2008

Evaluation of three methods for teaching intraverbals to children with language delays

Nicole Trosclair-Lasserre
Louisiana State University and Agricultural and Mechanical College

EVALUATION OF THREE METHODS FOR TEACHING INTRAVERBALS
TO CHILDREN WITH LANGUAGE DELAYS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by
Nicole M. Trosclair-Lasserre
B. S., Louisiana State University, Baton Rouge, 2001
M.A., Louisiana State University, Baton Rouge, 2005
December 2008

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Direct instruction is often necessary to develop language or expand language use in individuals with language delays. Previous research has begun to identify certain training conditions that result in more efficient use of instructional time devoted to language development. Specifically, incorporating mands into the instructional arrangement, increasing the quality of reinforcement delivered for interspersed tasks, and including instructive feedback stimuli into the consequences of learning trials have all demonstrated more efficient learning of targeted language skills. The purpose of the current investigation was to compare three methods for teaching intraverbals (i.e., conversation skills) to individuals with deficits in this area. Specifically, mand to intraverbal transfer of control, mand interspersal, and instructive feedback conditions were compared using a nonconcurrent multiple baseline across stimuli and multiple probe design. If mastery criteria for instructive feedback stimuli were not met, direct instruction was initiated for those intraverbals. In addition, generalization and maintenance probes were conducted to test for acquisition of symmetrical intraverbal behavior and retention of intraverbals over time, respectively. Training conditions incorporating mands into instruction did not result in faster acquisition of intraverbals relative to the instructive feedback condition. Two out of three participants acquired new intraverbals related to the instructive feedback stimuli; however, the third participant did not acquire intraverbals presented as instructive feedback even when direct instruction was initiated. Generalization was not explicitly programmed but was observed for two participants. Finally, no single training condition was associated with improved maintenance relative to the other conditions.

INTRODUCTION

By age 2, most children begin to emit comprehensible words and word combinations. However, some individuals fail to talk by this age, showing delays in expressive language. Language delays are often diagnosed when individuals demonstrate significant discrepancies in the number of recognizable words and two-word combinations spoken by age 2 when compared to what is considered normal language development (i.e., failure to produce at least 50 words and two-word combinations; Paul, 1991). Language development can be delayed in several different ways, such as late onset of language, slower rates of language development, or deviant use of language (e.g., only using object labels to name and describe things without ever requesting them; Hecht, 1986). Some researchers suggest that individuals with normal hearing, intelligence, and understanding of language eventually "outgrow" the delay without intervention (Whitehurst et al., 1991). Other researchers suggest that this may be the case if expressive language delay is measured in terms of vocabulary size and verbal fluency; however, the nature of the delay changes as individuals grow such that deficits are observed in more complex language, discourse skills, and academic achievement (Paul). In addition, language delays in individuals with other specific diagnoses, such as mental retardation and autism, may or may not follow the same pattern of language development as seen in typically developing individuals (Hecht).

Interventions that focus strictly on increasing the number and fluency of words do not produce long-term benefits for language-delayed individuals (Paul, 1991). Instead, language development programs need to incorporate basic and complex language skills. Language development programs are generally implemented through direct (i.e., clinician delivers services directly) or indirect (i.e., clinician serves as a consultant to parents, teachers, and/or caregivers who implement the intervention) service delivery methods (Olswang & Bain, 1991). Effective strategies for teaching language include direct instruction (e.g., Lovaas, 1977; Maurice, Green, &

Luce, 1996), incidental teaching (Hart & Risley, 1968), milieu teaching (Hart & Rogers-Warren, 1978), and Natural Language Teaching Paradigm (NLP; e.g., Koegel, O'Dell, & Koegel, 1987).

The remainder of this paper will focus on the behavioral approach to language development and treatment, specifically, Skinner's (1957) theory of verbal behavior and how it has been utilized to develop language programs for individuals with language delays. A description of Skinner's theory of verbal behavior follows as well as a review of research related to intraverbal behavior taught using transfer of stimulus control and interspersal techniques. Research related to instructive feedback and how it may contribute to the intraverbal literature is also discussed.

Skinner's Theory of Verbal Behavior

In 1957, Skinner developed a system by which verbal behavior, or language, could be conceptualized within the framework of the principles of behavior analysis. This conceptualization of verbal behavior differed from traditional conceptualizations of language. Traditionally, language is viewed in terms of expressive (as a speaker) and receptive (as a listener) language. It is generally thought that the first step in teaching language delayed individuals to communicate effectively is to teach the meaning of words (i.e., receptive language) outside of the context of communication with the assumption that once meaning is learned, the individual will utilize those words to communicate with others (Sundberg & Michael, 2001). Thus, the role of the speaker and listener are not considered during training because individuals are instructed as a listener with the assumption that these skills will generalize, with the individual eventually becoming a functional speaker. Skinner's account of language clearly distinguished between the role of speaker and listener, but mainly focused on the behavior of the speaker because he believed that the two roles (speaker and listener) involved different functional relations (Sundberg & Michael).

Skinner's account differed from traditional accounts of language by focusing on the environmental events occurring prior to and contingent on the verbal response of the individual as the speaker. He also suggested that verbal behavior was maintained by consequences delivered by another person (i.e., the listener). One of the main ways that Skinner's account differed from more traditional ones was that he separated verbal behavior form from function. That is, he emphasized that one word (i.e., form) of verbal behavior can serve multiple functions and that simply teaching multiple forms of verbal behavior does not necessarily lead to the development of multiple functions of each form. The unit of analysis in Skinner's theory of verbal behavior was the verbal operant. In general, this unit of analysis focused on the functional relationship between verbal behavior and the independent variables responsible for evoking and maintaining it (i.e., discriminative stimuli, motivating operations, and consequences; Cooper, Heron, & Heward, 2007). Thus, each type of verbal operant is defined by stimuli that evoke it as well as the consequences that maintain it.

Skinner recognized that typically developing individuals could acquire a response form with one function (e.g., saying "water" when the person would like water) and generalize use of the response form to serve other functions (e.g., saying "water" when the person sees water). However, individuals with delayed language may not necessarily demonstrate such generalizations. For example, a child may be able to label a car when shown a picture of a car but respond incorrectly when asked to name a vehicle that people drive. Thus, consideration of the functional independence of specific response forms suggests that direct instruction might be needed to establish various verbal operants.

Skinner identified a number of different verbal operants. They include the echoic, mand, tact, intraverbal, textual, copying a text, and taking diction. Of these, the echoic, mand, tact, and intraverbal represent the elementary verbal relations of which more difficult types of verbal behavior are shaped (Sundberg & Michael, 2001). For many children, these different verbal operants are shaped without explicit training through their interaction with the environment; however, children with language delays benefit from direct training. Thus, any language program developed for children with language delays should first establish these verbal operants before more complex types of verbal behavior are taught (Sundberg & Michael).

The echoic is a verbal response under the control of a verbal discriminative stimulus with point-to-point correspondence and formal similarity to the verbal response (i.e., the discriminative stimulus is identical to the targeted response) and is maintained by some type of nonspecific reinforcement (typically, conditioned reinforcement, such as praise). In other words, an echoic is evoked when the listener presents a verbal stimulus (e.g., “water”), the speaker responds by imitating the verbal stimulus (e.g., says “water”), and reinforcement is delivered for imitation of the verbal stimulus (e.g., praise). Point-to-point correspondence and formal similarity are evidenced by the fact that the targeted response is identical to the verbal stimulus. The reinforcer delivered is nonspecific because it is different from the stimulus referent of the targeted verbal response (e.g., praise is delivered as reinforcement in lieu of access to water).

The tact is a verbal response under the control of a nonverbal discriminative stimulus (e.g., an object or activity) and is maintained by some type of nonspecific reinforcement. Thus, the presence of some item or activity evokes a verbal response that labels, names, or describes the item or activity and the listener reinforces accurate labels or descriptions of the stimulus. For example, in the presence of a glass of water, the speaker says water, which is followed by the listener delivering reinforcement (e.g., praise). Again, reinforcement is nonspecific because the reinforcer differs from the stimulus referent.

Intraverbals are verbal responses under the control of a verbal discriminative stimulus without point-to-point correspondence or formal similarity with the response. Thus, the verbal discriminative stimulus is different than the verbal response. It is also maintained by some type of nonspecific reinforcement, such as praise or reciprocal conversation. For example, the listener, in the presence of the speaker might ask, “What do you drink when you are thirsty?” The speaker then emits the response water, which is followed by some nonspecific reinforcer (e.g., praise or reciprocal conversation). Intraverbals generally represent verbal interactions typical of reciprocal conversation.

Mands, or requests, are under the control of a motivating operation (MO) such as deprivation, satiation, or aversive stimulation and is maintained by whatever is being requested. Thus, the mand results in specific reinforcement and is the only verbal operant that allows the speaker to control his or her environment (Sundberg & Michael, 2001). For example, following a period of intense exercise, the speaker says water and the listener hands the speaker a glass of water.

Skinner’s account of verbal behavior has generated a limited amount of research since the publication of *Verbal Behavior* in 1957 (Michael, 1984; Sautter & LeBlanc, 2006). More recently, however, an increased interest in the clinical application of Skinner’s account of verbal behavior has been noted (Sautter & LeBlanc). Research specifically evaluating the verbal operants outlined by Skinner has primarily focused on the basic verbal operants (e.g., echoic, mand, tact, intraverbal), and more specifically, the mand. Sautter and LeBlanc reported that 72% of studies based on Skinner’s account of verbal behavior focused on the mand repertoire. Many studies also evaluated multiple verbal operants. The growing literature related to Skinner’s account of verbal behavior has generally supported his notion of the functional independence of verbal operants (e.g., Twyman, 1996), demonstrated the importance of the mand as a starting point for establishing language (e.g., Drash, High, & Tudor, 1999), and established transfer of stimulus control as a viable method for teaching verbal behavior (e.g., Finkle & Williams, 2001; see Sautter & LeBlanc for a detailed review).

The Intraverbal

As noted above, the intraverbal is the verbal operant related to most types of verbal interactions (i.e., conversation). Thus, many different types of discriminative stimuli can evoke intraverbal behavior (e.g., social questions, story telling, reading comprehension questions). Intraverbal behavior perhaps makes up the majority of an individual's speaking behavior. Because the intraverbal spans across so many types of verbal interactions, it may be one of the more important verbal operants to teach to individuals with language delays. While the intraverbal is not directly related to controlling one's environment like the mand, it is important for successful social interactions within a variety of community settings and situations (e.g., school, play groups, job interviews) and has the potential to directly influence the quality of an individual's life. Nonetheless, this type of verbal behavior has been largely overlooked within research focusing on Skinner's account of verbal behavior. In fact, in a review of the verbal behavior literature, Sautter and LeBlanc (2006) reported that only 14 studies had evaluated intraverbal behavior through 2004 with 9 of those studies being published between 1989 and 2004 (e.g., Braam & Poling, 1983; Chase, Johnson, & Sulzer-Azaroff, 1985; Daly, 1987; Finkel & Williams, 2001; Luciano, 1986; McDowell, 1968; Partington & Bailey, 1993; Partington et al., 1994; Sundberg, Endicott, & Eigenheer, 2000; Sundberg, San Juan, Dawdy, & Arguelles, 1990; Tenenbaum & Wolking, 1989; Watkins, Pack-Teixeira, & Howard, 1989).

Studies evaluating intraverbals have examined a variety of responses, including reading comprehension (e.g., Tenenbaum & Wolking, 1989), conversation, answering questions, and completing fill-in-the blank statements (e.g., Finkel & Williams, 2001). As discussed in the following sections, the majority of research on intraverbal behavior has focused on the evaluation of functional independence of verbal operants and transfer-of- stimulus-control procedures to teach intraverbals (e.g., Finkel & Williams; Partington & Bailey, 1993; Partington et al., 1994; Sundberg et al., 1990).

Transfer of Stimulus Control

Transfer of stimulus control refers to the process of fading out contrived controlling variables (e.g., response prompts, motivating operations) from the instructional arrangement so that responding is eventually under the control of naturally occurring antecedents (Cooper, Heron, & Heward, 2007). In the beginning stages of skill acquisition, contrived antecedent stimuli (e.g., response prompts) are often incorporated into training in order to establish the desired response in the individual's repertoire. In addition, including certain contrived antecedent stimuli decreases the likelihood of errors during teaching. Transfer of stimulus control is necessary so that the newly learned responses are eventually evoked by naturally occurring antecedent stimuli, thus contacting reinforcement available in naturalistic situations. Stimulus control can be transferred to naturally existing stimuli by fading response prompts or by gradually shaping stimulus control (Cooper et al.). For example, a therapist may use a verbal model prompt to teach individuals with language delays to respond to the question, "What is your name?" with "My name is ___." The therapist would initially prompt the response "My name is ___." by saying to the individual "say 'My name is ___." immediately after the question is presented. After successful imitation of the response by the individual, the therapist may fade the prompt by removing words from the end of the phrase one at a time (most-to-least prompt) or by delaying delivery of the verbal model (time delay) until the individual independently responds to the question "What is your name?"

Transfer-of-stimulus-control procedures have been used to teach intraverbal behavior to individuals with deficits in intraverbal behavior. Research evaluating transfer-of-stimulus-control procedures with intraverbals has generally focused on transfer of control from echoic, tact, and textual prompts to the intraverbal discriminative stimuli. An echoic prompt is a spoken model of the correct response. Tact prompts consist of the presentation of the referent stimulus or picture of the referent stimulus, which evokes the same response form as the targeted intraverbal response. For example, in order to use a tact prompt for the intraverbal stimulus, “What animal says ‘meow’?,” the therapist would present a picture of a cat in order to evoke the response “cat.” Textual prompts are similar to tact prompts except the therapist presents the correct response in written form and requires the individual to read the word.

Finkel and Williams (2001), for example, compared the efficacy of using textual and echoic prompts during a transfer-of-stimulus-control procedure while teaching intraverbal behavior in the form of answers to social questions to one participant diagnosed with autism. Three response types were measured: full-sentence targeted responses, partial answers, and nonsense responses or no response. A multiple baseline across behaviors design was used. Six questions (i.e., intraverbal discriminative stimuli) were randomly assigned to the textual or echoic prompt procedures, resulting in three sets of questions for each prompt type (e.g., "What’s your name?" "When’s your birthday?"). Textual prompts consisted of the therapist delivering the prompt “Read this” while placing the written answers in front of the child. Echoic prompts consisted of the vocal prompt “Say ___ (the correct response).” Both prompts were gradually faded by reducing the prompt by one word or phrase at a time from the end of the sentence to ensure the establishment of pure intraverbals. Results indicated that both prompting procedures were effective in establishing intraverbal behavior; however, the textual prompt resulted in faster acquisition of intraverbals and greater use of full sentence responses. Thus, these results suggest differential effects on acquisition based on the discriminative stimuli used during transfer procedures.

Partington and Bailey (1993) evaluated the efficacy of a transfer-of-control procedure (from stimuli that occasioned tacts to stimuli that occasioned intraverbals) for teaching intraverbals to typically developing children. Eight children were initially taught 20 tacts related to picture cards. A multiple probe design was used to evaluate intraverbal acquisition. During probe sessions, four intraverbal stimuli were presented and correct responses related to each were recorded. The intraverbal stimuli used during the study were categorical questions (e.g., “What are some toys?”) for which a number of correct responses could be emitted. Thus, all correct responses were recorded for each intraverbal stimulus. Training to teach the children multiple intraverbal responses to each of the categorical questions was initiated once stable levels of responding were observed during baseline probes. If the participant did not emit five correct responses for an intraverbal stimulus (i.e., categorical question), a picture card related to the categorical question was shown to the participant (i.e., a tact prompt; e.g., a picture of a doll). Training was discontinued when participants emitted at least four responses related to the intraverbal stimuli without tact prompts for two consecutive sessions. Results indicated that intraverbal behavior was successfully established through the transfer-of-control procedure with typically developing children. Maintenance probes were conducted 6 weeks after training and indicated that intraverbal responses acquired during training maintained once training was discontinued.

Another line of research related to transfer-of-stimulus-control procedures suggests that mand training may enhance acquisition of other verbal operants. However, no studies have examined the use of mand training when teaching intraverbals. A number of studies have examined the effects of combined training of mands and tacts on the acquisition of tacts (e.g., Arntzen & Almås, 2002; Carroll & Hesse, 1987) and the use of mand training to establish an echoic repertoire in individuals with no vocal communication skills (e.g., Drash, High, & Tudor, 1999).

For example, Carroll and Hesse compared the effects of two training procedures on the acquisition of tacts in six preschool-aged children. During tact-only training, the experimenters used a modeling procedure to teach participants to correctly tact objects. Once modeled responses were established, tact trials were alternated with other questions or commands (e.g., “Touch your nose.”) to match the session length to that of the mand-tact condition. Mand-tact training was conducted by alternating mand and tact learning trials within each session. Mand trials always preceded tact trials. Mand training within the mand-tact training condition consisted of a model of a missing part required to complete an object assembly task. The part was delivered contingent on the participant repeating the modeled response. Tact training within the mand-tact training condition was identical to the tact-only training condition, and the tact for the missing part was taught. Results indicated that acquisition of tacts occurred more rapidly during the combination training than when tacts were trained in isolation. In addition, better retention of tacts trained under the combination procedure was observed during follow-up probes. Arntzen and Almås (2002) replicated these findings with individuals with developmental disabilities; however, results indicated similar levels of tact retention during follow-up probes regardless of the training procedure used.

One limitation of these investigations was that acquisition was only evaluated under the training conditions. Thus, accurate responding under the mand-tact condition may have been controlled by both the nonverbal discriminative stimulus for the tact and the motivating operations for the mand. That is, the responses established via the mand-tact training condition may not have been pure tacts. If so, responses may not occur outside of the training situation. A better method would have been to assess the acquisition of tacts outside of the training conditions. It is possible that different outcomes would have been observed using more stringent mastery criteria.

Another potential use of mand training is to establish echoics for individuals with no vocal communication skills. Skinner (1957) noted that the mand is the first verbal operant to develop in infants and is subsequently used by parents to shape other types of verbal behavior. Thus, he suggests that the mand should be the starting point of any language program. This differs from the traditional approach to language training for individuals with developmental delays. Generally, a vocal imitation model is used to establish verbal behavior (i.e., the echoic). The therapist presents models of selected sounds and reinforces approximations of those sounds by the individual. Then, the therapist successively shapes the sounds into letter sounds and, eventually, into words by withholding reinforcement for previously reinforced vocalizations and delivering reinforcement contingent on closer approximations of correct imitations (Drash et al., 1999). Therapists using this approach do not deliberately select sounds that currently function as mands or arrange for powerful MO's. In contrast, mand training procedures capitalize on MO's and specific reinforcement, which may not only enhance verbal behavior training but may more closely approximate the natural development of language (Drash et al.).

For example, Drash et al. (1999) evaluated a method for establishing an echoic repertoire using mand training with three nonverbal individuals diagnosed with autism. The authors first conducted mand training by withholding access to preferred items and delivering access contingent on any appropriate vocal response emitted by the participant. After establishing the sounds as mands, the experimenters established an echoic repertoire by imitating the vocalizations emitted by the individual, which served as a prompt for an imitative response. Reinforcement then was delivered for the imitation of more specific responses (i.e., individual sounds or words). Results suggest that the mand can be used to develop echoics through transfer of stimulus control from the MO to the vocal stimulus. Based on these results, it is likely that the mand could also be used to establish other verbal operants (e.g., intraverbals) for individuals with language delays.

Combining mand training with the training of other verbal operants or using the mand to teach other verbal operants (e.g., intraverbals) might produce similar benefits as demonstrated in the above investigations; however, research has not addressed this possibility. The efficacy of the combined training evaluated by Arntzen and Almås (2002) and Carroll and Hesse (1987) and use of the mand to establish an echoic repertoire (e.g., Drash et al., 1999) is generally attributed to the inclusion of the unique controlling variables for the mand during training trials. That is, transfer of stimulus control from the MO for the mand to the discriminative stimulus for the tact or echoic occurs by pairing these antecedent stimuli. Alternatively, as discussed in the next section, the benefits may be due in part to interspersal effects.

Interspersal

Interspersal techniques generally involve the alternation of mastered and acquisition trials within the instructional arrangement (Charlop, Kurtz, & Milstein, 1992). Previous research has demonstrated faster acquisition of unknown tasks when known or mastered tasked are interspersed during instruction (e.g., Charlop et al.; Dunlap, 1984; Neef, Iwata, & Page, 1977; Neef, Iwata, & Page, 1980; Rowan & Pear, 1985). Benefits of the interspersal technique are attributed, at least in part, to the increased rate of reinforcement available during training (Charlop et al.). That is, reinforcement is delivered for correct responding on maintenance and acquisition tasks, increasing the density of reinforcement delivered during instruction. Because previously mastered tasks are alternated with those being taught, the individual accesses reinforcement more often than if the acquisition task was taught in isolation.

For example, Neef, Iwata, and Page (1980) evaluated the efficacy of interspersing known spelling words on the acquisition of unknown spelling words for three individuals diagnosed with mental retardation. Interspersal of known items was compared to high density of reinforcement for task-related behavior in a multielement design. Results indicated that participants mastered a higher number of previously unknown spelling words under the interspersal condition relative to the high-density reinforcement condition. In addition, participants preferred the interspersal technique relative to the high-density reinforcement procedure as indicated by participants' choices toward that condition (i.e., at least 75% when a choice was available). These results replicated previous research indicating higher levels of acquisition under interspersal conditions (e.g., Neef, Iwata, & Page, 1977). Results also suggest that the benefits of the interspersal condition may not be entirely due to increased reinforcement density.

Results of some studies suggest that delivering higher quality reinforcers for mastered tasks can increase acquisition of unknown tasks even when reinforcer quality is unaltered for the latter response (e.g., Mace, Mauro, Boyjian, & Ekert, 1997; Volkert, Lerman, Trosclair, Addison, & Kodak, 2008). For example, Volkert et al. evaluated the effects of differing reinforcer quality for known and unknown tasks on the acquisition of unknown tasks. In Experiment 1, different types of interspersal trials (i.e., known motor or known tact trials) were alternated with unknown tact trials (e.g., labeling pictures of animals, U.S. presidents, shapes) and compared to a constant condition during which only unknown tacts were presented. Higher quality reinforcement (praise plus edible reinforcers) was delivered contingent on responses to the unknown tact trials while lower quality reinforcers (praise only or praise plus intermittent edibles) was delivered for correct responding on the interspersal trials. Results indicated no clear differences between the interspersal and constant conditions. The authors hypothesized that the lack of differentiation between the conditions may have been due to the use of high quality reinforcement during unknown trials. Experiment 2 extended Experiment 1 by varying high and low quality reinforcement for known and unknown tasks. Results indicated that interspersal was more effective for some participants when using praise only for all responses (i.e., similar quality of reinforcement across known and unknown tasks) and when using a higher quality reinforcer for correct responses on the interspersal trials (i.e., for responses to known tasks only). These results suggest that, for some individuals, increasing the quality of reinforcement for responding to known tasks may enhance acquisition of unknown tasks during interspersal techniques.

Mace et al. (1997) examined the effects of reinforcer quality for compliance to high probability requests (i.e., requests associated with high levels of compliance) on compliance to low probability requests (i.e., requests associated with zero or low levels of compliance). In Experiment 1, the effects of varying reinforcer quality (e.g., praise versus praise plus an edible) for compliance to high probability requests were evaluated. Differences were measured in terms of differential levels of compliance to low probability requests and were evaluated in a reversal design. Results indicated that compliance to the low probability instruction only improved when higher quality reinforcers (i.e., edibles only or praise plus edibles) were delivered for compliance to the high probability requests. These results suggest that the efficacy of interspersing high probability requests with low probability requests can be enhanced by increasing the quality of reinforcement delivered for compliance to high probability requests. The results of Volkert et al. (in press), in which acquisition of new skills rather than just compliance was examined, were consistent with these findings.

These results provide further explanation for the effectiveness of interspersing unknown mand and tact trials (e.g., Arntzen & Almås, 2002; Carroll & Hesse, 1987). It is possible that the reinforcer delivered for mand responses in these studies (i.e., the item requested) represented a higher quality reinforcer than that delivered for tact responses (e.g., praise) because individuals were able to access stimuli that were requested. Thus, interventions targeting acquisition of other verbal operants might be enhanced by interspersing mand trials during training. The efficiency of training may also be increased by interspersing known mands instead of unknown mands. That is, treatment could focus exclusively on unknown verbal repertoires (e.g., intraverbals) while benefiting from the inclusion of higher quality reinforcement from the interspersal of known mands.

In summary, the mand has been used to establish certain verbal operants (e.g., echoics) and enhance acquisition of others (e.g., tact), but few, if any, studies have evaluated the efficacy of using the mand to establish or enhance acquisition of intraverbals. Several authors have suggested that intraverbal training may benefit by incorporating mands into language training programs (e.g., Carroll & Hesse, 1987; Sundberg and Partington, 1998). For example, Sundberg and Partington (1998) asserted, “The first general rule for early intraverbal training is to focus on what interests the child” (p. 201). The authors then described a transfer procedure in which basic intraverbal behavior could be established by transferring control from a MO to a verbal discriminative stimulus. Further research is needed to determine if the mand can be used to enhance intraverbal training either through a transfer of stimulus control procedure as suggested by Sundberg and Partington or by interspersing mand and intraverbal training trials as suggested by prior research on interspersal techniques.

Further studies aimed at identifying more efficient methods for teaching intraverbal behavior are important given the time constraints often placed on individuals responsible for teaching verbal behavior to individuals with language delays and the impact a functional verbal repertoire can have on an individual’s life. The previously described studies by Arntzen and Almås (2002) and Carroll and Hesse (1987) suggested one potential method for increasing the efficiency of language training (i.e., to capitalize on the unique controlling features of the mand). In addition, using a transfer-of-control procedure from mands to intraverbals may increase intraverbal instruction efficiency by using the MO for the stimulus and specific reinforcement to initially establish intraverbals in an individual's verbal repertoire. As described in the next section, another body of research suggests an additional method by which intraverbal instruction could be enhanced.

Instructive Feedback

Research evaluating benefits of instructive feedback also suggest that this method may be a viable alternative for increasing the efficiency of intraverbal training. Instructive feedback refers to extra, non-target information that is presented during the consequence of a learning trial (Werts et al., 1995). In other words, new information is presented (i.e., instructive) following the individual's response (i.e., feedback). A response to the instructive feedback stimulus is not required, and no contingencies are in place for responding or not responding to the stimulus. For example, when teaching an individual to identify a lion from a picture card, the individual is shown a picture card of a lion and asked, "What is this?" The individual emits the response (i.e., "lion") and the therapist responds by saying, "Great job! That is a lion. You spell lion 'L-I-O-N.'"). In this example, praise is delivered as reinforcement for the targeted response (i.e., verbally identifying a picture of a lion) and extra information is presented during the consequence of the trial (i.e., telling the individual the correct way to spell lion). The extra information (i.e., how to spell lion) is the instructive feedback stimulus. Generally, the main purpose of including instructive feedback stimuli in the learning trial consequence is to increase the efficiency of instruction by allowing students the opportunity to acquire new information without significantly increasing instructional time.

Research findings on instructive feedback generally indicate that much of the information presented as instructive feedback is acquired, although some studies demonstrate higher or lower levels of acquisition (Werts et al., 1995). Perhaps more importantly, benefits are generally seen when instructive feedback stimuli are subsequently taught in the future (e.g., Holcombe, Wolery, Werts, & Hrenkevich, 1993; Wolery et al., 1991). So, while results indicate some acquisition of skills related to the instructive feedback stimuli without specific instruction, faster mastery has been consistently observed for information previously presented as instructive feedback stimuli when later taught.

Wolery et al. (1991) evaluated the effects of presenting future target stimuli during consequences of current learning trials on future learning. Participants were eight individuals diagnosed with moderate handicaps who were taught to label occupations depicted in photographs. Future target stimuli (i.e., stimuli presented as instructive feedback) consisted of printed words of the occupations presented as pictures during picture name training. For example, if the targeted occupation was barber, a picture of a barber was presented, the targeted response was "barber," and the consequences for responding was delivered while simultaneously presenting a card with the word "barber" printed on it. Thus, the future target response consisted of word recognition instead of picture recognition. Four occupations were assigned to each condition. Learning trials with and without instructive feedback were alternated in a multielement design. During both conditions, a progressive time delay procedure was used to teach students to name the occupations in the pictures. The two conditions differed regarding the consequences delivered for correct responding. During the instructive feedback condition, correct responses resulted in praise plus presentation of the printed word of the occupation depicted in the picture. Therapists did not say the word when it was presented nor were students required to respond to the printed word. During the no instructive feedback condition, correct responses resulted in praise only. Thus, the only difference between the two conditions was the presentation of the written word during the consequence of the trial. Data were converted to the mean percentage of unprompted correct responses across stimuli. Acquisition was indicated by two sessions with 100% unprompted correct responses. Results showed that some participants acquired some of the reading comprehension targets without direct instruction. When direct instruction for these targets was initiated, those words previously presented as instructive feedback stimuli were acquired in less time than words not presented as instructive feedback. These results suggest that the efficiency of instruction can be increased by presenting future target stimuli (i.e., stimuli that will later be taught during direct instruction) during the consequence of current learning trials without significantly disrupting the current learning environment.

Results of a study by Holcombe and colleagues (1993) support the outcomes of Wolery et al. (1991). Holcombe et al. evaluated whether including instructive feedback during the consequences of current learning trials could increase the efficiency of instruction. A constant time delay procedure was used to teach four preschoolers with developmental delays to name number sets, number words, and roman numerals. During sessions without instructive feedback, each of the targeted stimuli was independently taught in the sequence presented above. Correct responses resulted in praise plus tokens that could be exchanged at the end of the session for a prize (e.g., stickers, pencils). Sessions with instructive feedback were similar except the next target stimulus in the sequence was presented while delivering the consequence for the currently taught target. For example, while teaching individuals to name number sets, a correct response resulted in praise, a token, and presentation of a card with the spelled out number just presented in numeric form (i.e., 2 and two). Once mastery criteria were met for sets, instruction was initiated for number word identification, with the corresponding Roman numeral presented as instructive feedback (i.e., two and II). Thus, in one condition, the sequence of number sets, number words, and Roman numerals was taught without introduction of the next step in the sequence at any time during instruction. In the other condition, subsequent targets in the teaching sequence were introduced as instructive feedback during the consequences of current instruction. Results supported those obtained by Wolery et al. (1991) in that stimuli presented as instructive feedback required fewer trials to master and were associated with fewer errors in responding than targets that were not presented as instructive feedback. In addition, less instructional time was required to teach all of the targets in the sequence. These results suggest that including information that will later be targeted during direct instruction during current learning trials can increase instructional efficiency for the future targeted stimuli without hindering current instruction.

PURPOSE

Results of previous research suggest that mand training may enhance training of other verbal operants and that using instructive feedback could foster future learning. Thus, incorporating mands or instructive feedback stimuli into instructional sessions might maximize instructional time during verbal behavior programs. This is important because educators often have a limited amount of time to work directly with individuals with language delays or other diagnoses. The results of research using mand training to enhance acquisition of other verbal operants suggest that direct instruction of verbal behavior could be economized while yielding faster acquisition of the other verbal operants without interrupting the acquisition of mands (e.g., Arntzen & Almås, 2002; Carroll & Hesse, 1987). Also, as reported by Sundberg and Michael (2001), mand training is frequently reported to be more enjoyable for therapists, parents, teachers, and children than training for other verbal operants, as indicated by decreased inappropriate behavior and increased willingness to participate in the language training programs. Thus, including mands into instructional sessions may increase the social validity of direct instruction for verbal behavior.

Using instructive feedback during verbal behavior instruction may also represent a method by which to increase the efficiency of service delivery. Previous research has indicated that incorporating instructive feedback stimuli does not significantly increase instructional time, nor does it interfere with acquisition of information presented in the learning trial (e.g., Holcombe, 1991; Holcombe et al., 1993; Wolery, Doyle, et al., 1991). In addition, while acquisition of instructive feedback stimuli has been variable, future learning of the information presented as instructive feedback has benefited in that faster acquisition of the instructive feedback information was observed when specific training was subsequently initiated (e.g., Holcombe et al., 1993; Wolery et al., 1991). So, it is possible that the use of instructive feedback could enhance verbal behavior programs. Results of instructive feedback research suggest that presenting novel intraverbal information during the consequences of learning trials for intraverbals or other verbal operants might enhance future acquisition of these intraverbals when directly taught without significantly altering the length of the current learning trial.

The purpose of the current investigation was to evaluate the efficiency of three methods for teaching intraverbals to individuals with language delays. An increasing time delay procedure with imitative prompts was used to teach intraverbals to participants. The efficiency of instructive feedback, mand to intraverbal transfer of control, and mand interspersal on the acquisition of intraverbals was evaluated based on the number of sessions required to meet a mastery criteria. Benefits of instructive feedback on future intraverbal learning was evaluated when acquisition of intraverbal information presented as instructive feedback was not observed during probe sessions. Generalization probes were conducted to evaluate acquisition of symmetrical intraverbal relationships related to training stimuli (see further description below). In addition, follow-up probes were conducted to evaluate potential differences in intraverbal retention as a result of the different training procedures. Finally, the current investigation sought to address limitations in previous research by using more stringent mastery criteria (i.e., acquisition probed outside of training conditions).

METHODS

Participants and Settings

Three children with language delays participated in the study. They were selected from children enrolled in a clinic providing early intervention and behavioral services and from an early intervention program for children with autism and other language delays. Participants were screened for inclusion using the Assessment of Basic Language Learning Skills Revised (ABLLS-R; Partington, 2006). Specifically, participants were administered the full or selected items from the ABLLS-R if a recently completed assessment was not available. The first three individuals to meet the criteria listed below with obtained caregiver consent to participate were enrolled in the study. The following criteria were met by all participants: (a) scored at least a 3 on item A16 of the Cooperation and Reinforcer Effectiveness section indicating that praise functioned as a reinforcer for that individual's behavior, (b) obtained no zero scores on items E1 through E13 of the Vocal Imitation section indicating that the individual reliably engaged in echoic behavior, (c) scored at least a 3 on items F4 and F5 of the Requests section indicating that the individual requested items when prompted and unprompted in the presence of the item, (d) scored a 4 on item G1 of the Labeling section indicating that the individual could tact preferred items, and (e) scored a 1 or below on items H8 through H18 on the Intraverbals section indicating that the individual did not reliably engage in intraverbal behavior related to item functions, classes, or features.

Greg was a 12-year-old boy diagnosed with autism, ADHD, and asthma. Greg used asthma medication on an as-needed basis during the investigation. He primarily spoke using four- to five-word utterances and was enrolled in an Applied Behavior Analysis (ABA) early intervention program for 3 months prior to this investigation. Kyle was a 4-year-old boy diagnosed with autism and was not taking medication during the course of the investigation;

however, he began a gluten-free diet between the completion of the first evaluation and the initiation of the second evaluation. He was enrolled in an ABA program for approximately 4 months prior to entering the current investigation. Prior to his enrollment in the ABA program, he was receiving services, but the nature and duration of those services are unknown. He spoke in three- to four-word utterances and used full sentences for some requests. Mary was a 3-year-old girl with no formal diagnosis but was being treated in an early intervention clinic for language delays. She was not taking any medications at the time of the investigation. She communicated using two- to three-word utterances along with complete sentences on occasion (e.g., to mand for items). She was enrolled in an ABA early intervention program for 10 months prior to the beginning of the investigation. None of the participants exhibited any sensory or physical impairment.

Graduate students, undergraduate students, or clinic staff conducted sessions during various phases of the investigation. Sessions were conducted in areas designated for individual instruction in both settings. Each area was equipped with materials necessary for sessions and included a table, chairs, area partitions, and stimuli used during training sessions (e.g., preferred stimuli, stopwatch, data sheets, etc.). Participants were blocked from engaging with other objects (e.g., trash can, text books, extra desks) present in the area when necessary.

Response Measurement, Interobserver Agreement, and Procedural Integrity

Experimenters and data collectors used pencil and paper to collect frequency data on the participant's responses in each session. During the paired choice preference assessment, data were collected on the number of times a particular stimulus was selected by the participant (defined as the participant touching one stimulus and not another when presented simultaneously). Data were converted to the percentage of trials each stimulus was selected by dividing the number of times it was chosen by the total number of trials the stimulus was presented and multiplying that number by 100. A preference for a particular stimulus was defined as participants choosing that stimulus a higher percentage of times relative to other stimuli.

During pre-training probe, baseline, training probe, training, generalization, and maintenance sessions, data were collected on the number of independent (defined as correct responses emitted following an intraverbal stimulus and prior to a model of the correct response), modeled (training sessions only; defined as correct responses emitted following a model of the correct response and prior to the end of the trial), error responses (defined as incorrect responses emitted at any point during the learning trial), and no response (defined as no responses emitted within 10 s of an intraverbal stimulus). Data collectors recorded responses on a trial-by-trial basis as soon as the response was emitted or once the trial duration ended (signaled by a timer). One trial consisted of the presentation of the S^D, a response emitted by the participant or the end of the trial duration, and presentation of the programmed consequence. Data were converted to percentage of trials each response type was observed by dividing the total number of each response type by the total number of trials and multiplying that number by 100. During training sessions, data were also collected on session duration by starting a stopwatch when the first S^D was delivered and ending it at the end of the consequence of the last learning trial. The main dependent variable was the total number of training sessions to meet the mastery criteria. Fewer training sessions under a particular condition would suggest a more efficient training method. Secondary analyses of efficiency were conducted by comparing the average session length for each training condition, with shorter session durations indicating a more efficient training method.

Interobserver agreement data was collected for at least 50% of preference assessment trials, 22% of reinforcer assessment sessions, 62% of pre-training probes, and 48% of baseline, training probe, training, generalization, and maintenance sessions by having a second observer simultaneously but independently record occurrences of the targeted responses and session durations. Agreement during the paired choice preference assessment, probes, and training trials was calculated by comparing the recorded responses of each observer on a trial-by-trial basis. Agreement was defined as observers scoring the same stimulus chosen (preference assessment) or same type of response emitted (probes and training trials) during each trial of each assessment. Agreement regarding session duration was defined as the degree to which each observer recorded similar session durations. Interobserver agreement coefficients for the preference assessment and probe and training trials were calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying that number by 100%. Interobserver agreement coefficients for session duration were calculated by dividing the smaller of the recorded session durations by the larger and multiplying that number by 100%. Greg’s mean agreement coefficients were 96.3% (agreement collected for the second preference assessment only) for preference assessment trials, 97.5% (range, 90% to 100%) for reinforcer assessment sessions, 97.5% (range, 90% to 100%) for pre-training probes, and 97.7% (range, 75% to 100%; responses) and 99.2% (range, 81.5% to 100%; duration) for baseline, training probe, training, generalization, and maintenance sessions. Mean agreement coefficients for Kyle were 96.5% (range, 92.9% to 100%) for preference assessment trials, 100% for reinforcer assessment sessions, 99.1% (range, 90% to 100%) for pre-training probes, and 98.3% (range, 90% to 100%; responses) and 99.3% (range, 82.3% to 100%; duration) for baseline, training probe, training, generalization, and maintenance sessions. For Mary, mean agreement coefficients were 100% for preference assessment trials, 96.4% (range, 60% to 100%) for reinforcer assessment sessions, 100% for pre-training probes, and 97.2% (range, 50% to 100%)

and 99.8% (range, 98.2% to 100%) for responses and duration respectively during baseline, training probe, training, generalization, and maintenance sessions.

Baseline, training probe, training, generalization, and maintenance sessions were also scored for procedural integrity related to the delay to the prompt (defined as the total number of seconds between the delivery of the discriminative stimulus and delivery or no delivery of a prompt of the correct response) and consequence delivery (defined as the type of stimulus change initiated by the experimenter following a response from the participant). Sessions were videotaped and data collectors scored each videotaped session for integrity as described below. Integrity was defined as the experimenter waiting the correct number of seconds between the presentation of the discriminative stimulus and the prompt (if necessary) based on the condition in place (delay to the prompt) and delivery of the programmed consequence based on the participant's response and condition in place. In other words, during baseline, training probes, generalization, and maintenance sessions, a correct delay was scored if the therapist did not deliver a model of the correct response during the 10-s trial interval. During training sessions, a correct delay was scored if the therapist waited the number of seconds indicated on the data sheet based on the increasing time delay before presenting a model of the correct response. A correct consequence delivery was scored during baseline, training probes, generalization, and maintenance sessions if the experimenter delivered praise following a correct response or ignored incorrect and no responses. During training, a correct reinforcer delivery was scored if the experimenter only delivered an error correction for incorrect responses during both mand conditions and an error correction plus instructive feedback during the instructive feedback condition, delivered no consequence for no response during all conditions, delivered praise plus instructive feedback for correct or modeled responses during instructive feedback sessions, delivered praise plus 20-s access to the item during mand transfer of control sessions, delivered

20-s access to the item during mand trials for correct responses or no consequence for incorrect mand responses and praise only during intraverbal trials for correct or modeled responses during mand interspersal sessions. Final integrity scores were converted to the percentage of trials with the correct delay used and consequence delivered by dividing the number of trials with integrity by the total number of trials and multiplying by 100. Integrity was scored for at least 19% of all sessions for each participant. Mean integrity scores for participants were collapsed across sessions and evaluations and were as follows: Greg 98% (delay; range, 80% to 100%) and 96.7% (consequence delivery; range, 80% to 100%), Kyle 98.7% (delay; range, 85% to 100%) and 97.3% (consequence delivery; range 85% to 100%), and Mary 93.8% (delay; range, 50% to 100%) and 92.9% (consequence delivery; range, 50% to 100%).

Experimental Design

A nonconcurrent multiple baseline across stimulus sets and multiple probe design was used to evaluate intraverbal acquisition. The three conditions were compared twice for each participant using a multielement design. Each evaluation consisted of training three different intraverbals (one under each condition) and presenting one intraverbal as instructive feedback. Thus, a total of eight intraverbals were taught to each participant in this study (i.e., four items per evaluation).

Procedures

Each participant was exposed to three pre-training assessments (i.e., preference assessment, reinforcer assessment, pre-training probes), intraverbal training, training probes, generalization probes, and maintenance probes. First, a paired choice preference assessment (Fisher et al., 1992) was conducted to identify four preferred stimuli for use during each condition and as the instructive feedback stimulus. Second, a reinforcer assessment was conducted to directly evaluate praise as a reinforcer for responding. Next, a series of mand, intraverbal, and generalization pre-training probes was conducted to determine whether participants requested preferred items (mand pre-training probes), answered questions related to the interspersal and training stimuli (intraverbal pre-training probes), and engaged in generalized responding regarding stimuli to be included during training (generalization pre-training probes; Kyle only), respectively. Third, intraverbal training was conducted to teach participants to answer questions regarding stimulus features. Fourth, training probes were conducted to evaluate whether intraverbal responses persisted in the absence of training conditions. Finally, generalization and maintenance probes were conducted to test for symmetrical intraverbal responses acquired over the course of the investigation and the maintenance of responses acquired during the investigation, respectively.

Pre-Training Assessments

Paired Choice Preference Assessment. A paired choice preference assessment (Fisher et al., 1992) was conducted prior to each evaluation to identify four stimuli for which intraverbal questions were developed and taught during training. Items were included in the preference assessment based on the participant's ability to mand for the object in the natural environment (i.e., participants independently manded or manded for the objects when prompted, as identified via caregiver report and directly evaluated during the pre-training probes described below). Eight items were evaluated during each preference assessment. The top four items, the top four similarly ranked items, or the top four items to pass pre-training probes were used in the remainder of the study. One item was randomly assigned to each condition and as the instructive feedback stimulus. Table 1 shows a summary of the assessment outcomes and the assignment of items to each condition. In an attempt to control for differences in preference between the stimuli, assignment of stimuli to each condition was counterbalanced within and across participants. For example, if the highest preferred item was assigned to the interspersal condition for participant 1 in the first evaluation, then the second preferred item might be assigned to that condition in the second evaluation. Then, for participant 2, the third preferred item might be assigned to this condition during the first evaluation and the fourth preferred item in the second evaluation. This was done for each condition of the investigation across all participants. The above procedures were repeated to identify stimuli used during the second evaluation of the multiple baseline design. To ensure that the relevant MO for the mand was present during training, the participant did not have access to the selected items outside of the training sessions for the duration of the evaluation.

Reinforcer Assessment. A reinforcer assessment was conducted to directly evaluate whether praise functioned as a reinforcer for each participant's responding. Responses taught during the reinforcer assessment were chosen based on deficits in the participant's repertoire regarding that skill and consisted of a receptive identification task (e.g., receptive identification of actions). Two targets were selected for each participant, and a nonconcurrent multiple baseline across stimuli design was used (one target was assigned to each of the two baselines). Sessions consisted of 10 trials. During each trial, the target was presented in an array of three cards (e.g., three different action cards). Each trial began when the experimenter placed the stimuli in front of the participant and presented the S^D (e.g., "Point to mowing."). During baseline, participants had 10 s to respond, and there were no programmed consequences for responding correctly or incorrectly. For all reinforcement sessions, a progressive time delay prompting procedure (Charlop, Schreibman, & Thibodeau, 1985) was used with the initial delay set at 0 s. During reinforcement sessions, brief enthusiastic praise (e.g., "Yeah! That's right!" accompanied with high fives, tickles, etc.) was delivered contingent on independent and physically guided responses. All incorrect responses resulted in an error correction. In other words, the

Table 1

Item rankings and percentage chosen during the paired choice preference assessment and assignment of items to each condition

Participant	Item (Condition Assignment)	Ranking	% Chosen
Greg			
Preference Assessment 1			
	Bubbles (Mand INT)	1	86%
	Movie (Mand TC)	2	86%
	Dog (IF STIM)	3	71%
	Water Snake (IF TRN)	4	71%
Preference Assessment 2			
	Legos (IF TRN)	3	57%
	Party Horn (Mand INT)	4	43%
	Sea Anemone (Mand TC)	5	43%
	Binoculars (IF STIM)	6	43%
Kyle			
Preference Assessment 1			
	Train (IF TRN)	1	86%
	Thomas Video (Mand INT)	2	86%
	Race Track (Mand TC)	3	71%
	Bubbles (IF STIM)	4	43%
Preference Assessment 2			
	Music (Mand TC)	2	86%
	Play Doh (IF STIM)	3	57%
	Stickers (IF TRN)	4	57%
	Microphone (Mand INT)	5	29%
Mary			
Preference Assessment 1			
	Bears (IF STIM)	1	86%
	Phone (IF TRN)	2	71%
	Bubbles (Mand INT)	3	57%
	Coins (Mand TC)	4	57%
Preference Assessment 2			
	Blue’s Clues (Mand TC)	1	86%
	Crayons (IF STIM)	2	71%
	Doll House (IF TRN)	3	57%
	Bus (Mand INT)	4	57%

experimenter said “no” while simultaneously physically guiding the participant to engage in the correct response. Following three consecutive trials within and across sessions with correct independent or guided responses, the delay was increased by 1 s. The delay was increased by 1 s until three consecutive sessions were obtained with at least 80% independent responding. Had a 10 s delay been reached, prompts would have been discontinued following two consecutive sessions with 80% correct independent or physically guided responses at the 10 s delay. Table 2 depicts the mean levels of independent correct responses during the last three sessions of baseline and reinforcement.

Table 2

Mean percentage of correct responses during the reinforcer assessment

Participant	Baseline	Reinforcement
Greg		
Baseline 1	0%	100%
Baseline 2	0%	100%
Kyle		
Baseline 1	23.3%	100%
Baseline 2	33.3%	100%
Mary		
Baseline 1	30%	90%
Baseline 2	30%	96.7%

Note. The percentage of responding during baseline and reinforcement reflects the mean performance during the last three sessions of each condition.

These findings indicate that when praise was paired with prompts, all participants acquired the responses required during the receptive identification task. These results suggested that praise functioned as a reinforcer. In addition, results indicated that the time-delay and reinforcement procedures used in the remainder of the study (which were identical to the procedures used in the reinforcer assessment) would be an effective method for teaching new skills to all participants and any potential differences observed would be related to the interspersal, transfer of control, or instructive feedback procedures.

Pre-training Probes. Intraverbal and mand probes were conducted prior to training to determine whether participants engaged in mand and intraverbal behavior related to the training stimuli. A similar number of words were selected for each intraverbal stimulus in an attempt to equate the difficulty level of the intraverbals evaluated in each condition (see Table 3 for a list of intraverbal stimuli used during training). Ten trials were conducted for each verbal operant for each of the stimuli used during training. During mand probes, the experimenter briefly showed the stimulus to the participant and then placed it out of sight. The experimenter then prompted the participant by saying "What do you want?" Participants had 10 s to request the stimulus being tested (i.e., the stimulus initially shown to the participant). Access to the training stimulus for 20 s was delivered contingent on a correct mand response within the 10 s interval. If the participant did not engage in a correct mand response within 10 s of the mand stimulus, the sequence was repeated (i.e., briefly showing the participant the item and placing it out of sight followed by the prompt "What do you want?") signaling a new trial. Mand probes were conducted for each of the four stimuli used during training. Correct responses were defined as emitting the correct object label (e.g., if the item was a bus, the verbal response was "bus"). There were no programmed consequences in place for incorrect responses or no response.

During intraverbal probes, the stimulus was not shown to the participant and remained out of sight. The experimenter delivered the question related to the stimulus (i.e., the intraverbal stimulus; e.g., "What is something that is a vehicle and is yellow?"). Praise was delivered contingent on correct responding during intraverbal trials to decrease potential misclassification of known intraverbals as unknown intraverbals (Lerman et al., 2005). There were no programmed consequences in place for incorrect responses or no response. The stimuli tested

Table 3

Intraverbal stimuli

Participant
Greg
Evaluation 1 Stimuli
"What's something you blow and can pop?" (Bubbles)
"What's something you watch that's on tape?" (Movie)
"What's something that is furry and barks?" (Dog)
"What's something that is green and squishy?" (Water Snake)
Evaluation 2 Stimuli
"What's something colorful and used for building things?" (Legos)
"What's something noisy that you use at birthdays?" (Party Horn)
"What's something that has tentacles and is soft?" (Sea Anemone)
"What's something you look through that magnifies things?" (Binoculars)
Kyle
Evaluation 1 Stimuli
"What's something that is a vehicle and goes choo choo?" (Train)
"What's something you watch on TV and is about trains?" (Thomas Video)
"What's something you drive on and goes round and round?" (Race Track)
"What's something you blow with a wand and can pop?" (Bubbles)
Evaluation 2 Stimuli
"What's something with lyrics that comes on the radio?" (Music)
"What's something soft that can be shaped into things?" (Play Doh)
"What's something colorful you get for doing something good?" (Stickers)
"What's something you sing into that makes you louder?" (Microphone)
Mary
Evaluation 1 Stimuli
"What is something that is furry and eats honey?" (Bears)
"What is something for making calls that rings?" (Phone)
"What is something that is soapy and you blow?" (Bubbles)
"What is something shiny and used for buying things?" (Coins)
Evaluation 2 Stimuli
"What is something about a dog that you watch?" (Blue's Clues)
"What is something for drawing that has many colors?" (Crayons)
"What is something with furniture that you play with?" (Doll House)
"What is something yellow that is also a vehicle?" (Bus)

during mand and intraverbal probes were used during training if the participant exhibited 80% correct mand responses and no more than 20% correct intraverbal responses during the probes.

Probe trials were also conducted to assess symmetrical intraverbal relations that were evaluated during generalization probes (Kyle only). For example, if the intraverbal pre-training probe was “What is something that is a vehicle and is yellow?” and the response was “bus”, the symmetrical intraverbal pre-training probe was “Tell me something about a bus,” and the correct response was “it is yellow,” “it is a vehicle,” or “it is a yellow vehicle.” These probes were identical to those previously described for intraverbals with the exception of the discriminative stimulus presented. They were conducted for each of the four stimuli that were used during training.

Pre-training probes were repeated prior to initiating the second evaluation of the multiple baseline design for new stimuli to be taught. All participants met the necessary criteria on pre-training probes (see Table 4).

Intraverbal Training

Baseline. During baseline, five trials were conducted for each intraverbal stimulus used during training, resulting in a total of 20 intraverbal trials per session. That is, five trials were conducted for intraverbal stimuli assigned to the transfer-of-control, instructive feedback (training stimulus and information presented as instructive feedback), and interspersal conditions, resulting in all four intraverbals being probed in one session for a total of 20 trials. Order of presentation was randomized prior to each session. During each trial, the referent item was out of the participant’s view. The experimenter presented the intraverbal stimulus (e.g., “What is something that is a vehicle and is yellow?”). Following the intraverbal stimulus, participants had 10 s to respond. Nonspecific reinforcement (i.e., praise) was delivered contingent on the targeted response (depended on the intraverbal stimulus presented). There were

Table 4

Percentage of correct responding during mand, intraverbal, and generalization pre-study probes

Participant	Mand	Intraverbal	Generalization
Greg			
Evaluation 1 Stimuli			
Bubbles	100%	0%	N/A
Movie	100%	0%	N/A
Dog	90%	0%	N/A
Water Snake	100%	0%	N/A
Evaluation 2 Stimuli			
Legos	100%	0%	N/A
Party Horn	100%	0%	N/A
Sea Anemone	90%	0%	N/A
Binoculars	100%	0%	N/A
Kyle			
Evaluation 1 Stimuli			
Train	80%	10%	0%
Thomas Video	100%	0%	0%
Race Track	90%	0%	0%
Bubbles	100%	0%	0%
Evaluation 2 Stimuli			
Music	100%	0%	0%
Play Doh	100%	0%	0%
Stickers	100%	0%	0%
Microphone	100%	0%	0%
Mary			
Evaluation 1 Stimuli			
Bears	90%	0%	N/A
Phone	100%	0%	N/A
Bubbles	80%	0%	N/A
Coins	100%	0%	N/A
Evaluation 2 Stimuli			
Blue’s Clues	100%	0%	N/A
Crayons	100%	10%	N/A
Doll House	100%	0%	N/A
Bus	90%	0%	N/A

no contingencies in place for nontargeted responses or no response. A new trial was initiated once 10 s elapsed from the presentation of the intraverbal stimulus, regardless of when a response was observed during that time. For example, if a correct response was emitted at 1 s following the presentation of the intraverbal stimulus, the experimenter waited 9 s prior to initiating a new trial. This was done to equate the length of a trial within each condition. Baseline consisted of at least three sessions and continued until stable levels of responding were observed for each of the intraverbal stimuli evaluated.

Training Probes (Transfer of Control, Instructive Feedback Training, Instructive Feedback Stimulus, and Interspersal). Prior to each series of training sessions (described below), intraverbal training probes were conducted for each intraverbal used during training and presented as instructive feedback. In other words, training probes always preceded training sessions (with the exception of the first series of training sessions). Probes were identical to baseline sessions and were conducted as a test of intraverbal acquisition in the absence of the different training conditions (e.g., mand interspersal, specific reinforcement, instructive feedback presentation). The training condition was discontinued contingent on three consecutive probe sessions with 80% correct independent intraverbal responses related to the stimulus being trained during that condition. In other words, four out of five correct independent responses for one stimulus had to be observed in order for training related to that stimulus to be discontinued. Stimuli being trained under other conditions not meeting mastery criteria remained in training until the criteria were met for those stimuli during probe sessions. All stimuli continued to be presented during the training probes regardless of whether mastery criteria were met. In other words, training probe sessions continued to alternate between all training and instructive feedback stimuli even after mastery criteria were met for one or more stimuli until all stimuli met the mastery criteria. Once the mastery criteria for all intraverbals (training and instructive feedback stimuli) were met, generalization probes were initiated (see further description below).

General Training Procedures. A progressive time delay prompting procedure was used in all training conditions (Charlop et al., 1985). The initial delay was 0 s. Following three consecutive trials with correct independent or modeled responses, the delay was systematically increased by 1 s within and across sessions until the mastery criteria were met (see Training probes above) or a 10 s delay was reached, whichever came first. If a 10 s delay was reached, prompts were discontinued following two consecutive sessions with 80% correct independent or modeled responses at the 10 s delay. Training was conducted in 30-min time blocks with at least one session for each training condition and one training probe in each session block. Participants were provided with at least a 1-min break between each session, which was necessary for the experimenter to reorganize materials.

Mand to Intraverbal Transfer-of-Control Training (Mand TC). The referent item was placed out of the participant's view. The experimenter delivered the intraverbal stimulus (e.g., "What is something that is a vehicle and is yellow?") and waited for the corresponding duration of time based on the increasing time delay procedure described above. If the participant engaged in the targeted response (e.g., "bus") within the delay following the prompt, the experimenter immediately delivered the nonspecific reinforcer (i.e., praise) while simultaneously delivering specific reinforcement (i.e., 20-s access to the referent stimulus). If the participant did not respond within the delay period, the experimenter modeled the correct response (e.g., "bus"). If the participant engaged in the targeted response prior to the end of the trial, the experimenter immediately delivered the identified nonspecific and specific reinforcers. If the participant did not respond after the model prompt and prior to the end of the trial, no consequence was delivered and the next trial was initiated. If the participant responded incorrectly at any point during the trial (i.e., engaged in a nontargeted response), the experimenter immediately delivered an error correction response (i.e., "No." followed by a model of the targeted response). No reinforcement was delivered for a targeted response following an error correction. A new trial was initiated once 10-s elapsed from the initial presentation of the intraverbal stimulus, regardless of when a response was observed during that time. For example, if a correct response was emitted at 1 s following the presentation of the intraverbal stimulus, the experimenter waited at least 9 s prior to initiating a new trial. However, following a correct independent or modeled response, the trial ended upon the termination of the reinforcement interval since it exceeded the 10 s trial limit. Following three consecutive trials with targeted independent or modeled responses, the delay to the model prompt increased by 1 s, as described above. Following five consecutive sessions with 100% independent responding, reinforcement fading would have been initiated in order to transfer control from combined intraverbal and mand to intraverbal only control. Reinforcement fading was never needed since all participants met the mastery criteria during training probe sessions prior to meeting the reinforcement fading criteria during the training sessions. Transfer-of-control sessions were discontinued contingent on three consecutive training probe sessions (described above) with 80% correct independent responding, regardless of whether specific reinforcement was completely faded out during training sessions. Generalization probes were initiated contingent on mastery of all intraverbal stimuli as described below.

Instructive Feedback Training (IF TRN). This condition was similar to the Mand TC condition with the following exceptions. First, reinforcement for independent or modeled correct responses consisted of nonspecific reinforcement only (i.e., the participant did not receive access to the referent stimulus). Second, instructive feedback related to novel intraverbal information was presented during the consequence of the learning trial. In other words, immediately following reinforcement, error correction, or the end of the 10-s trial interval with no response, the instructive feedback was delivered. For example, following the intraverbal stimulus "What's something that is green and squishy?" and the independent response "water snake", the experimenter said, "Good job." followed by, "A dog is furry and barks. [instructive feedback stimulus]." The instructive feedback stimulus (IF STIM) was chosen from items participants manded for in the natural environment and were different intraverbals from that used during training. A response to the instructive feedback stimulus was not required, and there were no consequences for responses related to it. Following three consecutive trials with correct independent or modeled responses related to the intraverbal training stimulus (IF TRN; e.g., water snake; not the IF STIM), the delay to the model prompt was increased as described above. Following three consecutive training probe sessions with 80% correct responses related to the training stimulus (i.e., IF TRN), instructive feedback training sessions were discontinued. If the mastery criteria for the intraverbal instructive feedback stimulus (i.e., three consecutive probe sessions with 80% correct independent responses related to the instructive feedback stimulus) was not reached prior to training termination, direct intraverbal training was initiated for the instructive feedback stimulus as described above for the training stimulus in this condition. However, if two consecutive probe sessions were obtained at or above 80% for the IF STIM and training was terminated for the IF TRN, one more probe session was conducted prior to initiating direct instruction to determine whether mastery would be observed (Greg and Kyle). This was done to eliminate potential confounds related to introducing direct instruction with two sessions at mastery levels of responding already obtained. Once the mastery criteria for all intraverbal stimuli were reached (with the exception of Mary), generalization probes were initiated as described below.

Mand Interspersal Training (Mand INT). Sessions were similar to the above conditions with the following exceptions. The experimenter alternated between known mand trials and unknown intraverbal trials within each session. Mand trials always preceded intraverbal trials. The identical correct response was required for the known mand trials and unknown intraverbal trials. Intraverbal trials were conducted as described above for the training stimulus in the instructive feedback condition (except that no instructive feedback was given). Mand trials began by the experimenter briefly showing the relevant stimulus to the participant and then removing the item from the participant's view. Once the item was removed from view the experimenter delivered the prompt, "What do you want?" Participants had 10 s to engage in the relevant mand (i.e., request the item briefly shown to the participant). Contingent on correct mand responses, the experimenter delivered 20-s access to the item. Incorrect responses (i.e., requests for stimuli not used in the training situation) did not result in access to the item and the intraverbal trial was initiated. If the participant did not respond within 10 s of the mand stimulus, the participant did not access the item and an intraverbal trial was initiated. Ten trials each of mands and intraverbals were conducted, for a total of 20 trials. Following three consecutive trials with independent or modeled intraverbal responses, the delay to the model prompt was increased as described above. Following three consecutive interspersal training probe sessions with 80% independent targeted intraverbal responses, interspersal sessions were discontinued. Once the mastery criteria for all intraverbal stimuli were reached, generalization probes were initiated as described below.

Generalization Probes (GEN). Generalization probes related to the intraverbals taught during training or presented as instructive feedback were conducted following acquisition of all intraverbals in order to evaluate whether participants acquired symmetrical intraverbal responses related to the training stimuli and instructive feedback stimulus. Generalization probes were similar to baseline and training probe sessions with five trials conducted for each trained intraverbal stimulus (training and instructive feedback), resulting in a total of 20 intraverbal trials per session. However, for each intraverbal taught during training, the experimenter delivered a novel but related intraverbal stimulus. For example, if during training the individual was taught to respond to “What is something you sing into that makes you louder?” with “microphone,” the generalization probe consisted of “Tell me something about a microphone.” with the correct response(s) being “you sing into it,” “it makes you louder,” or a combination of the two. At least five generalization probe sessions were conducted (Mary’s first evaluation was the only exception).

Maintenance Probes (MTN). Maintenance probe sessions were conducted for all participants (except for Mary’s first evaluation) following the generalization probes for each condition. Maintenance probes were identical to baseline sessions and were conducted for the stimuli taught in each condition. Maintenance probes were conducted one week following the last generalization probe with the exception of evaluation one for Kyle. Kyle’s evaluation one maintenance probe was conducted six weeks following the generalization probes due to a scheduled two week school closure that was immediately followed by temporary closure due to weather related problems. One maintenance probe was conducted for each evaluation.

RESULTS

Results of Greg's probe sessions are presented in Figure 1. Recall that probe sessions were implemented immediately prior to the daily baseline or training sessions (with the exception of the first training day) to assess acquisition of the intraverbals outside of the training conditions. Before training, Greg never engaged in correct intraverbal responses (*M* = 0%) with either stimulus set. During training of the first stimulus set, mean levels of correct intraverbal responses during the training probes were similar across conditions (Mand TC and Mand INT, *M* = 42.9%; IF TRN, *M* = 37.1%) and for the IF STIM (*M* = 40%). During training of the second stimulus set, intraverbal responding was highest for the IF STIM (*M* = 100%) and for the Mand TC condition (*M* = 93.3%). Lower levels of correct responding were observed for the Mand INT condition (*M* = 80%). The lowest levels of correct responding were observed for the IF TRN stimulus (*M* = 70%). There were slight differences across conditions in terms of generalization during both evaluations. The highest levels of generalized responding during Evaluation 1 were associated with the Mand TC condition (*M* = 100%), IF STIM (*M* = 96%), and Mand INT condition (*M* = 92%). During the second evaluation, the highest levels of generalized responding were observed under the Mand INT condition (*M* = 90%). Similar levels of generalized responding were observed for the remaining three stimuli (Mand TC, *M* = 77.5%; IF TRN and IF STIM, *M* = 75%). In terms of maintenance, responding was identical across both evaluations for each condition. The IF TRN condition was associated with slightly lower levels of correct responding (80%) relative to the Mand TC (100%), Mand INT (100%), and IF STIM (100%) conditions.

Figure 2 displays data from Greg's training sessions. Under training conditions, higher, more stable levels of independent responding were observed under the Mand TC condition during both evaluations (*M* = 70% and *M* = 83.3% for Evaluations 1 and 2 respectively). During

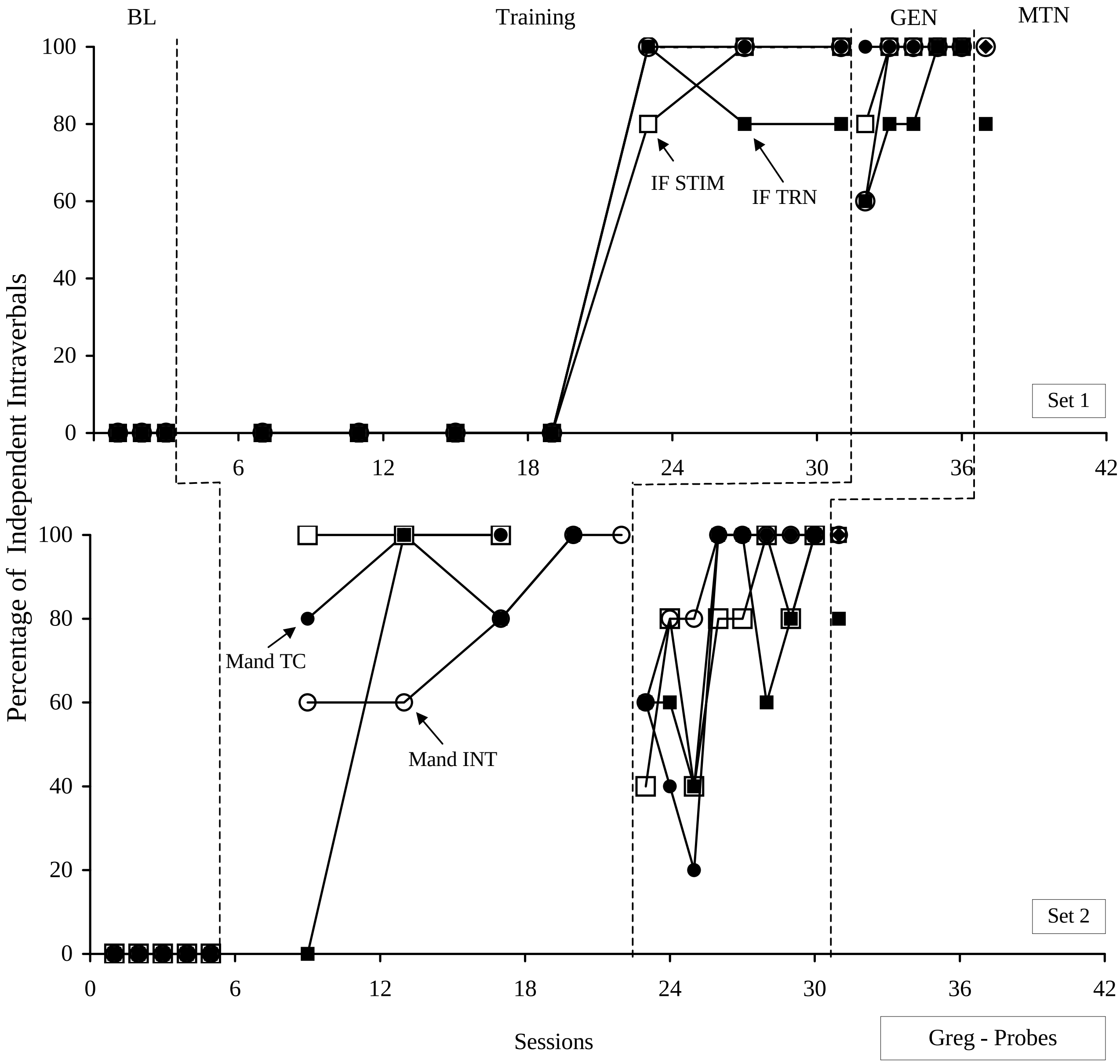

Figure 1. Percentage of Greg's independent intraverbals during probe sessions.

the first evaluation, similar levels of responding were observed during Mand INT (*M* = 30%) and IF TRN (*M* = 24.3%) training sessions. More stable levels of responding were also observed under the Mand INT condition (*M* = 80%) compared to the IF TRN condition (*M* = 65%) during the second evaluation.

The number of training sessions needed to meet the mastery criteria for Greg is presented in Figure 3. Across evaluations, fewer training sessions were needed to master the intraverbals during the second evaluation (second stimulus set) relative to the first evaluation (first stimulus set) for all training conditions. During Evaluation 1, the same number of sessions was needed for stimuli trained under all conditions (n = 7). During Evaluation 2, a similar number of sessions were needed across all stimuli (Mand TC, n = 3; Mand INT, n = 5; IF TRN, n = 4).

The duration of Greg's training sessions are presented in Figure 4. Data represent the average session duration for all training sessions in each condition across evaluations. Overall, IF TRN training sessions took less time to implement (*M* = 3.1 min) relative to both types of Mand sessions. In addition, Mand TC sessions took less time to implement (*M* = 5.3 min) than Mand INT sessions (*M* = 7.4 min).

Kyle's training probe sessions are presented in Figure 5. Mean levels of responding during baseline were 0% across both evaluations and all conditions. Mean levels of correct intraverbal responses during the first evaluation training probes were similar across Mand INT (*M* = 48.9%) and IF TRN (*M* = 47.5%) conditions, with slightly lower levels observed under the Mand TC condition (*M* = 35%). Kyle also met mastery criteria for the IF STIM without specific training during Evaluation 1, but levels of responding were lower than those observed under training conditions (*M* = 31.1%). During the second evaluation, the most stable levels of responding were observed for the Mand TC condition (*M* = 80%). Slightly lower levels of responding were observed under the Mand INT (*M* = 72%) and IF TRN (*M* = 72%) conditions.

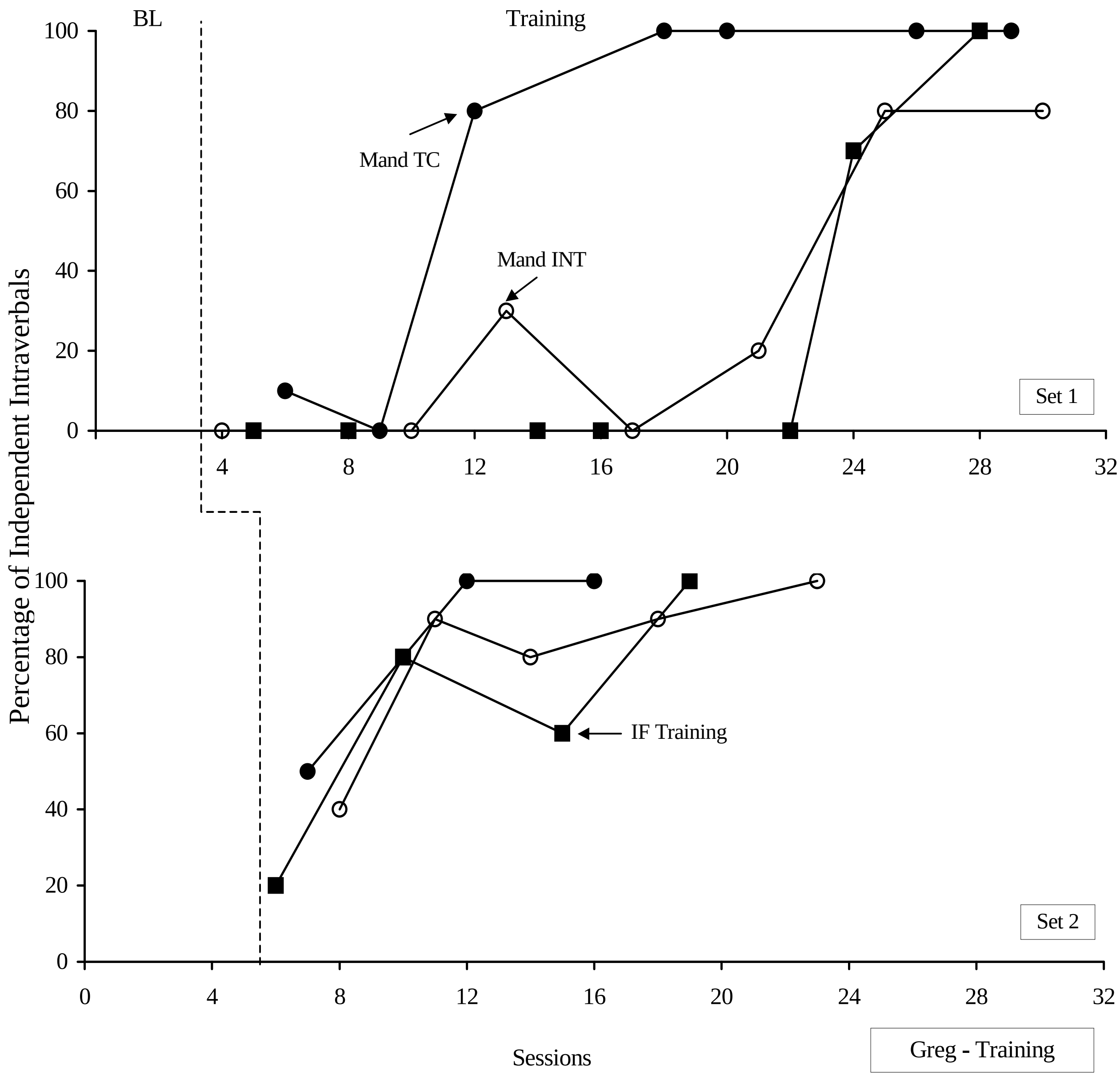

Figure 2. Percentage of Greg's independent intraverbals during training sessions.

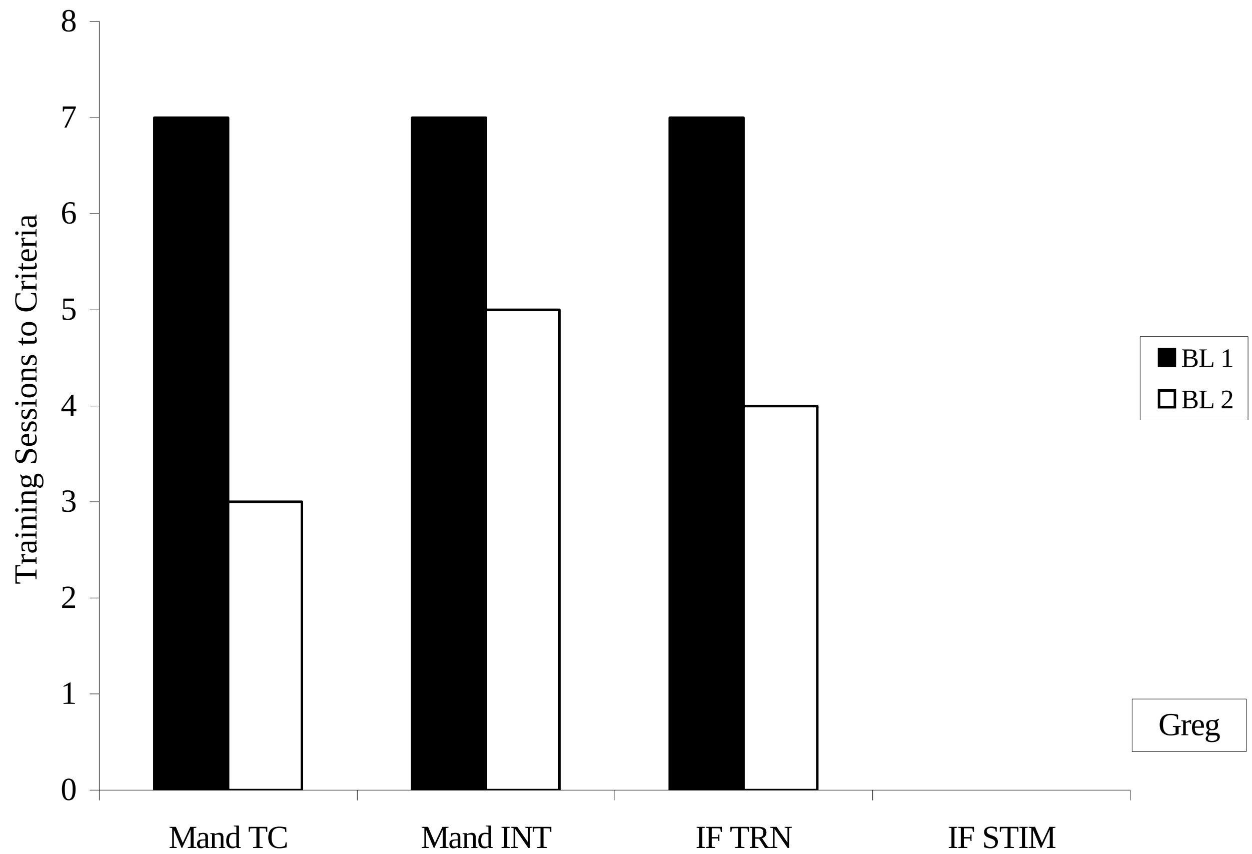

Figure 3. The number of sessions needed to meet mastery criteria for Greg.

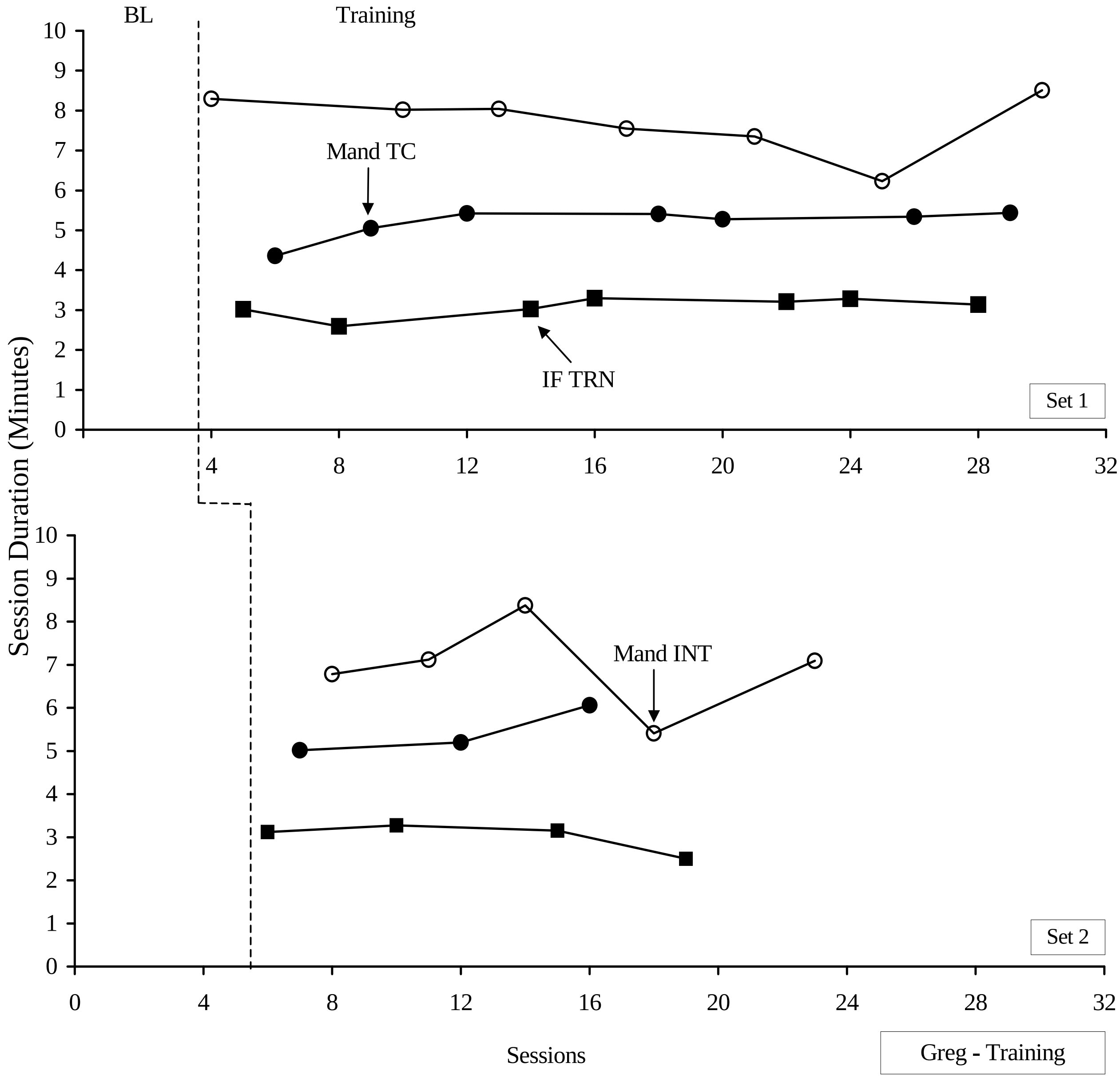

Figure 4. Training session durations for Greg.

He also met mastery criteria for the IF STIM, but again the lowest, most inconsistent levels of responding were observed (*M* = 52%). Generalized responding was not observed for any stimulus during the first evaluation, regardless of the training condition (*M* = 0%). During the second evaluation, however, generalized responding was observed, with similar levels of responding across training conditions (Mand TC, *M* = 88%; Mand INT, *M* = 88%; IF TRN, *M* = 84%; and IF STIM, *M* = 92%). Maintenance of responding was observed for Mand INT (80%) and IF STIM (100%), but not for Mand TC (0%) or IF TRN (0%) stimuli for the first evaluation. Similar levels of maintenance were observed during Evaluation 2 across all training conditions (Mand TC, Mand INT, and IF TRN = 100%; IF STIM = 80%).

Data from Kyle's training sessions are presented in Figure 6. The highest levels of independent responding during the first evaluation were observed under the Mand INT (*M* = 68.9%) condition, followed by the IF TRN condition (*M* = 56.3%). The Mand TC condition was associated with the lowest overall levels of responding (*M* = 46.3%). Different patterns of responding were observed during the second evaluation, with the highest levels of responding associated with the Mand TC condition (*M* = 90%). The IF TRN condition was associated with the second highest levels of responding (*M* = 72.5%). The lowest levels of responding during Evaluation 2 were observed under the Mand INT condition (*M* = 32%), with an overall decreasing trend in responding observed across sessions.

Figure 7 shows the number of training sessions Kyle needed to meet the mastery criteria. During both evaluations, a similar number of sessions was needed across all stimuli; however, fewer sessions were needed to master the intraverbals in Evaluation 2 relative to Evaluation 1 (Mand TC Evaluation 1, n = 8 and Evaluation 2, n = 3; Mand INT Evaluation 1, n = 9 and Evaluation 2, n = 5; IF TRN Evaluation 1, n = 8 and Evaluation 2, n = 4).

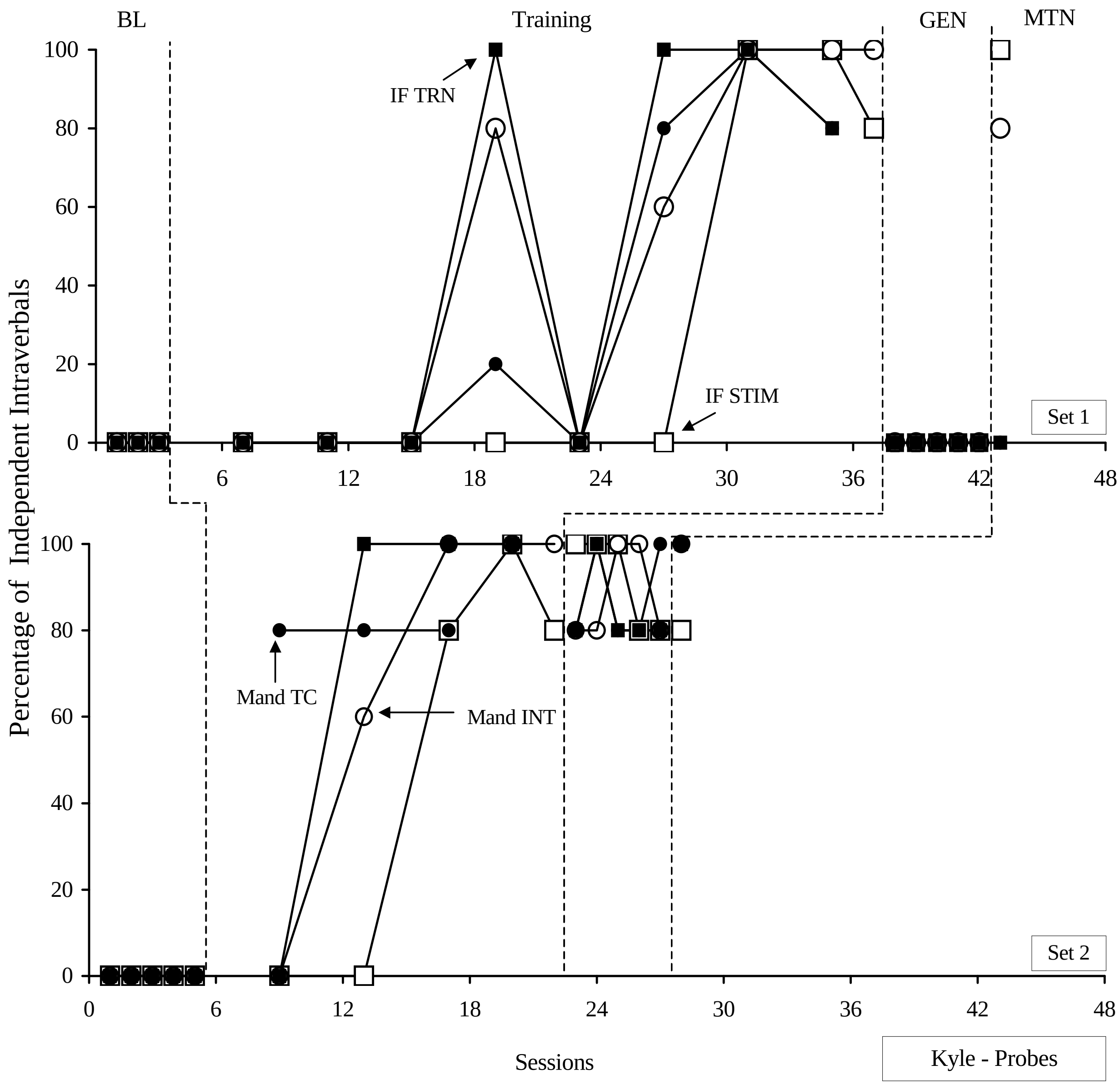

Figure 5. Percentage of Kyle's independent intraverbals during probe sessions.

Figure 8 displays the duration of Kyle's training sessions. Data represent the average session duration for all training sessions in each condition across evaluations. Like Greg, IF TRN training sessions took the least amount of time to implement (*M* = 2.9 min). In addition, lower durations were associated with Mand TC sessions relative to Mand INT sessions (*M* = 6.5 min and *M* = 8.2 min, respectively).

Results of Mary's training probe sessions are presented in Figure 9. Mary never engaged in correct intraverbal responses during baseline (*M* = 0%). During Evaluation 1, similar levels of responding were observed across all training conditions (Mand TC, *M* = 38%; Mand INT, *M* = 36%; IF TRN, *M* = 34%). Mastery criteria were not met for the IF STIM when presented as instructive feedback during the training sessions (*M* = 0%) or following direct instruction (*M* = 4%). During Evaluation 2, the highest levels of correct intraverbal responses were observed for the Mand INT and Mand TC conditions (*M* = 62% and 56%, respectively). The lowest levels of responding were observed for the IF TRN condition (*M* = 41.8%). In addition, Mary never met the mastery criteria for the IF STIM during the second evaluation prior to and after direct instruction (*M* = 1.5% and *M* = 0%, respectively). Unlike Greg and Kyle, she did not demonstrate generalized responding for any intraverbal stimulus during either evaluation (*M* = 0%). Responding during maintenance probes was slightly higher for stimuli trained under Mand INT and IF TRN conditions (100%) relative to the Mand TC condition (80%).

Data from Mary's training sessions are presented in Figure 10. During the first evaluation, correct responding increased more rapidly under the Mand INT and Mand TC conditions. The Mand INT condition produced the highest levels of responding (*M* = 91%) and the Mand TC condition was associated with the second highest levels of responding (*M* = 77%). For the second evaluation, a similar pattern of responding was observed, with the Mand INT and Mand TC conditions producing the highest levels of responding (*M* = 68%). For both

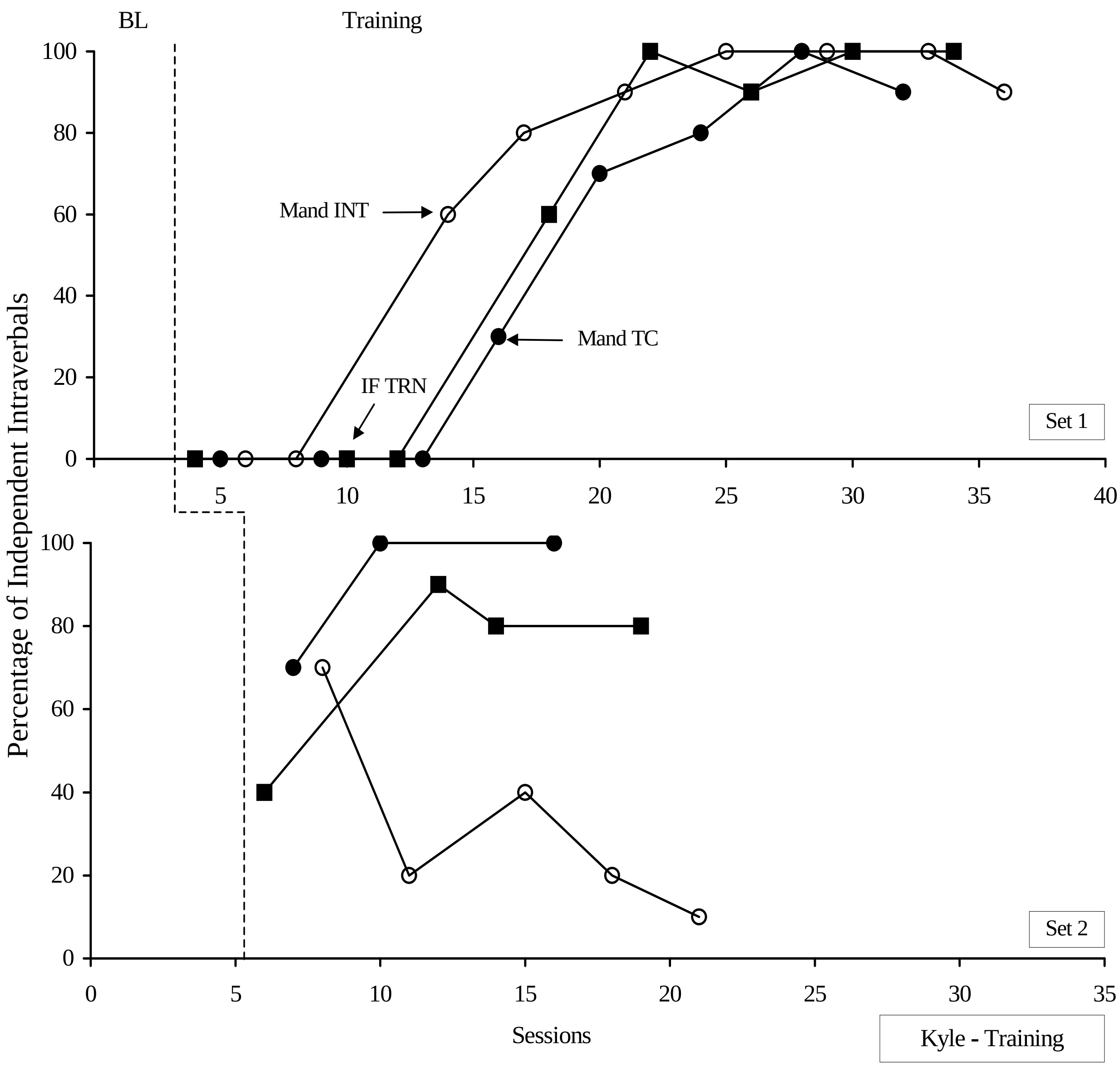

Figure 6. Percentage of Kyle's independent intraverbals during training sessions.

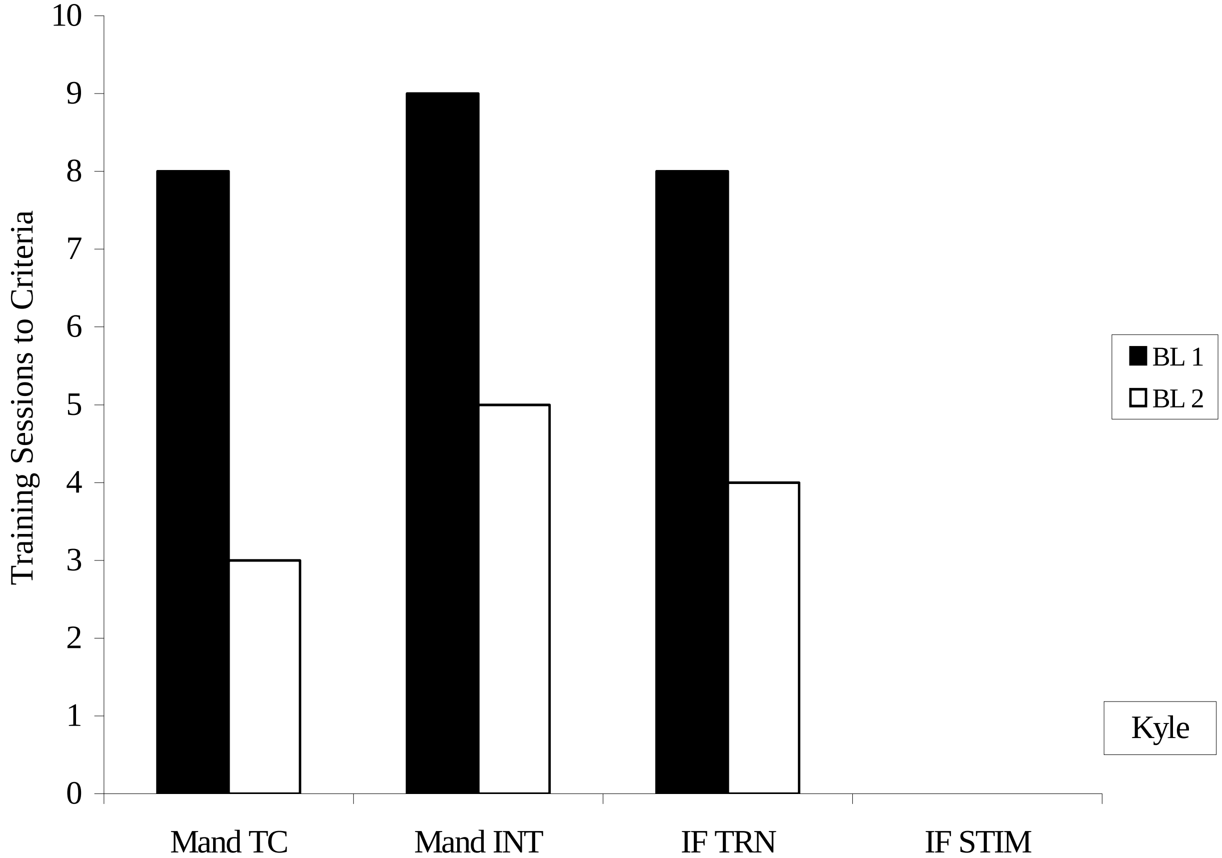

Figure 7. The number of sessions needed to meet mastery criteria for Kyle.

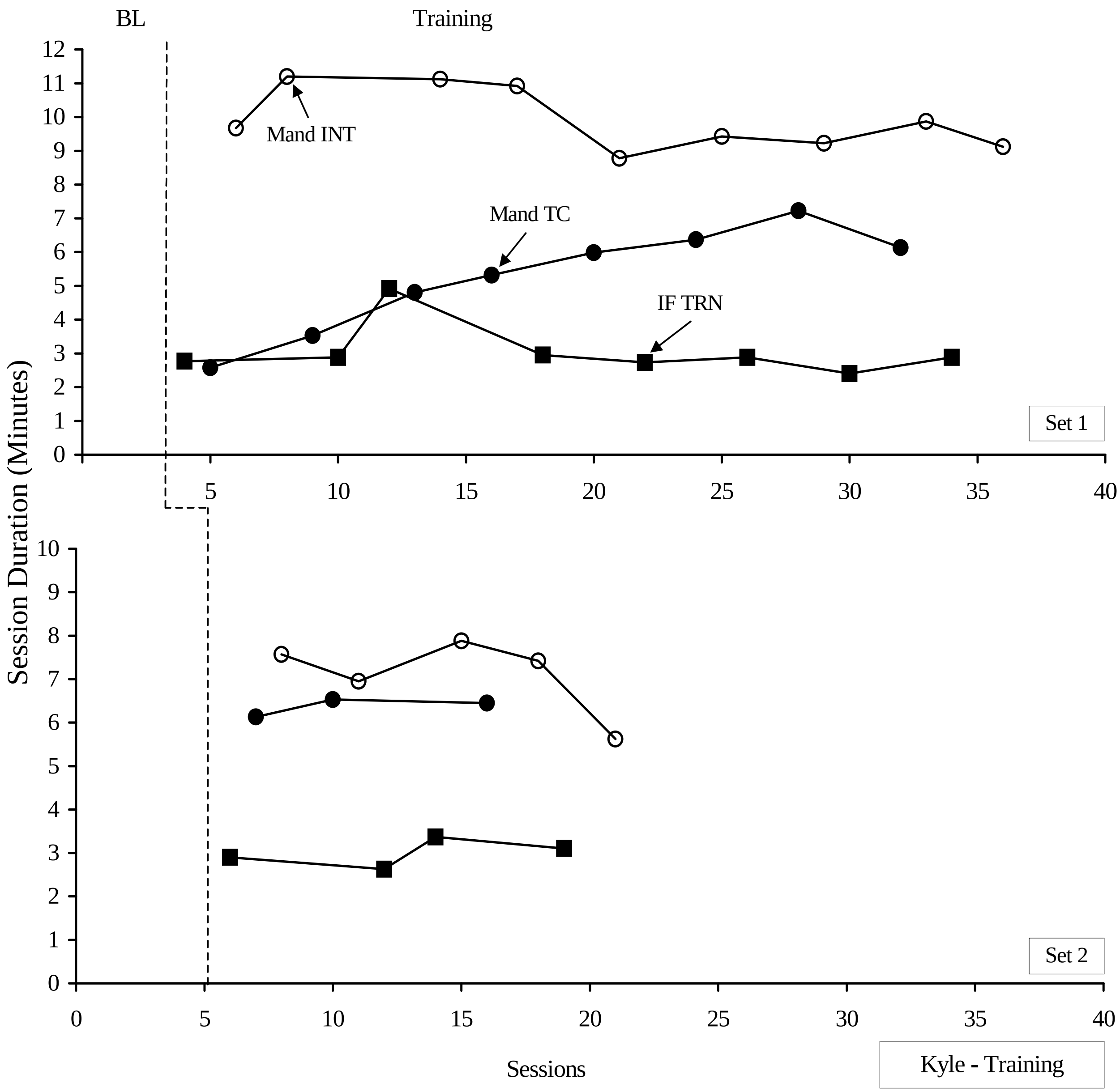

Figure 8. Training session durations for Kyle.

evaluations, the IF TRN condition produced the lowest levels of responding (Evaluation 1, M = 48%; Evaluation 2, M = 41.8%). When training was initiated for the IF STIM, responding remained low, and Mary never met the mastery criteria during either evaluation (Evaluation 1, M = 20%; Evaluation 2, M = 0%). The number of training sessions Mary required to meet mastery criteria is presented in Figure 11. During the first evaluation, the same number of sessions was needed for all stimuli (n = 10). During the second evaluation, fewer sessions were required for the stimuli trained under the Mand TC and Mand INT conditions (n = 5) compared to the IF TRN condition (n = 11).

The duration of Mary's training sessions are presented in Figure 12. Data represent the average session duration for all training sessions in each condition across evaluations. Generally, IF TRN training sessions took less time to implement (M = 3.2 min) relative to Mand TC and Mand INT sessions. Comparisons of Mand TC and Mand INT sessions indicate that Mand TC sessions took less time to implement (M = 6.2 min) relative to Mand INT sessions (M = 8.0 min).

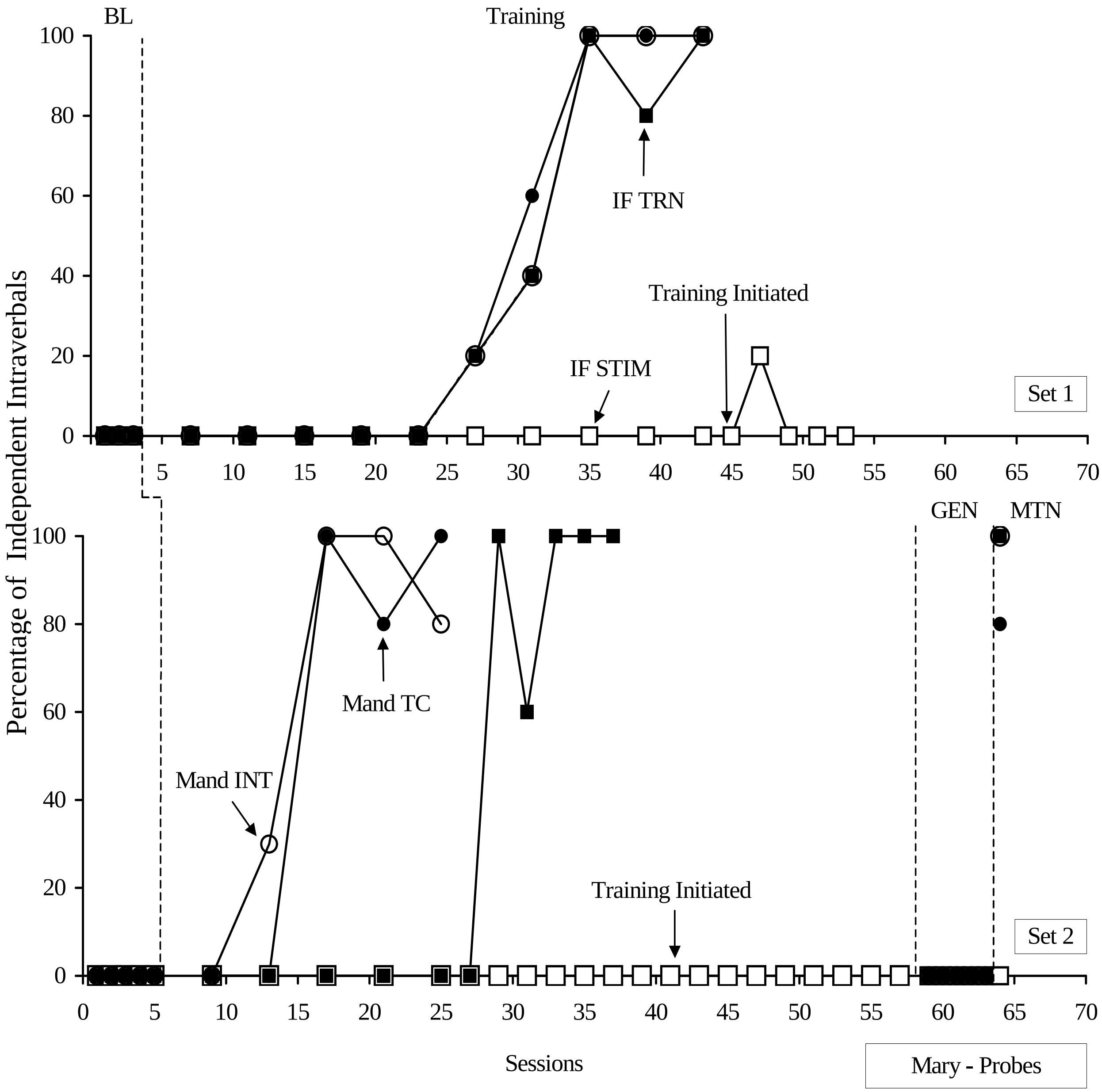

Figure 9. Percentage of Mary's independent intraverbals during probe sessions.

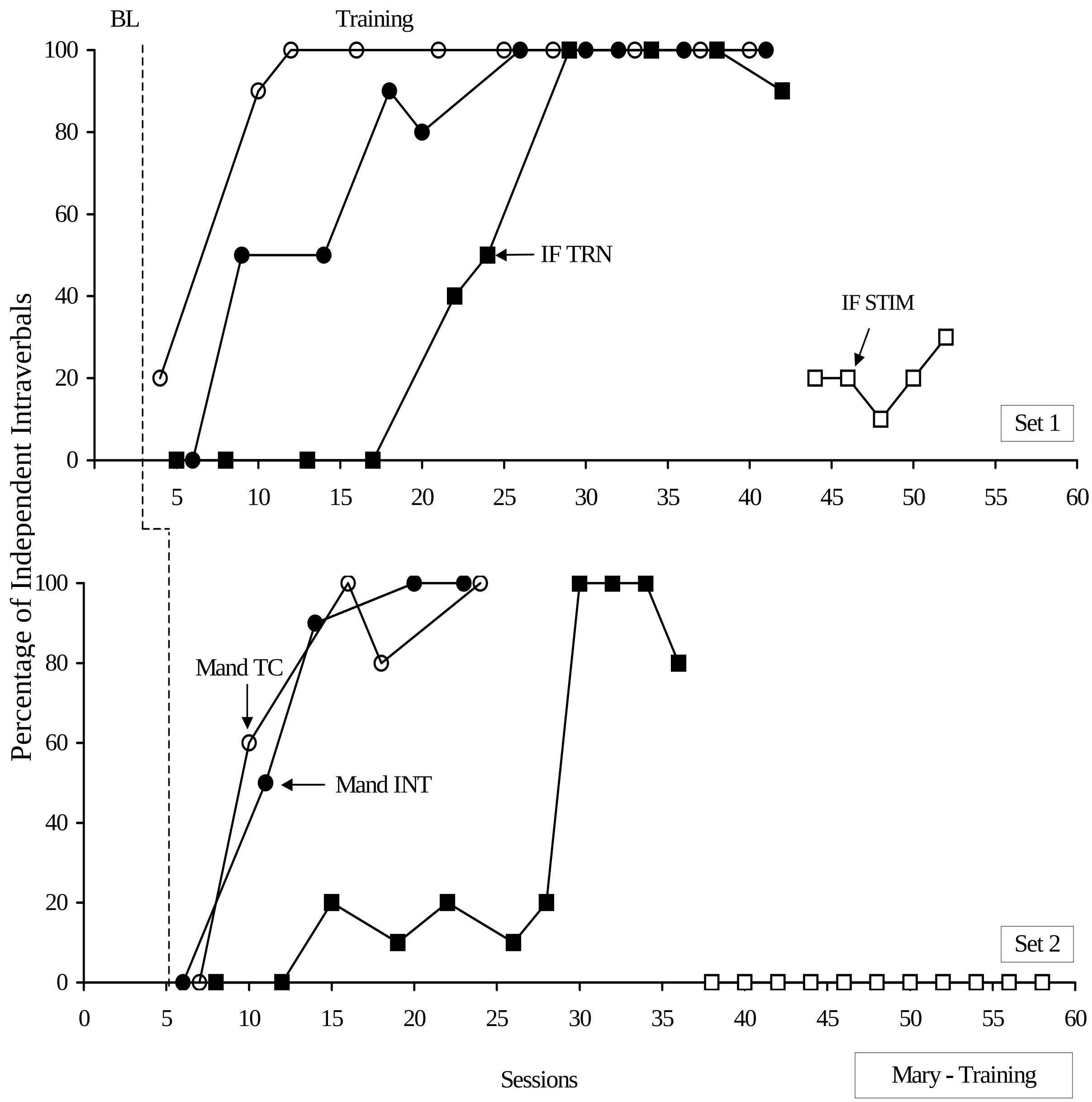

Figure 10. Percentage of Mary's independent intraverbals during training sessions.

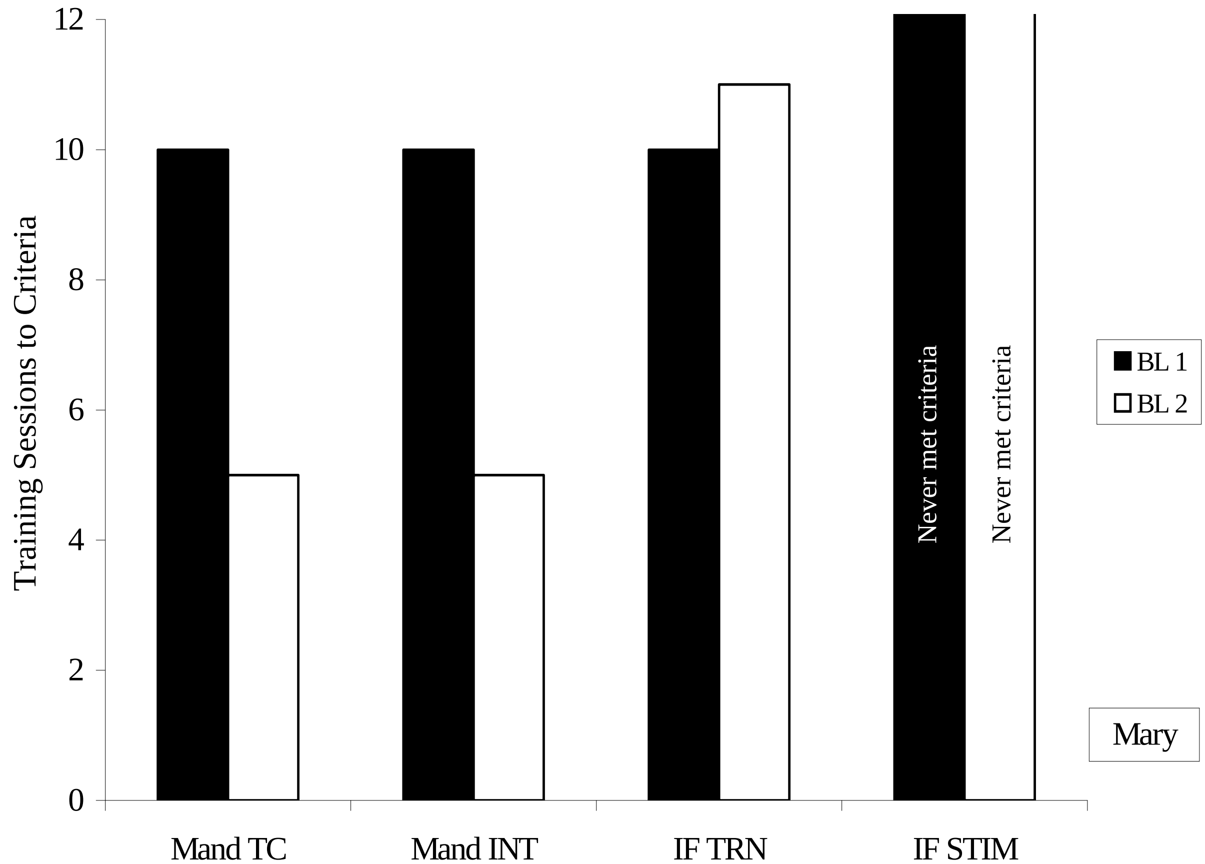

Figure 11. The number of sessions needed to meet mastery criteria for Mary.

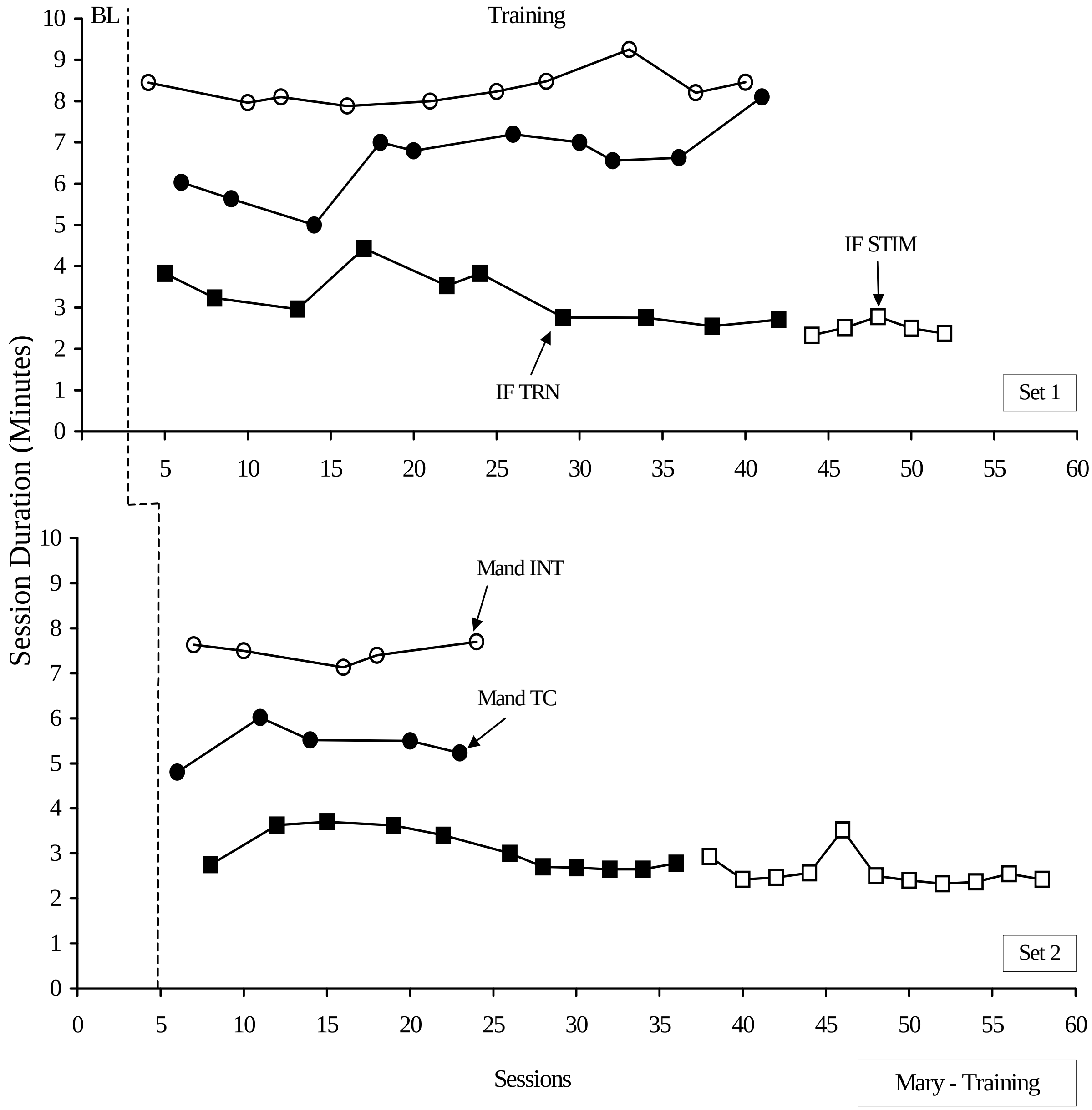

Figure 12. Training session durations for Mary.

DISCUSSION

The current investigation evaluated the efficacy of three methods for teaching intraverbals to children with language delays. Results suggested that all three methods were effective. Participants generally required a similar number of training sessions to meet the mastery criteria for the intraverbals taught under each training condition. However, the instructive feedback sessions took less time to complete than both mand conditions, and the mand transfer of control sessions took less time than the mand interspersal sessions. Results also indicate that two participants (Greg and Kyle) acquired intraverbals presented as instructive feedback without specific training. Finally, all participants demonstrated faster acquisition during Evaluation 2 relative to Evaluation 1.

Results suggest some important clinical implications for the selection of training methods during verbal behavior instruction. While differences were not observed across training conditions in terms of the number of sessions needed to meet the mastery criteria, session durations differed significantly. The instructive feedback sessions were the most efficient to conduct, followed by the mand transfer-of-control sessions. Clinicians and educators might consider choosing the most efficient strategy to maximize instructional time. On the other hand, Sundberg and Michael (2001) suggested that mand training is frequently reported to be more enjoyable than instruction involving other verbal operants. Generally, decreased levels of inappropriate behavior and increased willingness to participate in mand language training programs are reported by parents and therapists (Sundberg & Michael). Anecdotally, participants in the current investigation appeared to enjoy mand sessions more than instructive feedback sessions in that they expressed more enthusiasm by clapping and smiling when they received access to preferred items. Thus, incorporating mands into training might be beneficial even if instructional sessions take a little longer to complete.

On the other hand, the mand interspersal condition did not enhance training outcomes and was associated with the longest session durations. These results contradict previous research on interspersal procedures in that no benefits were observed by alternating a presumably higher quality reinforcer for the known task (i.e., specific reinforcement for the mand) with a presumably lower quality reinforcer for the unknown task (i.e., praise for the intraverbal; e.g., Mace et al., 1997; Volkert et al., 2008). Because specific reinforcement was never directly compared to praise to determine whether a qualitative difference existed, it is possible that access to the stimulus used during mand interspersal sessions did not represent a higher quality reinforcer than praise. In addition, praise was not paired with specific reinforcement during the interspersal task. Benefits may have been observed had the two types of reinforcement been combined. However, the mand transfer of control condition did combine specific reinforcement with praise and no benefits were observed in terms of response acquisition.

An unexpected outcome related to the mand interspersal training sessions was also observed during Kyle's second evaluation. When training was initiated, correct intraverbal responding was observed at generally high levels (i.e., 70% in the first training session). Mand responses were also high (i.e., 80%; data not presented). Following the first training session, both mand and intraverbal responding began to decrease. In fact, Kyle met the mastery criteria for this target during the training probes even though intraverbal responding continued to decrease across the training sessions. Interaction effects across conditions may provide one possible explanation for the decrease in correct responding during these training sessions. The incorrect responses emitted during these sessions were related to the stimuli used in other training conditions. For example, Kyle would often respond with the word "music" during these sessions, which was the item used in the Mand TC training condition. Music also was the highest ranked item from the preference assessment. In contrast, the reinforcer delivered for correct responses during interspersal sessions (the microphone) was the lowest ranked item in the paired choice assessment. Thus, it appears that the MO for microphone and music were both present during the interspersal sessions, which may have influenced which response was emitted during each trial.

While the overall findings are inconsistent with those of previous research utilizing combined training methods (e.g., Arntzen & Almås, 2002; Carroll & Hesse, 1987; Finkel & Williams, 2001; Partington & Bailey, 1993; Volkert et al., in press; Wolery, 1991), results extend previous research in several ways. First, this investigation extends the results of Arntzen and Almås and Carroll and Hesse by evaluating a similar procedure (mand interspersal) while teaching intraverbal behavior. Although the current investigation utilized known mands instead of unknown mands, the inclusion of the unique controlling variables of the mand was the same. Results support the conclusions made by Arntzen and Almås, who found that incorporating mands into training did not produce better retention (a finding that contradicted that of Carroll and Hesse). Nonetheless, both studies mentioned above found that incorporating mands into training resulted in faster acquisition of tacts, an outcome that was not replicated in the current investigation of intraverbal acquisition. In addition, the current investigation improved on these previous studies by utilizing a more stringent method for assessing mastery. That is, the experimenter probed for mastery outside of training conditions in the current study whereas performance was evaluated only during training sessions in previous studies. Thus, the results obtained in the Arntzen and Almås and Carroll and Hesse investigations under the mand-tact condition may not have represented pure tact behavior since tacts were not probed outside of the combination training procedure.

This investigation also extends previous research on the use of transfer-of-control procedures to teach verbal behavior. For example, previous research evaluating transfer-of-control procedures for teaching intraverbals has focused on transfer of control from echoic, tact, and textual prompts to intraverbal stimuli (e.g., Finkel & Williams, 2001; Partington & Bailey, 1993). The current investigation demonstrated the efficacy of transferring control from the MO associated with mands to the verbal discriminative stimulus of the intraverbals. Although the instructive feedback condition was equally effective, using a mand to intraverbal (or other verbal operant) transfer-of-control procedure may represent a procedure that is more in line with the natural progression of language development (Drash et al., 1999) and may increase the social validity of instruction.

It is possible, however, that other types of transfer-of-control procedures (e.g., echoic to intraverbal) would yield more efficient outcomes than mand transfer of control, particularly if problems were encountered when fading out the specific reinforcer. Results of the current investigation, however, suggest that fading specific reinforcement may not be necessary. Every participant engaged in pure intraverbal responses during the probe sessions in the absence of reinforcement fading during the training sessions. Thus, mand transfer-of-control procedures may be just as efficient, or even more efficient, than other transfer-of-control procedures.

Finally, previous research was extended by evaluating the use of instructive feedback to promote intraverbal acquisition. While previous instructive feedback research has focused on academic targets (e.g., vocabulary recognition), the current study extends this methodology to verbal behavior. Results are consistent with the instructive feedback literature in that mixed results were obtained (see Werts, 1995, for a review). Two of the three participants (Greg and Kyle) demonstrated acquisition of intraverbals presented as instructive feedback without specific training. One participant did not acquire those intraverbals presented as instructive feedback (Mary) even when direct instruction was introduced. Anecdotally, it was noted that Mary often responded to the instructive feedback stimulus with the response that had been reinforced during teaching. It is possible that pairing reinforcement with the instructive feedback information while training the intraverbal interfered with acquisition of the instructive feedback information. This interference may have continued even when specific training was introduced. The results for Mary, however, contradict previous research on instructive feedback (e.g., Holcombe et al., 1993; Wolery et al., 1991). One of the most consistent findings has been that less training is needed to teach individuals the information presented as instructive feedback compared to information not previously presented as instructive feedback. Nonetheless, the results for Mary should be viewed with caution because they were not replicated. In addition, the direct teaching phase was discontinued before she mastered the intraverbal due to time constraints presented by her impending and premature discharge from the program.

Several factors could be responsible for the failure to replicate previous research in this area (e.g., Arntzen & Almås, 2002; Carroll & Hesse, 1987). First, unlike previous investigations incorporating mands into training, this investigation interspersed known mands with unknown intraverbals. In both of the previously mentioned studies, the authors interspersed unknown mands and unknown tacts. Thus, the participants were taught the mand and tact for stimuli simultaneously. It is possible that similar outcomes would have been obtained had unknown mands been taught simultaneously with unknown intraverbals in the current investigation. However, in previous studies, the benefits of incorporating mands into tact training were attributed, at least in part, to the unique controlling features of the mand (e.g., the use of MO's and specific reinforcement). These same unique controlling features were present in the current investigation during the mand interspersal condition. It is also possible that similar outcomes were not observed due to the difference in the verbal operants being taught. The tact represents a response evoked by a nonverbal discriminative stimulus (e.g., the stimulus or picture of the stimulus) whereas the intraverbal is evoked by a verbal discriminative stimulus that is different from the response being required (e.g., a question about the stimulus). Thus, the intraverbal may represent a more abstract verbal operant compared to the tact or the mand. Results indicated, however, that incorporating mands into intraverbal training did not hinder acquisition of intraverbals, just that it did not enhance acquisition.

Differences previously described regarding how mastery was assessed in prior research may also account for the discrepant findings. Data collected during the training sessions in the current investigation indicated that participants generally began to respond more quickly under one or both of the mand conditions relative to the instructive feedback condition, which supports previous findings. Nonetheless, the mastery criterion was based on performance during the training probes instead of performance during the training sessions. This was done to ensure that intraverbal behavior was solely under control of the verbal discriminative stimulus before completing the evaluation.

Results of the generalization probes also were inconsistent across participants. Only one participant (Greg) consistently demonstrated symmetrical intraverbal responses during probes, and similar outcomes were obtained for all training conditions. Kyle demonstrated generalized responding, but only during Evaluation 2. Mary did not show this type of generalized responding. The lack of generalization for Kyle (Evaluation 1) and Mary is not surprising because no methods were included to promote generalized behavior change (Stokes & Baer, 1977). In other words, the current investigation took a "train and hope" approach to generalization in that training was initiated to teach specific behaviors and then tested to see if generalization occurred. According to Stokes and Baer, train and hope methodology does not represent a true method of programming for generalization.

Some limitations of the current investigation should be noted. First, the number and type of intraverbals that could be taught via the mand transfer of control and interspersal procedures were limited because the intraverbals had to be related to highly preferred stimuli that could be delivered during training. Many types of important intraverbals are not directly related to preferred stimuli or represent more abstract concepts (e.g., “What is your name?”). Using mands when teaching intraverbals, however, may give clinicians a starting point for increasing individuals’ intraverbal repertoires. In addition, some authors have suggested that initial intraverbal instruction should focus on things that interest the individual (Sundberg & Partington, 1998).

The methodology used during the reinforcer assessment represents an additional limitation. That is, the procedures utilized do not allow for a clear demonstration of reinforcement effects because prompts were combined with possible punishment of incorrect responses (i.e., stating “No.”). A better method would have been to select a response that occurred at a low level in the absence of prompts, deliver praise contingent on the response, and observe the effects of praise delivery on response rate. However, the procedures used in the reinforcer assessment were identical to the basic methods used across all training conditions and thus demonstrated that the procedure was effective for teaching new responses to each participant. An additional limitation is that the current investigation superimposed interspersal and mand transfer-of-control procedures on top of a general training procedure that included time delay, which is another method for transferring stimulus control. Thus, additional benefits may not have been observed because the same effective prompt fading procedure was used in all training conditions.

Another limitation is that pre-training generalization probes were conducted for one participant only (Kyle). Because Mary did not demonstrate generalized responding, it can be hypothesized that she would not have demonstrated such responding prior to the investigation. Greg, however, did demonstrate generalized responding, making it impossible to determine whether the symmetrical intraverbal responses were acquired during training or whether they were already in his repertoire. The limited amount of data presented for Mary represents an additional limitation. Results of her first evaluation were consistent with those of the other participants in that differences between conditions were not observed; however, this finding was not replicated with her second evaluation. Finally, the age of one participant (Greg) differed significantly from that of the other two participants. However, all participants demonstrated similar ability levels based on the ABLLS-R, and the results were fairly consistent across participants with the exception of the generalization probes.

There are several areas of future research suggested by the outcomes of the current investigation. First, future research could address the social validity of the various instructional procedures by collecting data on the children's inappropriate behavior during training and by having educators rate the acceptability of the various methodologies. Educators also could be asked to choose among the various methods. More research also is needed to directly compare the outcomes of various transfer-of control procedures, including those involving echoic, tact, and textual prompts, as well as stimuli associated with mands. Strategies to promote symmetrical intraverbal responses also should be evaluated in future research. It is possible that generalized responding would be enhanced though the use of multiple exemplar training or naturalistic training conditions (e.g., embedded instruction).

Overall, the current investigation extends previous research on verbal behavior by demonstrating the efficacy of teaching intraverbals via three common teaching methods previously used to teach other verbal operants. In addition, it provides a preliminary evaluation of training methods that can be used to enhance the efficiency of direct instruction for intraverbal behavior in terms of the amount of time needed to implement various instructional methodologies.

REFERENCES

Arntzen, E., & Almås, I. K. (2002). Effects of mand-tact training on the acquisition of tacts. *Journal of Applied Behavior Analysis, 35*, 419-422.

Braam, S. J., & Poling, A. (1983). Development of intraverbal behavior in mentally retarded individuals through transfer of stimulus control procedures: Classification of verbal responses. *Applied Research in Mental Retardation, 4*, 279-302.

Carroll, R. J., & Hesse, B. E. (1987). The effects of alternating mand and tact training on the acquisition of tacts. *The Analysis of Verbal Behavior, 5*, 55-65.

Charlop, M. H., Kurtz, P. F., & Milstein, J. P. (1992). Too much reinforcement, too little behavior: assessing task interspersal procedures in conjunction with different reinforcement schedules with autistic children. *Journal of Applied Behavior Analysis, 25*, 795-808.

Charlop, M. H., Schreibman, L., & Thibodeau, M. G. (1985). Increasing spontaneous verbal responding in autistic children using a time delay procedure. *Journal of Applied Behavior Analysis, 18*, 155-166.

Chase, P. N., Johnson, K. R., & Sulzer-Azaroff, B. (1985). Verbal relations within instruction: Are there subclasses of the intraverbal? *Journal of the Experimental Analysis of Behavior*, *43*, 301-313.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis, 2nd Ed*. New Jersey: Prentice-Hall Inc.

Daly, P. M. (1987). A description of the verbal behavior of students during two reading instruction methods. *The Analysis of Verbal Behavior, 5*, 67-76.

Drash, P. W., High, R. L., & Tudor, R. M. (1999). Using mand training to establish and echoic repertoire in young children with autism. *The Analysis of Verbal Behavior,16*, 29-44.

Dunlap, G. (1984). The influence of task variation and maintenance tasks on the learning and affect of autistic children. *Journal of Experimental Child Psychology, 37*, 41-64.

Finkle, A. S., & Williams, R. L. (2001). A comparison of textual and echoic prompts on the acquisition of intraverbal behavior in a six-year-old boy with autism. *The Analysis of Verbal Behavior, 18*, 61-70.

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. H., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*, 491-498.

Hart, B. M., & Risley, T. R. (1968). Establishing the use of descriptive adjectives in the spontaneous speech of disadvantaged preschool children. *Journal of Applied Behavior Analysis, 1*, 109-120.

Hart, B., & Rogers-Warren, A. (1978). A milieu approach to teaching language. In R. Schiefelbusch (Ed.). *Language Intervention Strategies*. Baltimore: University Park Press.

Hecht, B. F. (1986). Language disorders in preschool children. *Advances in Special Education, 5*, 95-119.

Holcombe, A., Wolery, M., Werts, M. G., & Hrenkevich, P. (1993). Effects of instructive feedback on future learning. *Journal of Behavioral Education, 3*, 259-285.

Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language teaching paradigm for nonverbal autistic children. *Journal of Autism and Developmental Disorders, 17*, 187-200.

Lerman, D. C., Parten, M., Addison, L., Vorndran, C., Volkert, V. & Kodak, T. (2005). A methodology for assessing the functions of emerging speech in children with developmental disabilities. *Journal of Applied Behavior Analysis*, *38*, 303-31.

Lovass, O. I. (1977). *The autistic child: Language development through behavior modification*. New York: Irvington.

Luciano, M. C. (1986). Acquisition, maintenance, and generalization of productive intraverbal behavior through transfer of stimulus control procedures. *Applied Research in Mental Retardation, 7*, 1-20.

Mace, F. C., Mauro, B. C., Boyajian, A. E., & Eckert, T. L. (1997). Effects of reinforcer quality on behavioral momentum: coordinated applied and basic research. *Journal of Applied Behavior Analysis, 30,* 1-20.

Maurice, C., Green, G., Luce, S. C. (1996). *Behavioral intervention for young children with autism: A manual for parents and professionals*. Austin, TX: PRO-ED, Inc.

McDowell, E. E. (1968). A programmed method of reading instruction for use with kindergarten children. *The Psychological Record*, 18, 233-239.

Michael, J. (1984). Verbal behavior. *Journal of the Experimental Analysis of Behavior, 42*, 363-376.

Neef, N. A., Iwata, B. A., & Page, T. J. (1977). The effects of known-item interspersal on acquisition and the retention of spelling and sight-reading words. *Journal of Applied Behavior Analysis, 10*, 738.

Neef, N. A., Iwata, B. A., & Page, T. J. (1980). The effects of interspersal training versus high-density reinforcement on spelling acquisition and retention. *Journal of Applied Behavior Analysis, 13*, 153-158.

Olswang, L. B. & Bain, B. A. (1991). Intervention issues for toddlers with specific language impairments. *Topics in Language Disorders, 11(4),* 69-86.

Partington, J. W. (2006). *The assessment for basic language and learning skills-revised (ABLLS-R).* Pleasant Hill, CA: Behavior Analysts, Inc.

Partington, J. W., & Bailey, J. S. (1993). Teaching intraverbal behavior to preschool children. *The Analysis of Verbal Behavior, 11,* 9-18.

Partington, J. W., Sundberg, M. L., & Newhouse, L. (1994). Overcoming and autistic child's failure to acquire a tact repertoire. *Journal of Applied Behavior Analysis, 27*, 733-743.

Paul, R. (1991). Profiles of toddlers with slow expressive language development. *Topics in Language Disorders*, *11*, 1-13.

Rowan, V.C., & Pear, J.J. (1985). A comparison of the effects of interspersal and concurrent training sequences on acquisition, retention, and generalization of picture names. *Applied Research in Mental Retardation, 6,* 127-145.

Sautter, R. A., & LeBlanc, L. A. (2006). Empirical applications of Skinner's analysis of verbal behavior with humans. *The Analysis of Verbal Behavior*, *22*, 35-48.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments design for instructional research. *Education & Treatment of Children, 8*, 67-76.

Skinner, B. F. (1957). *Verbal behavior*. Englewood Cliffs, NJ: Prentice Hall.

Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10*, 349-367.

Sundberg, M. L., Endicott, K., & Eigenheer, P. (2000). Using intraverbal prompts to establish tacts for children with autism. *The Analysis of Verbal Behavior, 17,* 89-104.

Sundberg, M. L., & Michael, J. (2001). The benefits of Skinner's analysis of verbal behavior for children with autism. *Behavior Modification, 25*, 698-724.

Sundberg, M. L., & Partington, J. W. (1998). *Teaching language to children with autism or other developmental disabilities.* Pleasant Hill, CA: Behavior Analysts, Inc.

Sundberg, M. L., San Juan, B., & Dawdy, M. (1990). The acquisition of tacts, mands, and intraverbals by individuals with traumatic brain injury. *The Analysis of Verbal Behavior, 8*, 31-41.

Tenenbaum, H. A., & Wolking, W. D. (1989). Effects of oral rate and inflection on intraverbal responding. *The Analysis of Verbal Behavior, 7*, 83-89.

Twyman, J. S. (1996). The functional independence of impure mands and tacts of abstract timulus properties. *The Analysis of Verbal Behavior, 13*, 1-19.

Volkert, V. M., Lerman, D. C., Trosclair, N. M., Addison, L., & Kodak, T. (2008). An exploratory analysis of task interspersal procedures. *Journal of Applied Behavior Analysis*, *41*, 335-350.

Watkins, C. L., Pack-Teixeira, L., & Howard, J. S. (1989). Teaching intraverbal behavior to severely retarded children. *The Analysis of Verbal Behavior*, *7*, 69-81.

Werts, M. G., Wolery, M., & Holcombe, A. (1995). Instructive feedback: Review of parameters and effects. *Journal of Behavioral Education*, *5*, 55-75.

Whitehurst, G. J., Fischel, J. E., Lonigan, C. J., Valdez-Menchaca, M. C., Arnold, D. S., & Smith, M. (1991). Treatment of early expressive language delay: If, when, and how. *Topics in Language Disorders*, *11*, 55-68.

Wolery, M., Doyle, P. M., Ault, M. J., & Gast, D. L. (1991). Effects of presenting incidental information in consequent events on future learning. *Journal of Behavioral Education*, *1*, 79-104.

VITA

Nicole M. Trosclair-Lasserre received a Bachelor of Science degree at Louisiana State University (LSU) in 2001 and a Master of Arts degree from LSU in 2005. During her four years of undergraduate study, she gained experience within the area of applied behavior analysis under the direction of Dr. Dorothea Lerman. Upon graduating from LSU with her bachelor's degree, she began working full-time at the Marcus Institute in Atlanta where she worked as an apprentice to Dr. Wayne Fisher, Dr. Cathleen Piazza, Dr. Henry Roane, and Dr. Meeta Patel and learned to provide behavior-based clinical services to children with various diagnoses who engaged in severe destructive behavior or had feeding disorders. Nicole continued to expand upon her interests in by enrolling in the doctoral program in school psychology at LSU. In graduate school, her research and experience was directed by Drs. Dorothea Lerman, Nathan Call, and Frank Gresham. She became a Board Certified Behavior Analyst in 2006. Nicole completed a pre-doctoral internship at the Louisiana School Psychology Internship Consortium and worked as a school psychologist in Lafourche Parish. She is currently employed with LSU Health Sciences Center in New Orleans in the Human Development Center. Her primary responsibilities include the development and oversight of an early intervention program for children diagnosed with autism and assisting with the development of an interdisciplinary master's degree program in applied behavior analysis in the School of Allied Health Professions.