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ABSTRACT

Three severely handicapped high school students were taught to self-deliver reinforcment after a teacher had given feedback concerning the rate of production. The students self-managed their reinforcement by use of a prosthetic to determine whether or not to give themselves reinforcement. The performance across seven tasks was evaluated during baseline, a condition of teacher-delivery of reinforcement and progressively thinner schedules of student-delivery of reinforcement. Results showed a steady improvement in performance over time, but comparisons between the conditions of teacher versus student control of reinforcement were not possible due to strong practice effect. Potential future benefits of developing self-management strategies are discussed. (Author)

A Procedure to Teach Students with Severe Handicaps to Self-Deliver Reinforcement *

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Running Head: Teaching Self-Delivered Reinforcement

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Abstract

Three severely handicapped students were taught to self-deliver reinforcement after a teacher had given feedback concerning the rate of production. The students self-managed their reinforcement by use of a prosthetic to determine whether or not to give themselves reinforcement. The performance across seven tasks was evaluated during baseline, a condition of teacher-delivery of reinforcement and progressively thinner schedules of student-delivery of reinforcement. Results showed a steady improvement in performance over time, but comparisons between the conditions of teacher-versus student-control of reinforcement were not possible due to a strong practice effect. Potential future benefits of developing self-management strategies are discussed.

A Procedure to Teach Students with Severe Handicaps to Self-Deliver Reinforcement

Interventions based on self-control of selecting reinforcers, monitoring of performance, selection of standards for performance, and delivery of reinforcement have been shown to be effective over a wide variety of behaviors with non-handicapped and mildly handicapped people (Ballard & Glynn, 1975; Bandura & Perloff, 1967; Dickerson & Creedon, 1981; Felixbrod & O'Leary, 1973; Gallant, Sargent, & Van Houton, 1980; Glynn, 1970; Lovitt & Curtis, 1969). While it appears that procedures based on self-management techniques are frequently equivalent in effectiveness to externally controlled interventions, interest in developing procedures based on self-management is rapidly growing. The self-management of intervention is preferred over more traditional approaches because there is less reliance on service providers. Because the clients themselves have control over the intervention, self-management procedures are believed to produce more meaningful and durable behavior change. Importantly, self-management techniques are increasingly becoming the interventions of choice for nonhandicapped people who desire to change their behavior. Thus, procedures to teach severely handicapped people to self-manage their own interventions would be desirable because self-management procedures are more normalized than are procedures based on external control. Within integrated

school sites, self-management procedures may have the additional advantage of creating an image of SH students who are capable of independently managing their own performance in contrast to an image of severely handicapped students as requiring direct teacher control on a continuous basis.

Research concerning self-management procedures with severely handicapped students has only recently been initiated (for a review, see Jackson & Boag, 1981). Within the mental retardation literature, several recent studies have targeted self-management variables including setting standards of performance (Snow, Mercatoris, Beal & Weber, 1982), self-prompting or cueing of behavior (Peters & Davies, 1981), and self-management of token economies (Shapiro, McGonigle & Ollendict, 1980). The studies conducted to date have found that self-management techniques are effective with mentally retarded students; however, the bulk of the studies conducted have been with students who fall within the mild to moderate range of handicaps and the experimental contexts have been of a clinical nature rather than contexts naturally occurring in classrooms for SH learners.

The major purposes of the present investigation are: (a) to test a procedure designed to teach severely handicapped students to self-deliver reinforcement after specified amounts of work have been completed, and (b) to investigate the effects of progressively thinner schedules of reinforcement on the performance of functional tasks. While studies have shown beneficial effects of relatively

thin and variable schedules of reinforcement with handicapped pupils (Van Houton & Nau, 1980), there have been few demonstrations of variable schedules of reinforcement with severely handicapped students. Finally, the students who participated in the study were leaving the public school program within the next year. The next most probable environment for the students was a sheltered workshop setting. Observations of worker behavior indicated that reinforcement (usually verbal) and feedback were given to clients on a much less regular basis and at considerably wider intervals than in the school environment. Thus, the ultimate purpose of the study was to prepare the students to function on tasks for ten to fifteen minutes without tangible reinforcement or pacing prompts from service providers.

Method

Participants

Three male students participated in the study. Jack could independently perform most basic self help behaviors such as grooming and dressing. He displayed low rates of performance during most tasks and required frequent pacing prompts to stay on task rather than engage in self-stimulatory behavior. Jack used a system of cards with written statements to communicate his needs and initiate social interactions. Gary was capable of many self help skills such as dressing and preparing simple meals. He

frequently perseverated on nonsense syllables resulting in a termination of work. He used signs to communicate, which typically consisted of one sign to label or request items. Earl had mastered most self help skills such as dressing. He was still receiving instruction in the preparation of simple meals, shopping skills, payment strategies, and bus riding. He was capable of producing full sentences, although the content of his utterances was usually bizarre and repetitive. Receptively, Earl could carry out two-step commands. Descriptive data of the participants are given in table 1.

Insert table 1 about here

Setting

The participants attended school on a regular public high school campus located in a middle class suburb. Experimental sessions were held in the participants' special education classroom during regular instructional times. The classroom was divided by partitions into several smaller sub-environments. Each sub-environment was designed to accurately simulate typical sub-environments which may be encountered in non-school settings. Thus, the classroom contained a kitchen area with a stove, sink, refrigerator, and a dining table; a vocational area with production tables and tasks selected from local workshops; and a leisure area containing a sofa, record player, and various games and hobby activities. Experimental sessions were conducted in the sub-

environments most appropriate for a given task.

Materials and Tasks

Tasks were selected from the students' IEPs so that the tasks used in the investigation would receive support in the school and home settings of the students. All of the tasks in the study were trained prior to the initiation of the experimental intervention. That is, the participants were already competent with the experimental tasks, although they required frequent prompts and verbal feedback to maintain performance at criterion levels. All materials used in the investigation were either typical domestic items such as silverwear, clothing, or hobby activities or vocational training materials available in hardware stores. A summary of the tasks and materials used in the investigation is given in table 2.

Insert table 2 about here

Experimental Procedures

Baseline. The teacher began the session by verbally cueing the student to do a task. If necessary, prompts were given to sit down and pick up the appropriate materials. Thereafter, the teacher delivered no prompts, feedback or reinforcement.

Self-managed reinforcement. The students were trained to self-manage their reinforcement with the use of a 1 x 1 cm cube to cue the delivery or non-delivery of reinforcement. The cube was made by modifying a standard die

by painting its sides either red or white. Immediately after 5 minutes of work, the students were cued to roll the cube. If, a red side was obtained, the participant was to self-deliver a reinforcer; a white side signaled the participant to return to work. By altering the ratio of red to white sides, a variety of variable schedules of reinforcement could be managed by the student.

The students were taught to self-manage their reinforcement using a standard correction procedure (see table 3). After working on task for five min, the teacher determined if the student had met a pre-set criterion of 20% more units of work (i.e. units assembled, table settings completed, pieces of yarn hooked, T shirts folded, or dishes washed). If the student had met the criterion, the teacher prompted the self-management responses by saying, "good fast working". If after the specified latency the student did not independently initiate a response, the student first received a gestural prompt and failing that, a manually guided prompt to complete a response. If after a 5 min work period the student did not meet the criterion, the teacher said, "you need to work faster". Sessions consisted of two 5 min work periods on the same task.

Insert table 3 about here

Reinforcers. Gary was taught to take sections of fruit for reinforcement; Jack took pieces of a Tyco brand HO model gas station; and Earl took chocolate kisses. If a

participant earned an item, he would take a break (usually for 10 to 15 sec) and eat the consumable reinforcer. Jack would put the pieces of the gas station into the model box to assemble later. The use of edible reinforcement was considered appropriate within the context of this study because the participants ate food over which they themselves maintained control. In terms of normalization, eating food during breaks within classrooms was a completely normal aspect of life at this high school. It should be noted, however, that eating food that was handed out by a teacher would have been potentially stigmatizing. Thus, the present reinforcement procedure was designed to appear as typical of non-handicapped behavior as possible and at the same time occur rapidly so as not to pull the student off-task for long durations of time. The same reinforcers were used during the teacher-managed reinforcement condition.

Teacher-managed reinforcement. As during the self-managed condition, the student worked for 5 min periods. If the student met the production criterion, the teacher said, "good fast working" and consulted a table of random numbers to determine if a student was to receive tangible reinforcement. The rate of reinforcement was yoked to that which the student received during the self-managed condition. As during the self-managed condition, the student was also offered the cube to roll to control for the possible reinforcing effects of manipulating the cube; however, during the teacher-managed condition the results of the roll had no bearing on obtaining a reinforcer.

Reinforcers were consumed in the same manner described earlier.

Experimental Design

Gary and Jack. A multiple baseline design across three behaviors was employed to assess the effects of teacher and student-managed reinforcement on the number of units of work completed. After stable baselines were achieved for the three behaviors, one behavior was selected for intervention. When a reliable change in the frequency of the first behavior was obtained, the same treatment was used to sequentially alter the frequency of the two remaining behaviors. The order of the treatments (i.e. student-managed vs. teacher-managed) was staggered across the two students to assess possible order effects.

Earl. A reversal design was employed with the order of treatments being ABACAC. A represents baseline; B, teacher-managed reinforcement; and C, student-managed reinforcement.

Measurement and Interobserver Agreement

Three types of dependent variables were measured. The productivity of the students was assessed by counting the number of units correctly completed during each trial. The number of prompts required for completion of self-managed responses was recorded. Finally, an assessment was made of the level of attentive behaviors toward the teacher, other students in the classroom and the reinforcers. The student's interest in receiving tangible reinforcement and attention to people was probed immediately before and after each roll

of the cube. Attentiveness to the teacher was defined as making eye contact, verbalizing, or changes in the student's orientation of his head towards a peer or teacher. Interest in the reinforcement or the reinforcement procedure was defined as smiling or changes in posture to indicate interest or excitement. The scores were aggregated across the two response classes to give a general index of student interest and responsiveness as a function of the reinforcement procedure. The aggregate score was produced by assigning a score of +1 if a change indicating increased interest occurred, a +1 if the student increased attentiveness to people, a +1 if the student started to smile after a roll, and a score of -1 if the student stopped smiling after a roll. Thus, for any given trial a range of aggregate scores from -1 to +3 was possible.

In approximately 20% of all sessions both performance and attentiveness data were scored independently by two observers. The second observer (the first author) also watched the trainer (the second author) to note any deviations from the experimental procedures and provided feedback to ensure the consistency of the independent variable throughout the study. A percentage of agreement coefficient was calculated for each reliability session. The agreement for the performance data was calculated as such:

$$\text{interobserver agreement} = \frac{\text{Smaller \# of units counted by trainer or observer}}{\text{Larger \# of units counted by trainer or observer}} \times 100$$

Eight reliability sessions were conducted for Jack and Gary,

and five were conducted for Earl. One hundred percent agreement was achieved during all 21 reliability sessions.

The agreement calculation for the attentiveness data did not include instances of the joint agreement on the absence of an attentiveness response: Interobserver agreement =

$$\frac{(\text{\# of agreements that a response occurred})}{(\text{\# of agreements}) + (\text{\# of disagreements})} \times 100$$

The interobserver agreement data for Jack ranged between 86% and 100% with an average of 88%. The interobserver agreement for Gary's data had a range of 50% to 100% and an average of 92%. The interobserver agreement for Earl's data was 100% on all five occasions. The lower reliability of the attentiveness data may have reflected the more rapid changes of those behaviors than is typically assessed in behavior analytic research. Earl's data showed consistent agreement on these responses because Earl was rarely responsive along these behavioral dimensions.

Results

Acquisition of Self-Managed Skills

The data for acquisition of the cube-rolling responses and the self-delivery of reinforcers indicated that the students could independently manage the procedure with five sessions of instruction. Soon after acquiring the cube-rolling and self-reinforcing responses, Gary attempted to alter the outcome by turning the cube to a red side following an unsuccessful roll. This occurred approximately

one out of every four unsuccessful rolls throughout the duration of the study. Jack and Earl consistently and independently complied with the outcome of the roll and as a result, the teacher was able to let them independently manage and deliver their own reinforcers. Gary, in contrast, required continued supervision by the teacher.

Task Performance

The number of units completed during each session by Jack are represented in Figure 1. Jack's data have been selected for presentation because they are typical of the data collected for the three participants; however, Jack's data are the most complete because the study had to be terminated due to summer vacation. Data for Gary was proceded as far as Baseline, Student VR-2, Teacher VR-2, Student VR-2 and Student VR-3. Earl's data contrasted Baselines, Student VR-2, and Teacher VR-2 within a reversal design.

Insert figure 1 about here

Jack's data (figure 1) show that stable baselines were achieved across the three experimental tasks. Intervention with teacher control of reinforcement on a VR-2 schedule produced a noticeable increase in the level of performance from the baseline levels. Some upward trend or drift was present in the data from the folding and rug hooking tasks, but drift was not apparent with the packaging task. When student control over the VR-2 was introduced, the upward

trend continued with the folding and rug hooking task. In addition an upward trend was produced upon introduction of the Student VR-2 with the packaging task.

Jack's data indicates a strong practice effect as evidenced by the continued upward trend throughout the data; therefore, it is not possible to conclude that either student or teacher control of reinforcement produces superior performance. The conclusion that student control over reinforcement is at least as effective as teacher control is possible since Gary's data, which counterbalanced the order of introduction of the treatments, also showed the same degree of upward trend throughout the data set.

Within Jack and Gary's data the strong upward trend was also evident as the progressively thinner schedules of reinforcement were introduced. Thus, conclusions that thinner schedules produced superior performance are not warranted. A summary of the data aggregated across the three participants is given in Figure 2. The performance steadily improved throughout the study for the three participants. A one month follow-up of Jack's data indicated that the improvement in performance continued to be maintained at high levels without any pacing prompts or reinforcement.

Insert figure 2 about here

Collateral Behavior Change

The degree of collateral behavior change of the attentiveness responses is depicted in table 4. The data

indicates that the three participants received higher scores when the roll of the cube generated reinforcement. Most frequently, the students smiled and showed positive affect following a favorable roll. When the roll was not successful, responses indicating positive affect, interest in the reinforcers, or interest in others were unlikely. There was an intermediate level of responding for the participants during the teacher-managed reinforcement phase. During the teacher-managed reinforcement phase, the roll of the cube had no relationship to the attainment of reinforcement, because the reinforcer was delivered prior to the cube roll. Since reinforcement was delivered regardless of the outcome of the roll, the data from the teacher-control phase serves as a neutral baseline to judge the influence of the cube during the student-managed phase on the collateral responses. Thus, compared to the data when the roll of the cube was meaningless, a positive or negative outcome during the student-managed reinforcement condition differentially affected the collateral behaviors toward people and the reinforcers.

Insert table 4 about here

Discussion

The study showed that three severely handicapped students could acquire the skills necessary for self-management of reinforcement. Jack and Earl consistently managed their own reinforcement throughout the study. Gary

required continued surveillance by the teacher to insure compliance with the outcome of the roll. Although the procedure is probably susceptible to individual differences, because the self-management skills were rapidly acquired, the cost (in training time) of trying the procedure is minimal.

The self-management of reinforcement was as effective as teacher delivery of reinforcement in the traditional manner. The procedure may prove to be advantageous because powerful reinforcers could be used without the stigmatizing effects associated with the "M&M syndrome". The procedure may also prove useful if it results in greater efficiency of teacher time. In the present study a minimal amount of teacher time was saved, because the teacher still counted the students work and prompted the student by saying, "good fast working". However, more time could be saved with the use of jigs or outlines of units on which students would place completed units and then self-deliver reinforcement when the outlines or jig positions were filled.

The use of the cube led to a natural and systematic randomization process. The cube also led to a simple procedure for thinning reinforcement. Because of the strong practice effect for the three participants, statements about improved levels of performance under thin schedules are premature; however, a steadily improving level of production across tasks and participants was observed as the study progressed. Jack's data is particularly impressive in that

during the student-management of reinforcement on the VR-6 schedule, Jack received tangible reinforcement on the average after every half hour of work and the high level of productivity that developed during the study was maintained in the absence of pacing prompts or tangible reinforcement.

Little is known about the interaction between attention or affective responses and the motivation to perform tasks by people with severe handicaps. The present study demonstrated that three severely handicapped students responded with a consistent pattern of such collateral behaviors in response to the experimental conditions. That is, responses which may be indicative of increased interest and positive affect appeared most frequently after a positive roll of the cube. These results support the study by Dunlap and Koegel (1980) which found increases in similar collateral behaviors when task variation was used as a motivational technique. In the present study, the differential responding provided evidence that the participants did in fact discriminate the consequences of the procedure.

The self-management of behavior is a complex process entailing the formation of standards of performance, the evaluation of performance, and the delivery of reinforcement (Bandura, 1971,1976,1977). The present study dealt with only one component of the self-management process. Procedures incorporating additional components of the self-management process have yet to be developed for students with severe handicaps. Future research should investigate whether

additional self-management behaviors can be taught to severely handicapped people. Ultimately, the development of self-management procedures may lead to a reduction in the classic problem of finding motivating effects that are naturally occurring in environments for routine and mundane tasks for which nonhandicapped people frequently create artificial reinforcers for themselves to maintain performance.

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Table 1

Descriptive Data

Participant	Age	Handicapping condition	I.Q. estimated	Source
Jack	18 yrs.	Autism	50	Leiter
Gary	20 yrs.	Severe Mental Retardation Autistic-like Behaviors	No scores available	
Earl	18 yrs.	Autism	46	WISC-R Verbal Subscale

Table 2

Descriptions of Tasks

Participant	Title and description of task	Location
Jack, Gary and Earl	Packaging a faucet repair kit Task description: Five bins of plastic washers and screws were located .3m in front of student. The student matched parts to an outline of parts taped to the table. When the outlines were covered the student placed the items into a box and stacked the box. Materials: ESCO brand faucet repair kit.	Vocational area
Jack	Rug hooking Task description: A commercially available rug hooking kit was used. The kit contained a rug hook, pieces of yarn and a cloth grid on which to hook the yarn. The student had to match the color of the yarn to the color of the grid. After matching the color, the student hooked the yarn into the grid using the rug hook. Materials: 2' x 2' Sunset Scene rug hooking kit.	Leisure area
Jack	Folding clothes Task description: Task consisted of folding t-shirts from a laundry basket. T-shirts were placed face down on a table. One arm at a time was picked up and folded over the back of the shirt. The shirt was then folded in the middle and stacked on the table. Materials: 30 t-shirts, laundry basket, table.	Kitchen area
Gary	Dishwashing Task description: Task began after lunch with dirty dishes piled into a plastic tub in the sink. Items were picked up, one at a time, washed in another plastic tub filled with soapy water, rinsed under the faucet and finally placed on a drying rack. Materials: Dirty dishes, sink, 2 plastic tubs, drying rack.	Kitchen area

Table 2 (continued)

Participant	Title and description of task	Location
Gary	Table setting Task description: The task was conducted before lunch. The student set eight place settings consisting of a plate, glass, knife, fork and spoon and a napkin. Materials: Sufficient silverware, napkins, dining-ware and kitchen table.	Kitchen area

Table 3

Instructional Procedures for Teaching Self Management of Reinforcement

Task analysis	Procedure
1. Work on task for five minutes. 2. Pick-up cube. 3. Roll cube. 4. If red side is obtained; pick up reinforcer and consume. 5. If white side is obtained, return to work.	After 5 minutes of work, the teacher counts the number of units or work completed. If the number of units completed is at least 20% greater than baseline, the teacher says, "good fast working" to cue the self-reinforcement responses. If after a 3 sec latency a student hasn't started a given response, the response is prompted by a a gesture. If the student does not initiate this response within 2 sec after a gesture the response is manually guided. If after 5 minutes of work the student did not work 25% faster than baseline, the teacher says, "You need to work faster" and prompts the student (if necessary) to resume work.

Table 4

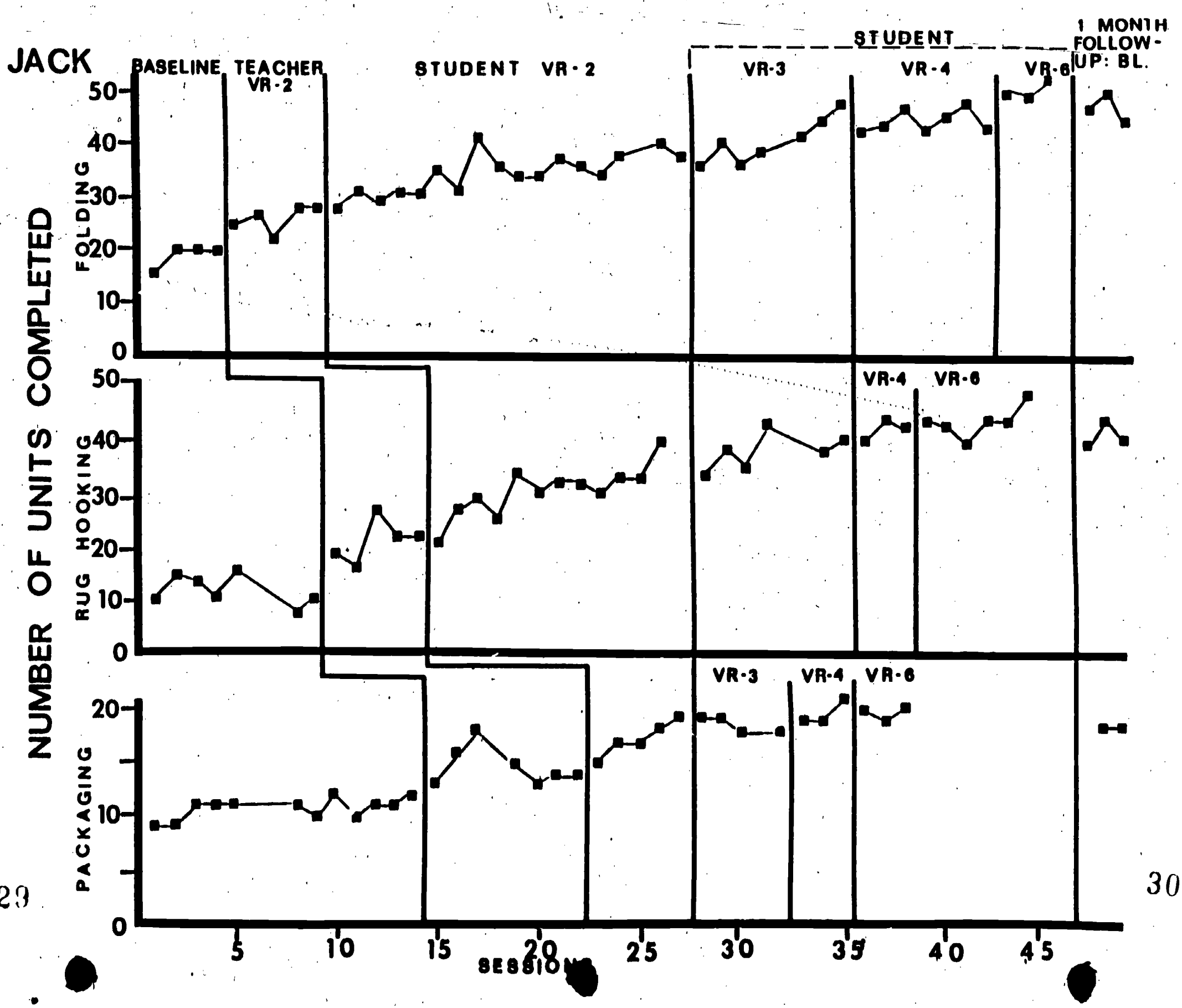
Mean Attentiveness Scores Per Trial Under Each Condition

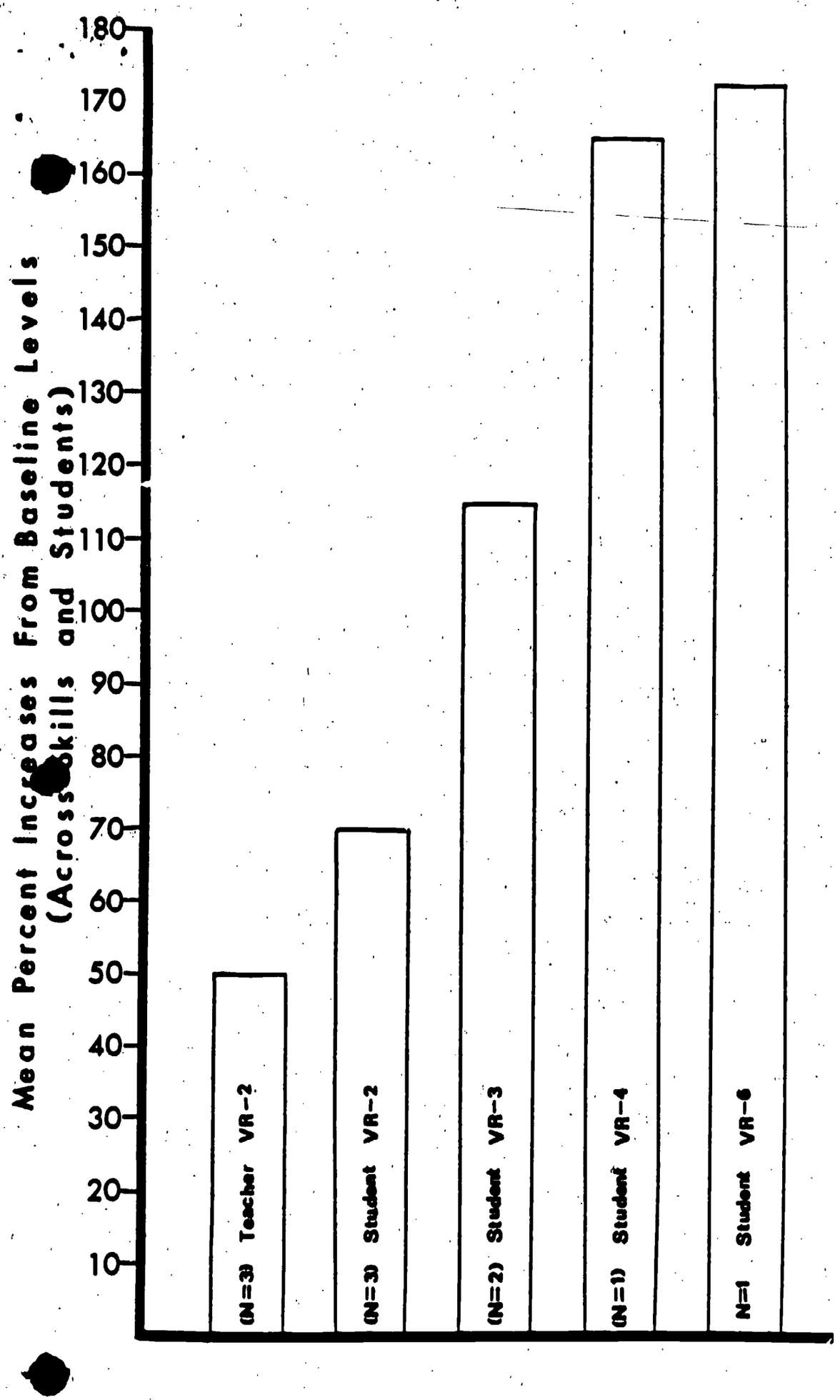
Experimental phase	Outcome	Mean score per trial		
		Jack	Gary	Earl
Self-generated reinforcement	+	.90	.50	.33
	-	.44	-.33	-.20
Teacher-generated reinforcement	non-contingent	.50	.16	0

Figure Captions

Figure 1. Number of units completed by Jack across three tasks and seven experimental conditions.

Figure 2. Mean percent increases from baseline levels in five experimental conditions. (Data is aggregated across seven tasks and three students. The "N" in each bar indicates the number of students represented in the bar.)


JACK
BASELINE
TEACHER VR-2
STUDENT VR-2
STUDENT
VR-3
VR-4
VR-6
1 MONTH FOLLOW-UP: BL.
NUMBER OF UNITS COMPLETED
FOLDING
RUG HOOKING
PACKAGING
50
40
30
20
10
0
VR-4
VR-6
VR-3
VR-4
VR-6
5
10
15
20
25
30
35
40
45
SESSIONS


Mean Percent Increases From Baseline Levels
(Across Skills and Students)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
(N=3) Teacher VR-2
(N=3) Student VR-2
(N=2) Student VR-3
(N=1) Student VR-4
N=1 Student VR-6