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Effects of a Required Attending Response
on Conditioned Reinforcer Effectiveness
in a Picture-Naming and Reading Task
with Retarded Children

by

Barry M. Brazier

A Thesis

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Abstract

Picture-naming and reading behavior of two retarded children was compared in two experimental conditions. In Phase 1 the conditions were the same: a correct-response light flashed after every correct verbal response, and a primary reinforcer was automatically delivered immediately following the light after every fifth correct verbal response. There was no consistent difference in performance for either subject between conditions.

In Phase 2, a lever-press response was required to produce primary reinforcers after correct verbal responding. Condition 1 remained the same in Phase 2 as in Phase 1. The verbal performance of one subject was consistently superior in the condition requiring a lever-press response during this phase. For the other subject, there was no consistent difference in performance between conditions during this phase, nor was there any consistent change in performance in either condition from Phases 1 and 2.

Phase 3, for the subject who showed an increase in performance during the lever-press contingency in Phase 2, was a reversal to the conditions of Phase 1, in that a lever-press response was no longer required to produce primary reinforcers. Performance for this subject improved dramatically in both conditions compared to the prior performance exhibited in either Phases 1 or 2, but there was no consistent difference between conditions. The research ended for this subject at this point. In Phase 3 for the subject who showed no difference in performance between Phases 1 and 2, another primary reinforcer was introduced, in addition to the initial primary reinforcer, but delivered

according to a different schedule of reinforcement. The subject's performance changed dramatically and immediately, and was superior in the condition requiring a lever-press response.

In Phase 4, which was a reversal to the conditions of Phase 2, performance in the condition not requiring a lever-press response improved to the level attained in the condition requiring a lever-press response, but there was no consistent difference between conditions.

Phase 5, which was identical to the conditions of Phase 4, was conducted following a 7 month break in the research, and performance in both conditions deteriorated with no consistent difference between them.

Phase 6 was a return to the conditions of Phase 3, in that two primary reinforcers were delivered according to two different schedules of reinforcement. Performance improved in both conditions, but was superior in the condition requiring a lever-press response. This superior performance was consistently maintained throughout this phase.

Phase 7 was a return to the conditions of Phases 2 and 4, and performance deteriorated to the point of extinction, with no consistent difference between conditions throughout the phase. Thus, when the magnitude of reinforcement was increased for the second subject, her performance replicated the major finding that was obtained with the first subject: presenting reinforcement contingent on a lever-press response, after correct verbal responding, produced better performance than did presenting reinforcement contingent only on correct verbal responding.

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INTRODUCTION

"Reinforcement - the control of behavior through its consequences - is generally recognized to be a key variable in determining the characteristics of behavior" (Sidman, 1960, p. 31). "A reinforcer (reinforcing stimulus) is an event which changes subsequent behavior when it follows behavior in time. Operationally, an event is identified as a positive reinforcer if the frequency of responses of a given class (operant) increases when the presentation of the event is made contingent upon a response of that class" (Morse, 1966, p. 53).

The most common experimental procedure with children involves the presentation of positive reinforcers. Such popularity probably stems from the fact that sensitivity to stimulus consequences is one basic criterion for establishing a response as an operant and that presentation of positive reinforcers is the most acceptable reinforcement to apply to children (Bijou and Baer, 1966).

One type of positive reinforcer that has proven popular with children has been classified as consummables (Bijou and Sturges, 1959) and include candy (M&M's, Smarties), other solid foods (raisins, currants, peanuts, cookies), and various liquids (milk, Kool-aid, apple juice). There are many studies in the literature where consummables have been used as reinforcers. For example, Fuller (1949) used a warm sugar-milk solution to shape arm-raising behavior in a "vegetative human organism". Patterson (1966) used M&M's as a primary reinforcer with a five year old boy to extinguish his tantrum behavior. Wolf, Risley, and Mees (1964) used bites of breakfast as a primary reinforcer to teach a $3\frac{1}{2}$ -year-old autistic boy to wear his

glasses.

It is evident that not all behavior is generated and maintained solely by primary reinforcers. A primary, or unconditioned, reinforcer (e.g., food, water, etc.) is a stimulus whose reinforcing properties do not depend on a history of conditioning - or at least, not on a history of conditioning that can be specified (Kelleher, 1966). Much, if not most, behavior of humans is generated and maintained largely by secondary, or conditioned, reinforcers (e.g., money, tokens, praise, etc.). Such conditioned reinforcers as poker chips and pegs (tokens) have been used in conjunction with such unconditioned reinforcers as candy, ice-cream, and cookies (as back-up reinforcers) to generate and maintain a wide variety of human behaviors (e.g., Dalton, Rubino, and Hislop, 1973, used tokens, praise, and candy with severely retarded children to test the effectiveness of a token economy system; Miller and Schneider, 1970, used pegs, snacks, and activities to generate and maintain writing responses with normal children in a Head Start program; Mandelker, Brigham, and Bushell, 1970, used poker chips, gym-time, cookies, and stories to compare the effects of token procedures on a teacher's social contacts with her students; and, Ferritor, Buckholdt, Hamblin, and Smith, 1972, used poker chips, ice-cream, candy, and field trips to generate and maintain attending behavior and correct work in a third grade classroom).

A review of the literature indicates that seldom is an unconditioned reinforcer used alone to generate and maintain behavior in higher organisms. Rather, unconditioned reinforcers are most often used in conjunction with conditioned reinforcers to generate and

maintain behavior; and with good reason. Many problems can arise when utilizing unconditioned reinforcers that can be easily rectified through the use of conditioned reinforcers. For example, it is often the case that the unconditioned reinforcer cannot be arranged to immediately follow the behavior to be strengthened. Because a reinforcer strengthens behavior it follows, any delay between a specific behavior and the presentation of the reinforcer reduces the probability of strengthening that specific behavior. For example, in an experiment with rats, Grice (1948) found that with as little as two seconds delay in delivery of the reinforcer, it required about ten times as many conditioning trials to form a discrimination than were required with immediate reinforcement.

A second problem, specific to utilizing primary reinforcers, is that presenting reinforcers immediately after a specific behavior often interrupts responding (Ayllon and Azrin, 1968). For example, reinforcing a child with M&M's involves time for consuming the candies that could have been utilized to generate more responses.

A third problem, often a natural consequence of the second, is that reinforcing a high rate of responding on a continuous or low intermittent schedule of reinforcement with primary reinforcement could cause satiation (Ayllon and Azrin, 1968). A continuous schedule of reinforcement is reinforcement of every response within the limits of an operant class, whereas a low intermittent schedule of reinforcement of some, but not all, responses within the limits of an operant class (Catania, 1968).

These, and other problems pertaining to the use of primary re-

inforcers may be circumvented by the use of conditioned reinforcers. A conditioned reinforcer bridges the delay between the desired response and the delivery of the reinforcer; a conditioned reinforcer allows sequences of responses to be reinforced without interruption by delivery and consumption of the reinforcer; a conditioned reinforcer allows the response to be reinforced at any time. This last-mentioned advantage is partially advantageous when using primary reinforcers (e.g., picnics, parties) whose presentation are restricted to time and place (Ayllon and Azrin, 1968).

However, while the effectiveness of conditioned reinforcers have been widely investigated in both basic and applied research (discussed extensively by Hendry, 1969; Kelleher, 1966; Kelleher and Gollub, 1962; and, Ayllon and Azrin, 1968), rarely have they been the specific variable of interest in either area of research; i.e., investigation into the precise conditions for developing a conditioned reinforcer. It could be that applied researchers see this as an issue for basic research, but Sidman (1960) states, and it is doubtful this statement is restricted to basic research, that precise investigation of specific variables is crucial to the science of behavior. He says "we must consider our science immeasurably enriched each time someone brings another sample of behavior under precise experimental control"(Sidman, 1960, p. 17).

Fortunately, there are a few applied studies that have investigated the precise conditions necessary for the establishment of a stimulus as a conditioned reinforcer. For example, Lovaas, Frietag, Kinder, Rubenstein, Schaffer, and Simmons (Note 1) initially paired

the conditioned reinforcer "good" with each bite of food received by a psychotic child independent of his behavior. After this pairing was well established each bite of food was then made contingent on a lever-press response. The conditioned reinforcer "good" continued to be paired with food delivery. Once the lever-pressing behavior was strengthened they gradually increased the number of correct responses required for a bite of food. Each correct lever-press response continued to be accompanied by the conditioned reinforcer "good". Lovaas, et.al. (Note 1) found they were able to strengthen and maintain lever-pressing behavior with much less primary reinforcement than was initially required as long as the conditioned reinforcer "good" was occasionally paired with the unconditioned reinforcer (food). Reynolds and Risley (1968) described the conditions under which adult attention would function as a reinforcer. They found pairing adult attention with primary reinforcers could increase a four year old child's rate of talking if they attended to the child verbally when she talked. Conversely, the adult attention lost its reinforcing properties when primary reinforcers were no longer paired with it. Stephens (Note 2) compared the effects of tokens and praise as conditioned reinforcers in a picture-naming task with retarded children. He reported that the children learned to name more pictures, emitted more correct responses, and spent less time engaging in inattentive behavior when praise was the conditioned reinforcer employed. However, Brazier (Note 3) reported that the children in his research learned to name more pictures, emitted more correct responses, and spent less time engaging in inattentive behavior when tokens were the conditioned reinforcer

employed. This example serves to emphasize the importance of Sidman's (1960) criticisms; i.e., that precise investigation of specific variables is the key to developing a science of behavior. Baer, Wolf, and Risley (1968) lend further support to Sidman by advocating that applied behavior analysis should attempt to analyze effective procedures into their effective components. In other words, precise investigation of specific variables.

In a more recent study, Stephens (Note 4) investigated the effects of sequential and non-sequential conditioned reinforcers in a picture-naming task with retarded children. Picture-naming behavior was compared in two experimental conditions. In one condition sequentially illuminated lights, which accumulated, were contingent upon correct responses, whereas in the other condition, light-flashes, which did not accumulate, were contingent upon correct responses. The subjects were reinforced according to a fixed-ratio schedule of reinforcement where delivery of a primary reinforcer was contingent on five correct verbal responses (FR5). In addition, during specific phases of the research, subsequent to emitting five correct verbal responses a lever-press response was required to produce primary reinforcement, to increase the likelihood that the children attended to the lights. Stephens found, initially, that performance was superior for one subject in the light-flash condition, as compared to the sequentially illuminated light condition, but not different for the other two subjects. With the introduction of the lever-press response requirement, he found performance was consistently superior in the light-flash condition for all subjects. Furthermore, when the

schedule of primary reinforcement was increased to FR10 the behavior of two subjects remained consistently superior in the light-flash condition, while the behavior of one subject deteriorated in both conditions. When the schedule of primary reinforcement was reversed to FR5 the performance in the light-flash condition seemed to be superior to the sequential light condition as a result of sequential lights discriminatively controlling low response rates when the probability of delivery of primary reinforcers was low. Furthermore, for two subjects, the lights in either condition seemed to function as conditioned reinforcers only when a specific attending response was required. This too would lend support to Sidman's (1960) criticisms regarding precise investigation of specific variables, since Stephens' research seems to indicate that the simple pairing of stimuli and reinforcers is not always a sufficient procedure for establishing stimuli as conditioned reinforcers.

The purpose of the present research, which was a systematic replication of Stephens (Note 2), was to further investigate one of his major findings. Stephens found, that for all subjects, performance in the light-flash condition was superior to that in the sequential light condition and that performance under FR5 was superior to that under FR10. He found also that the stimulus lights on the stimulus response panel apparently functioned as conditioned reinforcers for two of the three subjects, only when a specific attending response (lever-press) was required to produce primary reinforcement.

The present research, employing an FR5 schedule of primary reinforcement, compared two conditions, which differed only in that in

one condition a required attending response was necessary to produce primary reinforcers in some experimental phases. Specifically, correct-response light-flashes followed each correct verbal response in both conditions, with primary reinforcement contingent upon completion of the ratio of the schedule of reinforcement in effect. However, in one of the conditions in certain phases, subsequent to completing the ratio of reinforcement in effect for picture-naming and reading responses, a specific response was required to produce primary reinforcers. In summary, in one condition a correct-response light-flash followed each correct verbal response and was paired with the automatic delivery of a primary reinforcer after each fifth correct verbal response. In another condition, a correct-response light-flash followed each correct verbal response, but the subjects were required to emit a specific response following completion of the ratio of reinforcement in effect, in order to produce delivery of a primary reinforcer.

METHOD

Subjects

The subjects were two autistic children from Mapleside Cottage at the St. Amant Centre, Winnipeg, Canada. The children in this research had been hospitalized for several years prior and were chosen on the basis of the following criteria:

- 1) Both subjects could imitate some of the verbal responses of the experimenter. For example, if the experimenter held up a picture of a ball and said, "What's this? A ball"., the subjects would imitate the response "ball".
- 2) Both subjects had limited object-naming repertoires. Arlene could not speak in complete sentences, or imitate many words reliably, and in many instances per pronunciation of certain words was inappropriate. Gary had a more extensive verbal repertoire than Arlene and was able to talk in simple complete sentences.

Arlene was five years old and had been hospitalized for almost 4 years at the time of this research. She displayed very little unprompted verbal behavior and that verbal behavior emitted was often unintelligible. She preferred to play on her own and would often sit for long periods of time either staring at her hands, rocking back and forth, turning in circles, or a combination of all three. Arlene was totally naive to all aspects of this research. She had never encountered the experimental equipment, picture-naming procedures, or schedule of reinforcement used.

Gary was also five years old and had been hospitalized since he was two months old. Gary's verbal repertoire was more extensive than

Arlene's. He was a very hyperactive child, rarely sitting still for more than a few seconds. He was familiar with many aspects of this research having been a subject in two earlier experimental investigations (Stephens, Note 2, Note 4). Therefore, he had previously encountered the physical surroundings, equipment used, was familiar with the picture-naming procedure, and had been exposed to the schedule of reinforcement.

Apparatus

This research was conducted in the Behavior Modification Research Laboratory at the St. Amant Centre in Winnipeg, Canada. The laboratory was divided into several small cubicles of varying size, sufficient for research involving single subjects. The cubicle used in this research was approximately 8 ft. x 10 ft. and contained a low counter along one wall on which was placed a Lehigh Valley Electronics Modular Human Intelligence System (#520 - 02). The cubicle also contained a small child-size table, three child-size chairs, a one-way window, and a small hole through which passed power cables from the Human Intelligence System. The one-way window and hole were located in the wall separating the experimental cubicle from the equipment room. A subject was seated at the table opposite the experimenter with the Human Intelligence System located on the counter to his immediate left and within easy reach.

The Human Intelligence System was composed of six snap-on panels of which only two were operative throughout this research. One of the operative panels was a candy dispenser and the other contained two translucent stimulus-response keys. These keys could be individually

illuminated with red or green light from a source behind the panel. These panels were joined by cables to a programmable digital logic system located in the equipment room. The operation of this equipment was silent with the exception of a series of electromechanical counters. Two small push-button switches, operated by the experimenter, were connected to two inputs of the programming equipment.

A stimulus-response panel, 14 in. x 14 in. x 3 in., was located on the table in front of the subject. On the right side of this panel was a small blue light (correct-response light). Immediately below this light, on the side of the panel facing the subject, was a black lever approximately 1 inch in length. The stimulus-response panel was also joined by a power-cable to the equipment in the equipment room.

The picture-cards used throughout this research measured 5 in. x 7 in. and were of a high quality glossy cardboard. They were obtained from a Peabody Language Development Kit. The printed-word cards used in this research had the same dimensions as the picture-cards and were constructed by the author. The letters were printed on the cards with a Columbia and Chart Rubber Stamp Kit (#200) on flat-white paper.

Preliminary Procedures

Prior to conducting this research it was necessary to conduct preliminary training for Arlene to establish a number of behaviors, pre-requisite to the research, that were not in the subject's repertoire. Arlene was totally naive. She had not learned to make eye-contact or to name pictures. However, Gary had already learned to make eye-contact and to name pictures, so preliminary training procedures were instituted, not to train him, but rather, to ensure that

the pre-requisite behaviors existed in high strength and to maximize the likelihood that these behaviors would come under stimulus control of the experimental situation.

Shaping of Eye-Contact

Since Arlene was experimentally naive and had no attending behavior in her repertoire, it was necessary to shape eye-contact, as such a behavior would facilitate the establishment of other pre-requisite behaviors. A high rate of eye-contact increases the likelihood that the subject will learn to imitate with a high degree of accuracy. Also, with a high rate of eye-contact, the experimenter can be confident that when he prompts the subject in the appropriate steps of the picture-naming procedure, the subject is attending to him and not being reinforced for inattentive behavior.

The subject was seated opposite the experimenter, separated by a table in the experimental cubicle. Initially, the requirement for reinforcement was one second of eye-contact between the subject and experimenter. Each time the subject engaged in eye-contact with the experimenter the subject was reinforced. The time interval was gradually increased until the subject was making eye-contact with the experimenter for a full five seconds. For Arlene, this required three twenty minute sessions at the end of which time she was making eye-contact with the experimenter for three to five seconds consistently. For Gary, who was familiar with all aspects of the research, little time was necessary in shaping eye-contact. Within three or four trials he consistently engaged in eye-contact for durations of five seconds.

Shaping of Stimulus-Key Pressing

The equipment and procedures used throughout the research were introduced to the subjects prior to any experimental sessions being conducted so as to thoroughly familiarize them with the apparatus and general procedures. An attending response was defined as a depression of the appropriate stimulus-key, with enough force to activate the micro-switch, which turned off the illuminated, coloured background. Using an electro-mechanically detected key press as the attending response eliminates any possibility of experimenter bias that could be associated with the more commonly used eye-contact attending response.

Prior to the shaping procedure for key pressing, a few picture-cards were selected at random. The purpose of this was to find picture-cards that the subjects were able to consistently name, or whose names they could at least imitate, to ensure that the subjects would be reinforced for pressing the key during the shaping of this response. Once the subject engaged in eye-contact with the experimenter, one of the pre-selected pictures was immediately presented with the following verbal prompt: "Arlene (Gary), what's this? Apple (name of picture)". If the subject imitated the name correctly, the experimenter immediately pressed the hand-held push-button switch which flashed the blue correct-response light on the stimulus response panel for one second and automatically delivered a "Smartie" into the receptacle of the candy dispenser. If the child did not emit a response, or failed to imitate the name correctly, the experimenter placed the picture-card face-down on the table and waited for the

subject to make eye-contact again. This procedure continued until two picture-cards were found that the subject consistently imitated correctly. These picture-cards were used by the experimenter while shaping key pressing behavior.

The experimenter held one of the randomly chosen picture-cards beside the response key, with the blank-side of the card facing the subject. The experimenter then instructed the subject to press the key. When the subject pressed the key with enough force to activate the micro-switch, the experimenter immediately presented the picture-side of the card to the subject and said "Arlene, what's this? Apple". When the subject correctly imitated the picture-name she was immediately reinforced. If the subject did not imitate the name of the picture-card correctly, the experimenter immediately turned the picture card face-down and pressed the hand-held switch that re-illuminated the background of the stimulus key. As the procedure continued the number of verbal prompts to press the stimulus key were rapidly decreased. At the same time, the experimenter gradually withdrew the picture-card face-down on the table in front of him and pointed to the appropriate key. The pointing was gradually eliminated.

Throughout both shaping and experimental procedures the experimenter did not attend to the subject if the subject was engaged in inattentive behavior; i.e., not making eye-contact with the experimenter. The experimenter looked down at the table, watching the stimulus key peripherally, until the subject pressed the stimulus key sufficiently to turn off the illuminated background. The experimenter would then immediately present the face-side of the picture-

card to the subject and give the appropriate verbal prompt. This continued until both subjects consistently pressed the stimulus key in order to have a picture-card presented. This procedure required three twenty-minute sessions for Arlene and only two trials for Gary. At the end of this time both subjects consistently pressed the key when illuminated and only rarely when not. It was further observed that both subjects almost always made some verbal response when the picture-card was presented.

Picture-Naming Behavior

Prior to conducting this research it was necessary to ensure that the subjects were able to not only imitate picture-names but also to name them. Picture-naming behavior was established in the following manner: The picture-cards that were used in the shaping of key-pressing behavior, which both subjects could imitate, were presented to each subject according to the following steps.

(A) The experimenter presented the first picture-card, contingent on a key press, to the subject and said "What's this _ _ _ _ (name of picture)". If the subject imitated the name of the picture-card correctly he was immediately reinforced. The experimenter then proceeded to step (B). If the subject incorrectly imitated the picture-name, or failed to respond within 8 seconds, the experimenter re-illuminated the response key and remained at step (A).

(B) The same picture-card presented in step (A) was again presented to the subject contingent on a key press. When the picture-card was presented the experimenter said "What's this?". If the subject named the picture-card correctly, the experimenter immediately

reinforced him, and proceeded to step (C). If the subject did not name it correctly, or failed to emit a response, the experimenter returned to step (A).

(C) The second picture, which had been used in the key-press shaping procedure, was used in step (C) and the procedure used in step (A) was repeated. If the subject correctly imitated the name of the picture-card he was immediately reinforced. The experimenter then proceeded to step (D). If the subject incorrectly imitated the picture-name, or failed to respond within 8 seconds, the experimenter re-illuminated the response key and remained at step (C).

(D) The same picture-card presented in step (C) was again presented to the subject, contingent on a key press. When the picture-card was presented the experimenter said "What's this?" If the subject named the picture-card correctly, the experimenter immediately reinforced him. If the subject did not name the picture correctly, or failed to emit a response, the experimenter returned to step (C). These steps - (A - D) - were repeated until the subjects were correctly naming the pictures at least 50% of the time.

After one twenty minute session Gary could correctly name both picture-cards consistently. After four twenty-minute sessions Arlene could correctly name both pictures consistently.

Throughout the procedure for picture-naming behavior the schedule of reinforcement was gradually increased from a continuous reinforcement schedule (i.e., primary reinforcement contingent upon each correct response) to a fixed-ratio schedule of reinforcement in which primary reinforcement was contingent on five correct responses. The blue

correct-response light on the stimulus-response panel flashed on after every correct response for one second and was accompanied by the automatic delivery of the primary reinforcer after every fifth correct verbal response. No other conditioned reinforcer was used. The experimenter never praised the subject (i.e., "good boy") following a correct verbal response, nor did the experimenter ever say "no" following an incorrect verbal response, or an occurrence where the subject failed to emit a verbal response.

Misbehavior

Behaviors which compete with attending responses or are disruptive have often been classified in research of this type as misbehavior. Punishment is then usually made contingent on these behaviors (Sulzbacher and Houser, 1968). Misbehavior was dealt with in this research as follows:

(1) Punishment was not contingent on inattentive or disruptive behaviors. The subject could do as he wished as long as he remained seated in his chair. If he attempted to leave his chair he was immediately grasped by the shoulders and pushed down into his chair in a firm manner. This was accompanied by a sharp "No" from the experimenter.

(2) The immediate surroundings of the experimental cubicle were designed so that there was a minimum of opportunity for the subject to make unauthorized contact with the apparatus or items important to the research. The clock timing the sessions, and the microphone used to record verbal responses, were placed on the counter to the experimenter's right, out of reach of the subject. The only

objects within reach of the subjects were those on the table. This included the sheet for recording data, the stimulus-response panel, and the picture-card being taught. The subject was seated with the back of his chair against the wall and the table placed within an inch or two of the subject's chest. This restricted the subject's reach to the objects on the table. The data sheet and picture-card were held by the experimenter and attempts to grab these items were dealt with by keeping a firm grip on them while totally ignoring the subject. Such attempts soon extinguished as the subject was never successful in obtaining any of the articles. The frequency of grabbing or playing with the objects on the table decreased to a near zero level.

(3) It is possible that those picture-cards presented just prior to primary reinforcement might have acquired the status of a conditioned reinforcer. Thus, it could be argued that should a subject be misbehaving when a picture-card was presented, such inappropriate behaviors would be reinforced. It could be argued, then, that perhaps the picture-card should be presented contingent on a key press only when the subject was sitting quietly, to avoid adventitiously reinforcing inappropriate behaviors. However, this was not the procedure. Regardless of the behaviors of the subject, the picture-card was presented, contingent on a key press. This was done so as to avoid confounding of the effects of differential presentation of picture-cards with the effects of the schedule of reinforcement in effect. For example, one phase of this research might produce more "emotional" behaviors than another, and if the experimenter did not present picture-cards to the subject while engaging in these

inappropriate behaviors, the dependent variables could be affected. These effects could not be attributed to the independent variables, nor as a result of differential presentation of picture-cards, or a combination of both.

(4) Until the subject had pressed the stimulus key, the experimenter did not attend to the subject in any way. This procedure was maintained throughout this research to prevent the experimenter's attention from reinforcing any inappropriate behaviors of the subject.

Picture-Name and Word Baseline

This research involved an investigation of picture-naming and reading behavior, but both children were taught to name pictures first. A baseline was necessary to determine beforehand the words the subjects could or could not pronounce and the picture-cards each could or could not identify. If this was not done, any differences in picture-naming behavior, rather than being the result of the required attending response, might be the result of the pictures in one condition not being pronounceable by the subject, or more picture-cards in one condition being known prior to the experiment. To ensure that all picture-cards to be taught were unknown and pronounceable, the following procedure was carried out with a series of picture-cards.

(1) The experimenter presented a picture-card and said "What's this?"

(2) If the subject correctly named the picture the experimenter said "Good" and proceeded to the next picture. If the subject did not correctly name the picture, the experimenter repeated the question and said the name of the picture. If the subject correctly imitated the

name of the picture the experimenter said "Good" and proceeded to the next picture in the series. If the picture-card was not imitated correctly it was discarded from the experimental word pools.

(3) A large pool of approximately 75 picture-cards were presented three times according to Steps (1) and (2) on three consecutive days. Pictures that were named correctly without prompts from the experimenter on each day were categorized as Known Words. Pictures not correctly named, but whose names were imitated correctly on each day, were categorized as Unknown Words. All other pictures were discarded from the research. Throughout the baseline procedure every fifth correct response was responded to by the experimenter with "Good" (as was every other correct verbal response) and was accompanied by the delivery of a primary reinforcer.

Gary's baseline produced 53 Known Words and 20 Unknown Words. Arlene's baseline produced 5 Known Words and 41 Unknown Words.

Pictures categorized as Known and Unknown Words were then randomly assigned to two pools. One pool of Unknown Words was taught according to the conditions relevant to one experimental condition (Lever Condition) and the other pool according to the conditions relevant to the other experimental condition (Non-Lever Condition). For Arlene, the pools of Known and Unknown Words were replenished three times, by three further baselines taken during the course of the research. For Gary, it was necessary to change the task, as he was so proficient at naming pictures. Since it was so difficult to provide an ample supply of relevant pictures the task was changed from picture-naming to a printed-word reading task. The procedures for

taking a baseline and teaching the printed-words were identical to the procedures for taking a baseline and teaching picture-cards.

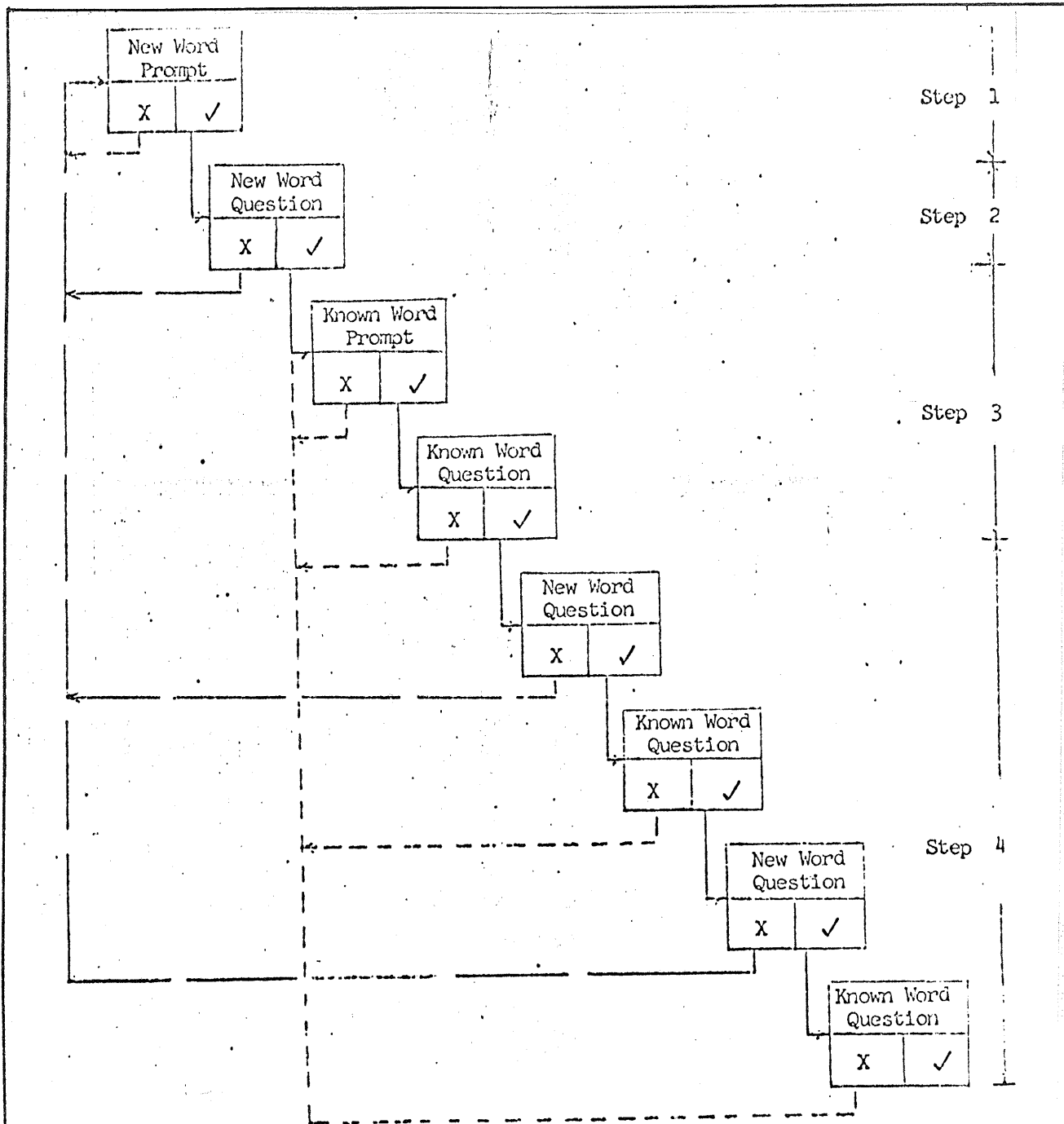
Picture-Naming and Word-Identification (Reading) Procedure

The procedure used for teaching the children to name picture-cards and printed word-cards was similar to that described by Martin (1969). Refer to Figure 1 when following the description of this procedure.

Insert Figure 1 About Here

(1) The experimenter presented a randomly chosen Unknown picture or word-card, contingent on a key press by the subject, and said "What's this? _____ (name of picture)". This was called a prompt trial. If the subject correctly imitated the name of the card, the experimenter immediately pressed the hand-held switch which caused the blue correct-response light on the stimulus-control panel to flash on for one second. The experimenter then proceeded to step (2). If the subject did not correctly imitate the name of the picture or word-card, the experimenter put the card face-down and repeated step (1). If the subject failed to emit a response within 8 seconds, the stimulus key light automatically came on, the experimenter immediately placed the card face-down, and waited for the subject to press the stimulus key. Step (1) was repeated until the subject correctly imitated the name of the card.

(2) Contingent on a stimulus key press, the experimenter imm-



Symbols

- X - incorrect imitative or naming response or response omission.
- ✓ - correct imitative or naming response.

Figure 1, Schematic Representation of Steps 1 - 4 of Picture-Naming Procedure

mediately presented the same Unknown card and said "What's this?" This was called a question trial. If the subject correctly named the card the experimenter immediately presented a single flash of the correct response light and proceeded to Step (3). If the subject incorrectly named the card, the experimenter placed it face-down, re-set the stimulus key light by pressing the hand-held switch, and returned to Step (1).

(3) When Step (2) was successfully completed, the procedures of Steps (1) and (2) were then repeated by the experimenter with a randomly selected Known card.

(4) Successful completion of Steps (1) and (2) with the Known card lead to four more question trials. The order of these question trials varied but both Known and Unknown cards were always given two trials each. The order varied from column to column on the data sheets, a sample of which is shown in Figure 1, to prevent the subject

Insert Figure 2 About Here

from learning the order of presentation of cards. If the subject emitted an incorrect response, or failed to emit any response on either question trial testing the Unknown card, the experimenter recorded an error and returned to Step (1) - the new word prompt trial. If the subject emitted an incorrect response, or failed to emit any response on either question trial testing the Known card, the experimenter recorded an error and returned to Step (2) - the known word prompt trial. The subject was required to emit correct responses in each

Subject: _____
Date: _____
NW: _____

N W P		N W P		N W P	
N W Q		N W Q		N W Q	
K W ₁ P ₁		K W ₂ P ₂		K W ₃ P ₃	
K W ₁ Q ₁		K W ₂ Q ₂		K W ₃ Q ₃	
N W Q		K W ₂ Q ₂		K W ₃ Q ₃	
N W Q		N W Q		N W Q	
K W ₁ Q ₁		K W ₂ Q ₂		N W Q	
K W ₁ Q ₁		N W Q		K W ₃ Q ₃	

Symbols

- N W - unknown (new) word, prompt trial
P
- N W - unknown (new) word, question trial
Q
- K W - known word, prompt trial
P
- K W - known word, question trial
Q

Figure 2. Daily session sheet for the picture-naming procedure.

Steps 1 - 5 are discussed fully in the text under the heading, Picture-Naming Procedure.

step in Column 1 of the data sheet (Figure 2) before advancing to Column 2.

(5) The identical procedure was followed in Column 2 with the following changes: a different Known card was used and the order of the last four question trials in Column 2 differed from the order of presentation in Columns 1 and 3. Advancement to Column 3 was contingent on correct responses in all steps of Column 2.

(6) The identical procedure of Column 1 and 2 was followed in Column 3 with the following changes: a different Known card was used and the order of the last four question trials in Column 3 differed from the order of presentation in Columns 1 and 2.

When Steps (1) to (6) had been successfully completed for an Unknown card - i.e., correct responses in all steps of all three columns - that card was said to have "reached criterion". It was then tested in the following manner: at the beginning of the next three consecutive sessions of the experimental condition in which the Unknown picture or word had reached criterion, the experimenter presented the card, contingent on a key press, and said "What's this?" If the subject correctly named the card on all three occasions, it was categorized as a learned or Known picture or word. If the subject failed to name it correctly on any of these three testing days, the experimenter again taught the card, using the same procedure and beginning at Step (1). Unknown cards were eliminated from the experiment and a new Unknown card taught if either of the following requirements were met:

(a) If, at the end of the sixth session, any Unknown picture

or word had not "reached criterion", it was eliminated.

(b) If an Unknown picture or word was not learned after the sixth time it had reached criterion, it was discarded.

According to the above requirements, five picture cards were eliminated from Arlene's word pool in the Lever Condition and six from the word pool in the Non-Lever Condition. Gary had no picture cards or printed-word cards eliminated from the word pool in either condition.

Experimental Procedures

The purpose of this research was to observe the effects of a required attending response on conditioned reinforcer effectiveness in a picture-naming and reading task with retarded children. There were two conditions - the Lever Condition and Non-Lever Condition. In order for the subject to receive primary reinforcers in the Lever Condition the subject was first required to attend to a blue stimulus (correct-response) light, and second, when required, to press a lever located immediately below the light. In the Non-Lever Condition the subject was not required to press the lever in order that primary reinforcers be delivered. The correct-response light still flashed for one second after each correct response and delivery of primary reinforcers was contingent on fulfillment of the ratio of the schedule of reinforcement in effect; i.e., a primary reinforcer was contingent on five correct responses.

Sessions were conducted at approximately the same time each morning Monday to Friday. In the Lever Condition, a twenty minute session was run under a fixed-ratio schedule of reinforcement; and, following a ten minute break, the Non-Lever Condition was run for

twenty minutes, using the same schedule of reinforcement. The sequence of the conditions was alternated each subsequent session.

Phase 1

A fixed-ratio schedule of reinforcement was in effect in both Lever and Non-Lever Conditions in Phase 1; a schedule of reinforcement where primary reinforcement was contingent on five correct responses. Presentation of a picture-card or printed-word card by the experimenter was contingent on the subject pressing the appropriate key; i.e., that key associated with either the Lever or Non-Lever Condition with ample force to close the micro-switch that turned off the coloured background. After each correct response the correct-response light on the stimulus control panel flashed for one second, and every fifth correct response was accompanied by the automatic delivery of a candy.

If the subject made an error by emitting an incorrect response, or failing to emit a response within 8 seconds, the experimenter re-illuminated the background of the stimulus key. Errors included incorrect responses and omissions; i.e., "errors of commission" and "errors of omission". Phase 1 lasted 19 sessions for Gary and 10 sessions for Arlene.

Phase 2

In Phase 2 the conditions prevalent in the Non-Lever Condition in Phase 1 remained the same. The correct-response light flashed on for one second following each correct response and, after every fifth correct response, was accompanied by the automatic delivery of a primary reinforcer. The Lever Condition was the same, with these exceptions: following the fifth correct response the correct-response

light on the stimulus control panel came on and remained on. Delivery of the primary reinforcer was contingent on the subject pressing the lever on the stimulus control panel with enough force to activate the micro-switch which turned off the blue light. This lever press resulted in the immediate delivery of the primary reinforcer. The subject had 8 seconds in which to press the lever. If the subject failed to press the lever in the required amount of time the experimenter pressed the lever, removed the primary reinforcer from the automatic candy dispenser, and recorded an error. The experimenter ignored the subject if this tactic was necessary. Gary never failed to press the lever in the required amount of time, at any time throughout the research, but it was necessary to employ this tactic twice for Arlene. Both occurrences were in Phase 2. Phase 2 lasted 20 sessions for Gary and 11 sessions for Arlene.

Phase 3

For Gary, Phase 3 was conducted to determine if any differences between the results of Phases 1 and 2 were a result of the experimental manipulations in Phase 2. If any differences in the results of Phases 1 and 2 were a result of the addition of the lever-press in the Lever Condition, then those differences should have disappeared when the lever press was no longer required. The removal of the required lever-press response was, then, simply a return to baseline conditions of Phase 1. Phase 3 lasted 12 sessions for Gary.

Since in Arlene's case, the addition of the lever press in Phase 2 had no apparent effect, Phase 3 was conducted to investigate the possibility that the lack of the differential effect that was obvious

in Gary's data was due to a weak primary reinforcer. At this point, in both conditions, one ounce servings of juice were delivered according to a variable-ratio schedule of reinforcement where the subject was reinforced an average of once every four correct responses. In addition to the juice, Smarties were still delivered according to the fixed-ratio schedule of reinforcement initially in effect. Otherwise the conditions described in Phase 2 remained the same in Phase 3. Phase 3 lasted 17 sessions for Arlene.

Phase 4

Phase 4 was conducted for Arlene (Gary did not serve past Phase 3) to determine if any differences between results of Phases 2 and 3 were a result of the experimental manipulation in Phase 3. If any differences in the results of Phases 1 and 3 were a result of the addition of juice on a variable-ratio schedule of reinforcement, then those differences should have disappeared when the juice was no longer present. Removal of the juice was simply a return to the conditions present in Phase 2. Phase 4 lasted 9 sessions for Arlene.

Phase 5

Phase 5 was conducted, following a 7 month break, to determine if the effects of Phase 4 had been maintained. That is, Phases 4 and 5 were identical; the only difference being the 7 month break between them. Phase 5 lasted 24 sessions.

Phase 6

Phase 6 was conducted to determine if the effects observed in Phase 3 (the presentation of juice on a variable-ratio 4 schedule of reinforcement, in addition to Smarties on a fixed-ratio 5 schedule

of reinforcement) resulted from the addition of juice reinforcement. If the differences in the results of Phase 3, compared to Phases 2, 4, and 5, were due to the addition of juice, then those differences should again be apparent in Phase 6, with the addition of juice. Phase 6 was therefore a return to the conditions present in Phase 3 and lasted 19 sessions.

Phase 7

Phase 7 was conducted to determine if removal of juice, the conditions present in Phase 6, would explain the differences between Phases 5 and 6. If the differences were due to the addition of juice, then removal of juice should have resulted in those differences disappearing. Phase 7 lasted 12 sessions.

Dependent Variables

Several dependent variables were measured in this research:

(1) The number of correct responses per session. A correct response was recorded by the experimenter each time the subject correctly named or imitated the name of the picture or word-card. In addition to recording correct responses with the aid of the experimental equipment, the experimenter also recorded responses on a data sheet placed on the table beside him.

(2) The number of errors per session. Each incorrect naming or incorrect imitation response, or each instance where a response did not occur within 8 seconds after the prompt or question, was recorded as an error by the experimenter. These responses were recorded in a manner similar to that of correct responses.

(3) The number of picture-names or printed word-cards learned

per session. These measures were recorded cumulatively and included only those picture or word-cards that had "reached criterion" via Steps (1) to (6) of the picture-naming procedure, and had been correctly identified, without a prompt, by the subject on three consecutive sessions of the experimental condition in which they had been taught.

(4) Total trials per session. This included the cumulative number of correct responses, incorrect responses, and omissions per session.

(5) Accuracy, defined as the ratio of correct responses to total trials per session. This ratio was obtained by dividing the number of correct responses by the number of correct responses, incorrect responses, and omissions per session.

Inter-Observer Reliability

In order to eliminate the possibility of experimenter bias, an inter-observer reliability coefficient was determined to check the consistency of the experimenter's decisions as to whether or not the subjects' responses were correct or incorrect.

Thirteen of Gary's experimental sessions, and eighteen of Arlene's, chosen at random, were recorded on audio-tape and an independent observer listened to the verbal responses of the subjects from these recordings. By virtue of the order of trials in the picture-naming procedure, before the observer heard any responses from the subjects, she would hear the experimenter verbally prompt the subjects, thus being informed as to what the correct response was. When the subject responded, the observer would then record whether or not she thought the response was correct or incorrect before she heard the

experimenter's decision. Since the experimenter never said "Good" after a correct response, or "No" after incorrect responses, or omissions, the only manner to determine how the experimenter had recorded the response was to follow a sample data sheet to see if the experimenter returned to a prompt trial, or proceeded to the next step. This procedure was used for all those sessions recorded. A comparison of the observer's and experimenter's data then revealed the number of agreements and disagreements. Agreements and disagreements were defined as follows:

(1) A disagreement was recorded if the observer recorded an incorrect response, and a comparison revealed that the experimenter recorded a correct response. If the comparison indicated the experimenter had recorded an incorrect response, an agreement was recorded.

(2) A disagreement was recorded if the observer recorded a correct response, and a comparison indicated the experimenter had recorded an incorrect response. If the comparison indicated the experimenter had recorded a correct response, an agreement was recorded.

Two inter-observer reliability coefficient percentages were calculated.

(a) The number of agreements on correct responses divided by the number of agreements on correct responses plus the total number of disagreements on correct responses.

(b) The number of agreements on incorrect responses divided by the number of agreements on incorrect responses plus the total number of disagreements on incorrect responses.

For Gary, the inter-observer reliability coefficient was 96%

and for incorrect responses was 93%. For Arlence, the inter-observer reliability coefficient for correct responses was 87% and for incorrect responses was 68%.

Results

Correct Responses

Figure 3 shows the number of correct responses per session for

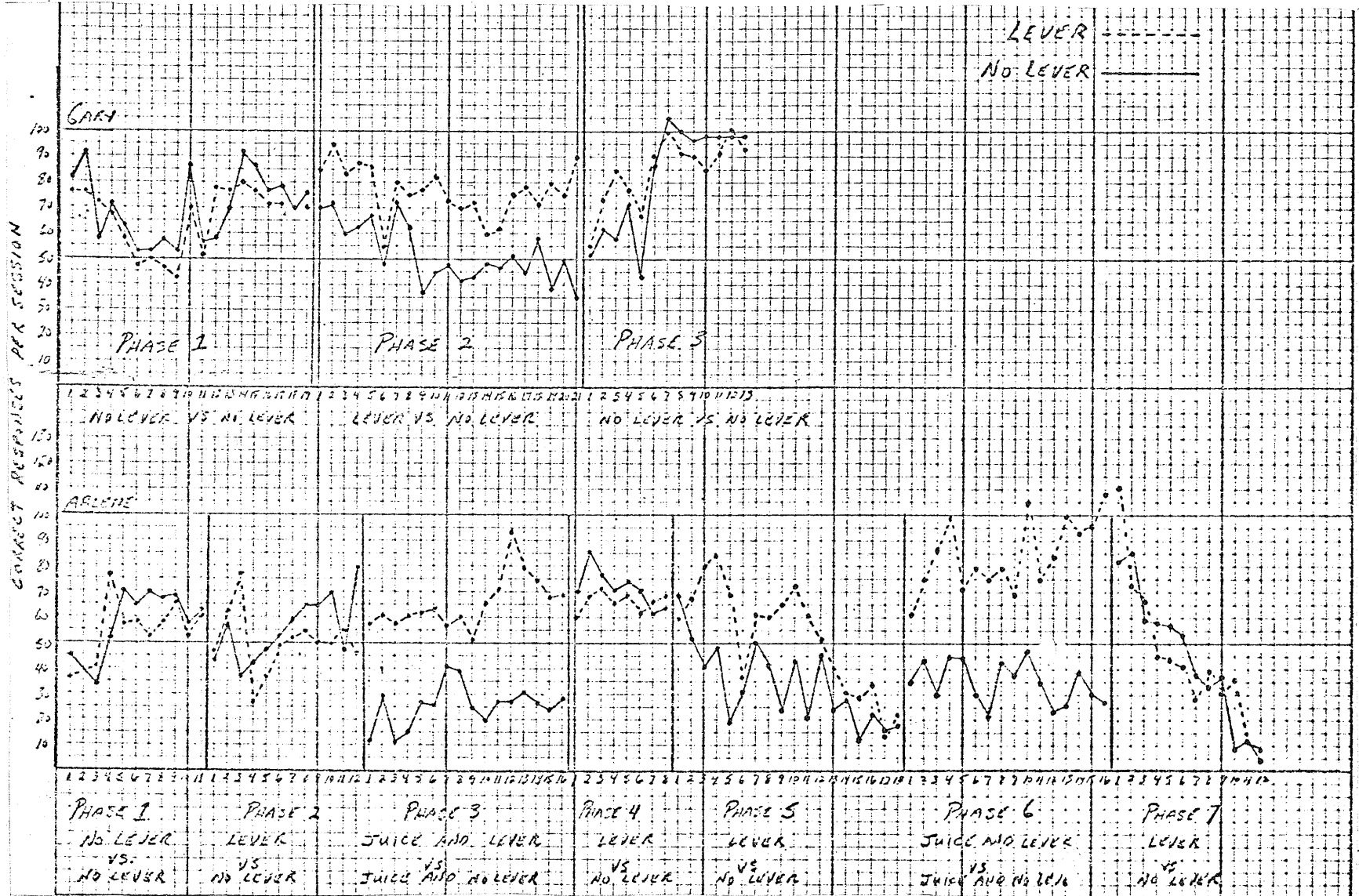
Insert Figure 3 About Here

both Arlene and Gary. There was no consistent session difference between the Lever and Non-Lever Conditions in Phase 1 for both subjects.

In Phase 2, Gary's data indicates that the introduction of the lever press contingency resulted in an increase in the number of correct responses per session in the Lever Condition and a subsequent decrease in the number of correct responses per session in the Non-Lever Condition. There were consistently more correct responses in the Lever Condition than in the Non-Lever Condition throughout this phase. Arlene's data indicates that the introduction of the lever-press contingency had no apparent effect on the number of correct responses per session in either condition and there was no consistent difference between conditions throughout this phase.

In Phase 3, which for Gary was a return to the conditions of Phase 1, Gary's data indicated that the deletion of the lever press contingency resulted in an increase in the number of correct responses per session in both conditions, with no consistent difference between conditions throughout this phase. In Phase 3 for Arlene, the addition of juice on a variable-ratio schedule of reinforcement in both conditions resulted in an immediate and consistent increase in the number of correct responses per session in the Lever Condition. Subse-

Figure 3. The total number of correct responses per session for each subject in the lever and no lever conditions.



quently, there was an immediate and consistent decrease in the number of correct responses per session in the Non-Lever Condition. This effect was consistent throughout Phase 3.

In Phase 4, which was the deletion of the juice, the number of correct responses per session increased immediately in the Non-Lever Condition. The Lever Condition remained stable and there was no consistent difference between conditions throughout this phase.

In Phase 5, which was the same as Phase 4 following a 7 month break, the number of correct responses decreased in both conditions with no consistent difference between conditions throughout this Phase.

In Phase 6, which was a return to the conditions of Phase 3, the addition of juice on a variable-ratio schedule of reinforcement was associated with a sudden increase in the number of incorrect responses per session in both conditions. However, there was a greater and consistent increase in the number of correct responses per session in the Lever Condition and this effect was consistent throughout this phase.

In summary, Gary's data indicated that the introduction of the lever press contingency had the effect of increasing the number of correct responses per session in the Lever Condition and subsequently decreasing the number of correct responses per session in the Non-Lever Condition. Arlene's data indicated that the initial introduction of the lever press contingency had virtually no effect on the number of correct responses per session in either condition. However, with the addition of juice on a variable-ratio schedule of reinforcement, the lever press contingency was associated with an increase in

the number of correct responses per session in the Lever Condition, and a subsequent decrease in the number of correct responses per session in the Non-Lever Condition.

Errors

Figure 4 shows the number of errors per session for both Arlene

Insert Figure 4 About Here

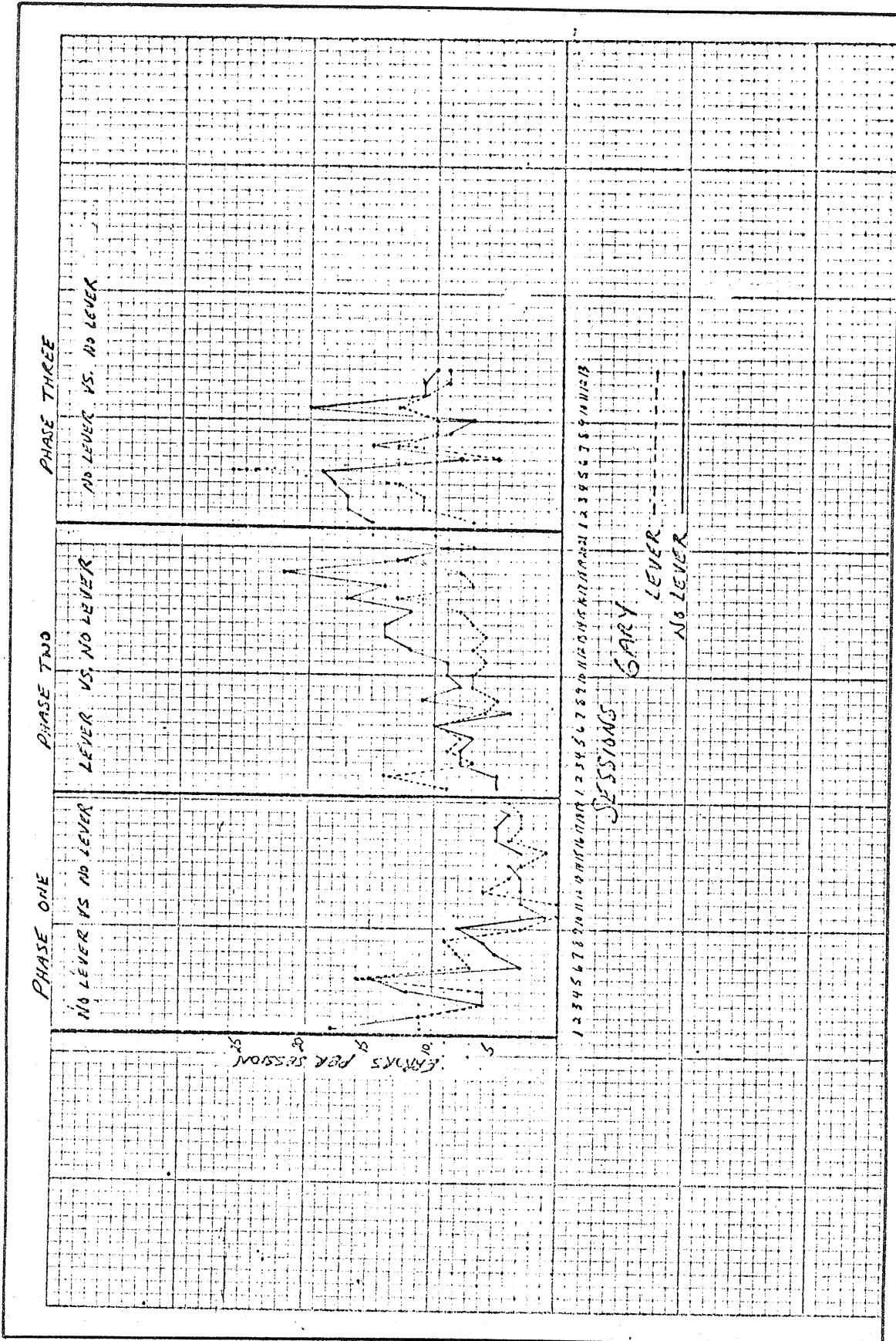
and Gary. There was no consistent difference from session to session between the Lever and Non-Lever Conditions in Phase 1 for both subjects.

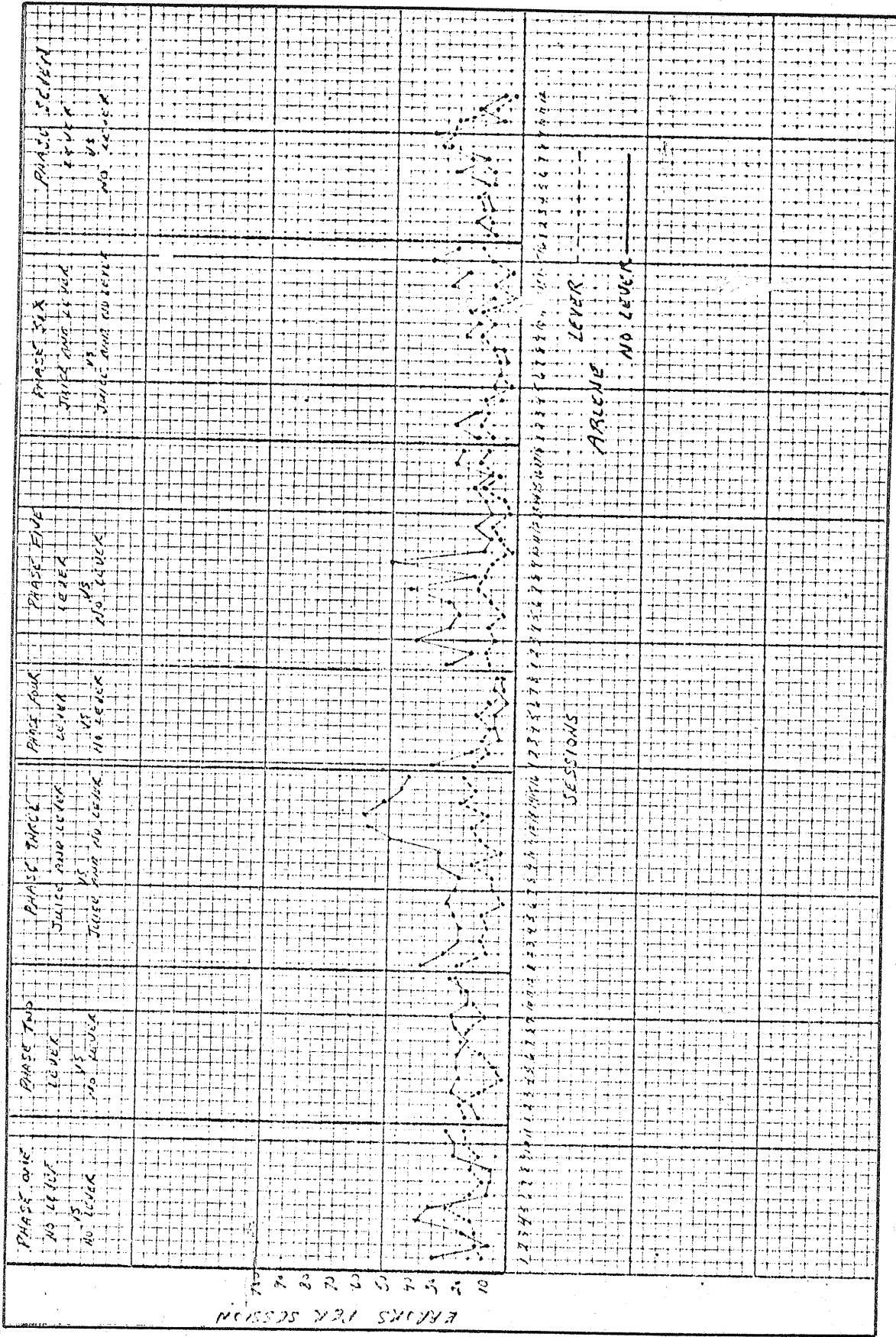
In Phase 2, Gary's data indicated that the introduction of the lever press contingency resulted in an increase in the number of errors per session in both conditions. However, there were consistently more errors per session in the Non-Lever Condition than in the Lever Condition. Arlene's data indicated that the introduction of the lever press contingency had no effect on the number of errors per session in both conditions and there was no consistent difference between conditions throughout this phase.

In Phase 3 of Gary's data, the number of errors per session in both conditions remained unstable with no consistent difference between them. Arlene's data indicated that the introduction of the juice resulted in an immediate and consistent increase in the number of errors per session in the Lever Condition between Phases 2 and 3. This effect was consistent throughout this phase.

In Phase 4 the number of errors per session decreased in both conditions to a near zero level.

Figure 4. The total number of errors per session for each subject in the lever and no lever conditions.





ARLENE LEVER

TRIALS PER SESSION

In Phase 5 the number of errors per session increased in both conditions, just as correct responses decreased in both conditions in this phase. For the first 15 sessions there was a consistent difference between conditions in the number of errors per session throughout the remainder of this phase.

In Phase 6 the addition of juice had very little effect initially. There was no consistent difference for the first ten sessions but this was followed by an increase in the number of errors per session in the Non-Lever Condition. The number of errors per session in the Lever Condition remained stable and this difference between conditions was maintained for the remainder of Phase 6.

In Phase 7, the deletion of juice had a stabilizing effect in both conditions with no consistent difference between conditions.

In summary, Gary's data indicated that the lever press contingency had the effect of increasing the number of errors in both conditions. Arlene's data indicated that the initial introduction of the lever had no effect on the number of the errors per session in both conditions. However, the addition of juice resulted in an increase in errors in the Non-Lever Condition and no difference was recorded in the Lever Condition between Phases 2 and 3.

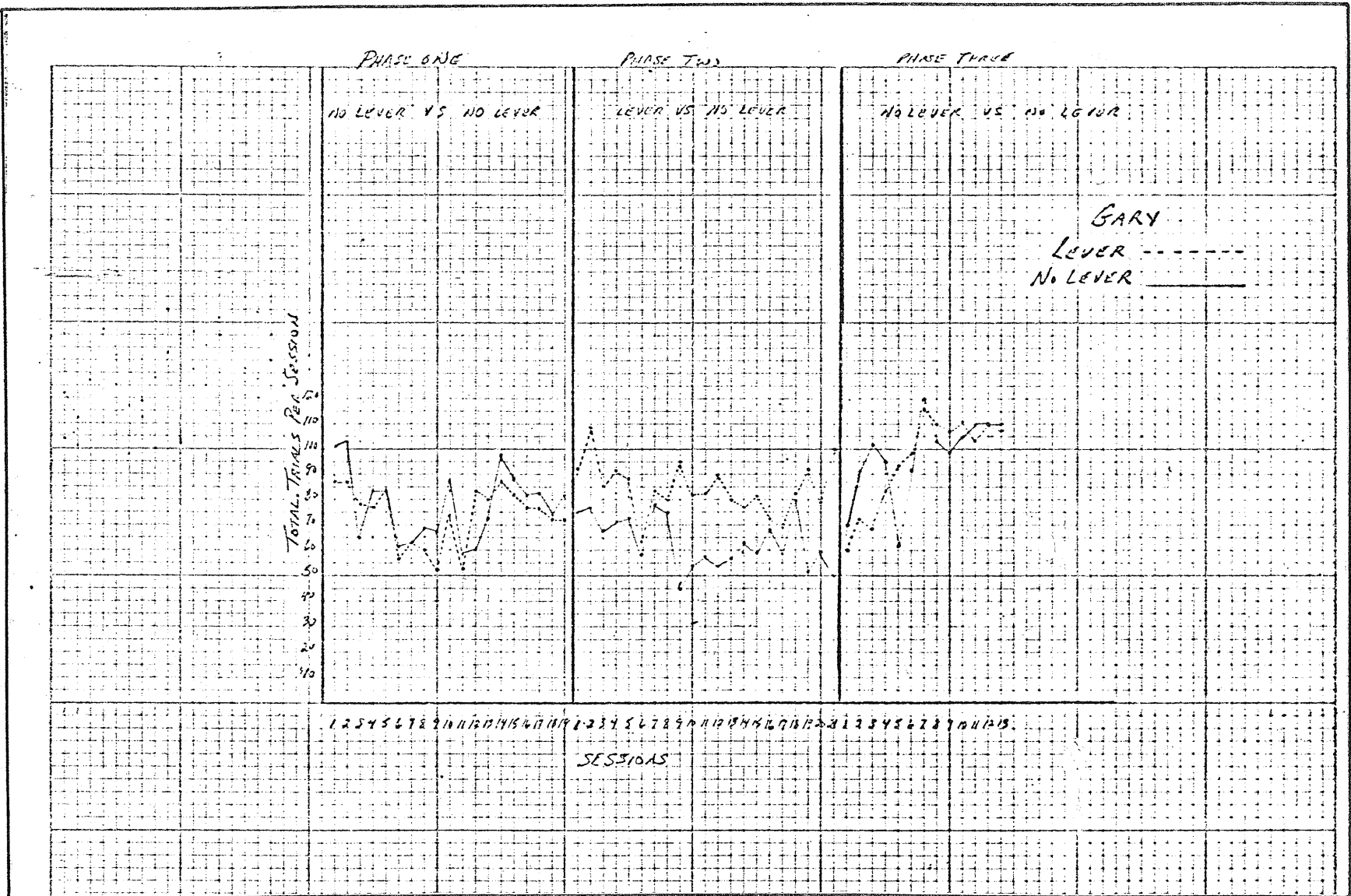
Total Trials

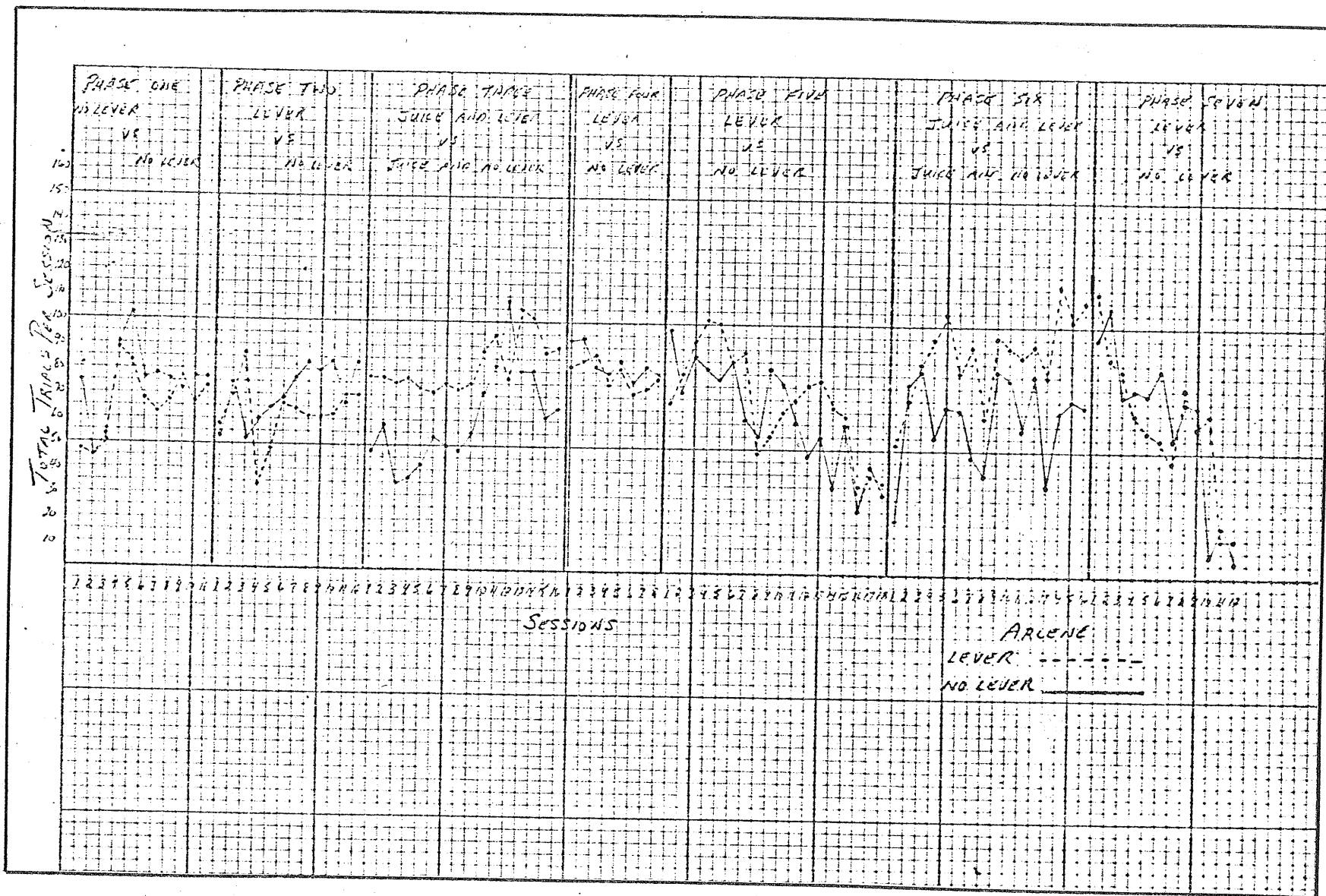
Figure 5 shows the number of total trials per session for both

Insert Figure 5 About Here

Gary and Arlene. There was no consistent session to session differ-

Figure 5. The total number of trials per session for each subject in the lever and no lever conditions.





ences in Phase 1 between the Lever and Non-Lever Conditions for both subjects. However, Gary's data indicated greater instability than Arlene's data in the number of total trials per session.

In Phase 2 for Gary, the addition of the lever was associated with a sudden and consistent difference between conditions. While there was only a slight increase in the number of total trials per session in the Lever Condition, there was a substantial decrease in the number of total trials per session in the Non-Lever Condition. This effect was consistently maintained throughout Phase 2. The reader is reminded that the number of correct responses in Phase 2 of the Non-Lever Condition took a sudden drop, thus, the effects on total trials is predictable since this variable is the sum of correct and incorrect responses per session. Arlene's data indicated that the addition of the lever had no consistent effect on the number of total trials per session. There was consistent instability in both the Lever and Non-Lever Conditions throughout Phase 2.

In Phase 3 of Gary's data, the deletion of the lever had a sudden effect on both conditions. The number of total trials suddenly increased in the Non-Lever Condition and just as suddenly decreased in the Lever Condition. This instability lasted approximately 7 sessions with the number of total trials gradually increasing in both conditions until there was no consistent session to session difference between them. Arlene's data indicated that the addition of juice was associated with a consistent difference in the number of total trials per session between conditions. Total trials increased in the Lever Condition, slightly decreased in the Non-Lever Condition, and this

difference was consistently maintained, with the exception of 3 sessions, throughout Phase 3.

In Phase 4, the deletion of juice was associated with an immediate increase in the number of total trials per session in the Non-Lever Condition, and a corresponding decrease in the Lever Condition. The two conditions stabilized with non consistent session to session difference throughout Phase 4.

In Phase 5, the number of total trials decreased gradually in both conditions with non consistent session to session difference throughout this phase.

In Phase 6, the addition of juice was associated with a rapid increase in the number of total trials per session in both conditions. Again, these results are predictable from looking at the data on correct responses and incorrect responses in this phase; i.e., correct responses increased substantially, while errors remained stable; hence, the corresponding increase in total trials. The Lever Condition had a greater increase than the Non-Lever Condition and this difference was maintained throughout Phase 6.

In Phase 7, the deletion of juice was associated with a sudden and continuous decrease in the number of total trials per session in both conditions. There was no consistent difference between conditions throughout this phase.

In summary, Gary's data indicated that the lever press contingency was associated with an increase in the number of total trials per session in the Lever Condition, and a subsequent decrease in the Non-Lever Condition. Arlene's data indicated that the initial intro-

duction of the lever had no consistent effect on the number of total trials. However, the introduction of the juice was associated with an increase in the number of total trials in the Lever Condition and a corresponding decrease in the Non-Lever Condition.

Ratio of Correct Responses to Total Trials

Figure 6 shows the ratio of correct responses to total trials for

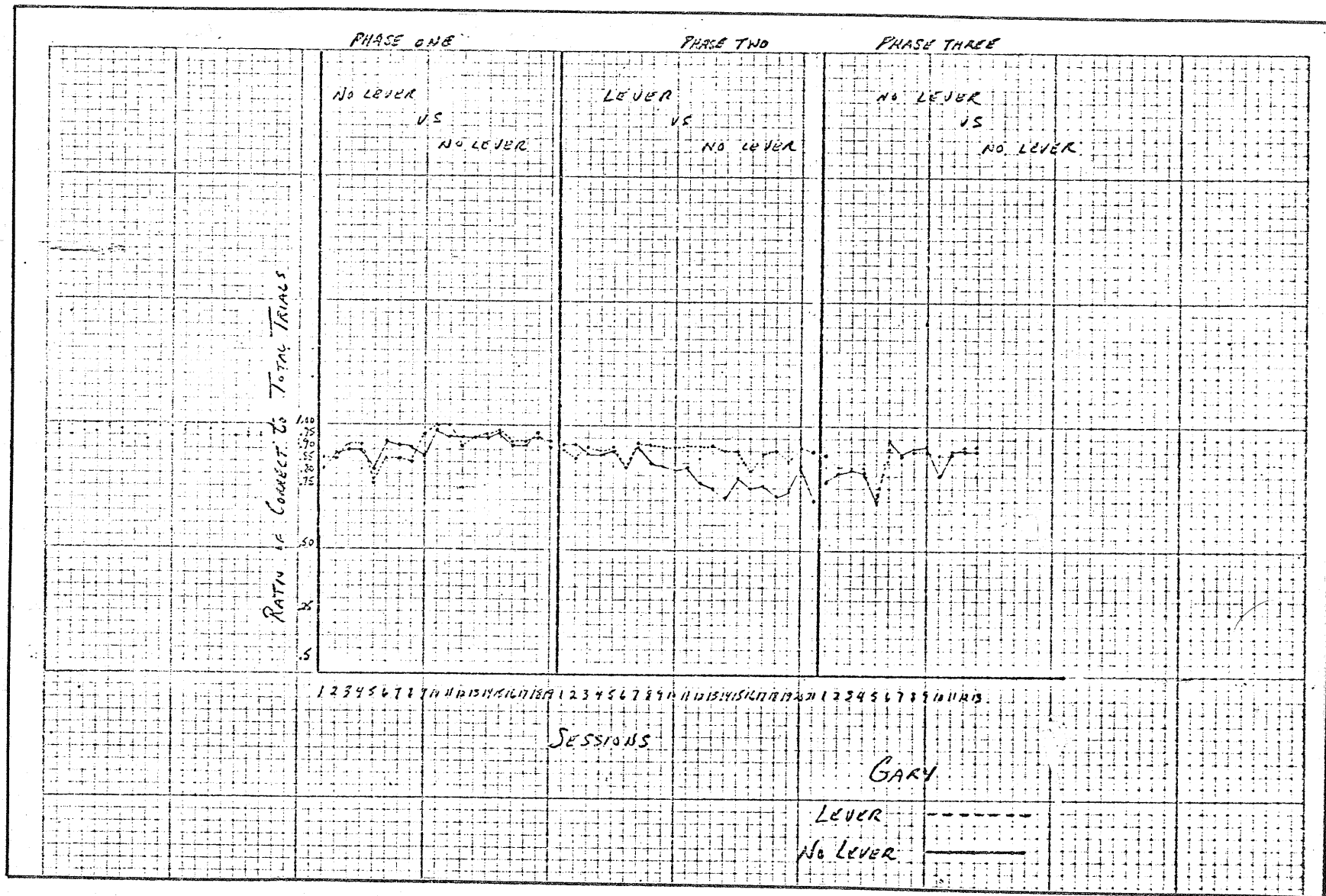
Insert Figure 6 About Here

Gary and Arlene. There was no consistent session to session difference in Phase 1 between the Lever and Non-Lever Conditions for both subjects.

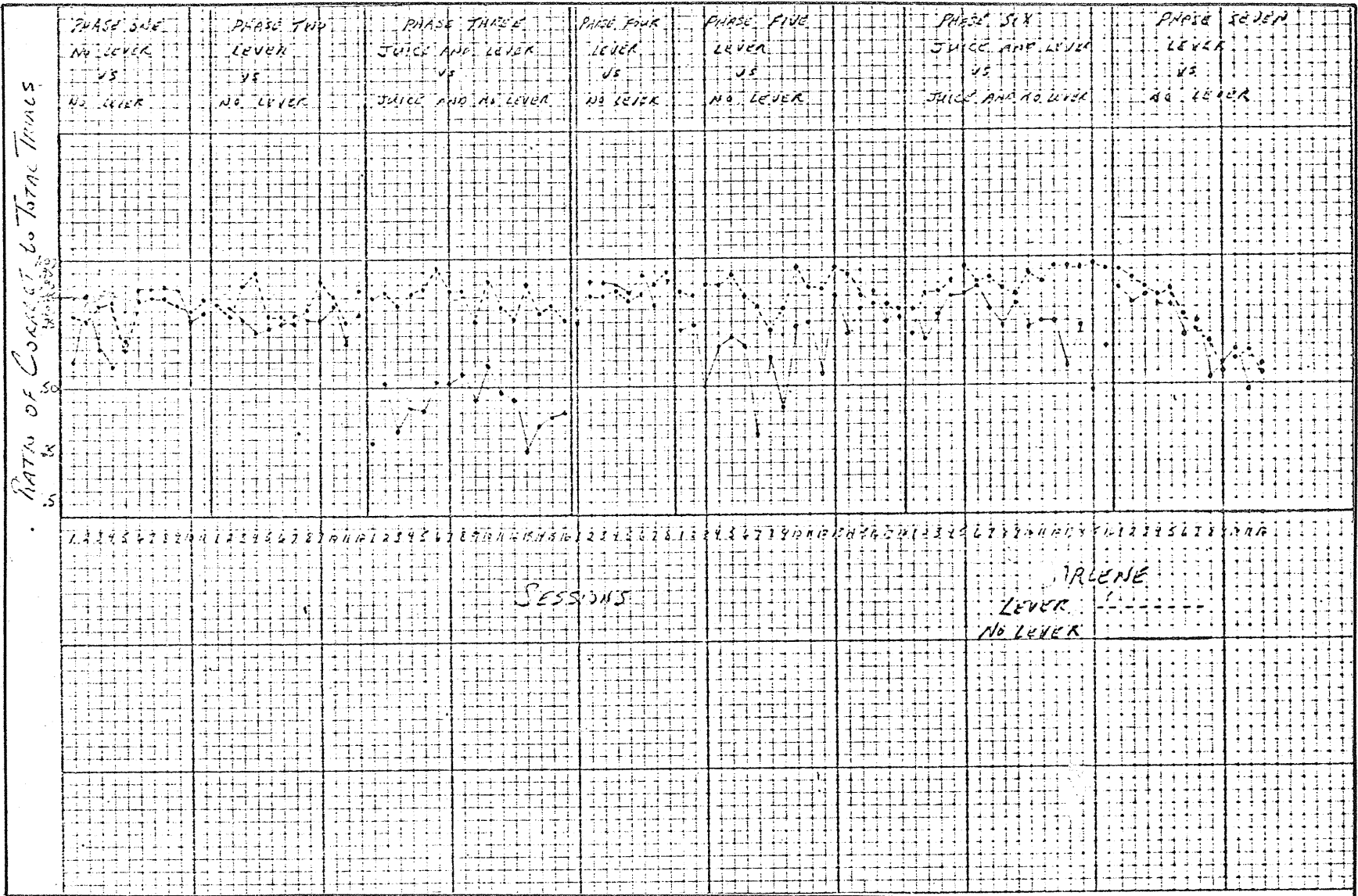
In Phase 2 of Gary's data, the addition of the lever resulted in a decrease in the ratio of correct responses to total trials per session in both conditions. The decrease was greater in the Non-Lever Condition and this effect was maintained throughout Phase 2. Arlene's data indicated that the addition of the lever had no consistent effect on the ratio of correct responses between conditions.

In Phase 3 of Gary's data, the deletion of the lever had a stabilizing effect on the ratio of correct responses to total trials in both conditions throughout this phase. Arlene's data indicated the addition of juice had an immediate and consistent effect on the ratio of correct responses to total trials between conditions. While the effects of the Lever Condition remained as they were in Phase 2, the effects of the Non-Lever Condition decreased immediately and substantially. This difference between conditions remained consistent throughout this phase.

Figure 6. The ratio of correct responses to total trials per session for each subject in the lever and no lever conditions.



RATIO OF CORRECT TO TOTAL TRIALS



In Phase 4, the deletion of juice had an immediate effect on the ratio of correct responses to total trials per session in both conditions. While the ratio in the Lever Condition only increased gradually and slightly, the ratio in the Non-Lever Condition increased immediately and dramatically. There was no consistent session to session difference between conditions and this effect was maintained throughout Phase 4.

In the initial sessions of Phase 5, which was actually the continuation of Phase 4 following a seven month break, the ratio of correct responses to total trials per session decreased substantially in the Non-Lever Condition. However, after approximately 15 sessions of instability and a consistent difference between conditions, the ratio of correct responses to total trials per session in both conditions decreased gradually and simultaneously. There was no session to session differences between conditions for the remainder of Phase 5.

In Phase 6, the addition of juice was associated with a small consistent difference between conditions in initial sessions, with this difference becoming substantially greater, and remaining consistent for the remainder of the sessions in Phase 6. While the ratio of correct responses in the Lever Condition remained stable throughout Phase 6, the ratio in the Non-Lever Condition became unstable and decreased steadily.

In Phase 7, the deletion of juice was associated initially with a slight increase in the ratio of correct responses to total trials in the Non-Lever Condition, and with non consistent difference between conditions. The ratio of correct responses to total trials decreased

steadily for the remainder of Phase 7.

In summary, Gary's data indicated that the lever press contingency was associated with a decrease in both conditions but this decrease was greater in the Non-Lever Condition. Arlene's data indicated that the initial introduction of the lever had no consistent effect on the ratio of correct responses to total trials. However, the introduction of juice was associated with an immediate and substantial decrease in the ratio in the Non-Lever Condition, and the effects remained stable in the Lever Condition.

Cumulative Words Learned Per Session

Figure 7 shows the cumulative number of words learned per

Insert Figure 7 About Here

session for both subjects.

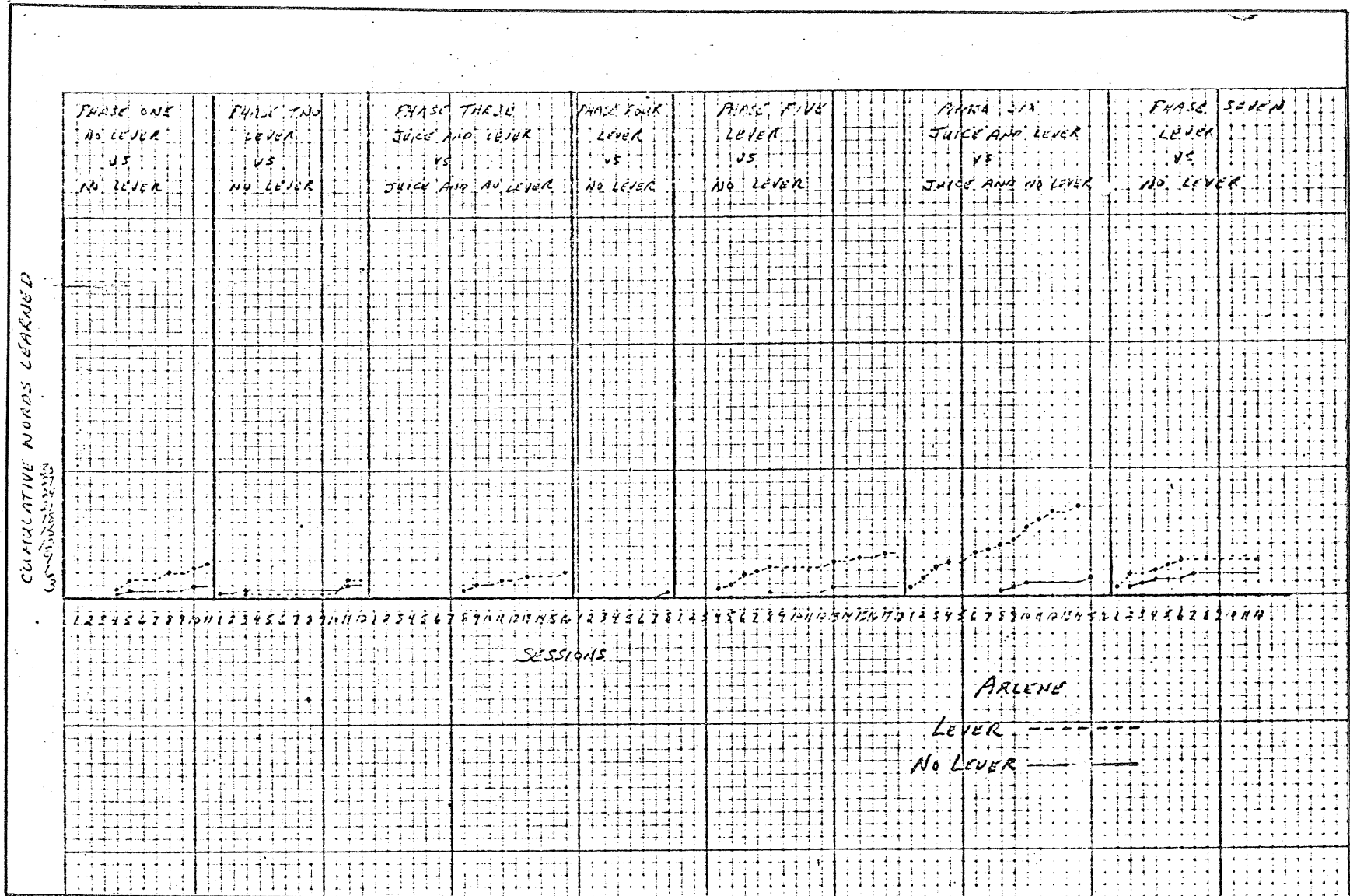
In Phase 1, Gary's data indicated that he learned to read 10 printed word-cards in the Lever Condition and 5 printed word-cards in the Non-Lever Condition. Arlene's data indicated that she learned to name 7 pictures in the Lever Condition and 3 pictures in the Non-Lever Condition.

In Phase 2, the addition of the lever press contingency was associated with Gary learning to name 6 printed word-cards in the Lever Condition, and 3 printed word-cards in the Non-Lever Condition. Arlene's data indicated she learned to name 4 pictures in the Lever Condition and 3 pictures in the Non-Lever Condition.

In Phase 3, Gary's data indicated that he learned to read 5

.....

Figure 7. The cumulative number of pictures and/or printed words learned by ... each subject in each phase in the lever and no lever conditions.



printed word-cards in the Lever Condition and 2 printed word-cards in the Non-Lever Condition. Arlene's data indicated that she learned to name 6 pictures in the Lever Condition and none (0) in the Non-Lever Condition.

In Phase 4, Arlene learned to name none (0) in the Lever Condition and 1 picture in the Non-Lever Condition.

In Phase 5, Arlene's data indicated that she learned to name 10 pictures in the Lever Condition and 2 pictures in the Non-Lever Condition.

In Phase 6, Arlene's data indicated that she learned to name 21 pictures in the Lever Condition and only 4 pictures in the Non-Lever Condition.

In Phase 7, Arlene's data indicated that she learned to name 8 pictures in the Lever Condition and 5 in the Non-Lever Condition.

Both subjects consistently learned more words in the Lever Condition than in the Non-Lever Condition. Gary's data indicated that he learned to read 21 printed word-cards in the Lever Condition and 10 in the Non-Lever Condition. Arlene's data indicated that she learned to name 56 pictures in the Lever Condition and 18 pictures in the Non-Lever Condition.

DISCUSSION

In summary, both subjects were reinforced initially for imitating picture-names or naming them on a fixed-ratio 5 schedule of reinforcement. However, Gary's task was later changed to a printed-word card reading task. There were two conditions in the research: the Non-Lever Condition and the Lever Condition. In the Non-Lever Condition each correct response was followed by a flashing light and each fifth correct response accompanied the flashing light with the simultaneous delivery of a primary reinforcer. In the Lever Condition the procedure was identical with the exception that following each fifth correct response the flashing (correct-response) light came on and stayed on. The subject was then required to press a lever which resulted in the immediate delivery of a primary reinforcer. In addition to this procedure, Arlene's research necessitated the addition of a second type of primary reinforcer and was delivered according to a variable-ratio schedule of reinforcement.

In general, the performance of both subjects was superior in the Lever Condition than in the Non-Lever Condition. Both subjects consistently made more correct responses and fewer errors per session, had more total trials per session, had higher ratios per session, and learned either more picture-names or printed word-cards in the Lever Condition than in the Non-Lever Condition.

For Gary, there was no consistent difference in performance between Conditions in Phase 1. He made approximately the same number of correct responses, errors, and total trials per session; similar ratios of correct responses to total trials per session, and learned to read

approximately the same number of printed word-cards in Phase 1.

With the addition of the required lever press response, Gary's performance was superior in the Lever Condition in Phase 2. He made more correct responses per session, fewer errors per session, more total trials per session, a higher ratio of correct responses to total trials per session, and learned to read more printed-word cards in the Lever Condition in Phase 2.

In Phase 3, which was identical to the conditions of Phase 1, Gary's performance again indicated no consistent difference between conditions for all of the dependent variables being measured except the number of printed-word cards learned. Gary made approximately the same number of correct responses, errors and total trials per session. He learned to read twice as many printed-word cards in the Lever Condition in Phase 3.

For Arlene, there was no consistent difference in performance between conditions in Phase 1. She made approximately the same number of correct responses, errors, and total trials per session, had similar ratios of correct responses to total trials per session, and learned to name approximately the same number of pictures.

In Phase 2, the addition of the required lever press response had no effect on Arlene's performance and there was no consistent difference between conditions. Arlene made approximately the same number of correct responses, errors, and total trials per session, had similar ratios of correct responses to total trials per session, and learned to name approximately the same number of pictures.

With the addition of a more powerful primary reinforcer in

Phase 3, Arlene's performance was consistently superior in the Lever Condition. She made more correct responses per session, fewer errors per session, more total trials per session, and had a higher ratio of correct responses to total trials per session in the Lever Condition. In addition, Arlene learned to name several pictures in the Lever Condition, whereas she did not learn any in the Non-Lever Condition.

With the deletion of the more powerful reinforcer, Arlene's performance decreased in Phase 4 and once again there was no consistent difference between conditions. Arlene made approximately the same number of correct responses, errors, and total trials per session, had similar ratios of correct responses to total trials per session, and learned to name approximately the same number of pictures.

Phase 5, for Arlene, was identical to Phase 4 and took place following a 7 month break. Initially, there was a consistent difference between conditions in that Arlene made more correct responses and fewer errors per session, and had a higher ratio of correct responses to total trials per session in the Lever Condition. Performance measured by the number of total trials per session and the number of picture names learned was highly variable, with no consistent difference between conditions in this phase measured by correct responses, errors, and ratios of correct responses to total trials, was short-lived. After approximately 12 sessions there was no consistent difference in performance between conditions. Arlene made approximately the same number of correct responses, errors, and total trials per session, and had similar ratios of correct responses, errors, and total trials per session. Thus, there was no consistent difference in performance

between conditions as measured by the above-mentioned dependent variables in Phase 5. Over-all performance in this phase decreased to the point of extinction.

In Phase 6, which was a return to the conditions of Phase 3, the addition of juice, which was a more powerful reinforcer, had the same effect on performance in Phase 3. Performance was superior in the Lever Condition in that Arlene made more correct responses, fewer errors, more total trials per session, had a higher ratio of correct responses to total trials per session, and learned to name more pictures.

In Phase 7, the deletion of the more powerful primary reinforcer resulted in there being no consistent difference between conditions. Arlene made approximately the same number of correct responses, errors, and total trials per session, and had similar ratios of correct responses to total trials. However, she did learn to name more pictures in the Lever Condition. Over-all performance in Phase 7 steadily decreased to the point of extinction.

There are several interesting points that warrant discussion at this point:

Prior to the introduction of the lever-press response, Arlene's performance indicated no consistent difference between conditions. With the introduction of the required lever press response, Arlene's performance again revealed no consistent difference between conditions. On the possibility that perhaps the primary reinforcer (Smarties) was not powerful enough to reveal the effect of a required attending response, one ounce servings of juice on a variable-ratio 4 schedule of

reinforcement, in conjunction with the original primary reinforcer on a fixed-ratio 5 schedule of reinforcement, were introduced. Performance in the Non-Lever Condition deteriorated, while performance in the Lever Condition improved, although only slightly. With the suspension of delivery of juice, performance in both conditions again indicated no consistent difference. In fact, performance in both conditions surpassed that level attained prior to the introduction of juice. Following a 7 month break in the research, the Lever Condition vs. the Non-Lever Condition was again put into effect. In this phase, performance steadily worsened and Arlene's picture-naming behavior virtually extinguished. However, with the re-introduction of juice in Phase 6, performance dramatically and immediately improved in both the Lever and Non-Lever Conditions. The Lever Condition was superior to the Non-Lever Condition and this was consistent throughout the phase. Thus, the effect first achieved in Phase 4 was replicated; i.e., the juice brought out the effect of the required attending response, substantially supporting the effectiveness and necessity for a powerful reinforcer.

There was one main difference between the Lever and Non-Lever Conditions which might account for the superior performance in the Lever Condition when a lever press response was required. Gary's data indicated that with the introduction of the required attending response in the Lever Condition, performance improved slightly in that condition, and decreased in the Non-Lever Condition. The only difference between conditions was that following a fifth correct response in the Lever Condition the correct-response light remained on, and a lever-press

response was required to produce the primary reinforcer. In the Non-Lever Condition, the primary reinforcer was delivered automatically following the fifth correct response. No lever-press response was required. It could be that the difference in performance between the two conditions was due to a more powerful discriminative stimulus and conditioned reinforcer in the Lever Condition. While a light-flash followed each correct response in both conditions, the correct-response light did not remain on following the fifth correct response in the Non-Lever Condition, nor was a lever-press response required to produce the primary reinforcer in that condition. It could be that the correct-response light was not as powerful a discriminative stimulus or conditioned reinforcer as in the Lever Condition. However, Phase 1 of Gary's data indicated a higher performance level in the Non-Lever Condition as compared to Phase 2. The introduction of the lever-press response in the Lever Condition appears to have produced a decrease in performance in the Non-Lever Condition. It can only be speculated that perhaps the required lever-press response made the correct-response light a more powerful discriminative stimulus and conditioned reinforcer, and that the resulting increase in the Lever Condition had some negative transitory effect on the Non-Lever Condition. Performance appears to have decreased in the Non-Lever Condition as a direct result of more powerful discriminative cues in the Lever Condition. It is almost indicative of a behavioral contrast effect. However, it only reasonably adheres to Reynold's (1967) definition; i.e., when the consequences of a response become less reinforcing in the presence of one stimulus, we can expect the frequency of the response to increase in the presence

of another stimulus, where its consequences remain reinforcing. What, in fact, did happen was that performance decreased in one condition, but only maintained its level and occasionally decreased slightly, in the other condition.

In Phase 2 of Gary's data, the addition of the required lever-press response resulted in only a slight improvement in the Lever Condition. This could be due to the possibility that the correct-response light was as powerful a discriminative stimulus and conditioned reinforcer as necessary to produce and maintain performance attained. Addition of the lever-press response may only have added slightly to an already high level of performance. Gary was a very sophisticated subject and it is likely that the effectiveness and merit of a required attending response could be better realized with a less sophisticated subject.

Arlene's data showed that the introduction of the required lever-press response in Phase 2 had virtually no effect on performance, maintaining that level attained in Phase 1. With the introduction of one ounce servings of juice on a variable-ratio schedule of reinforcement (which it was thought would result in more effective reinforcement of the behavior in both conditions) performance in the Lever Condition substantially improved, while dramatically decreasing in the Non-Lever Condition. Once again, perhaps this difference is due to more powerful discriminative cues and conditioned reinforcer in the Lever Condition as opposed to the Non-Lever Condition.

The introduction of the lever-press response had three main effects. First, Gary's performance was better in the Lever Condition

than in the Non-Lever Condition, whereas there was no difference between conditions when a lever-press response was not required. When reinforcement effectiveness was increased for Arlene by adding juice reinforcement, her performance was superior in the Lever Condition, whereas there was no difference between conditions when a lever-press response was not required. Second, performance for both subjects improved in the Lever Condition when a lever-press response was required to produce primary reinforcement. Third, performance for both subjects decreased dramatically in the Non-Lever Condition when a lever-press response was required in the Lever Condition. This effect was immediate for both subjects and maintained throughout the phase. When a lever-press response was no longer required, Gary's performance immediately improved in both conditions, reaching a level of performance never before attained. For Arlene, deletion of the juice in Phase 4 produced an effect similar to that Gary's indicated when a lever-press response was no longer required. Performance in the Non-Lever Condition immediately and dramatically improved. However, there was very little difference in performance in the Lever Condition and nonconsistent difference in performance between conditions.

In summary, the three main effects of the lever-press response were that performance was superior in the Lever Condition for both subjects, overall performance improved in the Lever Condition for both subjects, and performance decreased in the Non-Lever Condition for both subjects. It is possible that the superior performance in the Lever Condition can be partially accounted for by the effect the lever had on the correct-response lights that flashed on following each correct

response. If both Gary and Arlene were attending to the correct-response light only in those phases requiring a lever-press response, then that correct-response light would be a discriminative stimulus and conditioned reinforcer only in those phases. This explanation is compatible with Kelleher and Schoenfeld's (1950) view that merely pairing a stimulus with a reinforcer is not a sufficient condition for the establishment of that stimulus as a conditioned reinforcer. They stated that a stimulus, in order to acquire reinforcing properties, must be a discriminative stimulus for some response. In other words, the subject must "attend" to the stimulus. Ensuring that a subject will attend to a stimulus is achieved by establishing a stimulus as a discriminative stimulus for some operant response (Terrace, 1966).

As for the level of performance decreasing in the Non-Lever Condition, reasons for this are much more speculative. Perhaps the lever-press response so enhanced the discriminative stimulus and conditioned reinforcer qualities of the correct-response light in the Lever Condition that the light's discriminative stimulus and conditioned reinforcing properties were greatly reduced in the Non-Lever Condition. This could have been a behavioral contrast effect. Whatever the reason, the introduction of the required attending response had an immediate and maintained decreasing effect in the level of performance in the Non-Lever Condition.

It therefore seems that in this research, simply pairing a light that followed each correct response with a primary reinforcer was not a guarantee that the subjects were attending to the correct-response light. That is, the pairing procedure did not guarantee that the

light acquired discriminative control of the subject's responding. To increase the likelihood that the subjects attended to the light, a specific attending response (i.e., a lever-press) was required and differentially reinforced in the presence of the correct-response light. This required attending response did not guarantee that the subjects would attend to the light, but it increased the likelihood of that occurring. Performance did improve when this required attending response was added.

The results of the present research suggest the following conclusions. The data suggest that performance is superior in the Lever Condition only when a specific response is required to produce primary reinforcement. This would suggest that when a specific attending response is not required, the correct-response light may not be functioning as a conditioned reinforcer, even though the light is periodically paired with the delivery of primary reinforcers. It was observed in this research that Arlene rarely, and Gary never, pressed the lever in the absence of an illuminated stimulus light, and both subjects always pressed the lever when the lights were lit. This would suggest that the correct-response light discriminatively controlled lever-press responses. Therefore, performance may have been superior when a specific attending response was required, because the correct-response light was effectively serving as a conditioned reinforcer.

The sophistication, or functioning level, of the subject seems to warrant some consideration. Gary was a high functioning subject, and his performance improved simultaneously and dramatically in both conditions, with no consistent difference between them, when the

lever-press response was no longer required. Performance improved to a level higher than ever previously attained, and was maintained to the end of the phase. Arlene, on the other hand, was a low functioning subject, and her performance decreased in both conditions to the point of extinction, once the more powerful reinforcer was removed and the lever-press response no longer required. It seems, then, that once more subtle cues were in effect, Arlene's performance immediately improved. It is suggested that once Gary learned to attend, he continued to do so, even when more subtle cues were in effect and the lever-press response no longer being required. It is further suggested that perhaps the correct-response light continued to serve as a powerful and effective conditioned reinforcer, even when the lever-press response was no longer required. Thus, it may be the case that the level of sophistication is a determining factor with regard to the effectiveness of a required attending response.

This research has a number of implications for the use of conditioned reinforcers in procedures for training the mentally retarded. First, the research suggests that simply pairing a stimulus with the delivery of a reinforcer does not guarantee that the stimulus will acquire reinforcing properties. The likelihood of a stimulus acquiring reinforcing properties is increased if a specific response in the presence of that stimulus is required to produce the reinforcer. Thus, the addition of the attending response in this research made the lights a more effective conditioned reinforcer. Since tokens and praise are the two most common conditioned reinforcers used in applied settings this research would suggest that tokens are more likely than praise to ac-

quire reinforcing properties. Token usage requires a specific response to produce reinforcement; i.e., exchanging them for primary reinforcers. This would increase the likelihood of tokens acquiring reinforcing properties. However, this is not the case with praise. Praise is normally paired temporally with the delivery of other reinforcers. There is no required attending response and thus no guarantee that it is being attended to. To increase the likelihood of praise acquiring reinforcing properties a required attending response in its presence, such as a lever-press response, should be required to produce primary reinforcers.

Second, it appears necessary to have access to a powerful reinforcer in order for the required attending response to be effective. Until juice was added as a reinforcer for Arlene, in conjunction with Smarties, there was no consistent difference between Phases 1 and 2. The addition of juice resulted in the Smarties becoming a more effective and powerful reinforcer.

Third, it would appear that the effectiveness of a required attending response may be directly related to the sophistication, or functioning level, of the subject being worked with. If this research is any indication, then it would be suggested that to efficiently and effectively generate the effect of a required attending response, the subject should be highly sophisticated.

Finally, the results of this research would suggest that the most effective combination to use by someone teaching picture-naming or reading would be to use No Lever in both Conditions, since performance over-all was superior when there was no lever-press response required

in both Conditions. The total number of correct responses when a lever-press response was not required in either condition was far greater than the total number of correct responses when a lever-press response was required in only one condition. Similarly, there were fewer errors, more total trials, a higher ratio of correct responses to total trials, and more words learned when there was no lever-press response required in both Conditions than when a lever-press response was required in only one Condition. However, other research of this type (Stephens, 1974) indicates that when the lever-press response was required in both Conditions, performance was better than it was when the lever-press response was not required in both Conditions, and when the lever-press response was required in only one Condition. It seems essential that to unravel the confusion surrounding conditioned reinforcers and required attending responses, further research be conducted to investigate the effects of the various combinations. For example, can the effects generated in the combinations used in this research (No Lever vs. No Lever, No Lever vs. Lever) be replicated using a different research design - i.e., No Lever vs. No Lever and Lever vs. Lever - or are different effects generated? Research conducted to investigate these and similar questions can only serve to reduce the confusion prevalent regarding conditioned reinforcers and required attending responses.

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