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**ANALYSIS OF SOCIAL REFERENCING SKILLS IN CHILDREN WITH AUTISM**

by

**DEVORAH BRIM**

**A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.**

**2002**

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This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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**Abstract****ANALYSIS OF SOCIAL REFERENCING SKILLS IN CHILDEN WITH AUTISM****by****Devorah Brim****Advisor: Claire L. Poulson**

**Social referencing, a form of nonverbal communication, involves seeking out discriminative stimuli provided by others about contingencies in an ambiguous context in order to respond in a manner that produces reinforcement. Although demonstrated by typically developing infants, social referencing is notably absent or impaired in individuals with autism. In this study, behavioral procedures including verbal, visual, and manual prompting and reinforcement were used to teach four children with autism to exhibit a social referencing response chain composed of an observing response and a conditional discriminative response in the presence of variants of standard academic materials. Observing was defined as looking at the experimenter when presented with unfamiliar handwriting materials, verbal models, and video models. Conditional discriminative responding was defined as completing the handwriting task or imitating the verbal and video models in the presence of a head nod and a smile, and placing the handwriting materials or Language Master cards aside, or remaining seated in a chair in the presence of a headshake and a frown. All four children learned to exhibit social referencing. The ambiguous materials were then interspersed among the standard materials. One of the children showed discriminated social referencing, observing in the presence of the ambiguous stimuli and not in the presence of the standard materials. The other children were taught to discriminate the ambiguous and standard stimuli and to**

**exhibit social referencing only in the presence of the ambiguous materials. The effectiveness of the teaching procedures used is discussed in the context of a learning theory analogue of social referencing.**

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One of the core deficits associated with autism is lack of social competence (APA, 1994). Recent research endeavors have attempted to clarify the specific social nuances lacking in individuals with autism such as drawing attention (Krantz & McClanahan, 1998), initiating greetings (Charlop & Trasowech, 1991) and helping (Reeve, unpublished manuscript), for the purpose of remediation. An additional area of socialization identified as being markedly absent in children with autism is social referencing (Sigman, Arbelle, & Dissanayake, 1995). Social referencing, a traditional developmental psychology concept, refers to “the use of one’s perceptions of another’s interpretations of [a] situation to form one’s own understanding of that situation” (Feinman 1982, p. 445). Alternatively, social referencing has been characterized as the ability to seek out and use information in the reactions of others to guide one’s own responding in the contexts of uncertainty or ambiguity (Campos & Sternberg, 1981). In other words, social referencing is a social-interactive episode, occurring under specific stimulus conditions (i.e., uncertainty or ambiguity), that brings an individual into contact with social discriminative stimuli that influence how this individual’s “interprets”, or in behavioral terms, responds to the stimulus conditions that evoked this interaction. A social referencing episode includes three essential components: a) the referent, or the ambiguous object or event that evokes the solicitation of social information in the form of another’s response to that object or event, b) the referrer, or the individual who solicits the social information and whose behavior is influenced by the social discriminative stimuli provided by another, and c) the referee, or the individual who provides discriminative stimuli in the presence of the referent, that influence the referrer’s behavior (Feinman, Roberts, Hsieh, Sawyer, & Swanson, 1992).

In studies investigating social referencing in typically developing infants and children, the participant's parent (usually mother) or familiar adults have served as the referee (e.g., Hornik, Risenhoover, & Gunnar, 1987; Walden & Baxter, 1989). The most common referents investigated have been novel toys or toy-like objects (e.g., Hornik et al., 1987), an unfamiliar adult (e.g., Feinman & Lewis, 1983), and a reduced visual cliff (e.g., Bradshaw, Goldsmith, & Campos, 1987). The key independent variable in almost all experimental investigations of the regulatory function of social referencing is the manipulation of the affective content of the "referencing message" (i.e., the affective discriminative stimuli provided by the referee) (Feinman et al., 1992).

In the prototypical methodology, participants are randomly assigned to one of two or more referencing conditions. To use Feinman's language, conditions vary with regard to the affective content of the referencing message conveyed by the referee concerning the referent. The most common designs used in examining the impact of affective referencing messages have contrasted positive messages (e.g., joy) with negative messages (e.g., fear, disgust). Messages are conveyed through either a single channel of communication (e.g., facial expression) or through multiple channels of communications (e.g., facial, verbal, and gestural cues). After the message is communicated, the participants' behavior is examined to determine whether responses differ systematically among message conditions. The dependent measures used to determine the impact of the referencing message typically include approach and contact variables, and affective responding (Feinman et al., 1992).

The main etiological theory postulated in the social-referencing literature is "preformationist"; that is, social referencing, particularly in infants, involves "pre-wired"

responses and perceptions (Campos, 1983, p. 85). According to this theory, early on in life, the human infant perceives and understands the meaning of its mother's emotional expressions on an unlearned basis. Communication of meaning through emotional maternal expression serves to help the infant regulate its behavior in ambiguous contexts. An alternative theoretical model formulated by Gewirtz and Pelaez-Nogueras (1992) proposes that social referencing is the result of an infant's learning in contexts of ambiguity. In contrast to the nativist approach, Gerwartz and Pelaez-Nogueras (1992) argue that, although social referencing has evolutionary value, this observation is insufficient to justify the conclusion that the ability of infants to discriminate maternal affective cues is innate. Furthermore, they argue that the evolutionary adaptivity of Homo Sapiens is its capacity for learning and responding in accordance with ecological change. They cite as evidence the fact that infants in the first few months of life readily learn to discriminate visual, auditory, and tactile stimuli, through differential reinforcement. Thus, they propose that that an infant's response in the presence of maternal affective expressions is not a preprogrammed ability, but learned behavior, and that the social referencing chain is a conditioned behavior chain evoked by ambiguous objects or events. The affective cues that often function as discriminative stimuli during social referencing are not inherently different from other discriminative stimuli ( $S^D$ s); they adhere to the same principles of learning.

According to this operant-learning model of social referencing, in contexts of uncertainty, maternal facial expressions, that were once neutral, come to reliably predict reinforcing and/or punishing consequences for the infant's actions in those ambiguous contexts. An infant's responses (e.g., approach-avoidance, reaching) are viewed as

operant responses that are evoked by maternal or other facial expressions and shaped and maintained by the ensuing consequences (i.e., reinforcing or punishing events). The two central propositions that characterize this conceptualization are: a) maternal or other facial expressions are initially neutral (i.e., do not control responding in the presence of ambiguous stimuli or events), and b) through contingent reinforcement or punishment, these affective configurations come to predict consequences and thus acquire stimulus control over responding. The counter-argument that social referencing occurs in the absence of reinforcement can be easily diffused by viewing social referencing as a class of behavior that is initially reinforced, and maintained on intermittent schedules of reinforcement much like most of human behavior (Bijou & Baer, 1961).

From an operant learning standpoint, a social referencing response chain is comprised of the following components: a) unfamiliar or ambiguous objects or events that evoke an observing response (e.g., orienting toward another individual, b) the observing response that produces  $S^D$ s in the form of affective expression presented by the other individual, c) discriminative stimuli that typically consist of positive or negative affect that signals reinforcement, punishment or extinction for a given subsequent response, and d) the delivery of consequences following subsequent responding, that in turn, influence the probability of future occurrences of social referencing in similar contexts.

Gewirtz, Pelaez-Nogueras, Diaz, and Villate (1990, as cited by Gerwirtz and Pelaez-Nogueras, 1992) conducted a study that supported this paradigm of social referencing by demonstrating that initially meaningless maternal facial expressions that were presented contingent upon observing, and correlated with reinforcement and punishment contingencies, could come to control infant responding in ambiguous contexts. Twenty

infant-mother pairs participated in the study. Two different hand-to face “expressions” served as S+ and S- for reaching for a hidden toy. For half of the infants, reaching for the toy was reinforced in the presence of a fist-to-nose expression with the presentation of a taped musical baby melody. Reaching for the toy in the presence of a palms-to-cheeks expression produced one of three loud sounds including a harsh door buzzer, a taped sound of a concrete drill or a food blender. The roles of S+ and S- assigned to the arbitrary maternal expressions were reversed for the other half of the infants.

The results of the study demonstrated that infant reaching-for-toy behavior occurred in the presence of the maternal expression that signaled the delivery of reinforcement for this response, and not in the presence of the maternal expression that signaled the delivery of the loud harsh noise. Thus, infant reaching behavior had come under discriminative control of the arbitrary maternal expressions. The results of this study have theoretical implications for the supposition of a preformationist emotional bond inherent in social referencing. In fact, the Gewirtz et al. (1990) study indicates that it is unnecessary to posit such a bond. Furthermore, it is unnecessary to posit that “meaningful” affective discriminative stimuli be components of the social referencing chain because as this study demonstrated, arbitrary maternal expressions can become discriminative stimuli for social referencing.

While numerous studies have demonstrated the presence of social referencing in infants and small children, the Gewirtz et al. (1990) study is unique in its behavioral analysis of social referencing, and in its design and implementation of behavioral procedures to teach social referencing in the context of ambiguity. Gewirtz’s (1990) re-conceptualization of social referencing as learned behavior allows for the possibility of

teaching social referencing skills to individuals with impaired social referencing repertoires, such as individuals with autism. In the Gewirtz et al. (1990) study, maternal hand-to-face “expressions” not typically associated with various emotional states were established as S+ and S- for infant reaching to demonstrate that: a) social referencing may be established in the presence of previously “neutral” stimuli (i.e., stimuli that have not been paired with reinforcement or punishment contingencies), and b) social referencing is not dependent on “emotional bonding” nor is it limited to an “emotional” context. In studies that investigated social referencing in typical infants and children, the discriminative stimuli provided by adults, contingent upon infant observing, often included an affective component (e.g., a smile or frown) and a gestural component (e.g., a head nod or head shake, beckoning). This suggests that recognition of affect-related stimuli and gestures would be requisite skills in developing a social referencing repertoire. A number of studies have investigated the acquisition of affect and gestures in individuals with autism. A study by Gena, Krantz, McClannahan, and Poulson (1996) used behavioral procedures including modeling, verbal prompting, and reinforcement to teach four adolescents with autism to display contextually-appropriate affective verbal and gestural behavior in response to another’s affective display. In another study, Buffington, Krantz, and Poulson (1997) taught four children with autism to use contextually appropriate gestures across three response categories: attention directing/getting behavior, affective behavior, and descriptive behavior. With the systematic implementation of modeling, prompting and reinforcement, all four children acquired the trained gestures in the experimental setting and generalized gestural responding across novel stimuli, people and settings. These studies suggest that children

with autism can acquire component skills of social referencing, and thus perhaps social referencing.

The study described in this paper used behavioral procedures to teach social referencing skills to four children with autism. The teaching process included two behavioral objectives. One objective was to teach the participants to exhibit social referencing when presented with academic-task materials that were variants of standard academic materials. Toward this end, teaching sessions including presentations of the task variants only were conducted until the acquisition of social referencing, in accordance with the study criteria, was demonstrated. The second objective was to assess if the social referencing response chain acquired during this initial training: a) generalized from the experimental setting to the children's regular classroom, during their standard academic tasks and b) was a discriminated response, occurring in the presence of the task variants and not in the presence of the standard task materials, when these two sets of materials were interspersed in the classroom setting. In the event that social referencing was not exhibited consistently and exclusively in the presence of the task variants, discriminated responding in the presence of the task variants and standard task materials would be taught. The current study advances learning theory in two ways. The study is a demonstration of the use of the principles of learning to teach social referencing skills to children with autism. Secondly, the study addresses the issue of the etiology of social referencing and supports the operant learning paradigm of social referencing.

## Method

### Participants

Four children with autism participated in the study. All of the children attended educational classes at the Institute for Educational Achievement (IEA) and had previously received diagnoses of autism by independent agencies. All of the children had notable deficits in social referencing in the context of unfamiliar settings, situations or people. All of the children, however, had learned to exhibit appropriate eye contact in response to their name being called, in response to the directive “Look at me,” and during trained verbal and social exchanges in familiar settings with familiar people. On occasion, maintaining eye contact required prompting. All of the children could discriminate among task materials and independently obtain their various academic and play materials. In addition, all of the children exhibited some oral language including requesting preferred items and activities, and spontaneous labeling of objects in their environment.

Greg was five years old at the start of the study. Prior to the onset of the study, he had attended IEA for 10 months. Greg had acquired social skills including independently greeting familiar others by name. He also verbally initiated social-interactive activities (e.g., by approaching a familiar other and saying “Let’s read together”), could talk about preferred activities or upcoming events in full sentences, and maintained short conversation with teachers and peers. Initiation of these interactions, however, was primarily prompted by teachers or by Greg’s activity schedule (MacDuff, Krantz & McClannahan, 1993). Greg occasionally initiated eye contact with familiar others. He did not, however, exhibit social referencing in the presence of unfamiliar people, objects

or events. Greg's age-equivalent score on the Peabody Picture Vocabulary Test-Revised (PPVT-R) was 2-3 years.

Paul was five years old at the start of the study. He received two years of educational training at IEA prior to the onset of the study. Paul spontaneously requested preferred items (e.g., "Can I have soda?") and commented on objects or events (e.g., "Devorah's here") in his immediate environment, using phrases or short sentences. He also independently greeted others and occasionally spontaneously asked questions (e.g., "Where are you going?"). All other verbal and social exchanges including initiating a social-interactive activity, initiating a conversation, describing preferred objects or events were prompted by teachers or by Paul's activity schedule. Paul's age-equivalent score on the Peabody Picture Vocabulary Test-Revised (PPVT-R) was 4-1 years.

Ken was six years old at the start of the study. He had attended educational classes at IEA for three years prior to the onset of the study. Ken had limited verbal skills. He had a limited vocabulary and poor articulation. His spontaneous speech mostly consisted of requesting preferred items. On occasion, he would comment using previously trained 1-2 word phrases (e.g., "yellow truck"). All other verbal and social exchanges were prompted by teachers or by his activity schedule. Ken's age-equivalent score on the Peabody Picture Vocabulary Test-Revised (PPVT-R) was < 9 months.

Iris was five years old at the start of the study. She had attended IEA for 10 months prior to the onset of the study. The spontaneous language skills she had acquired included requesting for preferred items or activities using full sentences, commenting on objects in her immediate environment using 1-2 word phrases, and independently greeting familiar others by name. Her social skills, including initiating social-interactive

activities (e.g., approaching a familiar other and saying “Let’s read together”), describing preferred objects, and maintaining short conversation with teachers and peers, were primarily prompted by teachers or by her activity schedule. Iris’s age–equivalent score on the Peabody Picture Vocabulary Test-Revised (PPVT-R) was 1-11 years.

All of the children displayed low to moderate rates of stereotypic and disruptive behavior including non-contextual vocalization, toe walking, and tantrum behavior. During most of the academic day, the children received one-to-one instruction. They were accustomed to learning in both a discrete-trial format and through incidental teaching procedures. Each child also participated in a few small-group sessions per day. All of the children followed teacher directions, and were accustomed to using a token motivational system. Prior to the onset of the study, the parents of all the participants gave informed consent for their children’s participation in the study.

### Setting

In this study, social referencing was measured in two different settings. One setting, was a room at IEA, 3.0 x 10.8 m in size, occupied by the experimenter and experiment participants, and was referred to as the experimental room. Social referencing baseline and training sessions were conducted in this room. The experimental room contained a table, chairs, and a television and VCR on a television stand. The children’s token boards and data sheets were placed on the table. All other task materials were placed on a chair behind the table.

The second setting was the children’s regular classrooms. Pretest sessions, posttest sessions, and discriminated social-referencing training sessions were conducted in the three regular classrooms where the children attended educational classes. Two of the

classrooms were approximately 10.7 x 6.1 m each, and contained six desks in separate areas in the room for the students. Shelves along the walls contained the children's curriculum materials, books, and toys. A table and a few chairs stood in the center of each room. The third classroom was approximately 3.0 x 4.6 m and contained two desks and two chairs. Two bookshelves with the children's academic curriculum were placed against the wall facing the children's desk. A third bookshelf, containing books and toys was placed on the left side of the room.

In both settings, a video camera (Sharp camcorder, model VLH86OU) was present and used to record the behavior of the experimenter and the student's responses and interaction with the experimenter. Sessions were recorded for subsequent viewing to obtain reliability measures. The experimenter was a doctoral student in psychology with training in applied behavior analysis. She conducted all pretest sessions, posttest sessions, baseline, and treatment sessions.

### Materials

Social referencing skills were assessed and taught in the context of the following three academic tasks: handwriting, Language-Master imitation, and video imitation. These tasks were part of the children's standard academic program and included the following materials and responses. The handwriting task required drawing a vertical line to connect two dots. The materials used were a yellow # 2 pencil and an 8 1/2 x 11 inch sheet of paper with two dots, separated by a distance of approximately five inches on the page. The Language Master, an automated device that allowed verbal responses to be prerecorded on cards and then played back on the Language Master, was used to teach verbal imitation. The prerecorded verbal responses used in the study were single-word

models of common words (e.g., pencil and monkey) that the children were required to imitate. The video-imitation task involved imitation of a sequence of videotaped gross-motor responses (e.g., clapping and marching). These standard task materials were presented during the pretest sessions, posttest sessions and mixed discrimination training sessions.

The task materials that were taught to occasion social referencing were variants of the standard task materials described above. These task materials are referred to as “ambiguous” because two different contingencies operated in their presence, as signaled by the presentation of one of two experimenter- affective  $S^D$ s. Correct responding to the ambiguous materials did not necessitate any changes in the required response topography, to ensure that differences in responding to the standard materials and to the ambiguous materials were not a function of the absence of the required response topography from the children’s repertoire. A complete list of the ambiguous materials can be found in Table 1. For the handwriting task, the children were presented with writing utensils other than the standard # 2 pencil (e.g., a highlighter pen, a jumbo-sized marker) and a variety of writing surfaces (e.g., a paper plate, gift- wrap paper) that had dots identical to the dots on the standard handwriting sheets. The ambiguous Language Master cards contained the same prerecorded words as the standard cards, but were recorded in strange voices (e.g., a very high or low-pitched tone of voice) or with strange background sounds (e.g., a xylophone or a radio played in the background). The ambiguous video-modeled gross motor responses were identical to the gross-motor responses modeled in the standard video imitation task but were performed by individuals wearing costumes or by stuffed animals.

Table 1

Ambiguous Stimuli, Presented During Training and Probe Trials. Probe Stimuli Are Designated by (P).

<u>Task</u>		
Handwriting	Language Master Imitation	Video Imitation
Jumbo chalk/sticky note	Baby (low pitch)	Dog mask
Colored pencil/ colored index card	Guitar (sing-song voice) Monkey (shout)	Witch mask Pig costume
Pen refill/colored paper	Castle (high pitch) (P)	Barney
10-color pen/newspaper	Rabbit (slow)	Stuffed bear (P)
Jumbo mechanical pencil/	Pencil (fast)	Stuffed dog
Wrapping paper	Orange (background cough)	Paper bag mask
Crayon/shopping list	Sailboat (background sneeze)	Bare feet
Highlighter/streamer	Rainbow (background xylophone)(P)	Oven mitt (P)
Thin marker/calendar	Chicken (background maracas)	Model wrapped in a
Wipe off pad	Flower (background vacuum)	blanket (P)
Red pen/ paper plate (P)	Airplane (background radio)(P)	Model filmed
Jumbo marker/		upside down
Yellow legal sized paper (P)		Model standing in
Chalk in holder/paper bag (P)		bathtub

### **Response Definitions**

Two dependent measures were recorded over the course of this study. One dependent measure was percentage of trials with an observing and conditional discriminative response. This measure consisted of two sequential component responses. The first component response was the observing response. An observing response was defined as orienting toward, and looking at, the experimenter's face within 5 s of the presentation of the ambiguous task materials (i.e., handwriting materials, a verbal model presented on a Language Master, or a video model presented on a television screen). The occurrence of the observing response resulted in the presentation of one of two experimenter affective stimuli, referred to as S1 and S2. Both S1 and S2 were composed of a facial expression and a gesture. S1 was a smile defined as corners of the mouth turned up, displayed in conjunction with nodding of the head (i.e., an up and down head movement). S2 consisted of a frown defined as corners of the mouth turned down, accompanied by shaking of the head from side to side. The second component response was a conditional discrimination of these experimenter affective stimuli (i.e., S1 and S2). Demonstration of a conditional discriminative response in the presence of S1 and S2 required performance of one of three responses in the presence of S1, and one of four responses in the presence of S2. These responses are defined in Table 2. In the presence of S1, participants were required to either: a) complete a handwriting task (i.e., drawing a line to connect two dots drawn on a piece of paper, b) imitate a gross motor response of a videotaped model, and c) imitate a verbal model presented on a Language Master card. In the presence of S2, participants were required to demonstrate a trial-termination response including a)

**Table 2. Conditional Discrimination Responses for Each Task in the presence of the Experimenter Affective S1 and S2.**

<b>Task</b>	<b>S1</b>	<b>S2</b>
<b>Handwriting</b>	<b>Connect two dots drawn on a paper surface to form a 4-in vertical line using a writing utensil</b>	<b>Place writing surface writing utensil in discard bin</b>
<b>Language-Master Imitation</b>	<b>Imitate model of two-syllable word presented on Language Master card</b>	<b>Place Language Master card in bin without imitating</b>
<b>Video Imitation</b>	<b>Imitate gross-motor response presented by video model</b>	<b>return to seat without imitating gross-motor response</b>

placing handwriting materials in a discard box, b) place Language Master cards in a discard bin, c) returning to a seated position following the presentation of a video model, or any response other than the three responses reinforced in the presence of S1 (other than engagement in an inappropriate response such as stereotypic behavior). A measure of these combined response components (i.e., the social referencing response chain) was collected during the baseline and the social referencing training conditions of the study.

A second dependent measure was that of the first component of the social referencing chain only—the observing response. The observing response, as defined above, was orienting toward, and looking at, the experimenter’s face within 5 s of the presentation of the ambiguous task materials. Observing alone was measured during all experimental conditions. In addition, measures of observing were collected on a weekly basis during the standard handwriting, Language Master imitation, and video imitation tasks. Occurrences of observing during these tasks were recorded, to assess whether acquisition of social referencing in the presence of ambiguous task materials produced an increase in observing in the presence of the standard task materials.

### Experimental Design

A multiple-baseline-across-responses design was used in teaching social referencing to the four study participants. Social referencing training, described below, was introduced successively across responses and across children after the mastery criterion was met for each response. This criterion required an observing response followed by a conditional discrimination in the presence of S1 and S2 on 89% of trials (eight out of nine trials) or higher for three consecutive training sessions. The order of introduction of intervention across response types was varied across children to control for order effects.

The order of introduction for Greg was handwriting, video imitation, and Language Master imitation. The order of introduction for Paul was video imitation, handwriting, and Language Master imitation. The order of introduction for Ken was handwriting, Language Master imitation, and video imitation. The order of introduction for Iris was Language Master imitation, video imitation, and handwriting. The study also included pretest sessions and posttest sessions of social referencing, conducted in the children's regular classroom, in which ambiguous task materials were interspersed among standard task materials. The posttest sessions were presented in a staggered fashion in a multiple-baseline-across-participants design following post-criterion performances of three participants to experimentally assess the changes in social referencing in the presence of the ambiguous and standard task materials when interspersed amongst each other in the children's regular classrooms.

### Procedure

General Format. At the start of each session, the child was seated next to a table with the experimenter a few inches to the side and slightly behind the child. Task materials were placed on a chair behind the table. The Language Master, discard bin, and discard box were placed on the table. The television and VCR were placed facing the child at a distance of about three feet. The experimenter instructed the child that they would work together and that reinforcement could be earned for correct responding. Tokens were delivered contingent upon correct responding and were exchanged for preferred food items, or activities.

Trial Configuration. The presentation of each ambiguous task stimulus signaled the beginning of a new trial, and served as a discriminative stimulus for the social

referencing response chain. During the handwriting task, the experimenter placed the writing materials on the table in front of the child. During the verbal imitation and video imitation tasks, the experimenter ran the Language-Master card through the Language Master or turned the video on using a remote control device. Following the presentation of the ambiguous stimulus, the experimenter waited 5 s for the participant to exhibit an observing response. An observing response that occurred within 5 s of the presentation of an ambiguous training stimulus, during the first treatment sessions and the mixed discrimination training conditions was reinforced with praise and a token, followed by the presentation of S1 or S2. During both training-stimulus and probe-stimulus trials in subsequent treatment sessions, and during the pretest sessions, posttest sessions, and baseline condition, the production of an observing response resulted in the presentation of S1 or S2.

If the ambiguous training stimulus did not evoke an observing response within 5 s of its presentation, the prompting procedure described below was implemented. If the ambiguous stimulus did not evoke an observing response within 5 s of its presentation during the pretest sessions, posttest sessions, baseline condition, and ambiguous probe trials, the stimulus was removed, and a 3 s inter-trial interval began, during which no consequences was delivered. Following the inter-trial interval, a new trial was initiated with the experimenter's presentation of another ambiguous stimulus.

For each ambiguous-stimulus trial, if an observing response occurred within 5 s of the presentation of the ambiguous stimulus during all phases of the study, the experimenter presented either S1 or S2. During the pretest sessions, posttest sessions, training trials in the treatment condition and mixed discrimination training, a conditional discriminative

response in the presence of S1 and S2 resulted in the delivery of praise and a token. During the baseline condition and ambiguous probe trials in the treatment condition, reinforcement was not delivered following a conditional discriminative response. An incorrect response during ambiguous training trials in the treatment condition and during mixed discrimination training resulted in the implementation of a correction procedure described below. An incorrect response that occurred during ambiguous probe trials in the treatment condition, or during the pretest sessions, posttest sessions and baseline condition produced removal of the task stimuli and the start of the 3 s inter-trial interval.

Each treatment session consisted of 36 trials, with of 12 training trials and three probe trials from each of the three tasks. Session duration was approximately 20 minutes; sessions were conducted five days per week. Materials were randomly assigned to S1 and S2 conditions. Ten orders of trial presentations were prepared to prevent order effects. These orders were prepared using a controlled randomized procedure. That is, the materials were randomly assigned to trial positions with the exception that: a) no more than two consecutive presentations of either the S1 or S2 occur, b) no more than two consecutive presentations of materials from the same response type occur and c) no consecutive presentations of probe stimuli occur.

Pretest sessions. An initial assessment of discriminated social referencing was conducted with the four participants. Trials with ambiguous and standard stimuli were interspersed in the following manner: a ratio of 3:1 standard-to-ambiguous stimulus trials was used. Trials from each of the three tasks were presented in blocks of four. On three out of four of these trials, the standard stimuli were presented; on one trial, an ambiguous stimulus was presented. The blocks were presented using a controlled randomization

procedure such that no more than two consecutive blocks of trials from a given task occurred. Correct responding during ambiguous-stimulus trials was defined as exhibiting an observing response within 5 s of the presentation of the stimulus. Correct responding on ambiguous trials produced either S1 or S2. Conditional discrimination of S1 and S2 resulted in the delivery of praise and a token. Incorrect responding in the presence of ambiguous stimuli was defined as the absence of the child's emitting an observing response within 5 s of the presentation of the ambiguous stimuli. Failure to exhibit an observing response within 5 s of the presentation of ambiguous stimuli resulted in the experimenter's removal of the stimuli.

Correct responding during standard trials was defined as completing the task without emitting an observing response. Correct responding was reinforced with tokens and praise. Incorrect responding consisted of the child's emitting an observing response in the presence of the standard stimuli. If an observing response occurred following the presentation of the standard stimuli, the experimenter turned her head away from the child and then manually prompted a writing or imitating response.

**Baseline.** During baseline sessions, the experimenter initiated a trial by presenting writing materials, a video model, or a Language Master model. Occurrences of observing (i.e., orienting toward and looking at the experimenter's face) within 5 s of the presentation of each stimulus were recorded. If an observing response occurred, the experimenter displayed the pre-designated affective discriminative stimuli (S1 or S2) for 5 s. If a conditional discrimination occurred, the experimenter provided verbal feedback. If an incorrect response or no response occurred, the stimulus was removed after 5 s and the next trial began. Token reinforcement was provided along with verbal praise for on-

task behavior on approximately every third trial. These tokens were only provided after 5 s had elapsed from the last incorrect response so that incorrect responses were not inadvertently reinforced.

**Social Referencing Training.** A chain of two responses was taught during this condition. Observing, the first component response of the chain, was taught using a visual and verbal prompt. At the start of a trial, the experimenter initiated the interactive episode by presenting an ambiguous stimulus from one of the three tasks. The experimenter waited approximately 5 s and then prompted the child to turn his/her head and look at the experimenter by holding up a token to the child's view and then moving the token to the experimenter's eyes. If this did not evoke an observing response, the experimenter added the instruction "Look." Feedback for looking was then provided (e.g., "That's looking at me"). This prompting procedure was repeated until an independent observing response occurred. During the first session of treatment for each task, an independent observing response resulted in the delivery of praise and a token, to increase the probability of an independent observing response. During all subsequent sessions, independent observing responses were followed by the presentation of S1 or S2. The second component response, a conditional discrimination, was taught using a graduated-guidance procedure. Manual prompts were used to evoke writing, gross-motor imitation, and verbal prompts were used to evoke Language-Master imitation within 5 s of the presentation of S1; trial termination, described below, was manually prompted in the presence of S2. An independent conditional discriminative response (e.g., drawing a line following the presentation of a smile and a nod, or putting writing materials in the discard bin following the presentation of a frown and a head shake) occurring within 5 s

of the presentation of the discriminative stimulus produced token reinforcement and behavior-descriptive praise (e.g., “Super, you drew a line when I made a ‘happy’ face”). If an incorrect response occurred following the presentation of S1, the experimenter manually and/or verbally prompted the child to either: a) complete the handwriting task, or b) imitate the Language-Master or video model. If an incorrect response occurred following the presentation of S2, the child was manually prompted to terminate the trial by either depositing the referent (i.e., the handwriting materials or Language Master card) in the discard bin, or to sit down, following the presentation of a video model. Following this correction procedure, the trial was presented again. A token and praise were delivered following an independent correct response. If an incorrect response occurred again, the correction procedure was repeated until the child independently emitted the correct response. This correction procedure was used to ensure that the child’s responding immediately followed the training experimenter affective discriminative stimuli (i.e., S1 and S2) and therefore, came under the control of those stimuli and not the experimenter’s prompts. Observing and discrimination training were terminated when correct responding occurred on 89% of all trials for three consecutive sessions.

Within-session generalization of trained observing and conditional discriminative responding from the training stimuli to a novel set of task stimuli was measured by the presentation of probe trials. For each task, there were three stimuli designated as probe stimuli. These task stimuli were never associated with prompting or reinforcement; the target responses, however, were the same as those taught during the training trials. During the probe trials, the experimenter presented the task stimuli and waited for an observing response. If none occurred, she removed the materials. If an observing

response occurred, she presented the affective discriminative stimuli. During probe trials, reinforcement was not programmed to follow a correct discrimination, and the correction procedure was never to be used, to assess if social referencing generalized from the training stimuli to the probe stimuli.

**Assessment of Post-Criterion Performance.** Following achievement of the mastery criterion during the social referencing training condition, the children were presented with alternating sessions of ambiguous materials only or standard materials only. Sessions with ambiguous materials were identical to the social referencing training sessions. The sessions with standard materials were identical to the children's standard academic sessions described above.

**Posttest sessions.** The posttest sessions were identical to the pretest sessions described above. As mentioned earlier, the posttest sessions was sequentially introduced to three participants following a varying number of post-criterion performance sessions to allow for an experimental analysis of the effects of the interspersal of ambiguous and standard task materials in the children's regular classroom on observing in the presence of these stimuli.

**Discriminated Social Referencing Training.** Following below-criterion performance on the second posttest session, discrimination training among ambiguous and standard task materials was introduced. The difference between the posttest sessions and discrimination training was the implementation of the correction procedure during ambiguous-stimulus training trials. If the participant did not observe within 5 s of the presentation of an ambiguous training stimulus, the experimenter prompted the observing response by holding up a token to her eyes and saying "Look." Following a prompted

observing response, the ambiguous training stimulus was removed, and a 3 s inter-trial interval began. At the end of the inter-trial interval, the same ambiguous stimulus was presented again. If an independent observing response did not occur, the correction procedure was repeated once or twice until an independent observing response occurred (a third presentation of the correction procedure was never needed during this phase of the experiment for any of the participants).

### Social Validity

A measure of social validity was obtained to ensure that the participants exhibited more appropriate social referencing skills following intervention than prior to intervention. To assess the change in the children's social referencing skills from baseline to treatment, 36 pairs of videotaped interactive episodes (72 trials in all; 9 baseline and 9 treatment trials for each of the four children in the study) were presented to a group of 19 college undergraduate students enrolled in a course in advanced learning theory.

Each pair of trials depicted the identical target response (e.g., drawing a line to connect two dots) with identical stimuli (e.g., a paper bag and jumbo chalk). One of the trials in the pair was selected from the first four baseline sessions; the other trial was selected from last four treatment sessions prior to criterion-level performance. For each pair of trials, the college students were requested to select the trial that contained an observing response.

### Interobserver Agreement

Two experimenters employed at IEA, trained in Applied Behavior Analysis, independently scored the social referencing responses of study participants during

training and probe trials during a minimum of 40% of the baseline and social referencing training sessions. The experimenters also scored the responses of the study participants during training, probe, and standard trials during one of the two pretest session presentations, one of the two posttest session presentations, and during the first and last sessions of discriminated social referencing training. Their measures were analyzed for agreement with the primary experimenter's measures. Interobserver agreement was obtained on the percentage of trials containing an observing response alone and for a combined observing and conditional discriminative response. Interobserver agreement was calculated on a point-by-point basis. The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to obtain the percentage of interobserver agreement for these responses.

As indicated in Table 3, interobserver agreement was consistently 100% during the baseline condition for all trial types and all tasks. The mean percentage of interobserver agreement was maintained at 93% or higher during the social referencing training condition. The mean percentages of interobserver agreement for training trials had a range of 95% to 99%. The mean percentage of interobserver agreement for probe trials had a range of 93% to 97%. The mean percentages of interobserver agreement for the pretest sessions, posttest sessions, and first and last sessions of discriminated social referencing training are shown in Table 4. The mean percentage of interobserver agreement had a range of 87% to 100% throughout these conditions of the study.

To assess the integrity of the independent variable, interobserver agreement was calculated for the accurate presentation of task stimuli, experimenter affect, discrimination training procedures, and reinforcement contingencies. Mean percentages

Table 3

**Mean Percentage of Interobserver Agreement on the Percentage of Trials With an Observing Response Alone (Obs) and With a Combined Observing and Conditional Discriminative Response (Obs + CD) During Training and Probe Trial Types (TT) in the Baseline (Bl) and Treatment (Tr) Conditions for the Handwriting, Language-Master Imitation, and Video Imitation Tasks. Ranges (r) are indicated below each mean.**

		Handwriting		Language Master Imitation		Video Imitation	
<u>Cond</u>	<u>TT</u>	<u>Obs</u>	<u>Obs+CD</u>	<u>Obs</u>	<u>Obs+CD</u>	<u>Obs</u>	<u>Obs + CD</u>
Bl	Train	100	100	100	100	100	100
	Probe	100	100	100	100	100	100
Tr	Train	99	95	99	96	97	96
	r=	91-100	86-100	96-100	84-99	89-99	87-99
	Probe	95	97	96	94	96	93
	r=	84-100	87-100	81-99	83-98	87-99	86-99

**Table 4**

**Percentage of Interobserver Agreement on the Percentage of Trials with an Observing Response During Training, Probe, and Standard trials During the Pretest, Posttest, and First and Last Additional Discriminative Training Sessions for the Handwriting, Language-Master Imitation, and Video Imitation Tasks.**

		<b>Handwriting</b>	<b>Language Master Imitation</b>	<b>Video Imitation</b>
<b><u>Condition</u></b>	<b><u>TT</u></b>			
<b>Pretest</b>	<b>Train</b>	100	100	100
	<b>Probe</b>	100	100	100
	<b>Standard</b>	100	100	100
<b>Posttest</b>	<b>Train</b>	89	99	98
	<b>Probe</b>	95	95	97
	<b>Standard</b>	98	97	94
<b>First</b>	<b>Train</b>	99	97	98
	<b>Probe</b>	97	87	96
	<b>Standard</b>	96	98	97
<b>Last</b>	<b>Train</b>	100	98	96
	<b>Probe</b>	95	98	99
	<b>Standard</b>	100	100	100

of interobserver agreement on accuracy of presentation of treatment components are presented in Tables 5 and 6. With the exception of the probe trials during the handwriting task, the mean percentage of interobserver agreement for accuracy of presentation of task materials and affective stimuli was 100% for all trial types and tasks. Accurate presentation of the correction procedure and reinforcement occurred during 99-100% of all training trials. Presentation of these teaching procedures occurred on less than 1% of all probe trials.

## Results

Description of the results of this study is divided in to two parts. The first part is an analysis of the data obtained for measures of observing, social referencing and trials-to-criterion concerning performance during social referencing training. The second part is an analysis of observing alone during the pretest sessions, posttest sessions, post-criterion performance, and discriminated social referencing training. The individual results for each participant are graphically presented in Figures 1-13. For each figure, the dashed vertical line indicates the point at which treatment was introduced for each task. The closed circles represent the data obtained for performance during training trials under conditions of discrimination training. The open circles represent the data obtained for performance during probe trials under conditions of extinction.

### Performances During Social Referencing Training

Analysis of Combined Observing and Conditional Discriminative Responding. The percentage of observing and conditional discriminative responding, during baseline and treatment phases, for the four participants, are graphically presented in Figures 1 through 4. For all four subjects, there was a systematic increase in the percentage of trials that

Table 5

**Mean Percentage of Training and Probe Trials During Which the Experimenter Presented Correct Task Materials (Mat) and Affective Stimuli (Affect) in the Baseline and Treatment Conditions for the Handwriting, Language-Master Imitation, and Video Imitation Tasks.**

Condition	TT	Handwriting		Language Master Imitation		Video Imitation	
		Mat	Affect	Mat	Affect	Mat	Affect
Baseline	Train	100	100	100	100	100	100
	Probe	99	100	100	100	100	100
Treatment	Train	100	100	100	100	100	100
	Probe	100	100	100	100	100	100

**Table 6**

**Mean Percentage of Training and Probe Trials During Which the Experimenter Presented a Correction Procedure (CP) or Reinforcement (SR) in the Baseline and Treatment Conditions for the Handwriting, Language Master Imitation, and Video Imitation Tasks.**

Condition	TT	Handwriting		Language Master Imitation		Video Imitation	
		CP	SR	CP	SR	CP	SR
Baseline	Tr	99	100	100	100	100	100
	Pb	0	0	0	0	>1	0
Treatment	Tr	100	100	100	100	100	100
	Pb	0	0	0	0	0	0

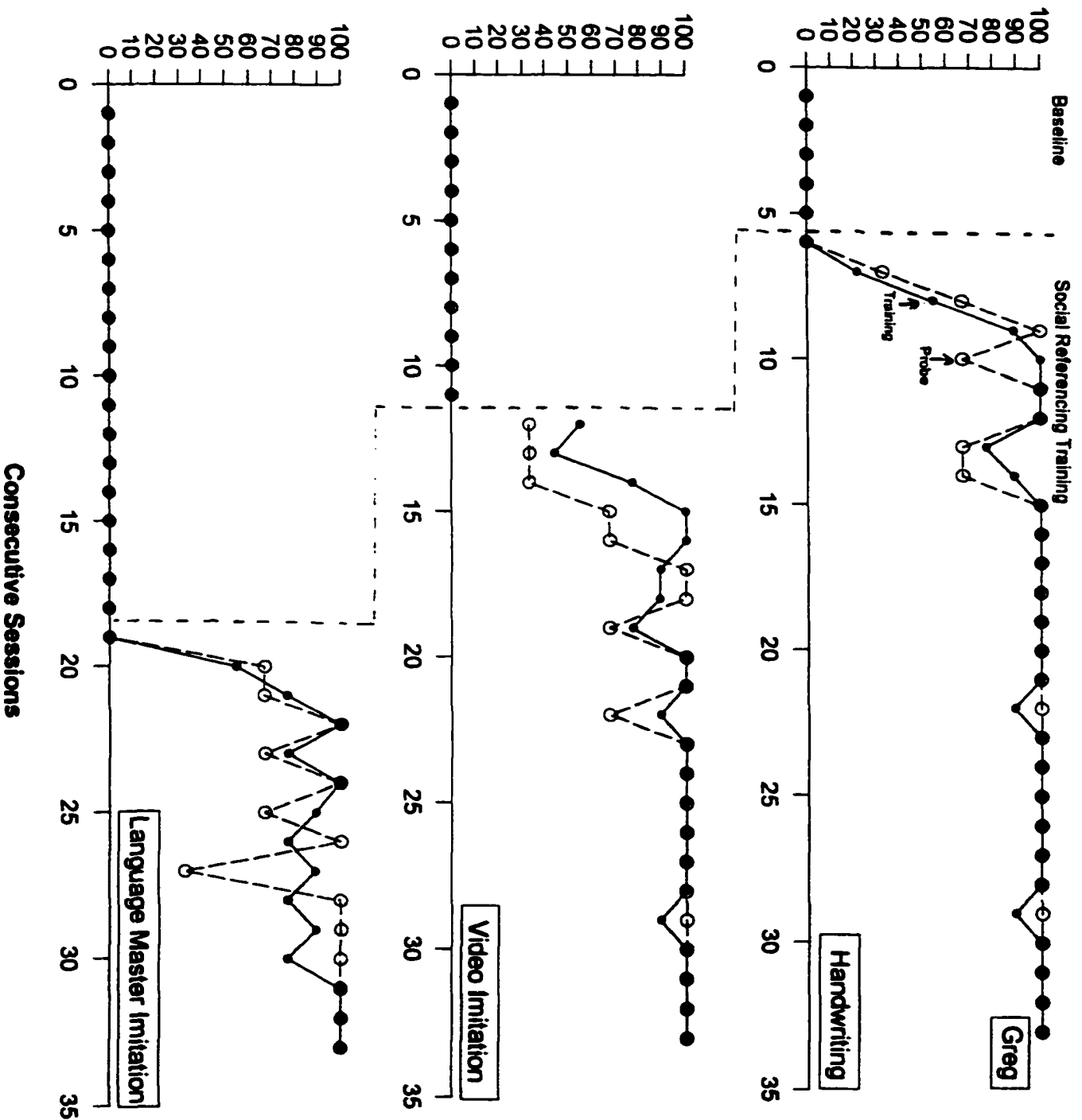
occasioned an observing and conditional discriminative response with the introduction of social-referencing training. A description of this function will be provided first for Greg, and then a more summarized description is provided for Paul, Ken and Iris.

For Greg, the percentage of training and probe trials during which he produced an observing and conditional discriminative response is presented by session in Figure 1 across three tasks. During the baseline conditions for all three tasks, the percentage of trials containing an observing and conditional discriminative response was 0% throughout all sessions. With the successive introduction of social referencing training across the three tasks, systematic increases in observing and conditional discriminative responding during both training and probe trials were observed. The increases in the percentage of trials containing an observing and a conditional discriminative response were observed only in the task under treatment.

With regard to the handwriting task shown in the top graph in Figure 1, the percentage of trials during which Greg exhibited observing and conditional discriminative responding systematically increased from 0% during baseline to 100% during the sixth treatment session. Responding during probe trials systematically increased to 100% within six treatment sessions. Similar increases in observing and conditional discriminative responding occurred in the video imitation, and Language-Master imitation tasks. That is, the percentage of training trials during which Greg produced an observing and a conditional discriminative response increased from an average of 0% during baseline to 100% by the fourth treatment session, for the both the video-imitation and Language-Master-imitation task. Similar increases were seen for the probe trials. The percentage of probe trials during which Greg produced an observing and a

**Figure 1. Percentage of training and probe trials during which Greg produced an observing response and a conditional discrimination.**

**Percentage of Trials with an Observing Response and a Conditional Discrimination**



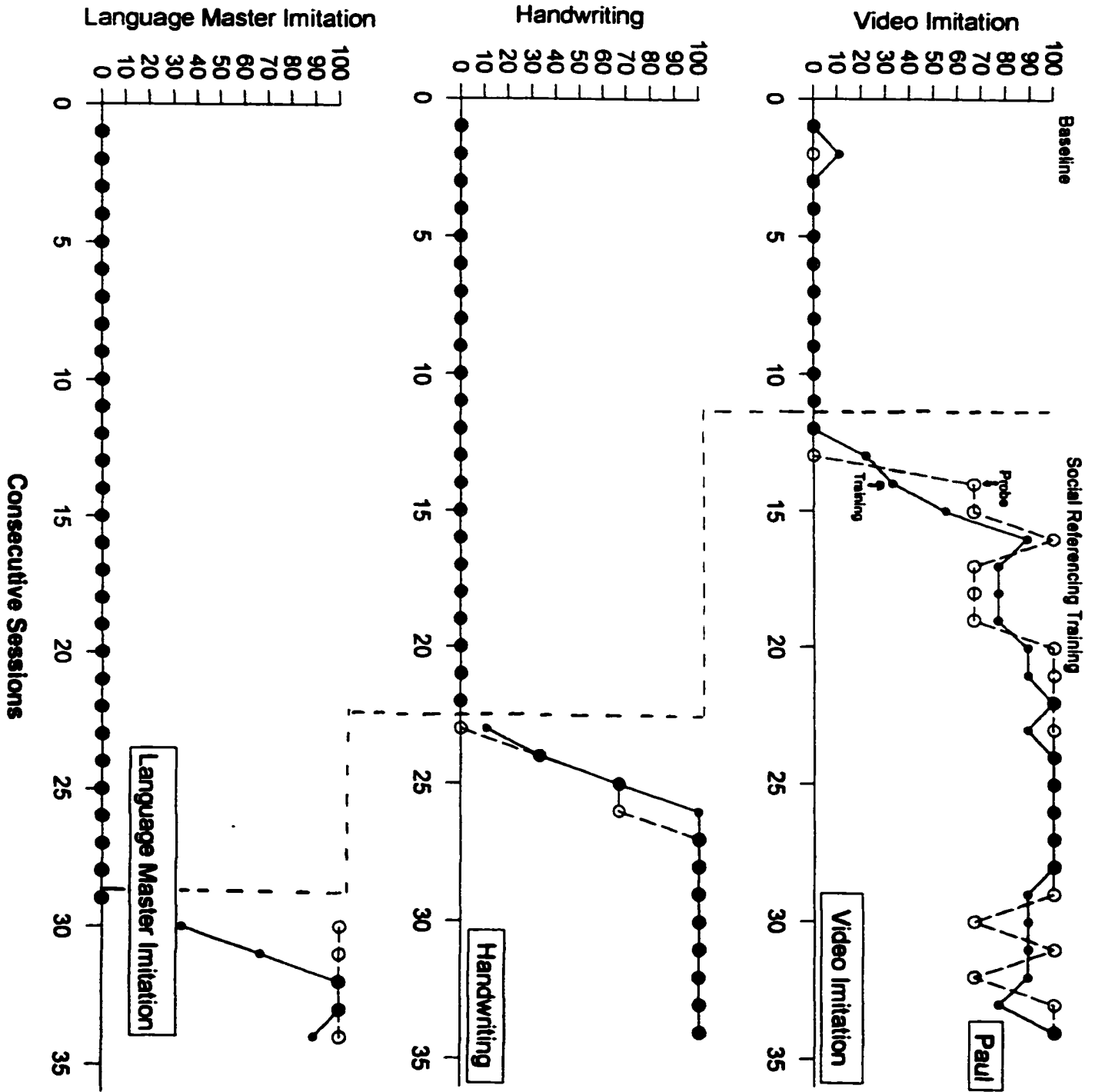
conditional discriminative response increased from 0% during baseline to 100% during the second and third sessions of treatment, for the video-imitation and Language-Master-imitation task, respectively. In this study, the mastery criterion was defined as the production of an observing and conditional discriminative response during a minimum of 89% of training trials for three consecutive sessions. Greg achieved the mastery criterion within 16 sessions for the handwriting task, and within six sessions for both the video imitation and Language-Master Imitation tasks. In all task types, once responding reached criterion level, very little variability in the accuracy of responding was observed.

These stimulus functions were replicated with three additional children. These data are shown for Paul, Ken and Iris, in figures 2-4, respectively. For Paul, Ken, and Iris, zero or low stable rates of observing and conditional discriminative responding were observed for all three tasks during baseline. With the successive introduction of treatment across each task, systematic increases in the percentage of training and probe trials containing an observing response and a conditional discrimination occurred. These increases occurred only in the task under treatment.

**Procedural Validity.** A main component of the social referencing training package was a correction procedure, described in the procedure section above. The number of presentations of the correction procedure per session across sessions, for each participant during the three tasks, is graphically depicted in Figures 5-8. This measure was collected with the expectation that during social referencing training the need for the correction procedure would decrease across sessions. As the data indicate, the correction procedure was not presented during baseline sessions. Implementation of the correction procedure began during the first treatment session. As the data indicate, a general decrease in the

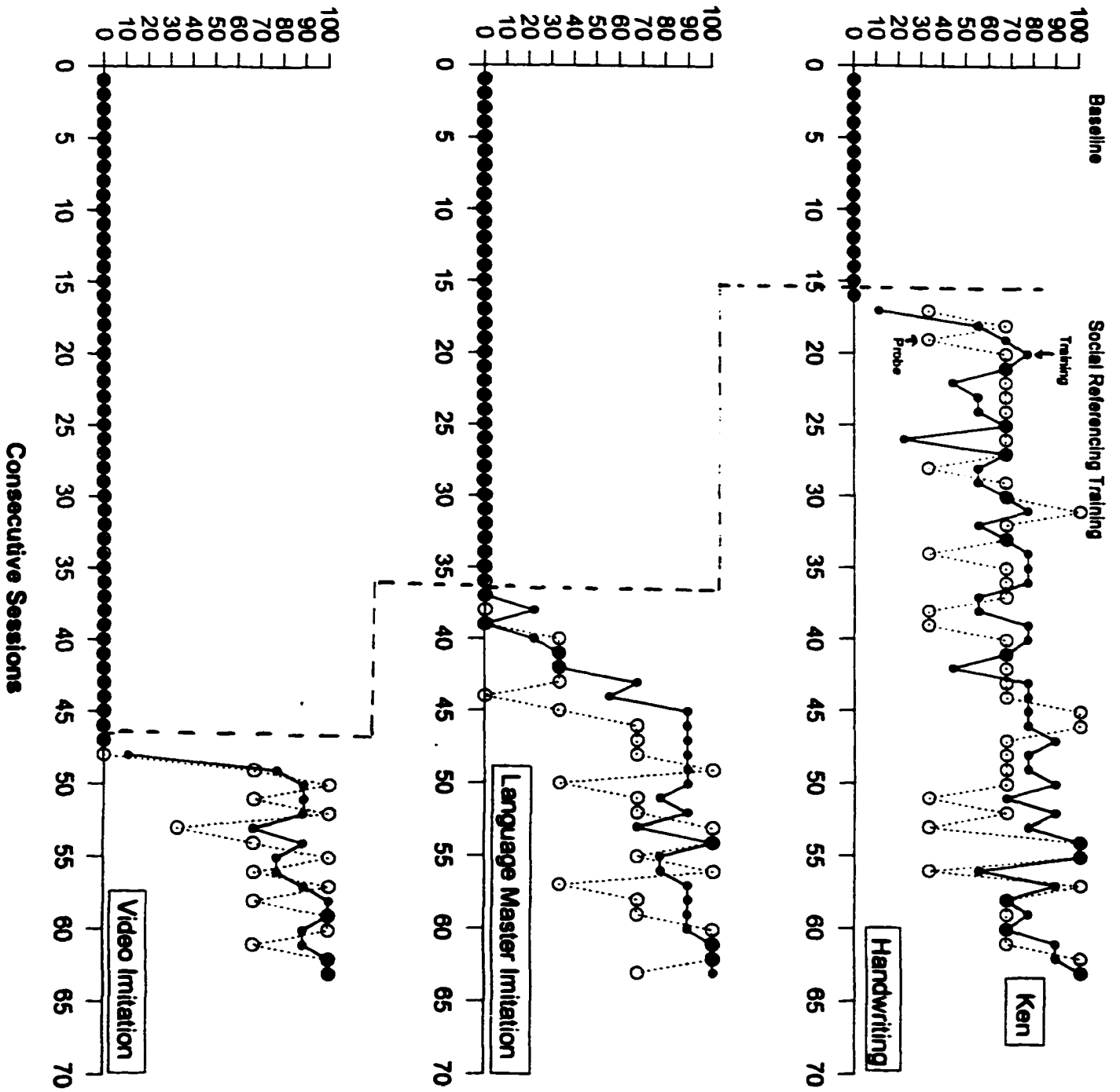
**Figure 2. Percentage of training and probe trials during which Paul produced an observing response and a conditional discrimination.**

Percentage of Trials with an Observing Response and a Conditional Discrimination



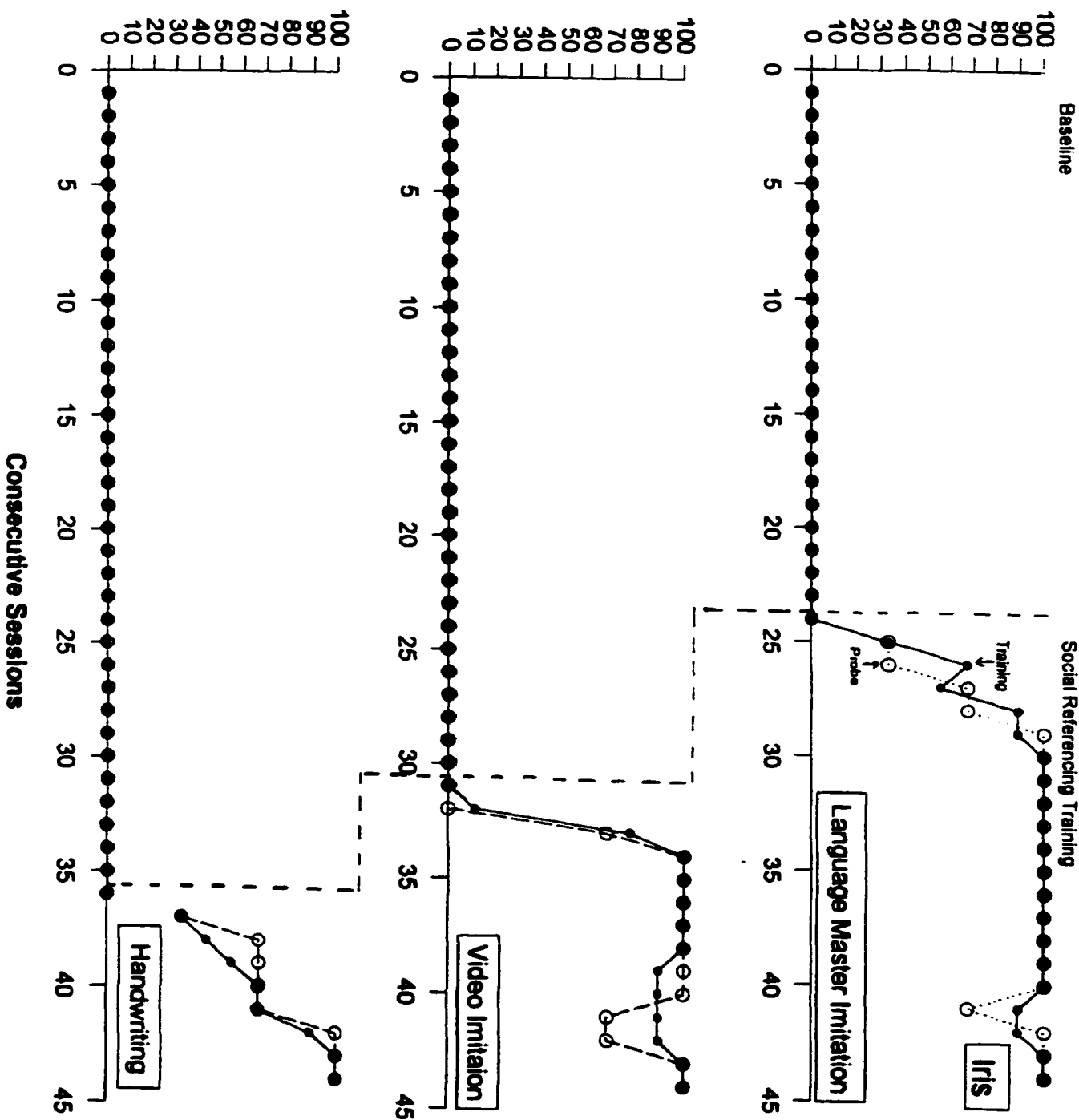
**Figure 3. Percentage of training and probe trials during which Ken produced an observing response and a conditional discrimination.**

Percentage of Trials with an Observing Response and a Conditional Discrimination



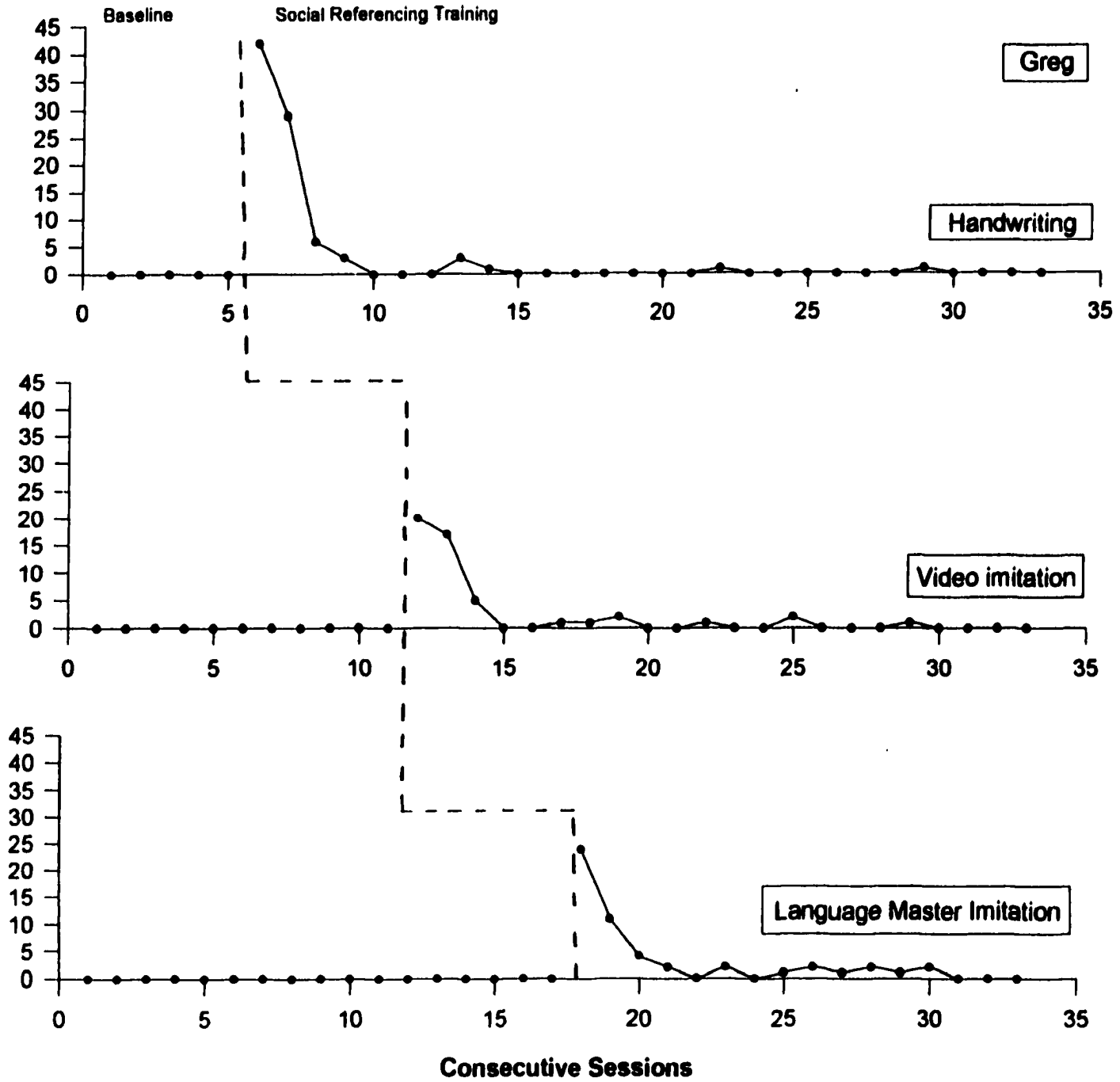
**Figure 4. Percentage of training and probe trials during which Iris produced an observing response and a conditional discrimination.**

Percentage of Trials with an Observing Response and a Conditional Discrimination



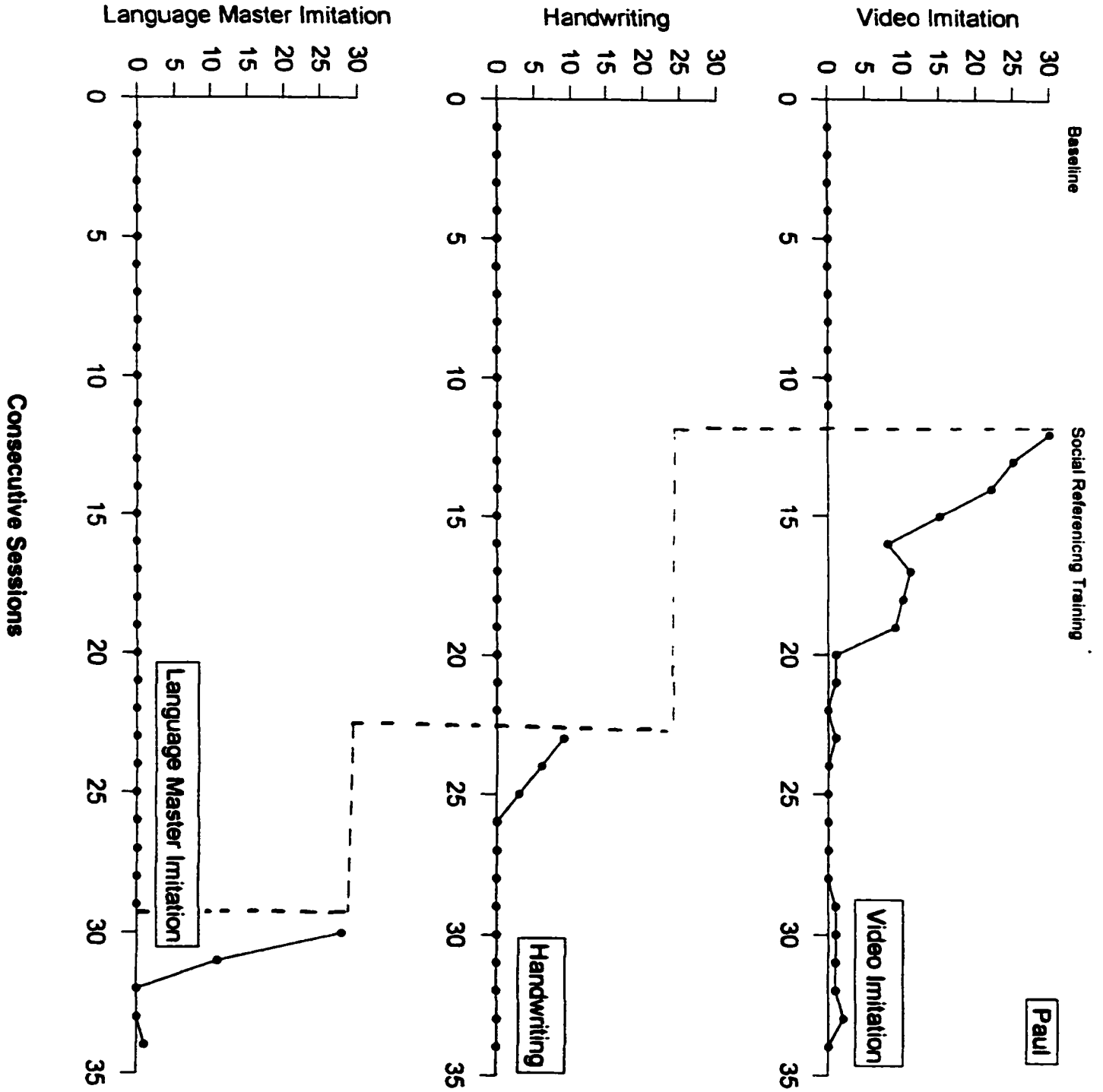
**Figure 5. Number of trials during which Greg was presented with a correction procedure.**

Number of Trials With a Correction Procedure



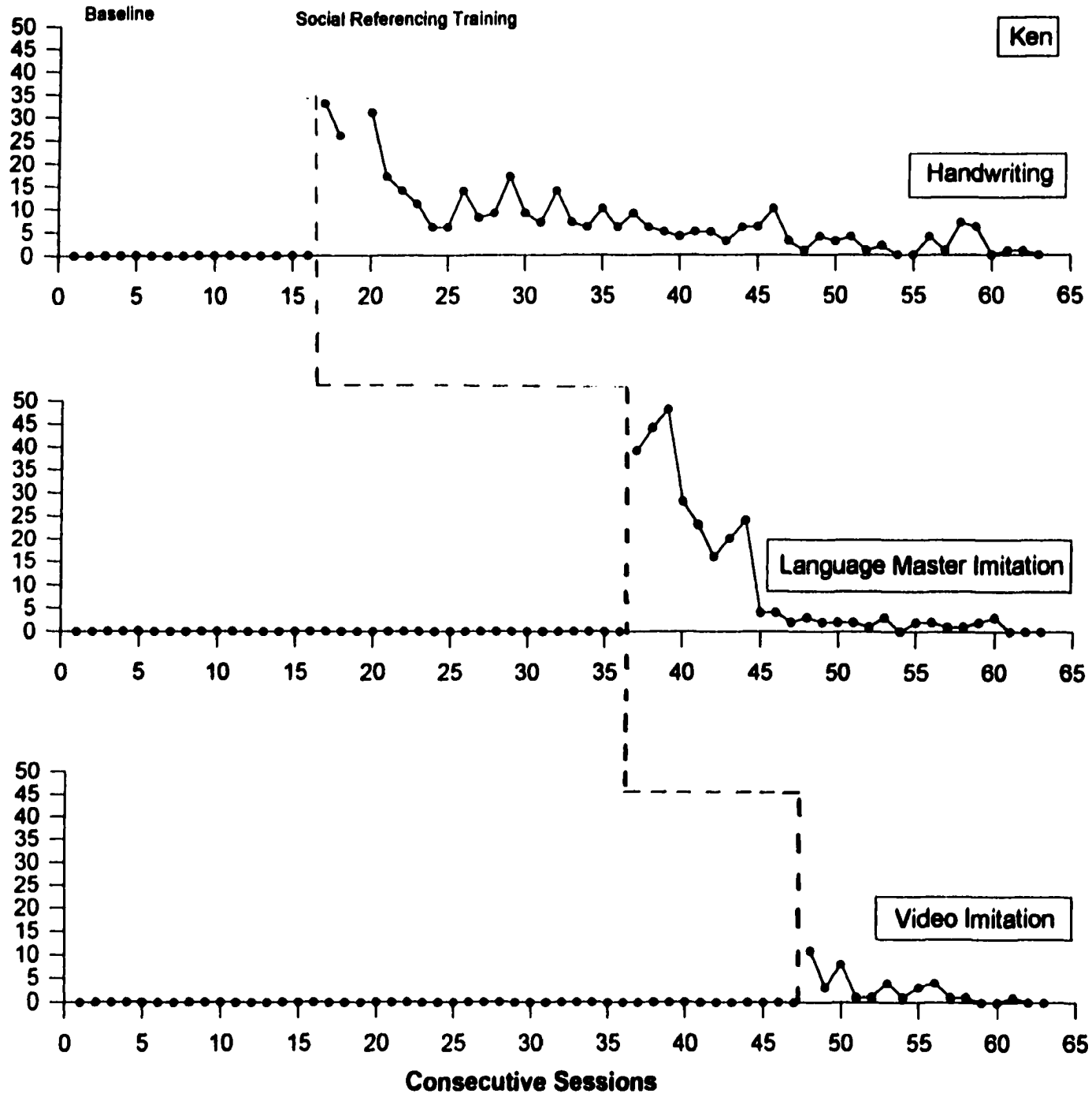
**Figure 6. Number of trials during which Paul was presented with a correction procedure.**

### Number of Trials With a Correction Procedure

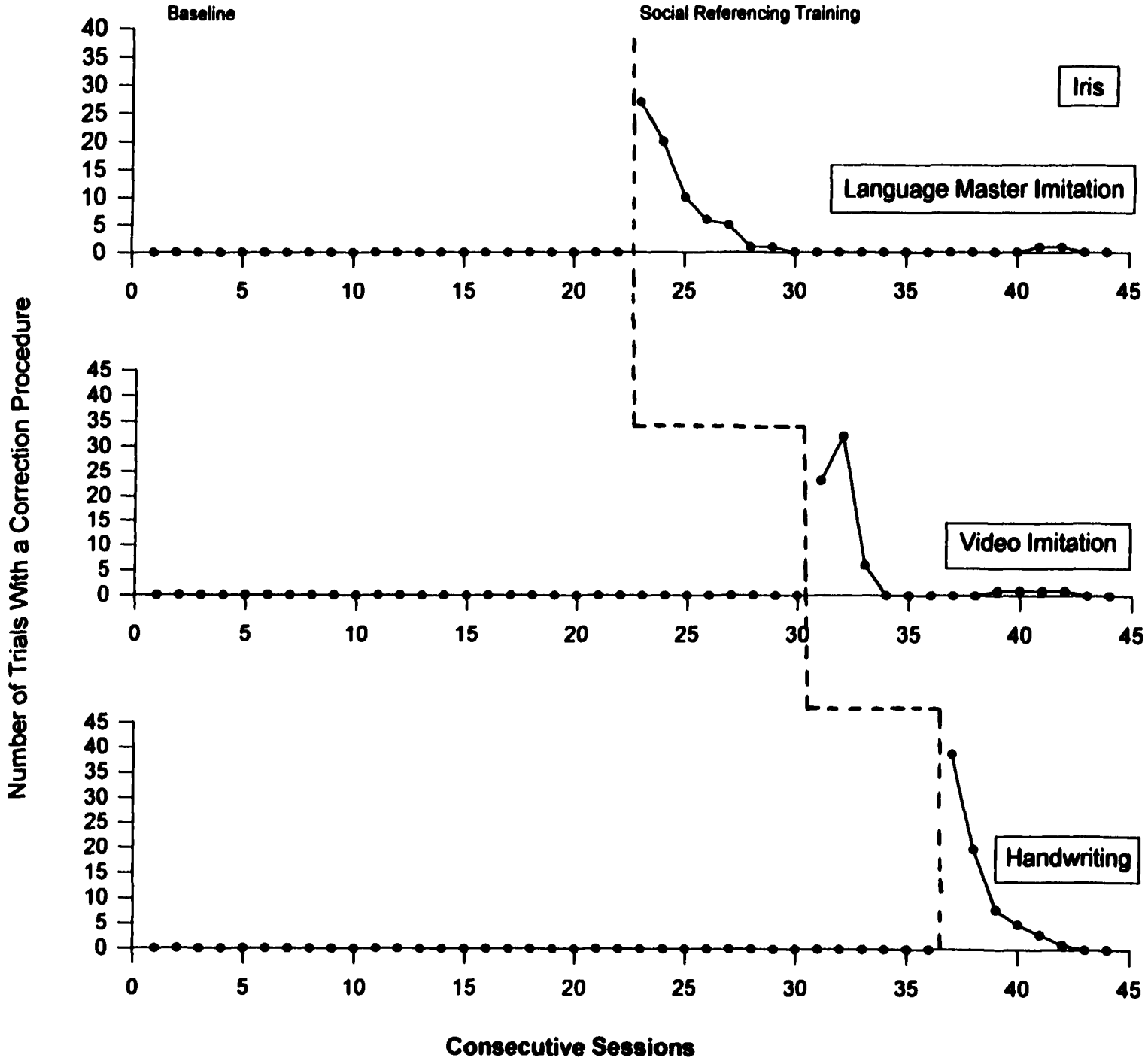


**Figure 7. Number of trials during which Ken was presented with a correction procedure.**

Number of Trials With a Correction Procedure



**Figure 8. Number of trials during which Iris was presented with a correction procedure.**



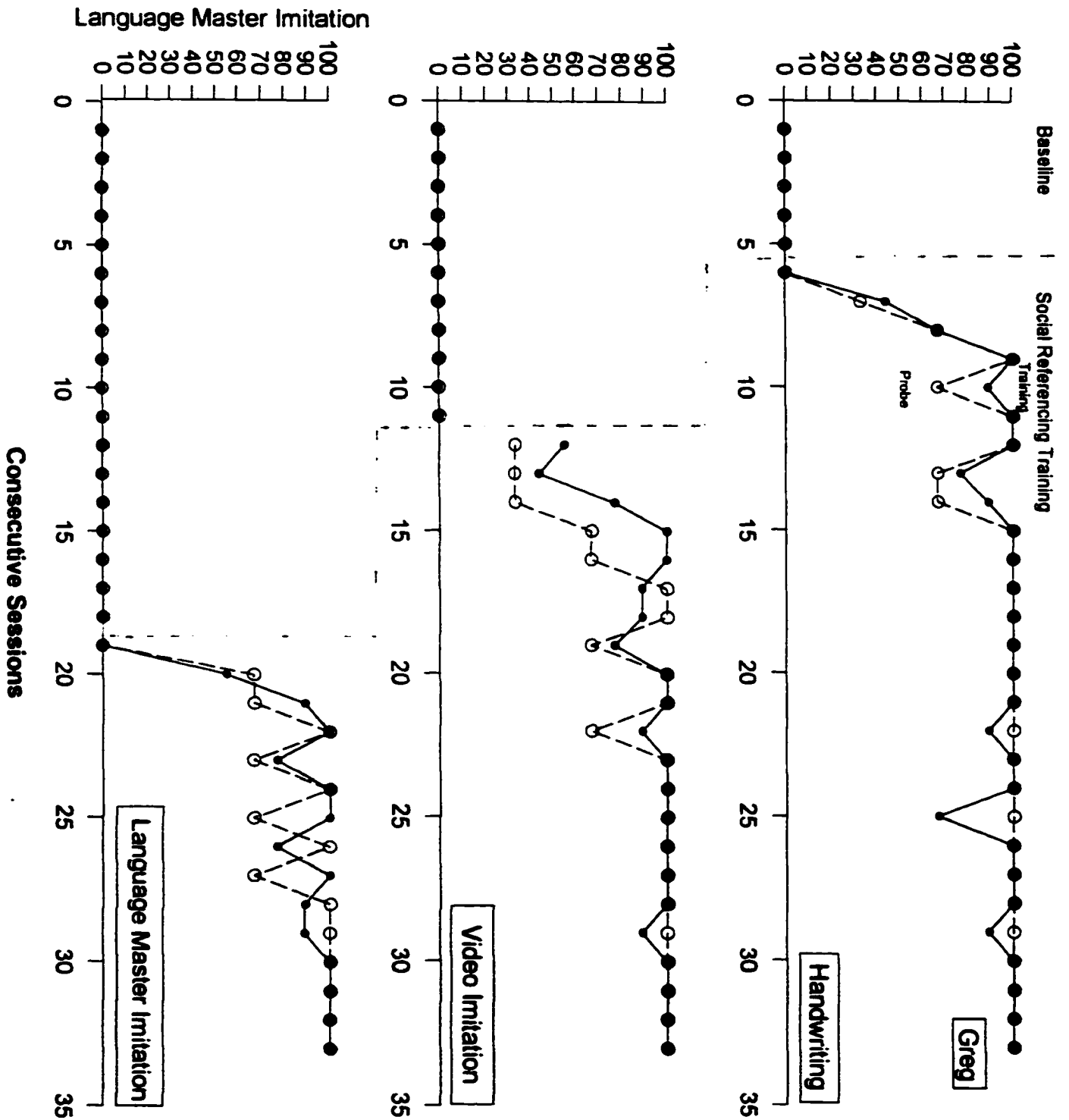
number of presentations of the correction procedure across treatment sessions was found for all four subjects across all three tasks. This finding supports the procedural validity of the teaching procedures used in this study.

Analysis of Observing Alone. Because social referencing at minimum involves a chain of responses initiated by an observing response and ending with a conditional discrimination, the data above were based on measures of the combination of these two responses. It would be important, however, to examine the effects of training on each of these two responses separately to determine the extent to which each of these responses was affected by the treatment procedures. This section is an analysis of the observing response alone, apart from the conditional discrimination. No separate analysis of the conditional discrimination alone was presented because the conditional discrimination was dependent on the observing response; by definition, it could only occur following the observing response. To assess the occurrence of the observing response alone, the percentage of trials containing an observing response was calculated across baseline and treatment phases. These data are depicted for each participant across the three tasks in Figures 9-12.

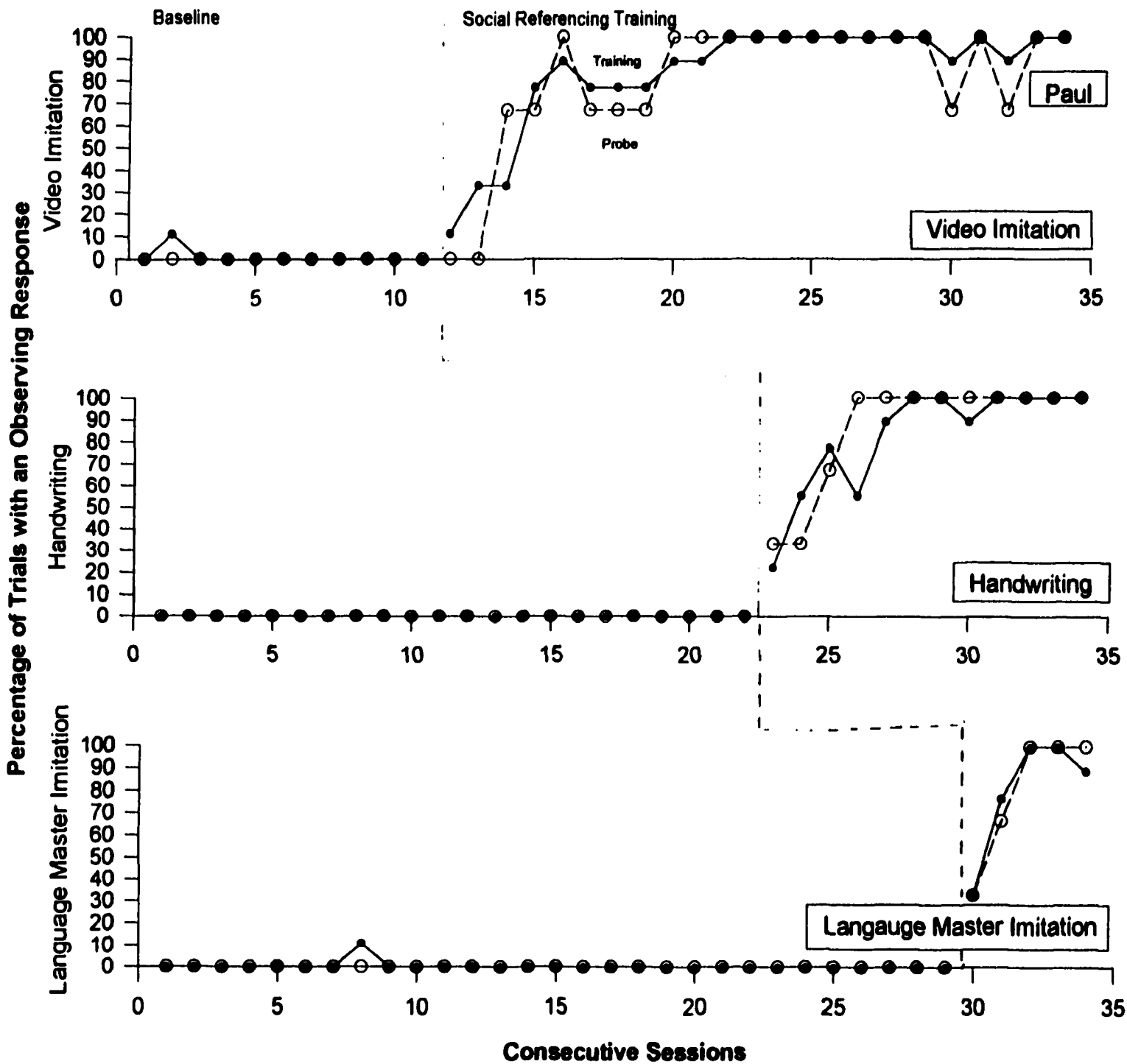
As the data indicate, during baseline, Greg, Ken and Iris emitted no observing responses. Paul, however, emitted one observing response in Session 2 during the video imitation task and one observing response during the Language Master imitation task in Session 8 during baseline. During social referencing training, the percentage of trials during which Greg exhibited an observing response systematically increased from 0% during baseline to 100% during the fourth session of treatment. An almost identical increase was seen for observing during probe trials. Similar increases in observing

**Figure 9. Percentage of training and probe trials during which Greg produced an observing response.**

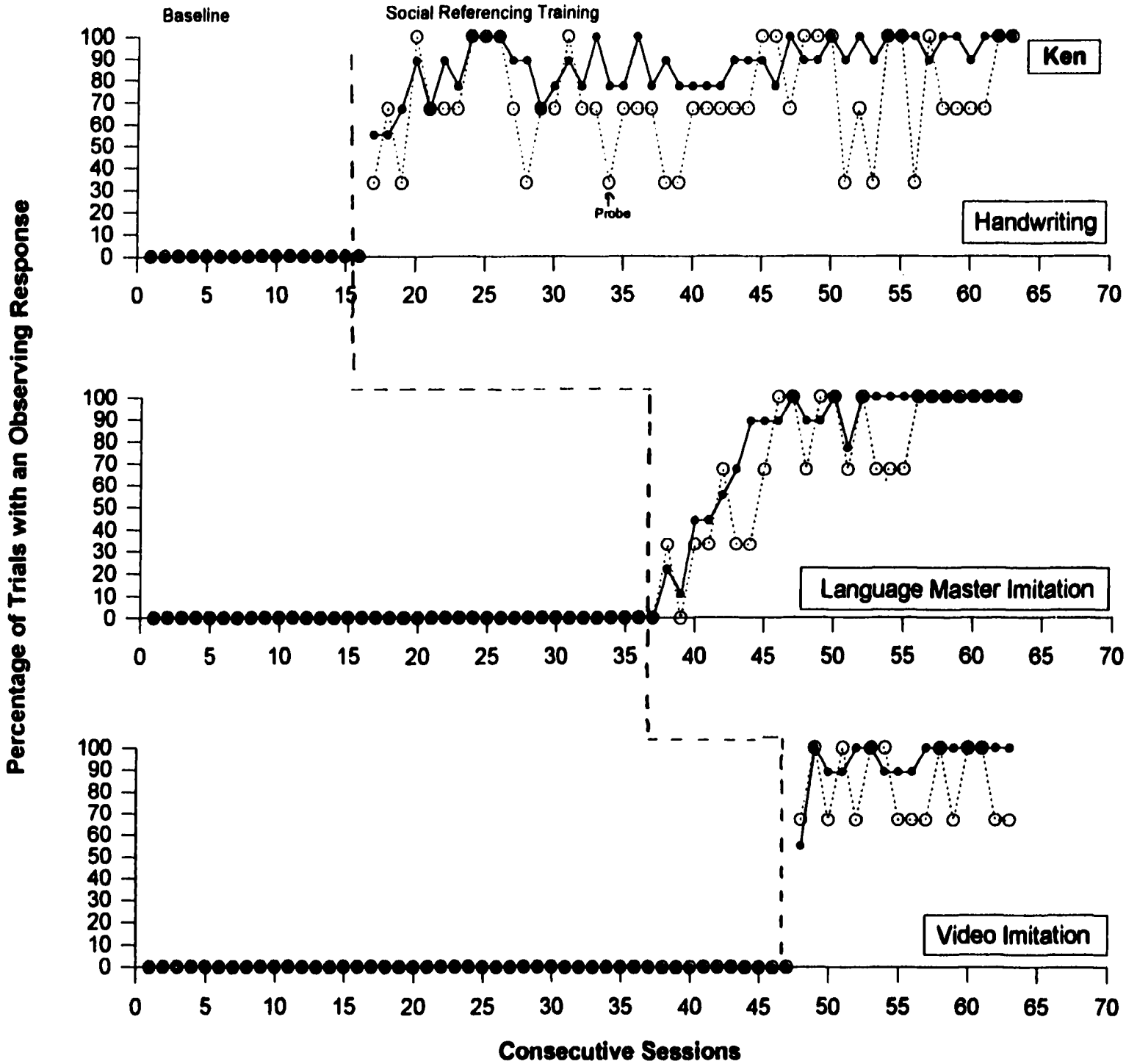
Percentage of Trials with an Observing Response



**Figure 10. Percentage of training and probe trials during which Paul produced an observing response.**

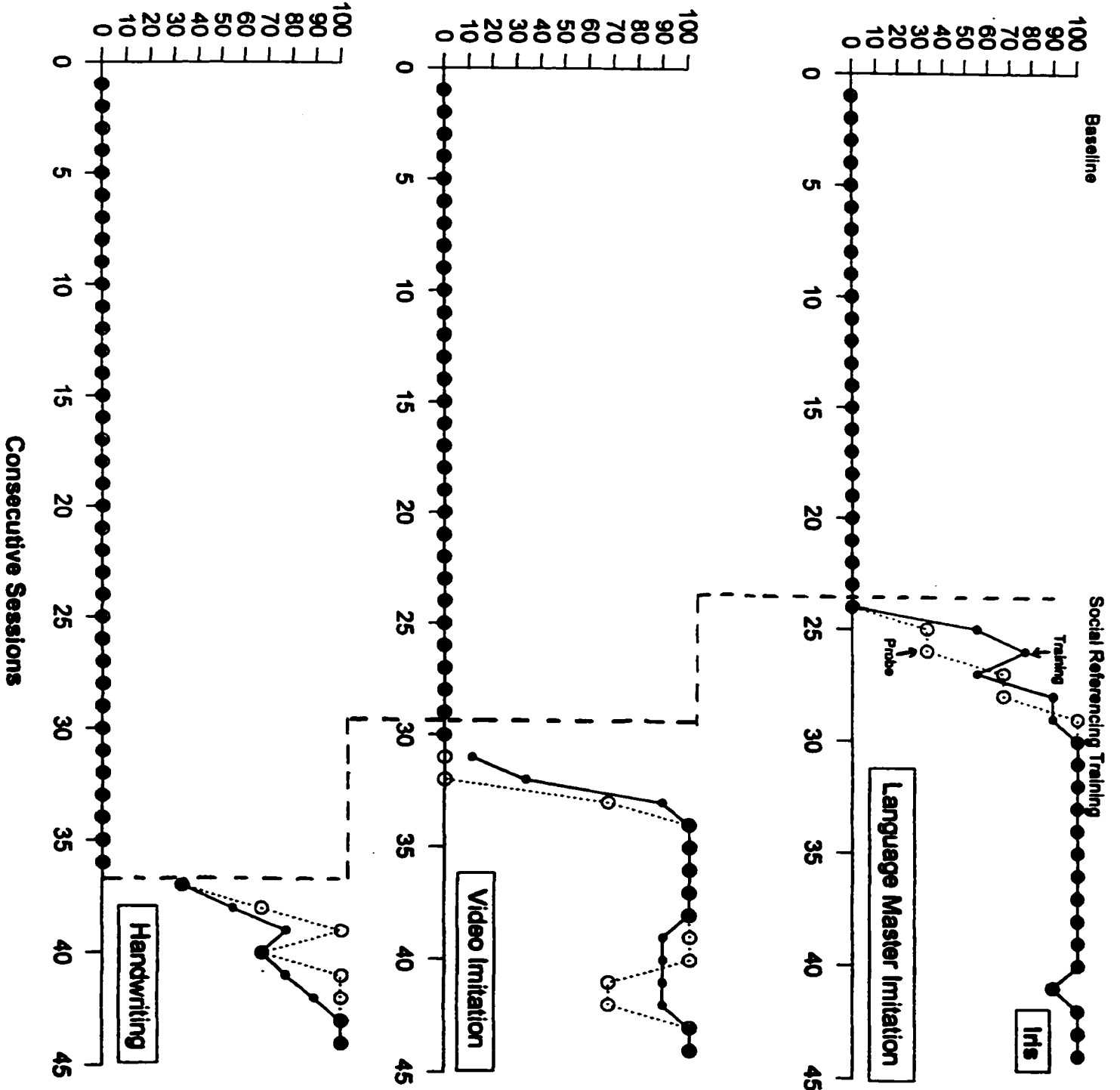


**Figure 11. Percentage of training and probe trials during which Ken produced an observing response.**



**Figure 12. Percentage of training and probe trials during which Iris produced an observing response.**

Percentage of Trials with an Observing Response



during training and probe trials were observed with the successive introduction of treatment during the video imitation and Language-Master imitation tasks. Paul, Ken, and Iris also showed systematic increases in the percentage of observing responses with the introduction of treatment. The percentage of trials with an observing response increased from 0% during the majority of baseline sessions to 100% during the last three treatment sessions for all four participants. In addition, the percentage of observing responses during probe trials increased from 0% during baseline to 100% during the last three sessions of treatment for all four participants.

### Discriminated Social Referencing

As noted in the introduction of this paper, one objective of this study was to teach a social referencing response chain. An observing response was trained to occur in the presence the ambiguous stimuli followed by a conditional discrimination of experimenter affective stimuli. The second objective of this study was to establish social referencing as a discriminated response chain that would be occasioned by the trained ambiguous stimuli, and not by ordinary and familiar stimuli (i.e., standard stimuli). To this end, pretest sessions and posttest sessions, during which ambiguous stimuli were interspersed among standard stimuli in the children's regular classroom, were conducted to assess the extent to which the participants would discriminate among these two sets of stimuli by displaying social referencing in the presence of the former and not the latter. Posttest sessions were introduced across participants in a multiple-baseline-across-subjects design to determine the effect of the interspersal of the ambiguous and the standard stimuli on social referencing in the presence of these stimuli. In the event that additional social

referencing training was needed, this training would be introduced across tasks simultaneously. For this reason, the data were collapsed across tasks.

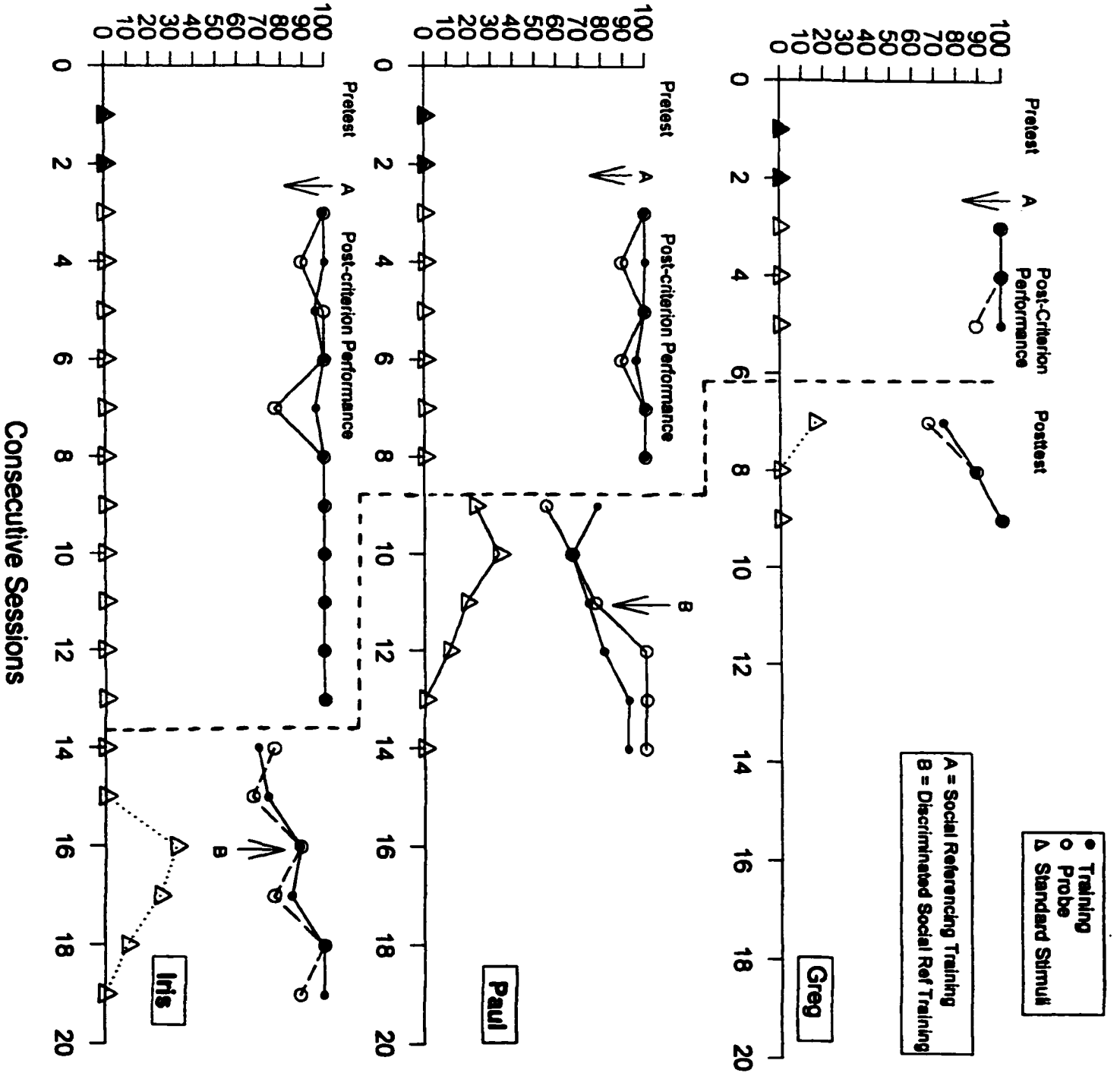
Analysis of Social Referencing During the Pretest sessions, Post-Criterion Performance, Posttest sessions, and Discriminated Social Referencing Training. During the pretest sessions and posttest sessions, the ambiguous training and probe trials were interspersed among standard trials during the children's academic tasks, conducted in the children's regular classroom. The percentage of training, probe, and standard trials during which Greg, Paul and Iris produced an observing response in the pretest sessions and posttest sessions is shown in Figure 13. Due to the extended amount of time required for Ken to acquire the social referencing chain, time constraints of the study did not permit him to participate did not participate in this phase of the experiment, because it took The percentage of trials with an observing response is collapsed across tasks.

During the two pretest sessions, all three children exhibited an observing response during 0% of the training, probe and, standard trials. Following achievement of the mastery criterion during ambiguous-stimulus training and prior to presenting the posttest sessions, post criterion performances during presentations of the ambiguous stimuli alone and the standard stimuli alone were established to serve as a baseline for comparison with performance during interspersed presentations of the ambiguous and standard stimuli, should discrimination training of these two groups of stimuli be needed. Greg, Paul, and Iris maintained criterion level performance during sessions with ambiguous stimuli only, and never observed during sessions with standard stimuli only.

The presentation of posttest sessions was staggered across participants to determine whether their introduction would cause changes in responding during ambiguous- and

**Figure 13. Percentage of trials with an observing response during pretest, post-criterion performance, posttest, and discriminated social referencing conditions for Greg, Paul and Iris.**

Percentage of Trials with an Observing Response



standard-stimulus trials. During the first posttest session, social-referencing performance fell below the mastery criterion for all three children. Greg demonstrated an observing response on 70% of training trials and 67% of probe trials. Paul exhibited an observing response on 78% of training trials and 55% of probe trials. Iris exhibited an observing response on 70% of experimental training trials and 77% of probe trials. In addition, two of the three children exhibited increases in observing during standard trials. Greg observed on 16% of standard trials. Paul exhibited an observing response on 23% of standard trials.

For Greg, responding during the second posttest session returned to mastery-criterion level. During this session, Greg observed on 89% and 100% of training and probe trials, respectively. In addition, Greg exhibited an observing response on 0% of the standard trials. Because Greg discriminated between the ambiguous task materials and the standard task materials, exhibiting social referencing in the presence of the former, and not in the presence of the latter, additional social referencing training was not introduced. To ensure that responding during presentations of interspersed ambiguous and standard trials would be maintained at criterion level, a third posttest session was presented. Once again, Greg performed at the mastery-criterion level, observing on 89% and 100% of training and probe trials, respectively, and on 0% of the standard trials.

For Paul and Iris, discriminated social referencing training was presented to return their performance to mastery-criterion level. For each of these children, treatment was introduced following two posttest sessions of below-criterion-level performance. Discriminated social referencing training consisted of mixed presentations of standard and ambiguous-stimulus trials according to the ratio described above. During standard-

stimulus trials, if the participant exhibited an observing response, he/she was manually or verbally prompted back to task. If an observing response did not occur during an ambiguous-stimulus trial, the experimenter prompted the participant to look at her by saying "Look" and holding up a penny. The task materials were removed and then presented again until an independent observing response was exhibited. The participants correctly discriminated the experimenter affective discriminative stimuli; thus discrimination training of the affective discriminative stimuli was not presented. Four sessions of discrimination training among standard and ambiguous stimuli were conducted for each of these two participants to return performance to the mastery-criterion level for each of the children.

Paul continued to exhibit below-mastery- criterion-level performance on the training and probe trials during the second posttest sessions. He observed during 67% of the training trials and during 67% of the probe trials. In addition, his rate of observing during standard trials increased to 34%. During the first session of discriminated social referencing training, observing during training and probe trials increased to 74% and 77%, respectively. Observing during standard trials decreased to 19%. In the last two sessions of training, performance returned to mastery-criterion level (92% during training trials and 100% during probe trials for both sessions). Observing during standard trials decreased to 0% during these two sessions.

For Iris, during the first session of discriminated social referencing training, the percentage of training and probe trials with an observing response increased to 89%. Observing during standard trials, however, increased to 32%. In the last two sessions of training, observing returned to mastery-criterion level: 100% for training trials, and 100%

and 89% during probe trials, for the third and fourth sessions, respectively). Observing during standard trials decreased to 10% during the third session of training, and to 0% in the fourth session.

### Social Validity

To assess whether changes in observing during baseline and during treatment were socially significant, the percentage of treatment trials that were scored by the participating college students as containing an observing response was calculated. It was found that 98.5% of all treatment trials were scored as containing an observing response; only 1.5% of all baseline trials were scored as containing an observing response.

### Discussion

The four children with autism who participated in this study exhibited deficits in social referencing skills. That is, the children rarely, if ever, observed for social discriminative stimuli during unfamiliar or ambiguous situations by looking toward familiar others, and responding discriminately as a function of the affective display of these others. In this study, acquisition of social referencing was a two-step process. During social referencing training, ambiguous task materials alone were presented, and a response chain comprised of two component responses was taught: observing in the presence of ambiguous task stimuli, and conditional discrimination of two affective stimulus configurations, comprised of one of two facial expressions (smile or frown) and one of two gestures (a head nod or head shake). With the implementation of this discrimination training treatment package, the children learned to observe in the presence of the ambiguous task materials, and to respond discriminately to the experimenter affective stimuli. During the social referencing training condition, observing and

conditional discriminative responding were verbally, visually and manually prompted by the experimenter until independent observing occurred in the presence of the ambiguous task materials, and independent conditional discriminative responding occurred in the presence of the experimenter affective stimuli. Independent responses were then immediately followed by the delivery of verbal and tangible reinforcers. The arrangement of contingencies between the discriminative stimuli (i.e., the ambiguous task materials and the experimenter affective stimuli) used in the study and reinforcement was intended to produce the exertion of stimulus control by these discriminative stimuli over observing and conditional discriminative responding. For all four participants across all three tasks, increases in the number of discriminative-stimulus presentations that occasioned observing and conditional discriminative responding occurred systematically following the introduction of the discrimination training procedures described above. That is, for each of the participants, these increases in responding occurred systematically following the introduction of treatment, for the task under treatment, and for no other task. This finding demonstrates a functional relation between the treatment procedures used and observing and conditional discriminative responding. Acquisition of the social referencing chain was, thus, the direct result of the treatment procedures used in the study.

#### Procedural Validity as Measured by Number of Trials With a Correction Procedure

The trends in the data describing the number of trials with a correction procedure across sessions are consistent with the demonstrated functional analysis between the treatment procedures and social referencing. With little exception, during the treatment condition, there was a decrease in the number of trials with a correction procedure across

sessions, prior to criterion-level performance. The need for fewer presentations of the correction procedure across treatment sessions demonstrates the effectiveness of the correction procedure in increasing the probability of the occurrence of a correct response. Overall, three of the four participants acquired the social referencing chain within 16 treatment sessions. Ken, however, required many more sessions to achieve criterion-level performance during the handwriting task. This finding is suggestive of differences in the learning histories of the participants in the study, described in the section below that discusses acquisition of observing alone.

#### Social Referencing as an Operant Response Chain

The results of this study suggest that children with autism can learn the component responses that comprise a social referencing chain. It would appear, then, that social referencing is an operant response chain that is sensitive to antecedent stimuli and consequences (Skinner, 1957). This demonstration of congruity between operant procedures and social referencing supports an operant account of social referencing (Gewirtz et al., 1990). The re-conceptualization of social referencing using an operant-learning paradigm allows for the development of specific teaching strategies to remediate the deficit observed in social referencing among children with autism, rather than regarding this deficit as an untreatable symptom predicted by the diagnosis of autism.

#### Generalization of Social Referencing

Observing and conditional discriminative responding occurred not only in the presence of the training stimuli, but also in the presence of experimental probe stimuli. Multiple exemplars of task materials were used in the handwriting, Language Master imitation and video imitation tasks. These exemplars all had several features in common. The

handwriting task involved a writing utensil and a paper surface. The Language Master stimuli all included a recorded verbal model of a familiar word. The video models included a gross-motor response that was part of the children's imitative repertoire. During treatment, reinforcement was delivered when an independent observing response was emitted in the presence of 27 pre-selected task stimuli (i.e., the training stimuli). Verbal and visual prompts were delivered in the presence of these stimuli to evoke an observing response when it was not produced. The children learned that reinforcement followed observing in the presence of these stimuli; hence, these stimuli set the occasion for the reinforcement of observing. The experimenter did not prompt to evoke an observing response, or reinforce an independent observing response, in the presence of the nine probe stimuli. The occurrence of an observing response in the presence of the task probe stimuli for three of the four participants suggests that not only did observing come under the control of stimuli that signaled the availability of reinforcement, but also under the control of nine stimuli that physically resembled those training stimuli. In fact, the rate of acquisition of observing and conditional discriminative responding during probe trials was very similar to the rate of acquisition of responding during training trials. This finding indicates that social referencing produced by the study's teaching procedures generalized from the trained stimuli to untrained stimuli (Guttman & Kalish, 1956). Moreover, the demonstration of generalized observing across same-task stimuli, and the discrimination among stimuli of different tasks, is suggestive of the formation of classes across same-task stimuli. Finally, this demonstration of operant stimulus generalization may have been facilitated by the use of multiple training stimuli (Stokes and Baer, 1977).

### Acquisition of Observing

In comparing acquisition of observing alone and acquisition of combined observing and conditional discriminative responding, it is interesting to note the respective rates of acquisition did not differ greatly from each other for three of the four participants. For Greg, Paul and Iris, acquisition of observing alone and acquisition of combined observing and conditional discriminative responding were remarkably similar across all three tasks. This finding suggests that when the children displayed an observing response resulting in the presentation of the experimenter affective discriminative stimulus, the children rarely failed to discriminate between the affective stimuli. It would seem, then, that conditional discrimination of the affective discriminative stimuli was either acquired very rapidly, or perhaps had already existed in these children's response repertoires. These data also suggest that the observing response was actually the more difficult response to acquire. It is conceivable, then, that the deficit in social referencing exhibited by individuals with autism might not be caused by a failure to discriminate affect-related stimuli. Rather, failure to exhibit social referencing may be the result of: a) the absence of discriminative control by ambiguity or uncertainty over observing, and/or b) deficits in observing and responding to social discriminative stimuli.

Unlike the other participants, Ken's rate of acquisition of observing alone and of combined observing conditional discriminative responding differed from each other. This discrepancy was most pronounced in the handwriting task. During the handwriting task, acquisition of observing and conditional discriminative responding required 14 more treatment sessions than acquisition of the observing response alone. It is possible that Ken's learning history differed from the other participants at the start of the study in

that he was less likely to discriminate among the facial expressions and gestures used in the study, prior to the onset of treatment. Thus, initial acquisition of the conditional discriminative response between the two experimenter-affective stimulus configurations required extensive training. The discrepancy in the number of treatment sessions to acquisition of observing alone compared to observing and conditional discriminative responding, decreased during the subsequent two tasks. This may be explained by the fact that the affective stimuli remained constant across tasks. Because handwriting was the first task during which treatment was introduced, it is possible that once Ken learned to discriminate between experimenter affective stimuli, conditional discriminative responding during this first task generalized to subsequent tasks. Specifically it would appear that acquisition of conditional discriminative responding in the handwriting task (i.e., in the presence of S1, write; in the presence of S2, terminate the trial) generalized to the Language-Master imitation task during which S1 occasioned verbal imitation and S2 occasioned trial termination.

#### Social Referencing in the Classroom Setting in the Presence of Standard Tasks Materials

Prior to the baseline condition in this study, pretest sessions including mixed trials of ambiguous and standard stimuli was conducted in the children's regular classrooms. During the two pretest sessions, the children exhibited an observing response on 0% of the ambiguous and standard trials. Following the demonstration of criterion-level performance at the end of social referencing training and post-criterion performance measures, posttest sessions, identical in form to the pretest sessions, were conducted. For all three participants, the percentage of ambiguous trials that occasioned an observing response decreased from the post-criterion performance level (i.e., observing on a

minimum of 89% of ambiguous trials) during the first posttest session. For two of the children, the percentage of standard trials occasioned observing increased during the first posttest session. For Greg, the decrease in social referencing during the ambiguous trials and the increase in observing during the standard trials was temporary. Observing returned to criterion level during the ambiguous trials and decreased to 0% during the standard trials in the second posttest session. For Paul and Iris, however, following below-criterion performance during two consecutive posttest sessions, conditional discrimination training of ambiguous and standard stimuli was introduced to return observing to the mastery-criterion level. Greg, thus, maintained social referencing responding across settings and discriminated between the standard and ambiguous stimuli, observing in the presence of the former and not in the presence of the latter. For Paul and Iris, social referencing was maintained to some extent in the presence of the standard stimuli and in the regular classroom setting, for the first two sessions of maintenance, but not at the mastery-criterion level. At that point, conditional discrimination training of the ambiguous and standard stimulus was introduced to prevent further decline in appropriate observing. A return to criterion-level performance required four training sessions both Greg and Iris.

#### Suggestions for Future Research

In this study, the ambiguous stimuli were presented in isolation until social referencing was reliably emitted in their presence. Only following criterion-level performance of the social referencing response chain, were the ambiguous stimuli interspersed among the standard stimuli to assess and teach discrimination among stimuli that should (i.e., ambiguous stimuli) and should not (standard stimuli) occasion social referencing.

Alternatively, social referencing could have been taught initially during mixed presentations of stimuli, in the children's regular classrooms. Observing in the presence of the ambiguous stimuli, and not in the presence of the standard stimuli, would have been prompted and reinforced from the beginning. Finally, the conditional discrimination of affective stimuli would be taught using similar discrimination training procedures. Although such a procedure would require fewer steps overall, it is not known whether acquisition would have occurred more rapidly using this alternative teaching approach. The procedure used in this study resulted in a fairly rapid rate of acquisition of social referencing, for three of the four participants. For these participants, a maximum of 16 treatment sessions was required for acquisition of social referencing. In addition, one of these children demonstrated discriminated social referencing when the ambiguous stimuli were interspersed among the standard stimuli in the regular classroom setting. The other two participants demonstrated discrimination of the ambiguous and standard stimuli in their regular classroom following only four treatment sessions each.

For Ken, acquisition of social referencing required almost four times as many sessions as the other participants. Compared to the other participant's, Ken also had the most difficulty learning to discriminate experimenter affect. It is possible that simultaneous teaching of the discrimination of standard and ambiguous stimuli and experimenter affect in the classroom would have resulted in even slower acquisition of social referencing. This question of which teaching method would produce faster acquisition is an empirical one and could be manipulated in future experiments.

The particular affective discriminative stimuli used in this study were a combination of facial expression and gesture: frown and smile, and head nod and head shake. Consistent

with the findings of Gena et al. (1996) and Buffington et al (1997), the participants in this study readily learned to discriminate the experimenter's affect and gestures. As mentioned above, because these particular combinations of affect and gesture are commonly used, it is possible that the children had an earlier learning history and thus more readily learned to discriminate these configurations in the course of treatment. Future studies could investigate the discrimination of additional affective and gestural stimuli related to other affective stimuli.

In this study, four children acquired social referencing skills in the context of changes in their curriculum materials. They learned to observe in the presence of ambiguous variants of their standard task materials for additional information (i.e., discriminative stimuli), and to proceed in accordance with the specific learning history established in this study, in the presence of the standard stimuli. Another discriminative stimulus that should evoke social referencing is the presence of unfamiliar adults. Social referencing in the presence of a "stranger" could help a child avoid harm. In addition, the absence of "acknowledgement" of an unfamiliar adult in a familiar setting could be viewed as socially inappropriate. Future studies could use the methods described in this study to establish unfamiliar people as discriminative stimuli for social referencing.

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