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AUTHOR Harrell, Peggy L.; And Others
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ABSTRACT

This study of two groups of four children (ages 6-9) with learning disabilities evaluated the effects of two contingencies (independent and interdependent) on the learning of students with learning and behavioral disabilities when conducted in small groups with constant time delay. Measures were collected on the rapidity with which children learned under the two contingencies, the amount of observational learning that occurred, and the extent to which students acquired additional information that was included in the feedback for correct responses. The results indicate that: (a) both instructional arrangements were effective with all students and all behaviors; (b) the independent contingency condition resulted in more rapid learning than the interdependent contingency; (c) students acquired nearly all of the behaviors taught to their group members, but it was not differentially affected by the two contingencies; (d) students acquired some of the additional information presented in feedback events, but it also was not differentially affected by the two contingencies; (e) when one group was presented with written words and verbal definitions, more learning clearly occurred on the written work than on the definition of the word. Attached charts shows each participant's responses on the interdependent and independent contingencies. (Contains 24 references.) (Author/CR)

Effects of Independent and Interdependent Group Contingencies on Acquisition, Incidental Learning, and Observational Learning

Peggy L. Harrell
University of Kentucky

Mark Wolery
Allegheny-Singer Research Institute

Melinda Jones Ault, Stephen T. Demers
University of Kentucky

Pamela W. Smith
Fayette County Public Schools

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Abstract

The purpose of this study was to evaluate the effects of two contingencies (independent and interdependent) on the learning of students with learning and behavioral disabilities when conducted in small groups with constant time delay. Eight students participated in the study; seven were taught four sets of behaviors and one was taught two sets. Measures were collected on the rapidity with which children learned under the two contingencies, the amount of observational learning that occurred, and the extent to which students acquired additional information that was included in the feedback for correct responses (i.e., incidental learning). A single subject design (adapted alternating treatments design) was used to evaluate the effects of the two contingencies. The results indicate that (a) both instructional arrangements were effective with all students and all behaviors; (b) the independent contingency condition resulted in more rapid learning than the interdependent contingency; (c) students acquired nearly all of the behaviors taught to their group members (observational learning), but it was not differentially affected by the two contingencies; and (d) students acquired some of the additional information presented in feedback events (incidental learning), but it also was not differentially affected by the two contingencies.

Effects of Independent and Interdependent Group Contingencies on Acquisition, Incidental Learning, and Observational Learning

Providing effective and efficient instruction to students with learning disabilities and mild mental retardation is a challenging task. Although numerous instructional strategies exist for teaching these populations (Mercer & Mercer, 1989), some strategies that were developed for students with severe disabilities are being evaluated with students who have milder disabilities. An example of such a strategy is the constant time delay procedure.

The constant time delay procedure involves the presentation of two types of instructional trials, 0-second trials and delay trials. In the 0-second trials, students are presented with a stimulus and task direction (e.g., "What's this?") and are immediately told the correct answer (i.e., teacher model). Students are reinforced for imitating the teacher's model. After one or two sessions conducted in this manner, delay trials are used. The students are presented with the stimulus and task direction and are given a fixed number of seconds to respond. If the student responds correctly, reinforcement is provided; if they do not respond, the teacher models the correct answer at the end of the delay interval, allows the student to imitate, and provides reinforcement. Constant time delay was effective in teaching multiplication facts (Cybriwsky & Schuster, 1988), sight words (Wolery, Ault, Gast, Doyle, & Mills, 1990), and spelling (Stevens, Blackhurst, & Slaton, 1991) to students with learning disabilities.

Recent research has begun to evaluate the relative efficiency of various strategies. Frequently, efficiency has been measured in terms of the rapidity with which learning occurs; specifically, the number of trials and minutes of instruction to criterion. If two strategies produce equal amounts of learning, the strategy that requires fewer instructional trials or minutes of instruction is considered more efficient. An alternative means of increasing the efficiency of instruction is to promote opportunities for observational and incidental learning. For example, if two strategies produce equally rapid acquisition of the behaviors taught to students, but one strategy also allows students to learn skills taught to his/her peers (observational learning) and/or to learn additional information that is not taught directly (incidental learning), then that strategy would be considered more efficient.

To promote observational learning, investigators have employed small group instructional arrangements in which each student is taught similar but different behaviors (Collins, Gast, Ault, & Wolery, 1991; Shelton, Gast, Wolery, & Winterling, 1991). To promote incidental learning (i.e., acquisition of stimuli not directly taught), investigators have used instructive feedback that involves presentation of additional stimuli during consequent events for correct responses (Gast, Doyle, Wolery, Ault, & Baklarz, 1991). Several studies have show that when such stimuli are added, students frequently acquire them, or some proportion of them, without direct instruction (Doyle, Gast, Wolery, Ault, & Farmer, 1990; Gast, Wolery, Morris, Doyle, & Meyer, 1990; Shelton et al., 1991; Stinson, Gast, Wolery, & Collins, 1991; Wolery, Alig-Cybriwsky, Gast, & Boyle-Gast, 1991).

In most direct instructional programs, systematic attention is given to the contingencies in effect. Two commonly used contingencies are independent and interdependent group contingencies (Litrow & Pumroy, 1975; McLaughlin, 1974). With independent contingencies,

the reinforcer is provided to each student based on their own performance. With the interdependent contingencies, reinforcement is provided to all members of the group based on the group's performance regardless of each individual's contribution to the group outcome. Although considerable information exists on the effects of group contingencies on social and academic behaviors, no research to our knowledge addresses the effects of group contingencies on observational learning in small group arrangements or on incidental learning as described above. The purpose of this study was to compare the effects of independent and interdependent group contingencies when implemented in small group instructional arrangements with constant time delay on the performance of children with learning disabilities. Of interest was whether either contingency would differentially affect (a) the rapidity with which students acquired the instructed behaviors, (b) the amount of observational learning of other group members' instructed behaviors, and (c) the amount of incidental learning of extra information included in the feedback for correct responses.

Methods

Participants and Setting

Two groups of four children (ages 6-9 years) with learning disabilities participated in the study. All children in Group I (3 males and 1 female) were enrolled in a self-contained classroom for children with severe learning disabilities. Two children in Group II (1 male and 1 female) were enrolled in the same self-contained classroom as Group I children, and two children (2 males) were enrolled in a special education resource room for children with learning and behavioral disorders. Demographic information and target behaviors for students are presented in Table 1. In addition to normal visual and auditory functioning with corrective appliances as needed, students met the following criteria: (a) followed simple verbal directions, (b) waited for assistance from the teacher for at least 3 seconds on unknown tasks, (c) remained on task for at least 10 minutes in small group instruction, and (d) attended school regularly.

Insert Table 1 about here

Experimental sessions occurred in a small group arrangement in the students' classroom (5.4 m X 9.1 m) in a public elementary school. It contained one semi-circular table, a large teacher's desk, and eight small desks and chairs placed throughout the room. The instructional sessions were conducted daily by the classroom teacher at the semi-circular table. Students not receiving instruction were provided with other activities in the room away from the experimental setting.

Materials

For Group I, the target instructional stimuli were photographs of objects and places from the Photo Cue Cards kit (Kerr, 1985). No visual stimuli were used for Group II. Incidental information for both groups included words (of objects, places, and antonyms) printed in black on lower case letters on white cards (10cm X 15cm). For the instructional conditions (independent and interdependent group contingencies), a chart was used which contained squares

for the number of correct responses required to access reinforcers at the end of the session. For the independent contingency, each student's photograph was displayed above the number of squares needed to access the reinforcer. For the interdependent contingency, a group photograph was displayed above the squares. A check was placed in each square for each unprompted correct response.

General Procedures

The sequence and purpose of each experimental condition are shown in Table 2. Initially, four sets of instructional stimuli were identified for each student; each set contained two target stimuli per student. Group I was taught to name pictures of functional objects and local places. Group II was taught to state the antonym for language concepts presented verbally by the teacher (e.g., "What is the opposite of 'least'?"). The antonyms were selected from the Bracken Basic Concepts Scale (Bracken, 1984). Each student in both groups learned behaviors different from their group members. Sets I and II for each subject were analyzed to ensure that they were of equal difficulty and then were randomly assigned to one of the two contingency conditions. This also was repeated for stimulus Sets III and IV. Stimuli were equated on the following variables: (a) selection of items from the same class, (b) demonstration of equal baseline performance (i.e., 0% correct on all behaviors), (c) approximate word length, (d) number of syllables, and (e) referent knowledge.

Insert Table 2 about here

Target-stimuli probe conditions (baseline assessment) were implemented for a minimum of three sessions before instruction and after students met criterion on each set. In addition, during probe conditions, students were assessed on their group members' target stimuli (observational-learning probes) and on the additional stimuli presented as feedback for correct responding during instruction (incidental-learning probes). The two instructional conditions (independent contingency and interdependent group contingency) were then used with separate sets of stimuli in two daily sessions, which were counterbalanced for time of day. Sets I and II were instructed first followed by Sets III and IV. In all instructional sessions, a 3-second constant time delay procedure was used until criterion level performance was achieved (i.e., two consecutive sessions at 100% unprompted correct responses).

The constant time delay procedure involved two types of trials, 0-second trials and 3-second delay trials, and used a verbal model of the target behavior as a controlling prompt (i.e., a prompt that would ensure correct performance). The 0-second delay trials were implemented during the first instructional session of each instructional condition and used the following trial sequence: For Group I, the teacher held up the stimulus card and said, "(Student's name), look, what is this?"; for Group II, the teacher said the task direction, "(Student's name), look; what's the opposite of (word)?" Immediately after these statements, the teacher said a verbal model of the correct response, waited 3-seconds for a response, provided the correct consequences for the student's response, and provided a 3- to 5-second intertrial interval. For the 3-second delay trials, the trial sequence was identical with one exception; the teacher provided a 3-second

response interval between the task question and the presentation of the model.

Five responses were possible: unprompted correct responses, defined as the student saying the correct word after the task question but before the delivery of the model; prompted correct responses, defined as the student saying the correct word within 3 seconds of the model; unprompted errors, defined as the student saying any word other than the correct word after the task question but before the model; prompted errors, defined as the student saying any word other than the correct word within 3 seconds of the model; and no response errors, defined as the student not saying anything after the model. Each instructional session for both groups contained 6 trials per student, 3 on each target stimuli. The order of trials were randomly determined for each session.

The consequences for correct responses (unprompted and prompted) were verbal praise plus presentation of additional stimuli for incidental learning. For Group I, the teacher said, "Good," showed a written word of the object/place depicted in the picture and said, "this says (word)." For Group II, the teacher said, "Good," presented the written word for the antonym and said, "This says (word)" and stated a short definition of the word that appeared on the card. Students were not expected to respond to these stimuli, and statements by students about them were ignored. For unprompted correct responses, the teacher placed a check in a square on the chart used to provide feedback to the students about the availability of reinforcement following the session. For unprompted error responses, the teacher said, "Wait if you don't know and I'll tell you." For prompted errors and no responses, the teacher said, "Wrong," followed by a repetition of the correct word.

Target-stimuli probe conditions. Probe conditions were conducted before and after each instructional condition to assess students' performance on target stimuli. Probe conditions included a minimum of three sessions and occurred in the small group arrangement conducted by the teacher. Each session contained 8 individual trials (one per stimulus) for each subject. The trial sequence was as follows: The teacher held up the picture (Group I only), said the student's name, presented an attentional cue (i.e., said "Look"), ensured that the student looked, delivered the task direction (for Group I, she said, "What's this?"; for Group II she said, "What's the opposite of _____?"), and provided a 3-second response interval. Three responses were scored by the teacher during the intertrial interval. These were: correct responses, defined as the student stating the correct word within 3 seconds of the task question; error responses, defined as the student stating anything other than the correct word within 3 seconds; and no responses, defined as the student not saying anything within 3 seconds of the task question. Correct responses were praised verbally, and error and no responses were ignored; a 3- to 5-second intertrial interval was used.

Observational-learning probe procedures. Observational learning (students' acquisition of behaviors taught to their peers) was assessed in a single session before and after each instructional condition by the investigator. These sessions were conducted individually for each student and included 24 trials, one for each stimulus taught to the other members of the group. The trial sequence and response definitions were identical to those used in the target-stimuli probe condition.

Incidental-learning probe procedures. Incidental learning (students' acquisition of stimuli included in the feedback for correct responding) was assessed before and after each instructional condition for 3 sessions by the investigator. These sessions were conducted individually for each student and included 32 trials, one trial for each of their own incidental behaviors and one for each of their group member's incidental behaviors. For Group I, the incidental stimuli were written words of the objects and places. For Group II, two incidental stimuli occurred for each instructional target - one was the written word of the antonym and the other was the definition of the antonym. For Group I and II, the written words were assessed using the following trial sequence: The investigator held up the stimulus card with the word and said, "(Student's name), look."; when the student looked at the card, the investigator said, "What word?" and provided a 3-second response interval. For Group II, the definition of the antonym trial sequence was as follows: The investigator said, "(Student's name), look" and waited for the student to look at her. When the student looked, the investigator said, "What does (word) mean?" A 3-second response interval was provided. Response definitions and consequences were identical to the target-stimuli probe conditions.

Independent variable: Independent and interdependent group contingency. Two contingencies were compared in this study. In one daily session with one set of instructional stimuli, an independent contingency was used. In this condition, each student could earn a reinforcer (small edible) for themselves at the end of the session by performing a specified number of correct unprompted responses. If a student did not have the needed number of correct unprompted responses at the end of the session, no reinforcer was delivered. Thus, in this condition, some students could receive a reinforcer at the end of the session when other students in the group did not. In the other daily session with the other set of instructional stimuli, an interdependent group contingency was used. In this condition, students worked together to earn a reinforcer (small edible) and receipt of the reinforcer was based on the average performance of the group. If the group as a whole performed the number of correct responses needed to earn the reinforcer, then they all received a reinforcer. If, as a group, they did not have a sufficient number of correct unprompted responses, then no student received the reinforcer.

In both conditions, the number of correct unprompted responses needed to access the reinforcer increased based on the performance of students. Three levels were used: (a) 33% of the trials, (b) 66% of the trials, and (c) 100% of the trials. After two days of meeting a criterion level, the next one was implemented. In the independent contingency condition, the criterion levels were based on each child's individual performance. In the interdependent group contingency condition, the criterion levels were based on the group's performance. Prior to each instructional session, the teacher stated the contingency that was in effect while displaying the chart with the students' photographs and the number of squares equalling the number of correct unprompted responses required to access reinforcers. In the independent contingency, the teacher told each student how many correct unprompted responses were required; for the interdependent contingency, the teacher told all the students as a group.

Review trial procedures. If students met criterion in one condition (i.e., independent or interdependent contingencies) before the other, review trials were provided. This involved one instructional trials on each student's target stimuli. The trial sequence was identical to that used

during instruction.

Experimental Design

An adapted alternating treatments design replicated across 8 subjects and four sets of behaviors was used to evaluate the effects of the two contingencies (Sindelar, Rosenburg, & Wilson, 1985). This design is a single-subject design allowing comparison of two instructional conditions (in this case contingencies) on the acquisition of sets of independent but equally difficult behaviors. Probe conditions are implemented to assess students' performance on behaviors prior to instruction, and then the two instructional conditions are applied to independent sets of behaviors in alternating daily sessions. Performance in each instructional condition was compared to probe performance to assess their effectiveness. Performance in the two instructional conditions were compared to one another to assess the relative merits of the two procedures.

The sequence of conditions were (a) Probe I - assess students' performance on stimulus Sets I-IV; (b) Instructional Comparison I - teach Set I with the independent contingency and teach Set II with the interdependent contingency in daily alternating sessions; (c) Probe II - assess students' performance on stimulus Sets I-IV; (d) Instructional Comparison II - teach Set III with the independent contingency and teach Set IV with the interdependent contingency; and (e) Probe III - assess students' performance on stimulus Sets I-IV. Also, observational and incidental learning were assessed at each probe condition.

Reliability

Reliability data were collected on students' performance (Tawney & Gast, 1984) and on the fidelity with which the teacher implemented the experimental conditions (Billingsley, White & Munson, 1980). Interobserver agreement and procedural reliability data were collected in at least 33% of the sessions for each condition by the investigator. A point-by-point method of computing interobserver agreement percentages was used: the number of agreements were divided by the number of disagreement plus agreements and multiplied by 100. For procedural reliability, the following teacher behaviors were assessed: stating the contingency that was in effect, asking the group if they were ready, waiting for an affirmative response, presenting the target stimulus, asking the student to look, ensuring that the student looked, stating the task direction, using the correct delay interval (0 or 3 seconds) and providing the prompt (if needed), providing the correct consequent events, recording the trial, and waiting the intertrial interval. Procedural reliability estimates were calculated by dividing the number of observed behaviors in each of the above categories by the number of planned behaviors in each category and multiplying by 100 (Billingsley et al., 1980).

Results

Reliability

For Group I, interobserver agreement on students' responding and procedural reliability were assessed in 33% of the probe sessions, 46.6 % of the independent contingency instructional

sessions, and 51.5% of the interdependent contingency instructional sessions. For Group II, interobserver agreement on students' responding and procedural reliability were assessed in 45.4% of the probe sessions, 75% of the independent contingency instructional sessions, and 36.3% of the interdependent contingency instructional sessions.

Interobserver agreement. For Group I, the interobserver agreement scores during probe conditions were 100% for all subjects. For the independent contingency condition, it was 100% for Michael, Natalie, and Lane, and 98.8% (range of 83.3-100) for Ronald. For the interdependent contingency condition, the scores were 100% for Michael, Natalie, and Lane; and 97.8% (range 66.7-100) for Ronald. All scores were 100% for Group II.

Procedural reliability estimates. For Group I, probe conditions were implemented correctly at 100% except for providing the correct consequent event (mean of 99.2, range 96.9-100). In the independent contingency condition, correct implementation was 100% for all behaviors except presenting the stimulus (mean of 99.7, range of 95.8-100), providing the correct consequent events (mean of 99.7, range of 95.8-100), and waiting the correct response interval (mean of 99.7, range of 95.8-100). In the interdependent contingency condition, correct implementation was 100% for all behaviors except providing the correct consequent events (mean of 99.7, range of 95.8-100) and waiting the correct response interval (mean of 99.3, range of 95.8-100).

For Group II, the percent of correct implementation during probe conditions was 100 for all behaviors except the teacher securing an attending response (mean of 98.3, range 91.7-100). In the independent contingency condition, the percent of correct implementation was 100 for all behaviors except delivering the task direction (mean of 99.7, range of 95.8-100) and waiting the correct response interval (mean of 99.3, range of 95.8-100). In the interdependent contingency condition, the percent of correct implementation was 100 for all behaviors except presenting the correct consequent events (mean of 98.2, range 91.7-100) and waiting the correct intertrial interval (mean of 98.7, range of 88.9-100).

Effectiveness of the Two Contingencies

Group I. The two contingencies and constant time delay were effective in teaching all instructed behaviors to all students. These data are presented in Figures 1-4. For stimulus Sets I and II, no student had a correct response during Probe I. Upon introduction of instruction, all students met criterion. During Probe II, all students maintained criterion level performance on Sets I and II, and all students had 0% correct performance on Sets III and IV except for Michael who had some correct responses on Set IV. When instruction was implemented on Sets III and IV, all students met criterion. All students had at least two sessions of 100% correct performance during Probe III on all sets.

Insert Figures 1, 2, 3, and 4 about here

Group II. The two contingencies and constant time delay were effective in teaching all

instructed behaviors to all children. These data are presented in Figures 5-8. For stimulus Sets I and II, no student had a correct response during Probe I. After introduction of instruction, all students met criterion. During Probe II, all students maintained criterion level performance on Sets I and II, and all students had 0% correct performance on Sets III and IV. When instruction was implemented on Sets III and IV, all students who were instructed met criterion. One student, Ford, was transferred to another school after Probe II, and did not participate in training on Sets III and IV. All students who participated in Probe III displayed higher performance than in Probes I and II.

Insert Figures 5, 6, 7, and 8 about here

Effects of the Two Contingencies on the Efficiency of Acquisition

The effects of the two contingencies were evaluated by comparing the number of trials, errors, and minutes of instruction to criterion and the percent of errors to criterion. These measures were calculated from the first instructional session until each student met criterion (i.e., two consecutive sessions at 100% correct unprompted responses). The data for both groups are presented in Table 3.

Insert Table 3 about here

For each measure (number of trials, errors, and minutes of instruction, and percent of errors), 15 opportunities existed to compare the effects of the two contingencies (4 comparisons for Group I on Sets I and II, 4 for Group I on Sets III and IV, 4 for Group II on Sets I and II, and 3 for Group II on Sets III and IV). In terms of trials to criterion, the independent contingency required fewer trials than the interdependent contingency on 10 of the 15 comparisons, was equal on three, and required more trials on two. Across all sets and subjects, the independent contingency required 76.4% of the trials required by the interdependent contingency. In terms of minutes of instructional time, the independent contingency required fewer minutes on all 15 comparisons than the interdependent contingency. Across all sets and subjects, the independent contingency required 73.4 percent of the minutes of instructional time required by the interdependent group contingency. In terms of the number and percent of errors to criterion, the independent contingency produced fewer errors and lower error percentages on 12 of the 15 comparisons, was equal in one case, and produced more errors in two cases. Across all sets and subjects, the independent contingency produced 41.2% of the errors produced in the interdependent contingency. Based on these data, it appears that the independent contingency resulted in more efficient acquisition (i.e., more rapid learning) than the interdependent contingency.

Effects of the Two Contingencies on Observational Learning

Observational learning (students' acquisition of stimuli taught to group members) for both groups are presented in Table 4. In most cases, students did not respond correctly to their

peers' stimuli prior to instruction; after instruction, the percent of correct responses were 100% during 24 of the 30 assessments. These data appear to indicate that the students' observational learning was not differentially affected by the two contingencies.

Insert Table 4 about here

Effects of the Two Contingencies on Incidental Learning

Incidental learning (students' acquisition of stimuli presented during feedback for correct responses) also was evaluated. For Group I, the incidental learning involved reading the word that represented the object or place depicted in the picture (target stimuli). For Group II, the incidental learning involved reading the word of the antonym and stating a definition of the antonym. Data are presented in Table 5 on each student's acquisition of the incidental information for their target stimuli and on each student's acquisition of the incidental information for their group members' target stimuli. Based on the data in Table 5, all students learned some of the incidental information for their own target behaviors. Some children (e.g., Michael in Group I and Mark in Group II) learned all of the incidental information for their own target stimuli, but other students (e.g., Lane in Group I and Luke in Group II) learned relatively little of the incidental information for their target behaviors. For Group II who had two types of incidental information (reading the word and stating a definition of it), the subjects tended to have higher percentages of correct responses on the word reading task. All students acquired some of the incidental information that was presented for their group members' target stimuli. The two contingency conditions did not appear to affect students' incidental learning differentially.

Insert Table 5 about here

Discussion

This study was conducted to evaluate the effects of two contingencies (independent contingencies and interdependent group contingencies) implemented in small group instructional sessions using constant time delay on the rapidity with which children acquired the targeted behaviors, other group members' targeted responses (observational learning), and additional information included in the feedback for correct responses (incidental learning). Six findings are evident from this study. First, the procedures were implemented as planned with a high degree of procedural fidelity. This finding is consistent with a large body of research indicating that teachers can be trained to implement constant time delay with a high degree of compliance with planned procedures (Wolery et al., in press).

Second, the two contingencies and constant time delay were effective in teaching all behaviors to all children. This finding replicates considerable earlier research documenting the effectiveness of constant time delay with students who have disabilities and independent

contingencies (Wolery et al., in press). However, no previous study had documented that the procedure would be effective with interdependent group contingencies; thus, this study extends the existing research in this regard.

Third, in terms of the rapidity with which children acquired their target responses, the independent contingency produced more rapid learning than the interdependent group contingency. The differences in the number of trials and minutes of instruction to criterion, and the number and percent of errors to criterion were consistent across students and across the sets of stimuli and were of sufficient magnitude to be educationally relevant. For example, on the average, students learned the same number of behaviors in about one fourth fewer trials and one fourth fewer minutes of instructional time. Such a difference may represent a considerable saving of time over the course of a school year, meaning that this extra time could be devoted to other instructional tasks. In terms of errors, students made less than half as many errors in the independent condition as in the interdependent condition. An explanation for the superiority of the independent contingency may be related to the process of establishing stimulus control. As is well known, the use of continuous reinforcement results in more rapid establishment of stimulus control than intermittent reinforcement (Wolery, Ault, & Doyle, 1992). The independent contingency may have resulted in more consistent reinforcement for unprompted correct responses for each individual student than did the interdependent group contingency. An alternative but compatible explanation may be found in the cooperative teaching literature. Although group contingencies and other variables are related to higher levels of prosocial behavior than independent contingencies, learning appears to be facilitated by group goals and individual accountability (Slavin, 1989). The independent contingency may have communicated more individual accountability than the interdependent condition. The more rapid learning produced by the independent contingency in this study is at odds with two previous investigations comparing group and individual contingencies (McLaughlin, 1981, 1982). McLaughlin documented the superiority of interdependent contingencies over independent contingencies for students with learning disabilities on academic tasks (i.e., reading and spelling). However, three notable differences exist between this study and McLaughlin's. In McLaughlin's studies, the subjects were older than the students in this study. Also, in his studies, students earned points as part of the classroom token economy. In this study, the reinforcer was accessed (if earned) immediately after the session. Finally, in McLaughlin's studies the reinforcement for students in the individual contingency condition were yoked to the amount of reinforcement received by students in the group contingency condition. They were limited in the independent contingency condition by the amount of reinforcement available in the group contingency condition. In the current study, access to reinforcement was based solely on students' performance in relation to a preset and preannounced criterion. Clearly, these differences present opportunities for future research.

Fourth, in this study, students' observational learning was evaluated. Previous research (e.g., Shelton et al., 1991) indicates that when students are taught different skills in small group arrangements they are likely to acquire some of the skills taught to their group members. However, to our knowledge, no investigation has compared the effects of independent and interdependent group contingencies on observational learning. In this study, students acquired nearly all of the skills taught to their peers when both contingencies were used. This high level of learning may have masked any differences that existed between the two contingencies;

however, it is clear that considerable observational learning occurred.

Fifth, in this study, students' learning of extra stimuli included in the feedback for correct responses was evaluated. Previous research has documented that adding such information to the feedback will result in acquisition of that information (Stinson et al., 1991; Wolery, Alig-Cybriwsky, et al., 1991; Wolery, Doyle, et al., 1991). However, no study has evaluated the differential effects of independent and interdependent group contingencies as was done in this study. The results seem to indicate that all students acquired some of this extra information, some students acquired nearly all of the extra information, other students acquired much smaller amounts, and the two contingencies probably were not related to the amount of learning. Also, of interest, these students acquired some of the extra information that was presented to their peers; again, however, this learning was not differentially affected by the two contingencies.

Finally, unlike other studies, students in Group II were presented with two additional stimuli: the written word and a statement of the word's definition. The word was presented in visual form (i.e. written on a card) with a verbal comment from the teacher (i.e., "This says [word]."). The definition was presented only verbally, the teacher said, "(Word) means ___." Although some students learned both stimuli, more learning clearly occurred on the written word than on the definition of the word. Several explanations may exist for this difference: The written word (a) may be easier to learn, (b) was presented through two sensory modalities, (c) was presented first, and (d) was repeated in the definition. Future research should address procedures for presenting multiple extra stimuli during feedback.

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Table 1

Description of Participants

Group Student	Gender	Age	Diagnosis and Test Results Medications, and Related Services Received	Target Behaviors Independent Contingency	Target Behaviors Interdependent Contingency
Group I					
Michael	Male	9 yr. 9 mo.	Learning Disability, but formerly Educable Mentally Handicapped. WISC-R Verbal IQ: 73; K-ABC: MPC: 65, Sequential. Processing: 89, Simultaneous Processing: 54; Taking Ritalin; Speech/ Language, Occupational, and Physical Therapy.	dictionary jacks car dealership cemetery	album crossword puzzle parking lot skyscraper
Ronald	Male	7 yr. 4 mo.	Learning Disability; intellectual capacities undetermined; Columbia Mental Maturity Scale estimate: 81; Cognitive level estimate: low average range; Taking Ritalin; controlled seizures; Speech/Language Therapy.	yarn crochet hooks flea market greenhouse	thermostat sewing machine music store bakery
Natalie	Female	6 yr. 8 mo.	Learning Disability; K-ABC MPC: 95; Sequential Processing: 83; Simultaneous Processing: 106; Test of Early Language Development (TOLD): Standard Score: 76; Described as "autistic like."	kitty litter patterns drive-in theater	binoculars cooler operating room airport
Lane	Male	6 yr. 8 mo.	Learning Disability; Stanford Binet Form IQ: 82; WPPSI incomplete (4 subtests within average limits); correct hearing loss; controlled seizures; Speech/Language Therapy.	hot water bottle globe parking garage trailer park	toothpicks pliers museum handicapped parking
Group II					
Mark	Male	6 yr. 1 mo.	Learning Disability; WPPSI Full Scale IQ: 93, Verbal IQ: 81, Performance IQ: 107 TOLD, Standard Score: 85.	separate heavy arriving sharp	loose both farthest multiply
Carla	Female	9 yr. 8 mo.	Learning Disability; WISC-R Full Scale IQ 63, Verbal IQ: 66; Performance IQ: 67; Speech/Language Therapy.	all rough ending curved	unequal same start empty
Luke	Male	9 yr. 10 mo.	Educable Mentally Handicapped; WISC-R Full Scale IQ: 59, Verbal IQ: 60; Performance IQ: 65; Speech/Language Therapy.	always forward dim with	minus before less few
Ford	Male	7 yr. 8 mo.	Learning Disability; WISC-R Full Scale IQ: 89, Verbal IQ: 82, Performance IQ: 100; IQ: 82, Performance IQ: 100; TOLD, Standard Score: 67.	narrow thick	most deep

Table 2

Sequence and Purpose of Each Experimental Conditions

Condition	Purpose
Target-Stimuli Probe I	Conducted to assess students' initial performance on behaviors targeted for instruction (i.e., Stimulus Sets I, II, III, and IV).
Observational-Learning Probe I	Conducted to assess students' initial performance on behaviors that were to be taught to group members (i.e., Stimulus Sets I, II, III, and IV).
Incidental-Learning Probe I	Conducted to assess students' initial performance on stimuli presented during feedback for correct responses; included stimuli for each student's target behaviors and stimuli for group members.
Instructional Condition I	Conducted to evaluate the effects of independent (Stimulus Set I) and interdependent (Stimulus Set II) contingencies on students' learning.
Target-Stimuli Probe II	Conducted to assess students' performance on instructed behaviors (Sets I and II) and on behaviors to be taught (Sets III and IV).
Observational-Learning Probe II	Conducted to assess students' observational learning of behaviors taught to their peers (Sets I and II) and to assess their performance on behaviors that would be taught to their group members.
Incidental-Learning Probe II	Conducted to assess students' incidental learning of stimuli presented during feedback events for Sets I and II and to assess their performance on behaviors that would be taught to their group members.
Instructional Condition II	Conducted to evaluate the effects of independent (Stimulus Set III) and interdependent (Stimulus Set IV) contingencies on students' learning.
Target-Stimuli Probe III	Conducted to assess students' performance on all instructed behaviors (Sets I, II, III, and IV).
Observational-Learning Probe III	Conducted to assess students' observational learning of all behaviors taught to their group members.
Incidental-Learning Probe II	Conducted to assess students' incidental learning of stimuli presented during feedback events for all behaviors (Sets I, II, III, and IV).

Table 3

Number of Trials, Errors, and Minutes of Instructional Time to Criterion and Percent of Errors to Criterion for Groups I and II

Group / Stimulus Sets / Subject	Efficiency Measure					
	Number of Trials to Criterion		Number of Minutes to Criterion		Number (Percent) of Errors to Criterion	
Condition:	Independ.	Interdepend.	Independ.	Interdepend.	Independ.	Interdepend.
Group I						
Sets I & II						
Michael	60	66	64:36	70:05	0 (0.0%)	1 (1.5%)
Ronald	54	84	59:26	84:09	7 (13.0%)	17 (20.2%)
Natalie	42	60	41:06	65:05	0 (0.0%)	1 (1.7%)
Lane	42	42	41:06	49:08	3 (7.1%)	4 (9.5%)
Sub-total	198	252	64:36	84:09	10 (5.1%)	23 (9.1%)
Sets III & IV						
Michael	36	48	30:57	43:31	1 (2.7%)	4 (8.3%)
Ronald	36	42	30:57	38:31	1 (2.7%)	6 (14.3%)
Natalie	36	36	32:26	33:49	0 (0.0%)	0 (0.0%)
Lane	60	84	52:37	73:09	9 (15.0%)	15 (17.9%)
Sub-total	168	210	52:37	73:09	11 (6.5%)	25 (11.9%)
Total Group I	366	462	117:13	157:18	21 (5.7%)	48 (10.4%)
Group II						
Sets I & II						
Mark	36	66	28:47	35:25	0 (0.0%)	1 (1.5%)
Carla	72	66	55:40	57:19	8 (11.0%)	9 (13.6%)
Luke	36	84	28:47	70:01	5 (13.9%)	33 (39.6%)
Ford	48	36	40:50	33:10	3 (6.3%)	2 (5.5%)
Sub-total	192	252	55:40	70:01	16 (8.3%)	45 (17.9%)
Sets III & IV						
Mark	36	36	19:25	19:58	4 (11.1%)	0 (0.0%)
Carla	36	60	19:25	33:06	1 (2.8%)	7 (11.7%)
Luke	48	78	25:27	42:59	7 (14.6%)	19 (24.4%)
Ford	--	--	--	--	--	--
Sub-total	120	174	25:27	42:59	12 (10.0%)	26 (14.9%)
Total Group II	312	426	81:07	113:00	28 (9.0%)	71 (16.7%)
TOTAL Groups I & II	678	888	198:20	270:18	49 (7.2%)	119 (13.4%)

Table 4

The Percent of Observational Learning by Group and Contingency

Group / Subject	Instructional Stimulus Sets							
	Set I and II				Set III and IV			
Condition:	Independ.		Interdepend.		Independ.		Interdepend.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Group I								
Michael	0	100	0	50	0	100	0	100
Ronald	0	100	0	100	0	100	0	100
Natalie	0	100	0	100	0	100	0	100
Lane	0	100	0	100	0	100	0	100
Subtotal	0	100	0	87.5	0	100	0	100
Group II								
Mark	33	100	0	100	25	100	50	100
Carla	0	33	0	67	0	75	0	0
Luke	0	100	17	100	0	100	0	100
Ford	0	100	17	83				
Subtotal	8.3	83.3	8.5	87.5	8.3	91.7	16.7	66.7
Total for Groups I & II	4.1	91.6	4.3	87.5	3.6	96.4	7.1	85.7

Table 5

Percent of Correct Responses on Incidental Learning Measures

Group / Stimulus Sets / Student Condition:	Incidental Stimuli For Student's Target Behaviors				Incidental Stimuli For Group Members' Target Behaviors			
	Independ.		Interdepend.		Independ.		Interdepend.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Group I (Word Reading)								
Sets I & II								
Michael	0	100	0	100	0	100	0	100
Ronald	0	50	0	100	0	83	0	67
Natalie	0	50	0	0	0	17	0	17
Lane	0	100	0	0	0	17	0	0
Subtotal	0	75	0	50	0	54.3	0	46
Sets III & IV								
Michael	0	100	0	100	0	100	17	100
Ronald	0	100	0	0	0	0	0	83
Natalie	0	100	0	100	0	50	0	17
Lane	0	0	0	0	0	0	0	0
Subtotal	0	75	0	50	0	37.5	4.3	50
Total Group I	0	75	0	50	0	45.9	2.1	48
Group II (Word Reading)								
Sets I & II								
Mark	50	100	50	100	100	100	100	100
Carla	0	100	0	0	17	67	0	50
Luke	0	100	0	100	0	0	0	50
Ford	50	50	0	100	0	83	0	100
Subtotal	25	87.5	12.5	75	29.3	41.8	25	75
Sets III & IV								
Mark	0	100	0	100	75	100	100	100
Carla	0	100	0	100	25	50	25	50
Luke	0	50	0	50	0	0	0	0
Ford	--	--	--	--	--	--	--	--
Subtotal	0	83.3	0	83.3	33.3	50	41.7	50
Group II (Stating Word Definition)								
Sets I & II								
Mark	0	100	0	100	17	100	100	100
Carla	0	0	0	50	0	17	0	17
Luke	0	0	0	0	17	0	0	50
Ford	0	0	0	0	17	0	0	0
Subtotal	0	25	0	37.5	12.8	29.3	25	41.8
Sets III & IV								
Mark	0	100	0	100	0	75	0	75
Carla	0	0	50	0	0	0	0	0
Luke	0	50	0	0	0	75	0	25
Ford	--	--	--	--	--	--	--	--
Subtotal	0	50	16.7	33.3	0	50	0	33.3

Figure Captions

Figure 1. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Michael during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 2. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Ronald during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 3. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Natalie during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

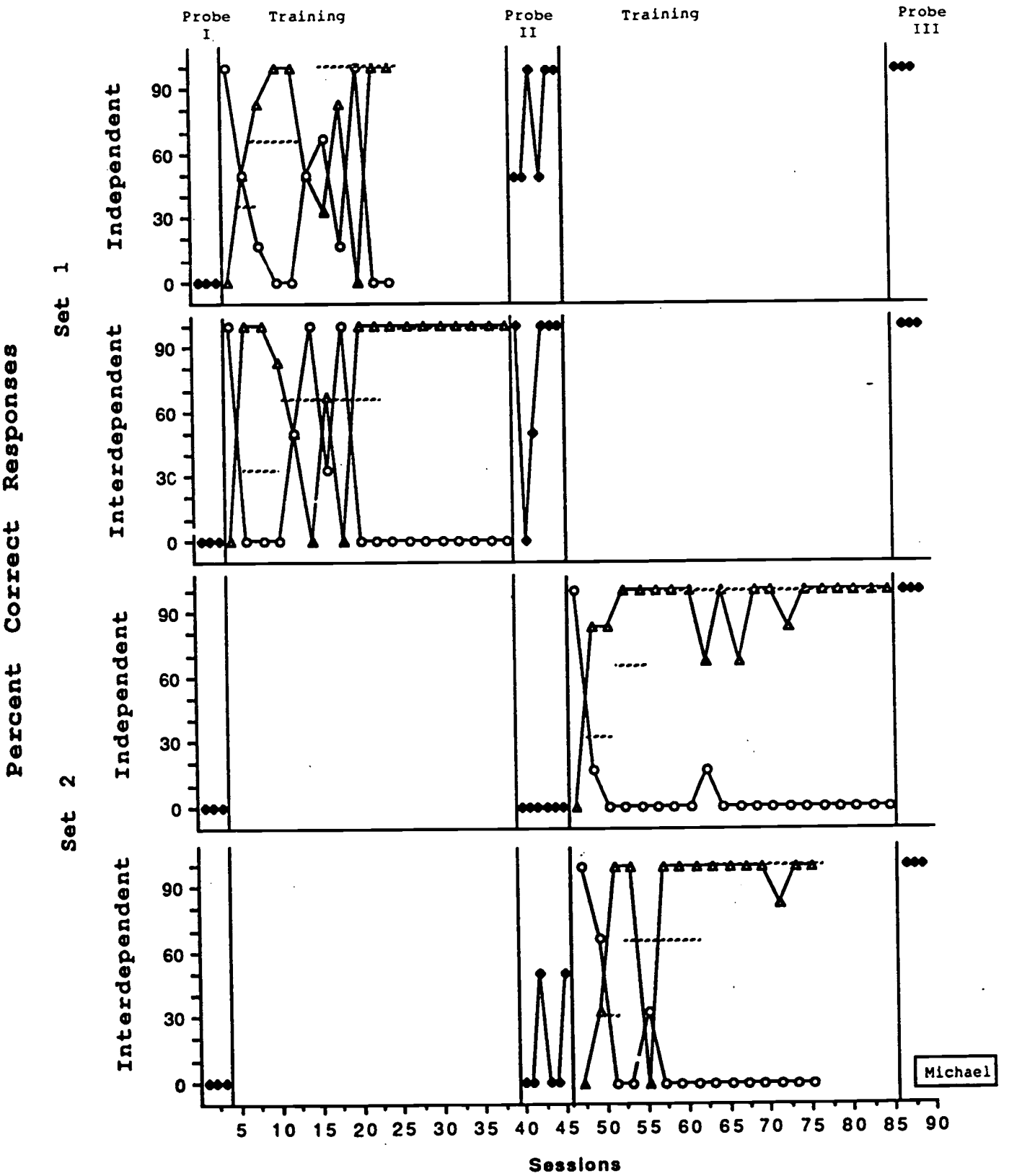
Figure 4. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Lane during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 5. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Mark during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 6. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Carla during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 7. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Luke during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 8. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Ford during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.


Probe I
Training
Probe II
Training
Probe III
Set 1
Independent
Interdependent
Set 2
Independent
Interdependent
Percent Correct Responses
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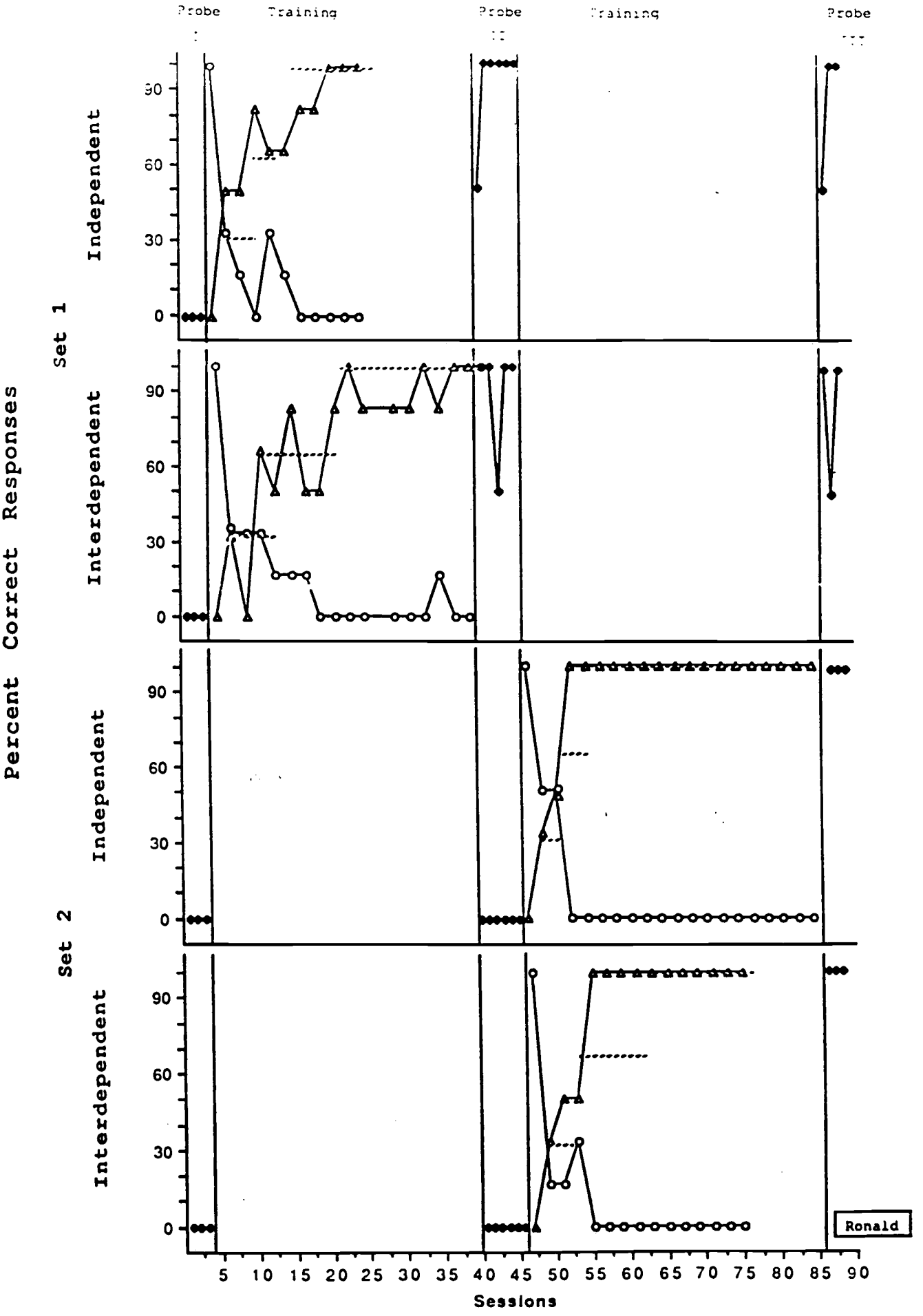
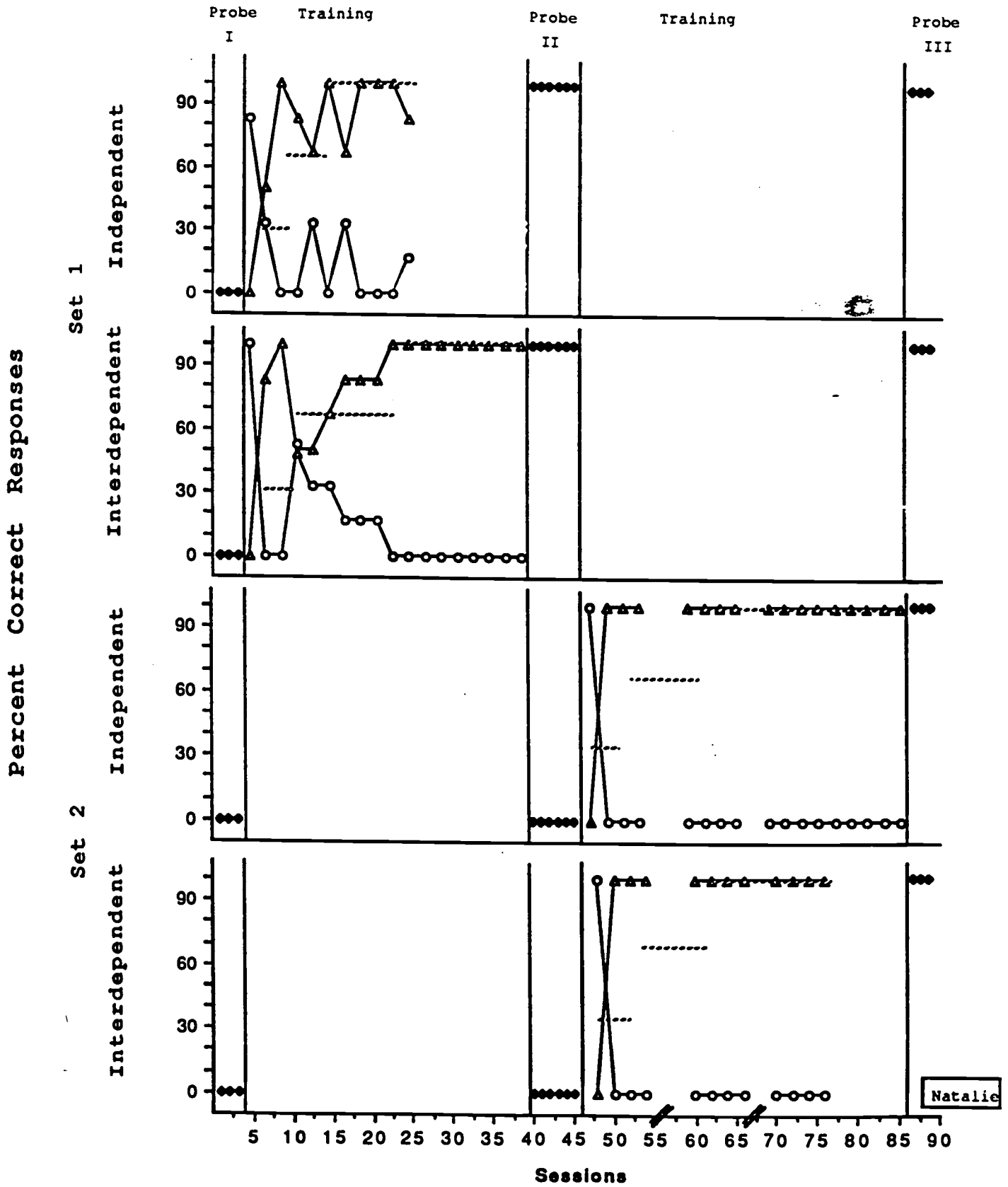
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Michael


Probe
I
Training
Probe
II
Training
Probe
III
Percent Correct Responses
Set 1
Independent
Interdependent
Set 2
Independent
Interdependent
0
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Ronald


Probe I
Training
Probe II
Training
Probe III
Set 1
Independent
Interdependent
Set 2
Independent
Interdependent
Percent Correct Responses
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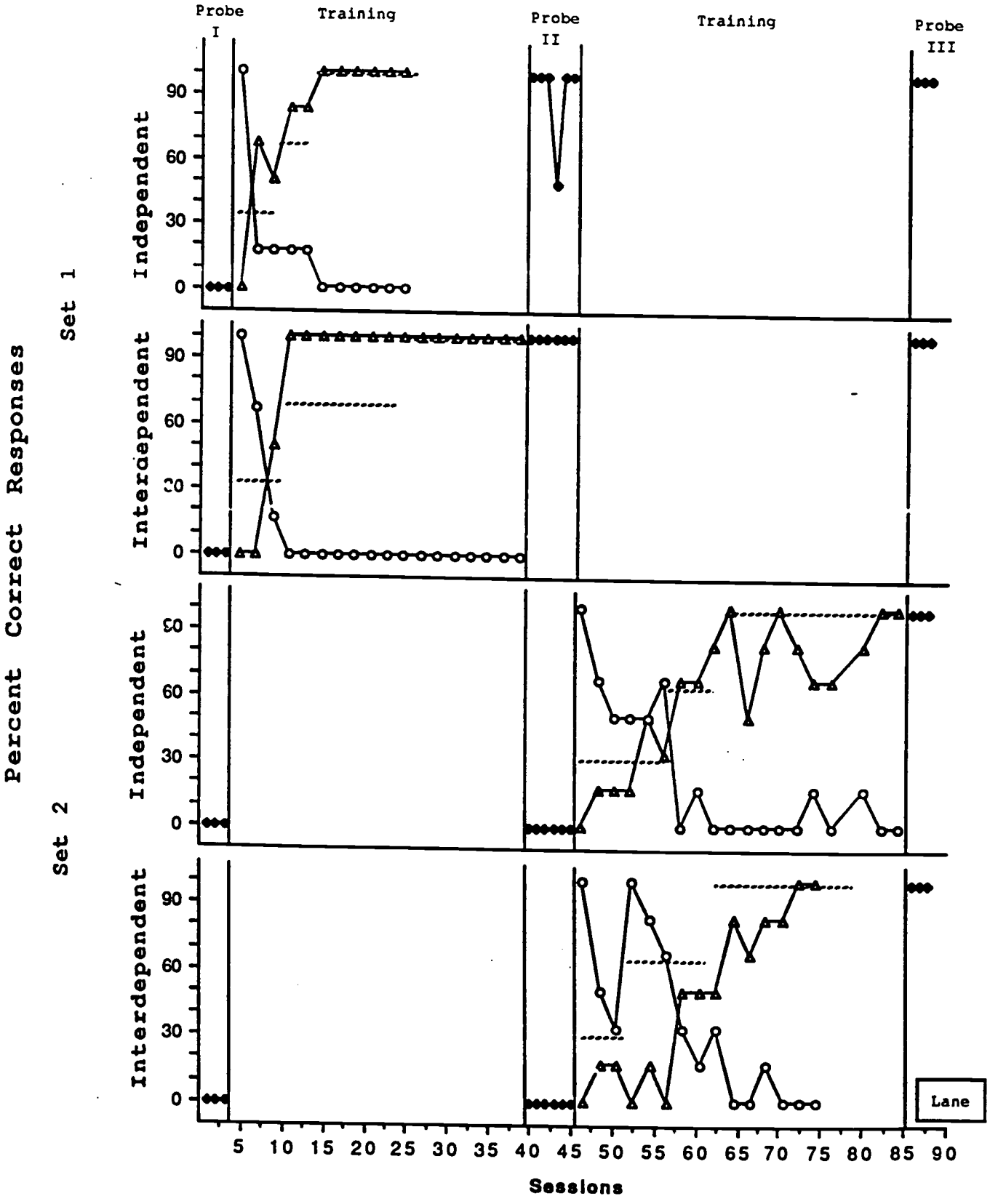
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Natalie


Probe I
Training
Probe II
Training
Probe III
Set 1
Independent
Interdependent
Set 2
Independent
Interdependent
Percent Correct Responses
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30
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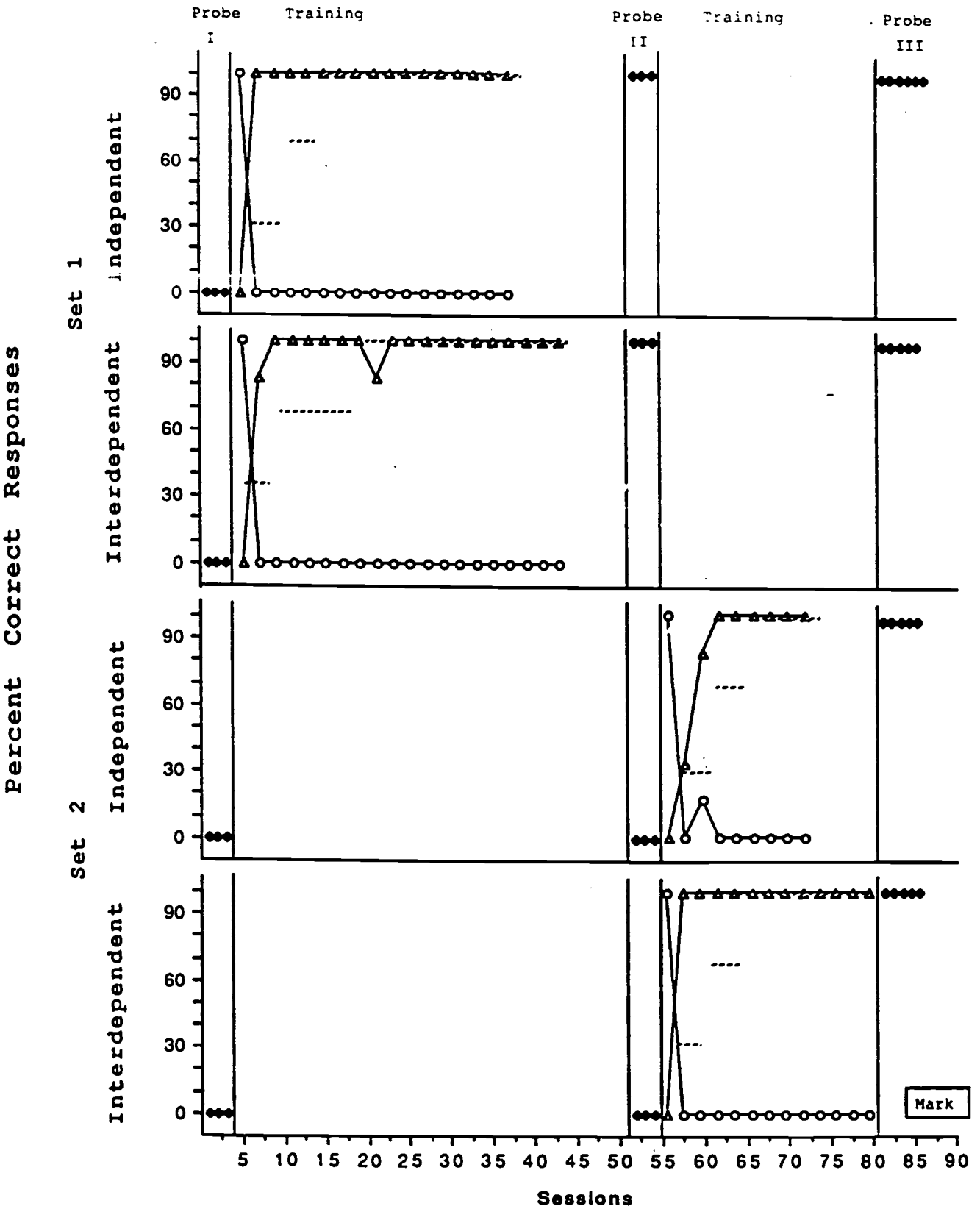
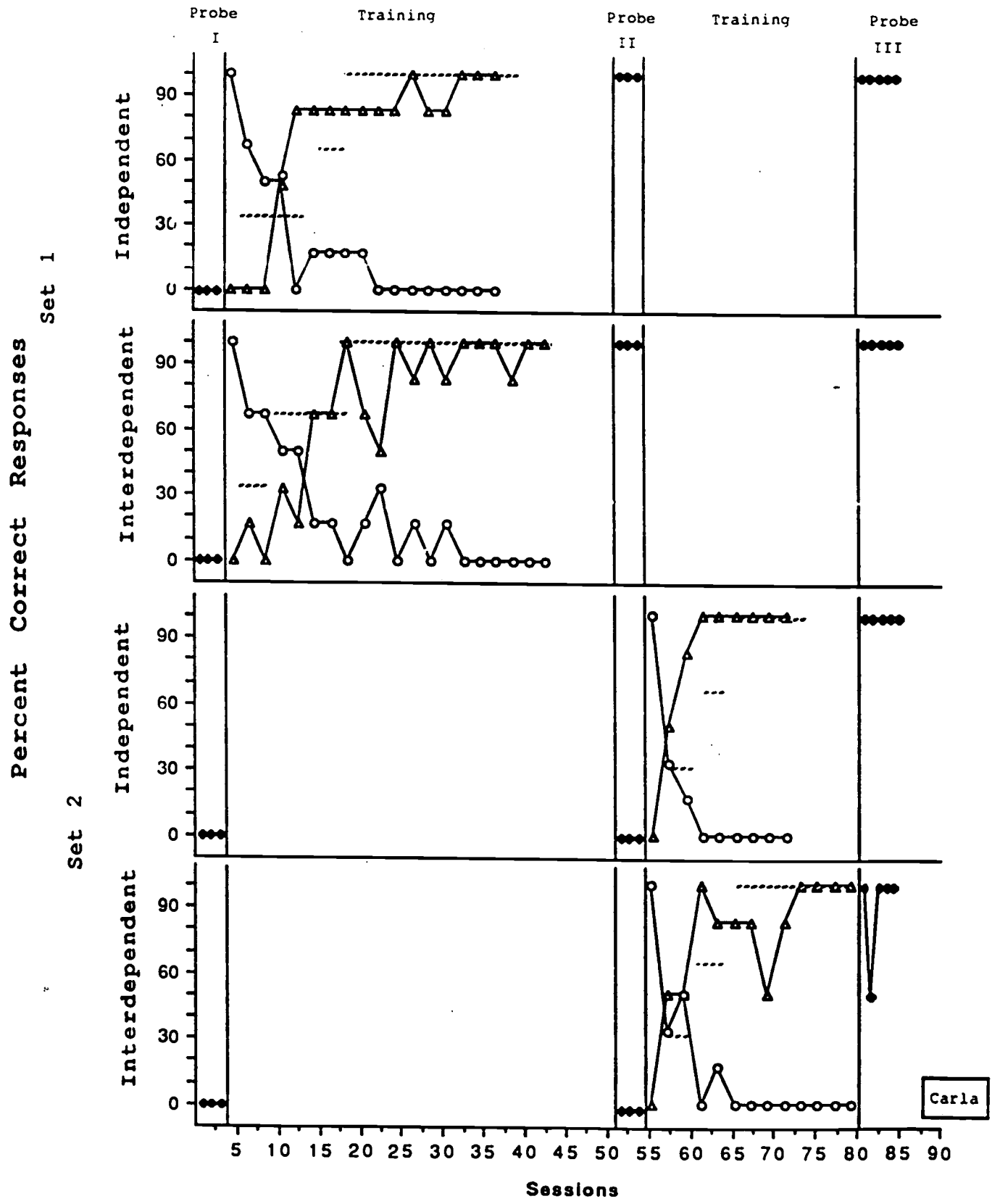
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Lane


Probe I
Training
Probe II
Training
Probe III
Set 1
Independent
Interdependent
Set 2
Independent
Interdependent
Percent Correct Responses
0
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Mark


Probe I
Training
Probe II
Training
Probe III
Independent
Interdependent
Independent
Interdependent
Set 1
Set 2
Percent Correct Responses
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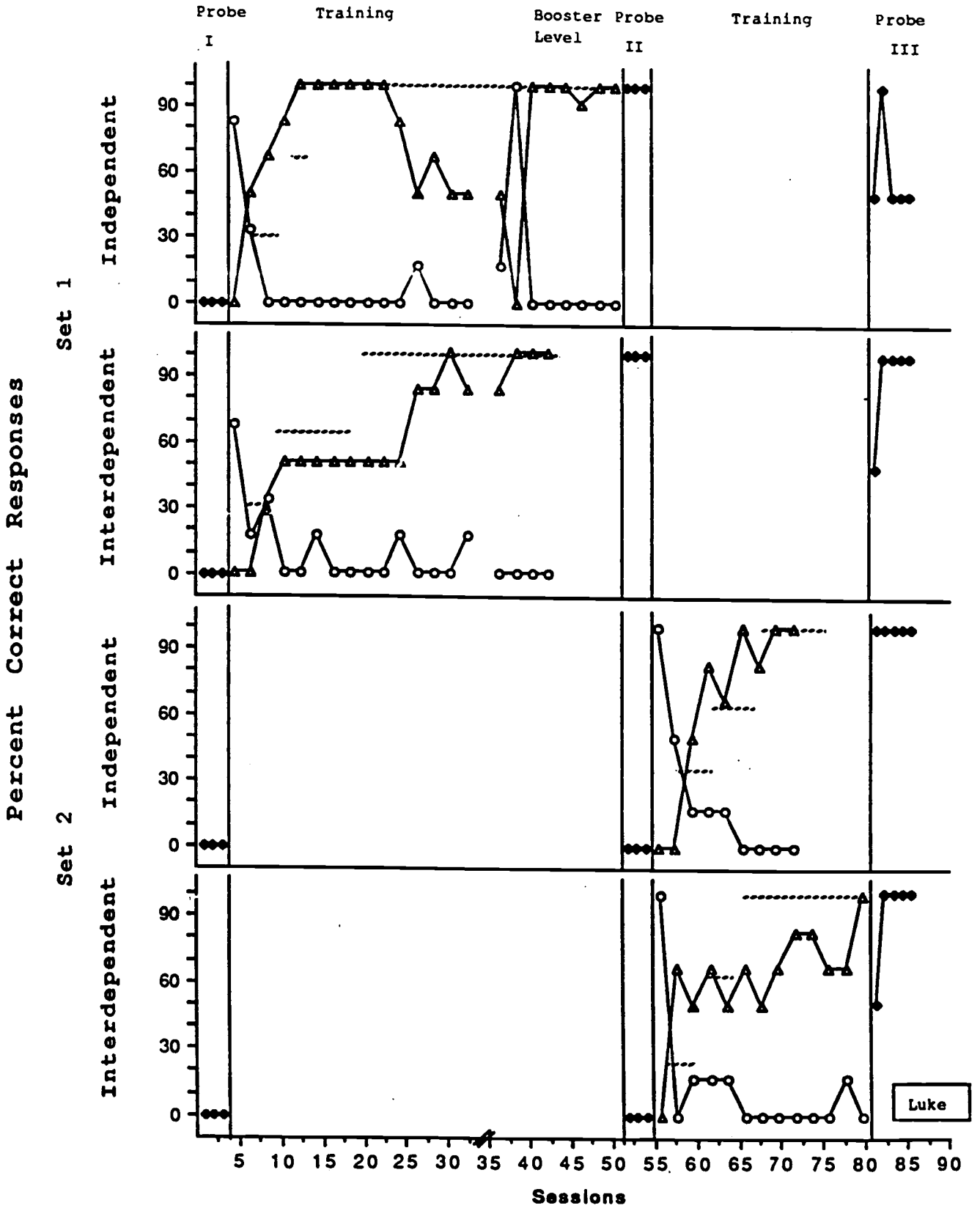
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Carla


Probe I
Training
Booster Level
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Independent
Interdependent
Set 2
Independent
Interdependent
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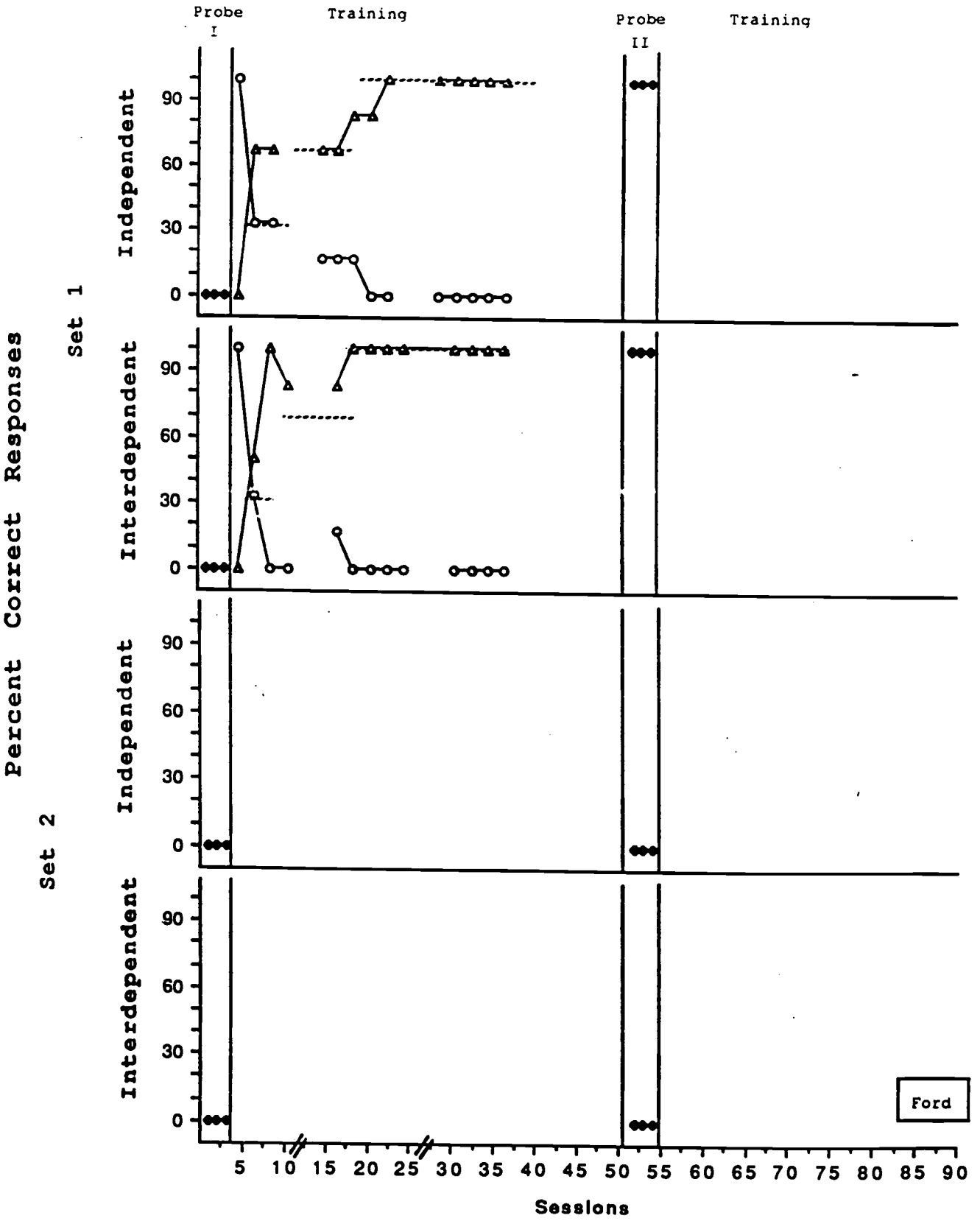
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Luke


Probe I
Training
Probe II
Training
Independent
Interdependent
Independent
Interdependent
90
60
30
0
Percent Correct Responses
Set 1
Set 2
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Ford

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