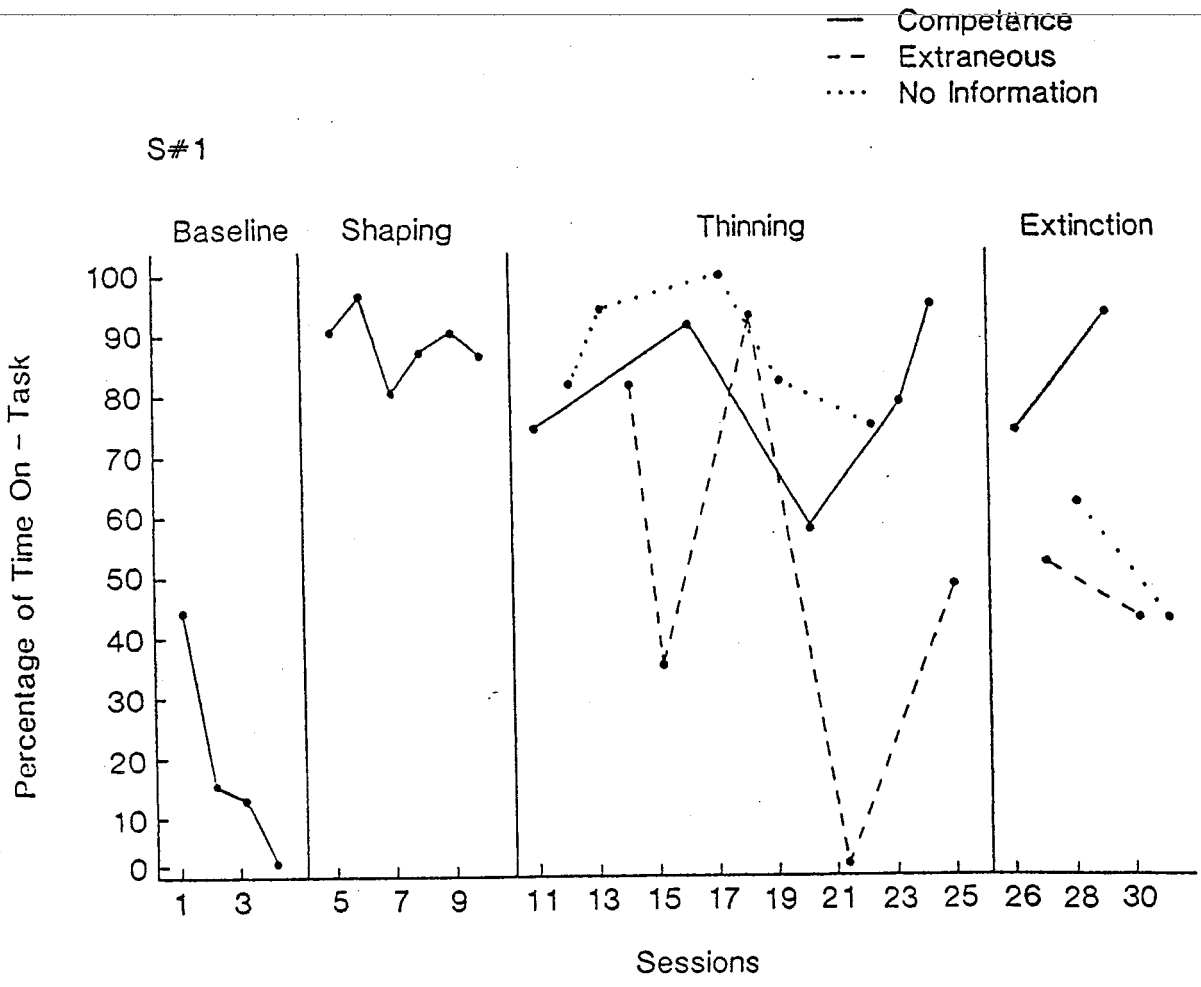

Figure 1. The percentage of time on-task during each session for Subject #1. The headings Competence, Extraneous, and No Information refer to the alternating treatments. Sessions are shown in the order in which they occurred.

Beginning with Session 16 extinction conditions were initiated and Subject #1 received no further tokens. In the extinction phase, competence messages were superior to both extraneous and no information conditions, which did not differ from each other. The mean levels of on-task behavior during extinction were 87%, 53%, and 48% for Competence, No Information, and Extraneous message conditions respectively.

Subject #2. Subject #2 also showed low baseline rates of on-task behavior (mean = 14%). On two occasions during baseline he refused to work and wandered about the room. He was easily distracted and uninterested in his assigned work.

On Session 5 token procedures were initiated. On-task behavior for Subject #2 was difficult to shape and he took more time to reach the preset criteria. (Only the last six shaping sessions are shown in Figure 2.) His behavior followed a typical pattern in which he would have two to three good sessions followed by a poor session in which on-task behavior dropped substantially (e.g. below 50%). It was only after ten shaping sessions that Subject #2 attained the preset criteria. The mean for this phase was 85%.

The reinforcement schedule was thinned and reward messages interspersed beginning on Session 11. Compared to the shaping phase, there was an overall decrease in on-task behavior during thinning regardless of the reward conditions. However, a comparison of the three conditions revealed that competence messages resulted in the smallest decrease in on-task behavior with a mean during the thinning phase equal

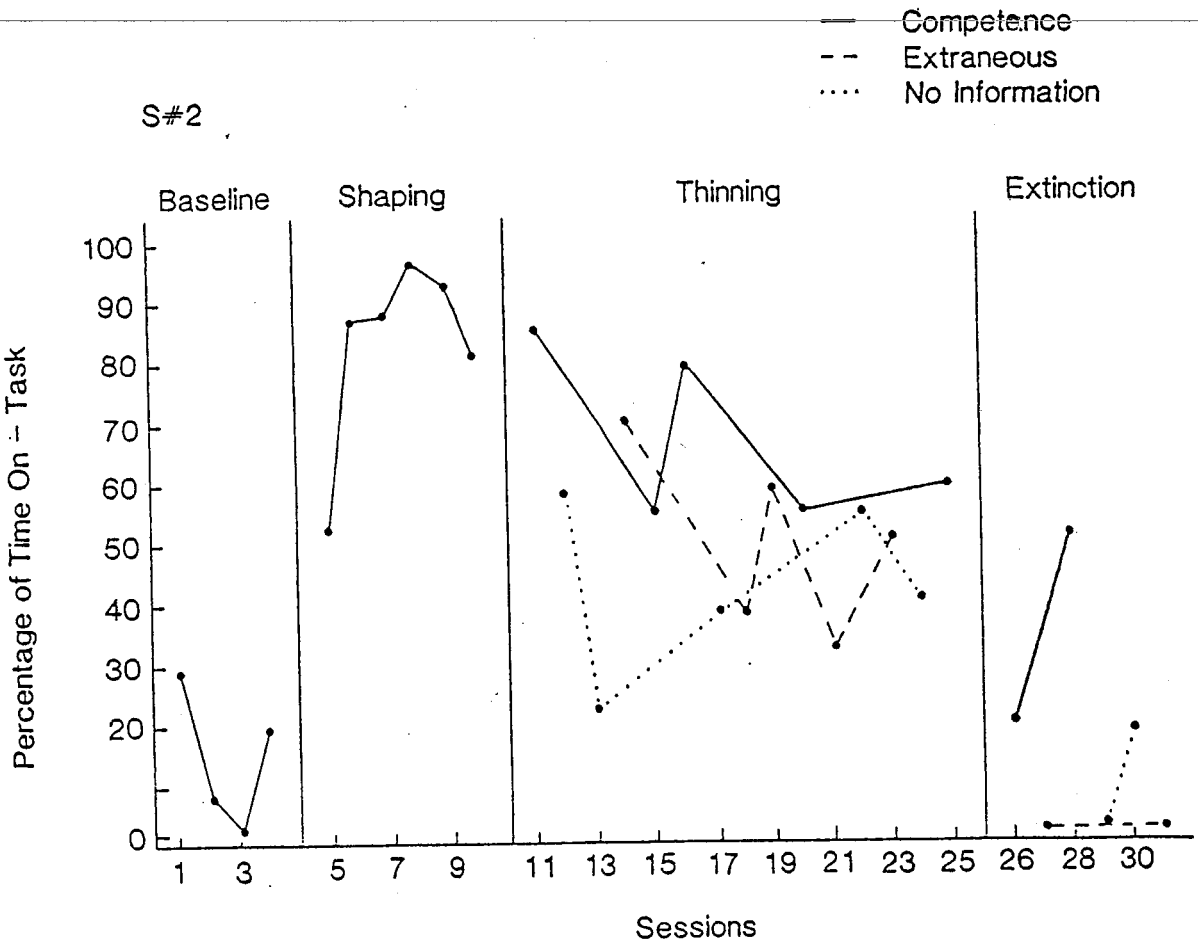

Figure 2. The percentage of time on-task during each session for Subject #2. The headings Competence, Extraneous, and No Information refer to the alternating treatments. Sessions are shown in the order in which they occurred.

to 67%. In contrast, the extraneous and no information conditions resulted in much lower rates of on-task behavior with means of 40% and 50%, respectively.

On Session 26 extinction conditions began. With extraneous and no informational conditions, it can be seen that on-task behavior was nearly extinguished. The means for these two conditions were 0% and 9% respectively. In contrast, the mean performance under the competence condition was substantially higher at 36%.

Subject #3. Subject #3's mean level of on-task behavior during baseline was 13%. It can be seen (Figure 3) that he refused to work on three occasions. The ensuing token phase rapidly increased on-task behavior above the required criterion (mean level = 83%) within six sessions. On Session 11 thinning procedures were started.

The data from the thinning phases are extremely variable and inconclusive in that this subject maintained his on-task behavior regardless of the reward messages used. The means from the thinning phase were 81%, 78%, and 71% for Competence, Extraneous and No Information conditions respectively. Likewise, when the extinction schedule was introduced in Session 26, no clear pattern of results emerged. The means for extinction were 68%, 67%, and 53% for Competence, Extraneous and No Information conditions respectively.

Experimenter Behavior

Table 1 shows the mean percent occurrence for each experimenter behavior throughout the study. Since these data were similar for each subject, they have been averaged across the children. It can be seen that the most frequent code was no interaction. The tutoring category

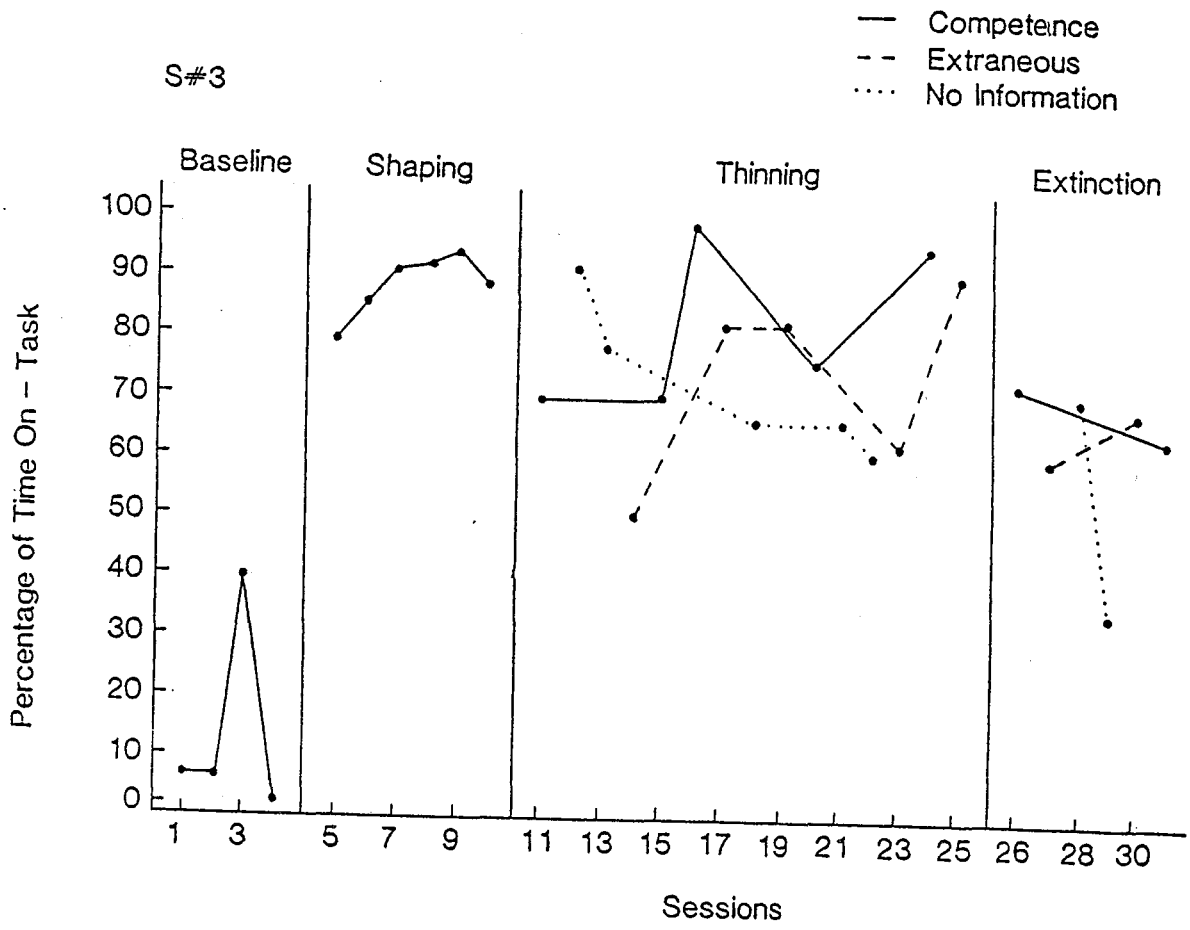

Figure 3. The percentage of time on-task during each session for Subject #3. The headings Competence, Extraneous, and No Information refer to the alternating treatments. Sessions are shown in the order in which they occurred.

Table 1
Mean % of Intervals of Experimental Behavior
Throughout All Sessions

			Thinning			Extinction		
	Baseline	Shaping	Comp	Ext	No Inf	Comp	Ext	Inf
No Interaction	88.2 (5.2)	69.3 (10.7)	75.8 (10.5)	70.1 (18.8)	73.1 (15.0)	78.3 (11.1)	81.9 (10.4)	78.2 (11.0)
Positive Interaction	.36 (.61)	2.27 (2.16)	.93 (1.77)	1.96 (2.55)	2.17 (2.5)	1.68 (1.64)	0 (0)	0 (0)
Negative Interaction	0 (0)	.51 (1.43)	.14 (.56)	.40 (1.16)	.15 (.61)	0 (0)	0 (0)	0 (0)
Requests	8.60 (5.07)	11.2 (9.30)	11.4 (8.59)	15.5 (12.0)	8.94 (7.32)	7.56 (5.61)	8.10 (5.07)	9.05 (4.7)
Tutoring	1.85 (5.07)	15.3 (10.3)	14.2 (13.6)	11.4 (10.8)	14.9 (9.9)	12.4 (12.7)	8.30 (5.81)	11.09 (9.2)

Note. Standard deviaitons are in parentheses.

increased somewhat between baseline and shaping phases. Aside from this, however, there were no other major changes, particularly across the alternating treatments. This indicates that the experimenter was consistent across the alternating conditions.

DISCUSSION

The pattern of results during thinning was similar for Subjects #1 and #2 in that competence reward messages were found to be superior to extraneous reward messages in maintaining on-task behavior. This essentially replicates Katz and Vinciguerra's (1982) earlier work . The present study also included an extinction phase. In the brief period of time in which tokens were withdrawn completely, the competence reward message was also found to be superior to the extraneous reward message in maintaining on-task behavior.

The pattern of results during thinning was also somewhat different for Subjects #1 and #2. While in both cases competence messages were superior to extraneous messages during thinning, the role of the no information condition was less clear. For Subject #1 the no information condition resulted in rates of on-task behavior that were similar to those obtained with the competence reward message during thinning. But for Subject #2 the no information condition produced rates equal to those obtained with the extraneous reward message condition. Thus, during thinning the no information condition produced inconsistent effects. One source of inconsistency could be that the no information condition was open to variable interpretation, i.e, it was ambiguous. Subject #1 may have interpreted the no information condition positively while Subject #2 may

have interpreted it negatively. This may have contributed to discrepancies in performance.

During extinction, however, these differences were absent. Subjects responded similarly in that competence reward messages produced better performance than did the no information or extraneous reward message conditions. The latter two conditions produced lower rates of on-task behavior. Taking into account the subject's behavior during thinning and extinction, it may be that the no information condition is open to variable interpretation when at least some rewards are present. When rewards are unavailable as in extinction, even subjects previously prone to positive interpretations during thinning become susceptable to negative ones.

Because equal amounts of reinforcement were earned during each condition, the differences in response rate cannot be attributed to discrepancies in the amount of reinforcement earned. Likewise, the consistency of the experimenter's behavior across the alternating treatments rules out alternative explanations such as increased praise or tutoring.

One possible explanation for the superiority of the competence reward message condition stems from research on intrinsic interest and rewards which reflect competence (Rosenfield, Folger, and Adelman, 1980). Using an intrinsic interest paradigm, Boggliano and Ruble (1979) rewarded children for playing with puzzles, and simultaneously manipulated information about their competence at the task. Children's performance was made to look better or worse compared to their peers by feedback from

a scoreboard. When the rewards were later withdrawn and intrinsic interest was assessed in a free choice situation, children who had received rewards coupled with competence information persisted longest at the puzzle task. Other investigators working with an intrinsic interest paradigm have also found that rewards which convey competence can facilitate motivation and task persistence (Anderson, Manoogian, & Reznick, 1976; Rosenfield, Folger, & Edelman, 1980). The finding that better shortterm maintenance was obtained with messages stressing increases in personal competence is also consistent with Bandura's self-efficacy theory (Bandura, 1977).

In contrast to enhacing feelings of competence, the extraneous reward message condition often elicited anger and negative reactions from the children. These feelings may have lowered motivation or evoked competing behaviors which contributed to the poor performance obtained with this reward message condition.

Subject #3 was seemingly unaffected by the experimental conditions. However, he did show some awareness of the reward messages as evidenced by his comments throughout the study. For example, Subject #3 frequently commented in response to reward messages that "You (meaning the experimenter) always say that." It could be that Subject #3 realized that no matter what was said he always earned the same number of tokens. In this sense he may not have been persuaded by the reward messages or found them sufficiently credible to alter his performance.

Other methodological problems in the present study need to be addressed. First, it became difficult to try and change children's reward

attributions from one session to the next. The possibility exists that there was carry over in the child's thinking from one session to the next. Utilizing a between group design, in which children receive only one reward message, would control for carry over effects. Second, as noted with Subject #3, the children may not have believed what the experimenter said, instead, giving more weight to their own ideas about what happened. In order to assess this possibility, children should have been questioned about the kinds of attributions they were actually making. This would have been especially useful in determining whether differenses for Subject #1 and #2 in the no information condition resulted from different attributions about the reinforcement schedule change. Thus, future studies in this area should make use of between group designs and some means of assessing attributions.

To summarize, results of the present study indicate that the meaning or significance subjects attach to reinforcement reductions viz. reward associated messages may exert control over behavior. Since situations in which nothing is said about the reinforcement schedule change may result in positive or negative interpretations, it would seem unwise to leave this to chance. The present study supports the use of competency-based reward messages during the thinning process. Encouraging children to believe that reinforcement reductions represent increases in personal competence may be a way to facilitate the thinning process without losing previous performance gains.

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