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Teaching Intraverbal Behavior to Severely Retarded Children

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The present study evaluated procedures to teach single and multiple intraverbal responses, and assessed whether intraverbals and tacts are functionally independent. A delayed echoic prompting procedure was used to assess transfer of stimulus control. Probes were interspersed among intraverbal training trials to measure the emergence of intraverbals that were not directly trained. Following intraverbal training, visual stimuli were presented to determine whether response topographies transferred to tact conditions. The results suggest that special training is necessary for the acquisition of intraverbal responding in retarded individuals, and provide some support for the functional independence of intraverbals and tacts at the time of acquisition.

Skinner (1957) defined the intraverbal as a form of verbal behavior in which the controlling variable is a verbal stimulus that lacks point-to-point correspondence with the response. Point-to-point correspondence exists when each component of a discriminative stimulus controls in sequence the same component of the response. For example, the response "red" as a result of hearing someone say "red" has point-to-point correspondence between the stimulus and the response. (This represents an echoic relation.) In this case, the "r" in the stimulus controls the "r" in the first part of the response, the "e" in the stimulus controls the second part of the response, and the "d" in the stimulus controls the final part of the response. On the other hand, if the response "red" were made to the verbal stimulus "Name a color" there would be no point-to-point correspondence, hence the relation would be intraverbal.

Many academic behaviors that are typically considered to demonstrate knowledge are intraverbal relations (Skinner, 1957). Reciting poems, stating the properties of objects not present, naming examples of a class (such as foods or animals), and answering questions are all examples of intraverbal responding. In addition, intraverbal behavior plays an important role in conversation. Thus, acquisition and generalization of intraverbal responding is essential for normal intellectual and social development, and it is important to develop programs to teach intraverbal responding to individuals for whom these skills are deficient or absent.

Some efforts have been made to teach generalized intraverbal behavior. For example, Braam, Sundberg, and Stafford (1978) used a transfer of stimulus control procedure to teach intraverbal responding to mentally retarded subjects. Subjects were instructed to make a different sign (e.g., "apple") in the presence of a signed verbal stimulus (e.g., "eat"). If no response occurred within 10 seconds, or if an incorrect response was made, an appropriate nonverbal prompt (e.g., a picture of an apple) was presented. Generalization of responding across trainers was observed only when both prompted and unprompted correct responses were reinforced with a token.

In a more recent study, Braam and Poling (1982) trained subjects to emit intraverbal responses within response classes to verbal stimuli. Once again, a procedure designed to transfer stimulus control from nonverbal (pictorial) stimuli to verbal stimuli was used. Correct responses were followed by presentation of a picture corresponding to the response and a token. An increase in correct

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responding was observed only as training for each verbal stimulus occurred.

Luciano (1986) successfully conducted a systematic replication of the Braam et al. (1978) and Braam and Poling (1983) studies. She also extended this area of research by (1) using speech rather than sign language, (2) increasing the size of the response class, (3) examining the emergence of receptive behavior, and (4) examining several variations of the transfer procedure such as a shorter delay to the prompt. Her results demonstrate that a more effective intraverbal repertoire can be established with mentally retarded subjects by slightly modifying Braam's training procedures.

Partington and Bailey (1980) found that normal preschool children who did not make intraverbal responses could be taught to do so using a procedure similar to that of Braam et al. (1978). Training consisted of the experimenter presenting a verbal stimulus, such as "What are some toys?" Correct responses were reinforced with praise followed by an instruction to emit another response. Incorrect responses, or no responses, were followed by the presentation of a nonverbal prompt (e.g., a picture). This procedure was effective in bringing verbal responses under control of verbal stimuli. However, there was no generalization of intraverbal responding to untrained verbal stimuli.

The above research suggests that training procedures designed to transfer stimulus control from nonverbal to verbal stimuli can be effective in teaching simple (one word) intraverbal responses under the control of specific verbal stimuli. These studies raise questions about the conditions under which trained intraverbal responses are occasioned by other appropriate stimuli. Intraverbal responses are maximally functional if they are not restricted to specific stimuli. For example, it would be seem desirable for students to say their name when asked "Who are you?" as well as "What is your name?"

A second question is related to effective training of more complex intraverbals such as "sentences" containing both an adjective and a noun. Although transfer of control from visual to verbal stimuli appears to be effective for training simple responses, procedures designed to transfer control from an echoic stimulus to a verbal stimulus may provide greater flexibility in training multiple component responses.

A related concern in language training is whether verbal operants established under one set of stimulus conditions will be emitted under other conditions. Skinner (1957) suggested that the elementary verbal relations are functionally independent. Recent research has provided some evidence for the functional independence of mands and tacts at the time of acquisition (e.g., Hall & Sundberg, 1987; Lamarre & Holland, 1985). These findings suggest that other verbal operants may be functionally independent as well.

The present study was designed to address the following questions:

1. Whether a procedure that transfers control from an echoic prompt to a verbal stimulus is effective in establishing simple and multiple intraverbal responding.
2. Whether the training procedure will result in the occurrence of intraverbal responses that were not directly trained.
3. Whether response topographies established under intraverbal conditions will be emitted under tact conditions.

EXPERIMENT I

METHOD

Subjects and Setting

Two children, a 10-year-old girl and a 9-year-old boy served as subjects. Both subjects were classified as severely retarded according to their performance on standardized tests. The subjects were chosen because of their extremely limited intraverbal repertoires. Both subjects had functional tact repertoires.

All sessions were conducted individually in a small vacant office at the school the children attended. The subject and experimenter sat directly across from each other at a table during two 20-minute daily sessions. All sessions were recorded on audio tape.

Stimuli

The adjectives, noun classes, and nouns for both subjects are shown in Table 1. Adjectives included a color, a size, and a texture. Noun classes included animals, toys, clothing, furniture, and linen. The stimuli in a tact

generalization series consisted of sixty pictures or objects that corresponded to adjective/noun combinations (e.g., a picture of a brown bear).

Table 1
Adjectives, noun classes, and nouns used for training.

Adjective Classes			Noun Classes				
Textures	Colors	Sizes	Animals	Toys	Clothing	Furniture	Linen
soft	brown	big	horse	car	dress	table	blanket
			cat	ball	pants	couch	sheet
			bear	doll	coat	bed	towel

Procedure

There were three training conditions: (1) intraverbal training with adjectives, (2) intraverbal training with each noun class, and (3) multiple response training. First, subjects learned a simple intraverbal response for each of three adjectives. For example, the response "soft" was trained to the verbal stimulus "Name a texture." Second, intraverbal training was conducted for the first of five noun classes. For the first noun class (animals), subjects learned three different responses (horse, cat and bear) to the verbal stimulus "Name an animal." Third, multiple response training was conducted on each of the nouns within the first noun class. During this training subjects learned a multiple (two word) response. For example, the response "big bear" was trained to the verbal stimulus "Name a bear." Following multiple response training for the three nouns within the animal class, simple intraverbal training began for the second class (toys). This sequence was repeated until multiple training was completed for all 15 nouns. The training sequence was the same for both subjects. The animal class was trained first, followed by the toy, clothes, furniture, and linen classes.

Correct responses during training were followed by praise and the delivery of a token. Each token earned was placed on a piece of poster board on which ten circles were drawn. When all ten circles were filled, the subject chose a sticker, made a dot-to-dot picture, or sang a song.

Intraverbal training with adjectives. Each trial was initiated by the experimenter giving one of three verbal instructions: "Name a color," "Name a size," or "Name a texture." If the subject failed to respond within two seconds, or responded incorrectly, an echoic prompt was provided from the adjectives in the training list (i.e., brown, big, or soft). Following the prompt, the instruction was repeated. A response was considered incorrect if it was not an appropriate adjective for the verbal stimulus. For example, "big" would be considered incorrect in response to "Name a color."

Following every third training trial, a probe trial was conducted to measure the emergence of multiple responses. Probes consisted of the experimenter saying "Name a(n) _____" (animal, toy, piece of clothing, piece of furniture, or piece of linen). A response on a probe trial was considered correct if it was a multiple response appropriate for the verbal stimulus. For example, the response "blue doll" would be correct in response to "Name a toy," but incorrect in response to "Name a piece of clothing." No differential consequences were delivered on probe trials.

Each training session was terminated when a criterion of 9 out of 10 consecutive unprompted correct responses was met, or when 42 trials had been completed. Intraverbal training with adjectives was terminated when the criterion was met for three consecutive sessions.

Intraverbal training with noun classes. Training on these relations began immediately after intraverbal training with adjectives was completed. On the first trial in a three trial series, the subject was instructed to "Name a(n) _____" (animal, toy, piece of clothing, piece of furniture, or piece of linen depending on the noun class being trained), followed by two trials in which the instruction was "Name a different one." If, on the first trial in the series, the subject responded incorrectly, or failed to respond within two seconds, the experimenter prompted the response by saying one of the three nouns in the class being trained (i.e., horse, bear, or cat for the animal class). Following the prompt, the initial instruction was repeated. This correction procedure was repeated until the subject made a prompted correct response. However, if an incorrect response or no response was made following the verbal stimulus "Name a different one," a prompt was delivered but the verbal stimulus was not repeated.

The repetition of a response within a three trial series was recorded as incorrect. For example, if a subject responded "horse" on the first trial, "bear" on the second trial, and then "horse" again on the third trial, the response on the third trial was scored as incorrect. Therefore, the prompt varied depending on the subject's particular response on that trial. If an error occurred on the third trial in a series, the prompt consisted of the remaining member of that class. If an error occurred on the second trial, the prompt was selected from the remaining two members of the class.

As in intraverbal training with adjectives, a probe trial was conducted following every third training trial. There were two types of probes during this condition: Intra-class probes and inter-class probes. On probes within the noun class currently being trained (intra-class probes) the experimenter said "Tell me about a different _____" (e.g., *animal* if the noun class of animals was being trained). Intra-class probes were intended to determine whether intraverbal responses would generalize to a verbal stimulus that differed from the training stimulus. Probes for noun classes that had not been trained or that had previously been trained (inter-class probes) were identical to those during intraverbal training with adjectives, that is, the experimenter said "Name a(n) _____" (e.g., toy). Classes were probed in the same order they were trained. Thus, every fifth probe was an intra-class probe. A response on a probe trial was considered correct if it was an untrained multiple response appropriate for the verbal stimulus. For example, "big dog" would be an appropriate response to "Tell me about a different animal." No differential consequences were delivered on probe trials.

Training sessions were terminated when the subject correctly named the nouns on 9 out of 10 consecutive trials with no duplicate responses between probes. When the subject met criterion for three consecutive sessions for a particular noun class, multiple training began for the nouns in that class.

Multiple response training. Each noun within a class was trained separately. The delayed prompting procedure was the same as that used during intraverbal training with noun classes. On the first trial in a three trial series, the verbal stimulus specified a particular member of the noun class currently being trained (e.g., "Name a horse") followed by two trials in which the instruction was "Name a different one." An error or no response on the first trial was followed by an echoic prompt from a list of all possible multiple responses (adjective/noun combinations) for that particular noun (e.g., "brown horse," "big horse," or "soft horse") after which the verbal stimulus was repeated. If an error occurred in response to the verbal stimulus "Name a different one," the experimenter provided the prompt and resumed training by initiating a new three trial series. A response was recorded as correct if it consisted of a previously trained adjective combined with the training noun (e.g., "big horse"), or an untrained adjective combined with the training noun (e.g., "fat horse").

As in the two previous training conditions, a probe trial was conducted following every third training trial. Probes were identical to those used during simple intraverbal training with noun classes. A response on a probe trial was considered correct if it was an untrained multiple response appropriate for the verbal stimulus.

Sessions were terminated when the criterion (9 out of 10 consecutive unprompted correct responses) was met or after 42 trials. Training for each noun was completed when responding met the criterion for three consecutive sessions.

Review sessions. Each training session began with 10 review trials of previously acquired intraverbal responses. Responding was not reinforced on these trials. Following ten correct prompted or unprompted responses review sessions were terminated and training started.

Tact series. After multiple intraverbal training was completed on all 15 nouns, a tact series was presented to determine whether the multiple response form trained under intraverbal conditions would be emitted under tact conditions. The stimuli consisted of a series of 60 pictures or objects depicting the various adjective/noun combinations used during multiple intraverbal training (e.g., a picture of a big dress), as well as novel combinations (e.g., a picture of a brown shirt). This series was presented twice. On the first presentation, the experimenter showed the subject the stimulus and asked "What is this?" If the subject made a simple response

(e.g., "horse") the experimenter said nothing, removed the stimulus, and presented the next stimulus. If the subject made an incorrect response or no response, the experimenter supplied a simple prompt (e.g., "horse") and then presented the next stimulus (the procedure was non-corrective). If the subject made a correct multiple response (e.g., "big chair") praise and a token were delivered and the next stimulus was presented.

During the second presentation of the stimuli, if the subject made a simple response, an incorrect response, or no response, a multiple prompt (e.g., "brown bear") was provided. Following the multiple prompt, the verbal stimulus "What is this?" was repeated. Correct unprompted multiple tact responses were reinforced.

Agreement

An assistant listened to tape recordings of sessions and coded responses on standardized data sheets that were checked against those scored by the experimenter. The method of calculating agreement was number of agreements / (number of agreements + number of disagreements) x 100. Agreement averaged 99% (range 98% to 100%).

Results and Discussion

Trials to Criterion

Mastery criterion for each adjective, noun class, and noun was defined as 9 out of 10 unprompted correct responses for three consecutive sessions. The number of trials to criterion as a function of training is shown in Figure 1 for both subjects.

There was a general decrease in the number of trials to criterion as training progressed. This trend is especially evident in the data for Subject 1. The number of training trials this subject required to meet criterion ranged from 30 for both dress and sheet to 382 for adjectives. After training on the clothing class, Subject 1 met criterion for each noun class and noun in relatively few trials (with the exception of the linen class). The performance of Subject 2 was more vari-

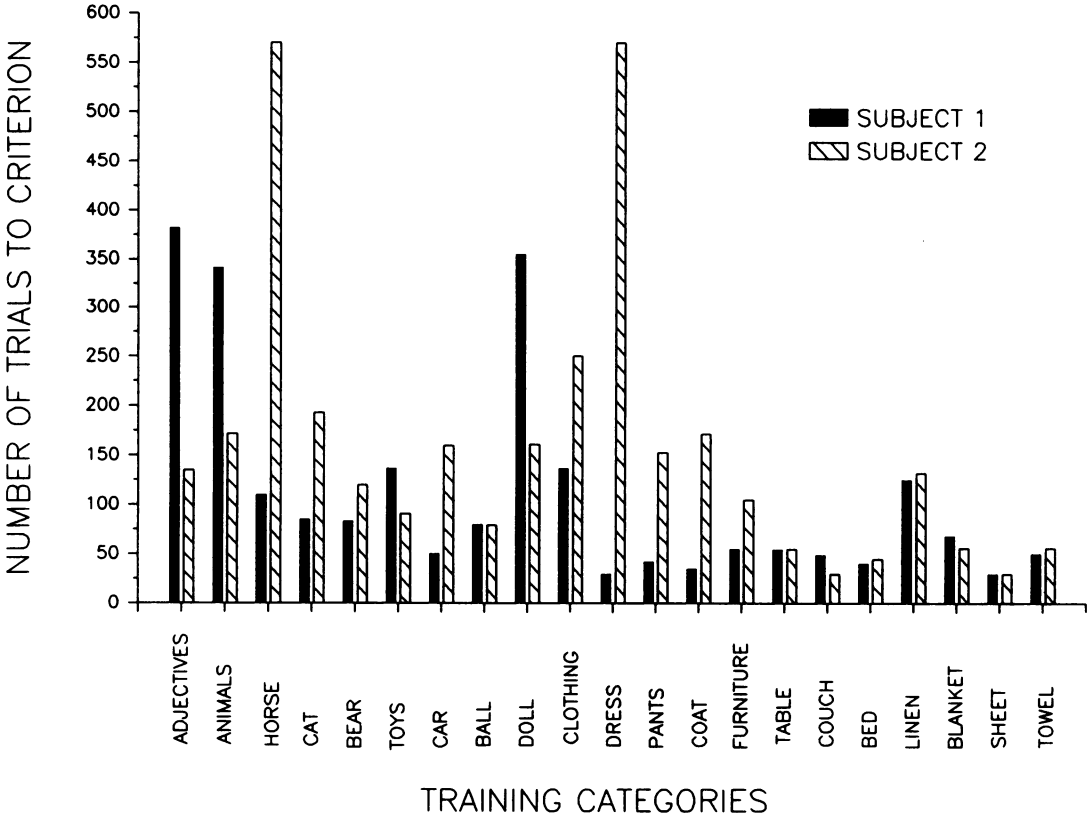

Fig. 1. Number of trials to criterion during training for adjectives, noun classes, and nouns for Subjects 1 and 2.

able than that of Subject 1. The number of trials to criterion for this subject ranged from 30 for sheet and couch to 572 for dress. The decreasing trend in number of trials to criterion as training progressed suggests that the procedure was effective in transferring control from the echoic prompt to the verbal stimulus.

Untrained Multiple Responses During Training Trials

A response was recorded in this category if it was a correct multiple response (adjective/noun combination) that occurred during a training trial but prior to training for that particular noun. For example, if the verbal stimulus was "Name a horse" and the subject said "brown horse" without direct training, the response was scored as an untrained multiple response. Subject 1's performance is represented in Figure 2. The data are plotted as the cumulative number of untrained multiple responses as a function of sessions for each noun class.

Subject 1 made a total of 37 untrained multiple responses during training. This subject made no untrained multiple responses during simple intraverbal training for the first (animals) or third (clothing) noun classes. However, for the other three classes, multiple responses were emitted prior to multiple training for the nouns within the classes. The number of multiple responses was low in the first two noun classes, but considerably higher in the following three classes. Furthermore, the majority of multiple responses in the last two classes were made during simple intraverbal training (e.g., "brown couch" in response to "Name a piece of furniture.").

The performance of Subject 2 is represented in Figure 3. As with Subject 1, multiple

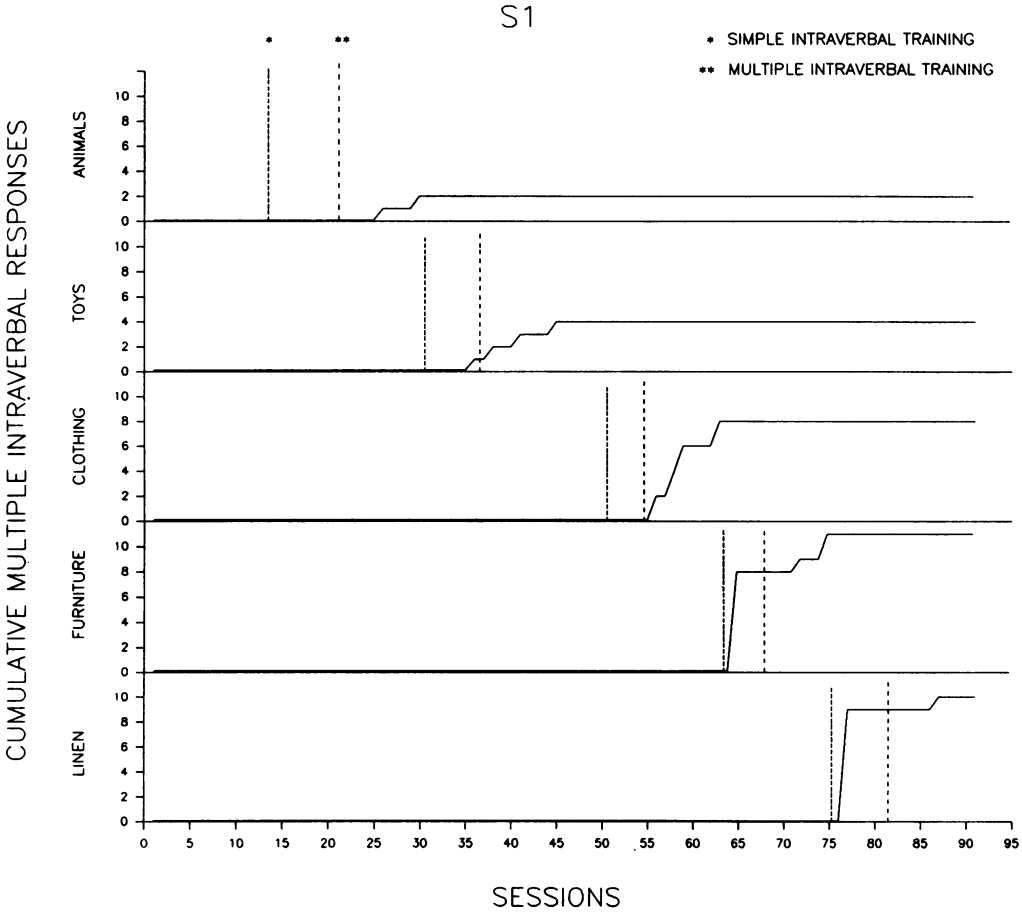

Fig. 2. Cumulative multiple responses for all nouns within classes as a function of training trials for Subject 1. Only those responses that occurred prior to training for any particular noun are plotted.

responses were emitted only after multiple training began on the nouns in the first class. However, multiple responses were made by this subject during simple intraverbal training on all subsequent noun classes. This subject made a total of 92 untrained multiple responses during training.

For both subjects the largest increase in responding occurring following multiple response training on the first two noun classes. These data indicate that appropriate multiple responses occurred without direct training as a function of multiple response training on nouns in other classes.

Untrained Multiple Responses During Probes

A response was recorded in this category if it was an untrained multiple response appropriate for the verbal stimulus. Relatively few multiple responses were emitted by either subject on probe trials. Subject 1 made only three untrained multiple responses; one for animals, one for furniture, and one for linen. Subject 2 made a total of 12 untrained multiple responses during probe trials: six for animals, five for toys, and one for clothing.

The low rate of multiple responses during probes may have resulted from using the same training stimuli repeatedly over many trials during simple intraverbal training for noun classes. For example, during simple intraverbal training on the noun class of animals, the verbal stimuli "Name an animal" and "Name a different one" were used throughout the course of training. Because simple responses such as "horse" were considered correct during this training condition, subjects were exposed to many reinforced trials of simple intraverbal responding. Therefore, when probes were

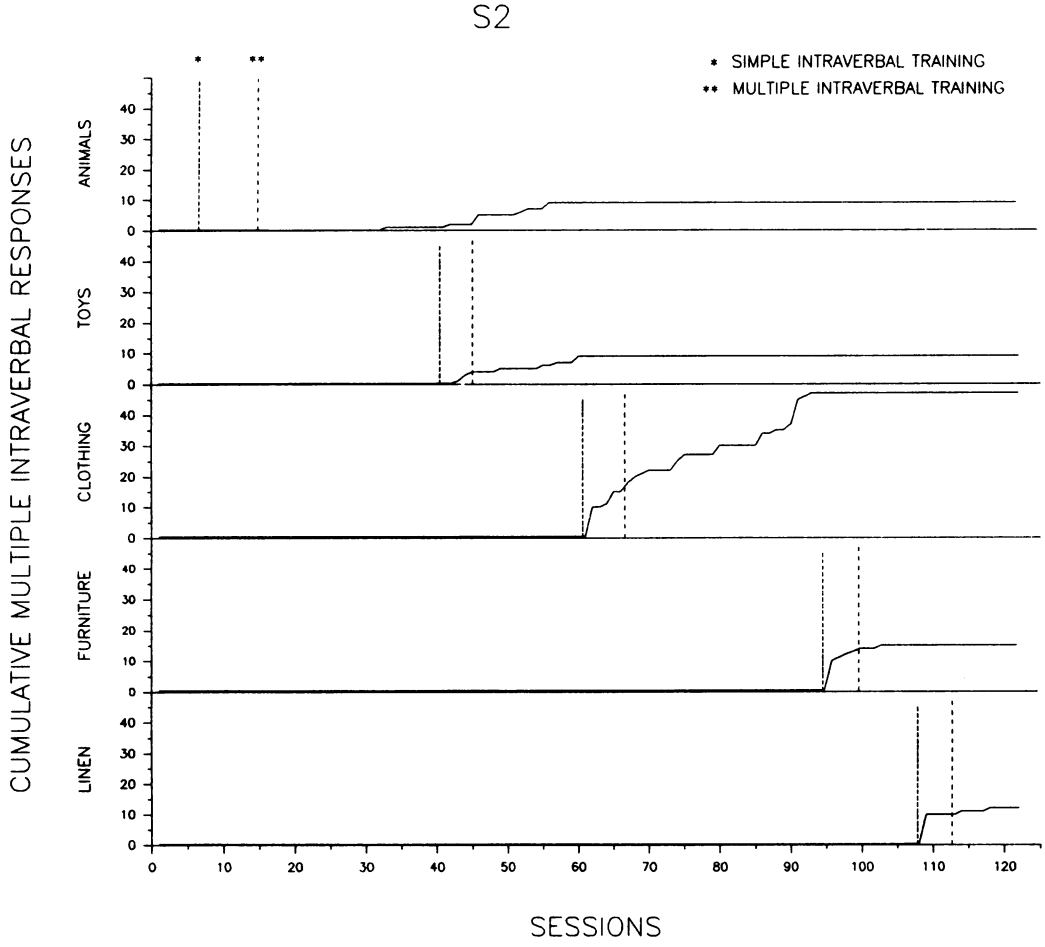

Fig. 3. Cumulative multiple responses for all nouns within classes as a function of training trials for Subject 2. Only those responses that occurred prior to training for any particular noun are plotted.

interjected that consisted of the same verbal stimulus used during noun class training, that stimulus may have occasioned a simple intraverbal response. This problem was addressed in Experiment 2.

Untrained Multiple Responses During Review Trials

A response was recorded in this category if it was a trained response to a novel stimulus, (e.g., "brown horse" to "name an animal") or a novel response to a training stimulus (e.g., "blue socks" to "name a piece of clothing"). Both subjects made more untrained multiple intraverbal responses during review trials than during probes. Subject 1 made a total of 15 untrained responses during review trials; seven for animals, six for toys, and one each for furniture and linen. Subject 2 made 23 untrained multiple responses during review trials; nine in the animal class, and seven each in the toy and clothing classes. No untrained multiple responses were made by Subject 2 during review trials for the linen or furniture classes.

Tact Transfer

A response was recorded as a correct simple tact if it was a one word response that preceded the prompt and was appropriate for the nonverbal stimulus. A response was considered a correct multiple tact if it was a two-word (adjective/noun) response emitted prior to the prompt and appropriate for the stimulus. The percentage of correct unprompted simple and multiple tacts emitted on the first and second stimulus presentation for Subjects 1 and 2 is shown in Figure 4.

For both subjects, simple tacts were highly accurate following intraverbal training suggesting the possibility that intraverbal training produced simple tacts. However, both subjects had relatively well developed simple tact repertoires prior to their participation

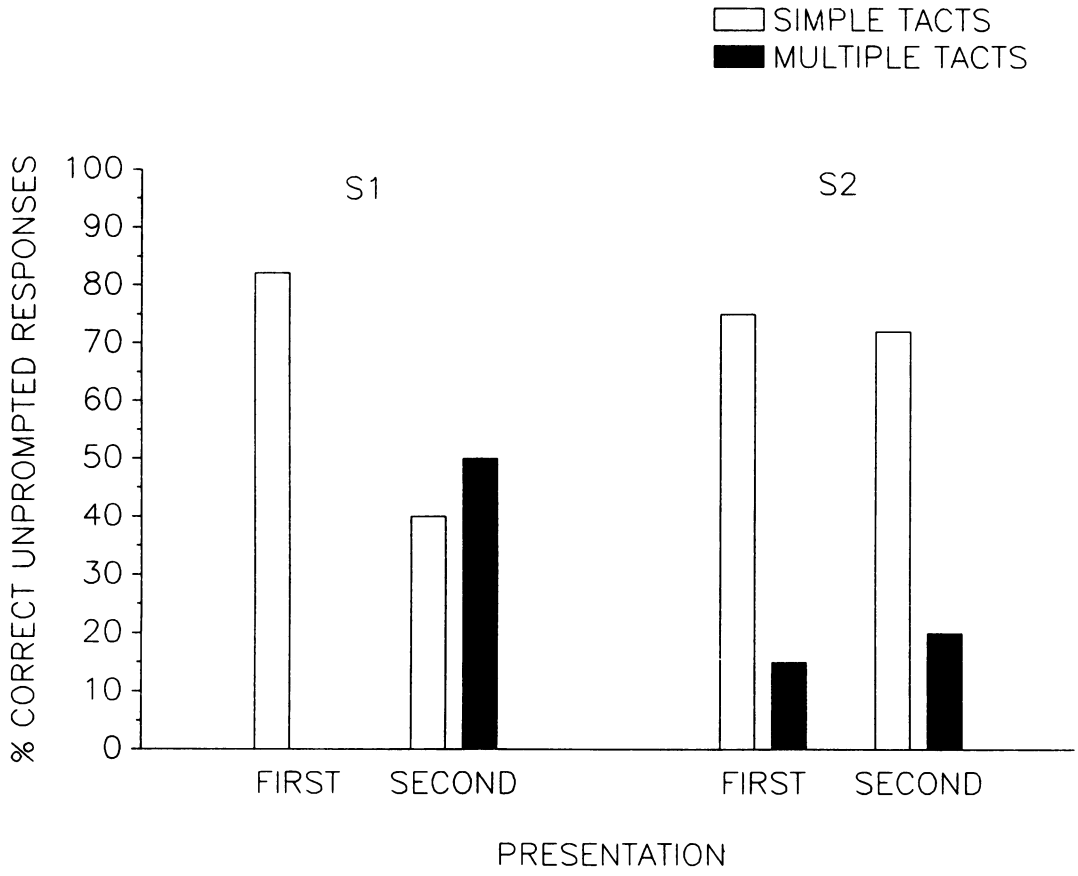

Fig. 4. Percentage of correct unprompted simple and multiple tacts emitted on the first and second stimulus presentations for Subjects 1 and 2.

in the present study, and it seems likely that the simple tacts emitted were acquired prior to intraverbal training.

The data show little transfer of the multiple response form trained under intraverbal conditions to a tact task. Subject 1 made no multiple tact responses during the first presentation of the stimuli (prior to training). On the second presentation this subject made 30 unprompted multiple tacts (50% of the total responses). Subject 2 made nine correct multiple tact responses (15% of responses) on the first presentation and 12 multiple tact responses (20% responses) on the second presentation of the stimuli. Both subjects showed an increase in unprompted multiple tacts from the first presentation to the second one. This suggests that tact training (multiple prompts) was responsible for the increase in correct responding. The only evidence for transfer is found in Subject 1's multiple tact responses on the first stimulus presentation.

EXPERIMENT 2

An important consideration in the language training of severely handicapped children is the relative efficiency of the training program. The purpose of Experiment 2 was to determine whether multiple responding can be established without the simple intraverbal training with adjectives and noun classes used in Experiment 1.

METHOD

Subjects

Two children, a 10-year-old boy and a 12-year-old girl participated. Both subjects had been previously classified as severely retarded according to their performance on standardized intelligence tests. Neither subject participated in the previous experiment. Subjects were selected because pre-experimental observation revealed severely limited intraverbal repertoires, although both subjects had functional tact repertoires. Both subjects received speech therapy as part of their school curriculum.

Procedure

The procedure was identical to Experiment 1 with the exception that intraverbal training with adjectives and simple intraverbal training with noun classes were omitted. Subjects were exposed only to multiple response training for 15 nouns. Each noun was trained separately and in the same order as Experiment 1. Probes introduced following every third training trial were identical to those used during multiple response training with nouns described in Experiment 1. After multiple response training was completed for all 15 nouns, the same tact series used in Experiment 1 was presented.

RESULTS AND DISCUSSION

Trials to Criterion

Criterion was met for each noun when the subject made 9 out of 10 unprompted correct responses for three consecutive sessions. The number of trials to criterion for Subjects 3 and 4 are plotted as a function training on each noun in Figure 5.

Responding for both subjects showed a clear decrease in the number of training trials required. The number of trials required by Subject 3 ranged from to 33 for bear to 272 for horse. The range for Subject 4 was 30 for coat and sheet to 434 for horse. As training progressed, fewer prompts were needed because multiple responses were emitted prior to the delivery of the prompt.

Untrained Multiple Responses During Training

A response was recorded in this category if it was a correct multiple response (adjective/noun combination) that occurred on a training trial, but prior to training for that particular noun. Both subjects made a number of untrained multiple responses during training trials. The cumulative number of untrained multiple responses for Subjects 3 and 4 are plotted as a function of training sessions in Figure 6. Subject 3 made a total of 56 untrained multiple responses during training across 51 sessions. The cumulative number of responses increased gradually and steadily across sessions for this subject, with most increases occurring on about every third session.

Subject 4 made a total of 44 multiple responses across 62 training sessions. For this subject, there was a slow increase in the number of untrained multiple responses for the first 20 training sessions followed by a sharp increase that approached the steady increase seen in Subject 3's responding.

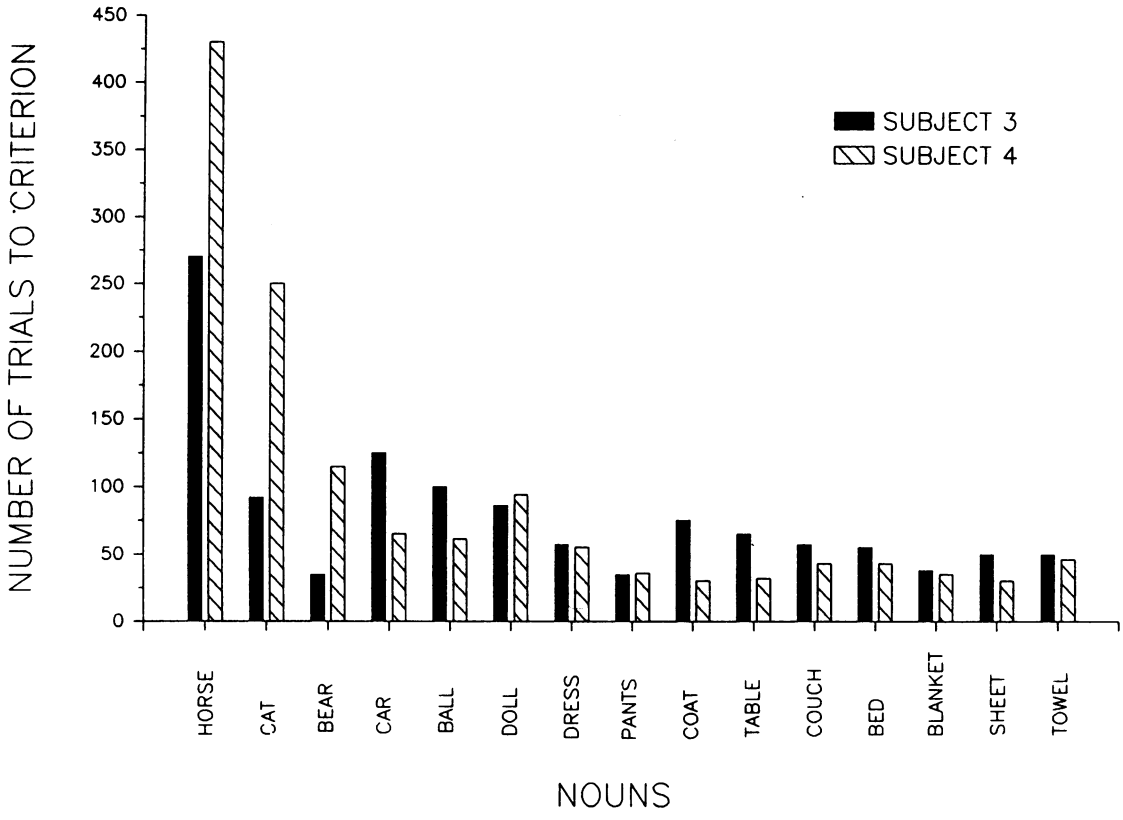

Fig. 5. Number of trials to criterion as a function of training for each noun for Subjects 3 and 4.

Untrained Multiple Responses During Probes

Few untrained multiple responses were made by either subject on probe trials. Subject 3 made a total of 11 multiple responses during probe trials. No multiple responses were emitted during probes for the first noun class (animals) until training for nouns in that class began. However, seven multiple responses were made during probes for the toy class, five of which occurred prior to training for the nouns in this class. Only one multiple response was made during probes for the clothing class, and none for the furniture or linen class. Five of the 11 multiple responses (45) occurred during the first 10 training sessions. This relatively rapid initial increase was followed by a slow and gradual increase over the next 35 sessions, with no multiple responses made on probes during the last 6 training sessions.

Subject 4 made a total of seven multiple responses during probe trials. The majority of these (5) were in response to the verbal stimulus "Name a toy," and they occurred prior to multiple response training on the nouns in the toy class. This subject also made one multiple response each for the animal and clothing classes. Six of the seven multiple responses were made on probes that occurred during the first 18 training sessions. Only one other multiple response was made on a probe trial (session 40), although training continued for more than 40 additional sessions.

Tact Transfer

A response was recorded as a correct simple tact if it preceded the prompt and was appropriate for the visual stimulus. A response that preceded the prompt and was composed of an adjective/noun combination appropriate for the stimulus was recorded as a correct multiple tact. The percentage of correct unprompted simple and multiple tacts made by each subject on the first and second stimulus presentation is shown in Figure 7.

Subject 3 made 27 multiple tacts during the first presentation of the stimuli (45% of

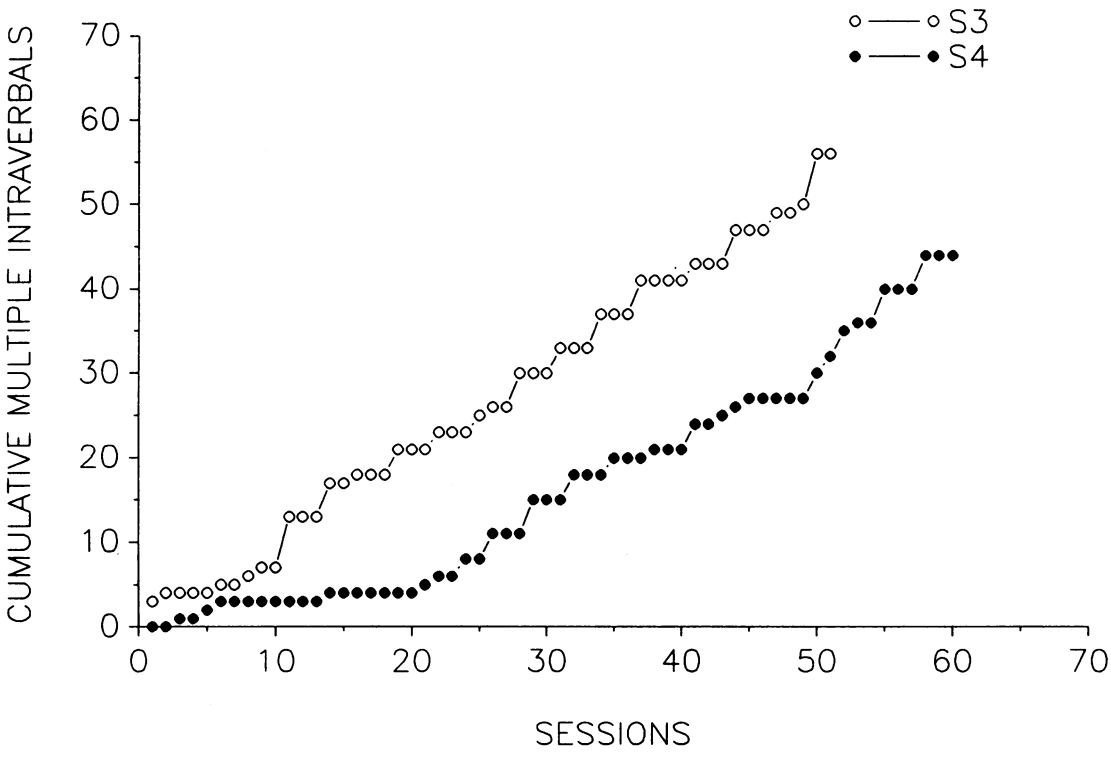

Fig. 6. Cumulative multiple responses as a function of training sessions for Subjects 3 and 4. Only those responses that occurred prior to training for any particular noun are plotted.

total responses). On the second presentation, this subject made 52 multiple tacts (87% of total responses). Subject 4 made no multiple tacts on the first presentation of the stimuli and 30 on the second presentation (50% of total responses). These data show little transfer of the multiple response form to a nonverbal stimulus.

Both subjects showed an increase in unprompted multiple tacts from the first presentation to the second one. This increase suggests transfer of control from the multiple verbal prompts used on the second presentation to the visual stimulus. The only evidence for transfer of the trained multiple response form to tact conditions is in Subject 3's responding on the first presentation of the visual stimuli.

GENERAL DISCUSSION

The present results indicate that a procedure that transfers control from an echoic prompt to a verbal stimulus is a viable way of teaching intraverbal responses. In contrast to delayed prompting procedures with nonverbal (tact) prompts, the use of echoic prompts allows for training of responses involving abstract adjectives that would be difficult to represent by a picture. For example, it would prove very difficult to find a picture that would represent "soft horse." Such procedures may provide an easy, cost effective, and functional method of teaching more complex intraverbal responding (e.g., grammatically correct sentences) to language impaired individuals.

The present procedure was effective in directly training multiple (two-word) as well as simple intraverbal responses. In Experiment 1 subjects were first taught simple intraverbal responses for adjectives and noun classes. In addition, untrained multiple responses were emitted before multiple training, but only after multiple responses were directly trained for the first noun. These findings indicate that even when a simple intraverbal repertoire is present, special training may be required for the acquisition of multiple responses. However, once multiple response training begins, untrained multiple responding may emerge.

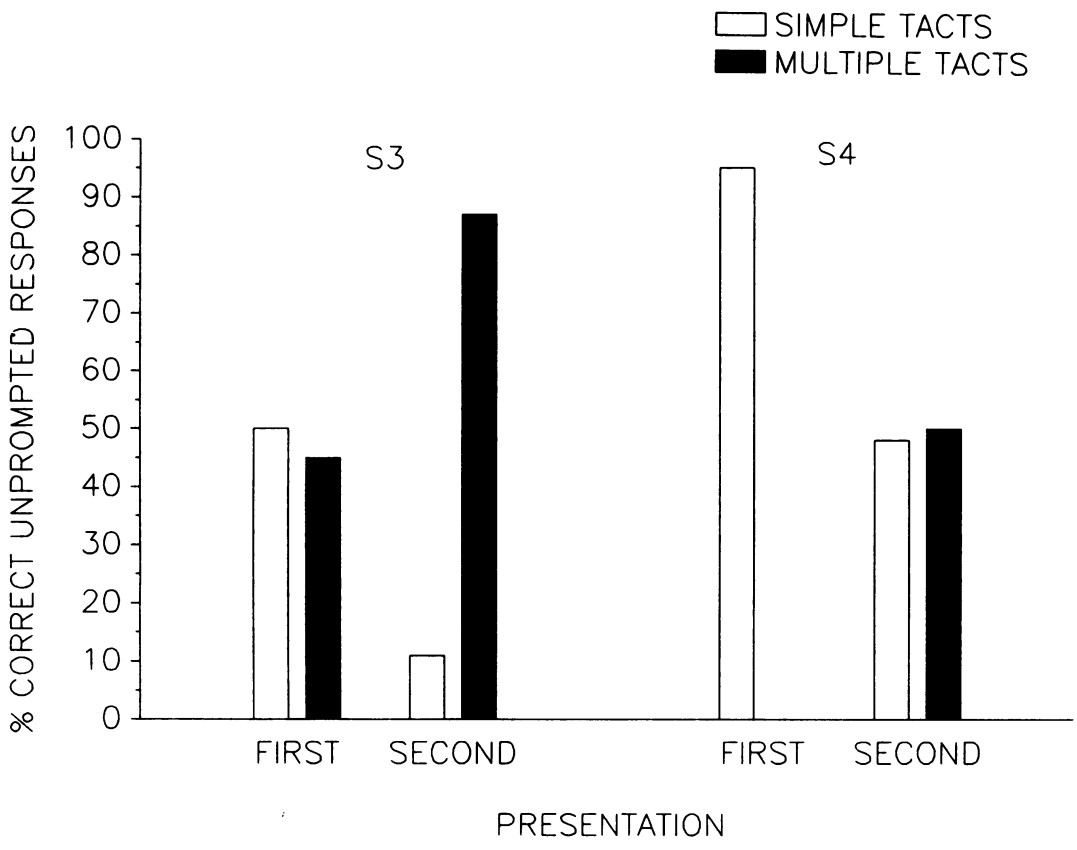

Fig. 7. Percentage of correct unprompted simple and multiple tacts emitted on the first and second stimulus presentations for Subjects 3 and 4.

In both Experiment 1 and 2, the cumulative number of untrained multiple intraverbal responses increased as a function of training sessions, with the largest increases occurring after multiple training on the first two noun classes for Subjects 1, 2, and 4. This suggests that some minimum training is required before untrained multiple responding occurs.

The procedure used in Experiment 2 (eliminating adjective and simple intraverbal training) resulted in faster acquisition of multiple responses. However, the number of untrained multiple responses was limited relative to the number observed in Experiment 1. That is, subjects in Experiment 1 emitted a number of multiple responses such as "brown bear" when presented with the verbal stimulus "Name an animal" whereas few such responses were made by subjects in Experiment 2. Because subjects in Experiment 2 were not exposed to simple intraverbal training for noun classes, a simple response to the verbal stimulus for a noun class (e.g., "name a piece of linen") was never acquired, thus none could be emitted. However, these subjects made untrained multiple responses during training trials to stimuli directing a response to a specific noun, such as "Name a towel." This suggests that the relation between the number or types of simple intraverbal responses trained stimulus prior to multiple tact training for Subjects 2 and 3, and after training for Subjects 1 and 4. However, this training did not result in reliable and consistent multiple tacts, despite the fact that all subjects had fairly strong tact repertoires prior to participation in the present study. It is also interesting to note that, during multiple training, Subjects 2 and 4 each made a spontaneous multiple tact to objects in the experimental setting (Subject 2 said "purple car" when selecting a sticker and Subject 4 said "big

chair"). Despite this, the present data indicate that verbal topographies established under intraverbal conditions may not be produced under tact conditions. Other researchers (e.g., Lamarre & Holland, 1985; Hall & Sundberg, 1987) have found that establishing specific verbal responses under tact conditions was not sufficient to produce the response under mand conditions at the time of acquisition. Collectively, these findings provide support for Skinner's (1957) suggestion that verbal operants are functionally independent at the time of acquisition.

Future research could provide a more complete analysis of the necessary and sufficient conditions for functional independence versus transfer of intraverbals and tacts, as well as other verbal operants. In the present study, simple tacts were highly accurate after intraverbal training, suggesting that intraverbal training transferred positively to simple tacts. However, this possibility was not directly assessed in the present study since a tact baseline was not established prior to intraverbal training.

The procedure used in the present study may have restricted the range of conditions under which trained responses were emitted. In Experiment 1, the verbal stimuli during probes were identical to those used during simple intraverbal (noun class) training, and likely occasioned simple responses. In Experiment 2, probes consisted of verbal stimuli that had never been used during training, and occasioned few responses. Further research is needed to identify training procedures that generate intraverbal responding under a range of appropriate stimulus conditions. In addition, it is important to delineate effective procedures for establishing increasingly complex chains of intraverbal responses.

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