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Comparison of Two Word Learning Techniques and the Effect of Neighborhood Density for Late Talkers

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Abstract

The investigators compared two techniques for teaching expressive vocabulary to late talkers: modeling with an expectant pause and modeling with an evoked child production. They also explored the influence of neighborhood density on children's real word learning. Three late talkers (ages 25–33 months) received two alternating vocabulary treatments (expectant pause and evoked production) in the home. Two participants were identified as having an expressive language delay, and one participant was identified as having an expressive and receptive language delay. During the expectant pause treatment, the clinician paused several seconds after each target word model, looking at the child expectantly. In the evoked production condition, after each target word model, a child was prompted to say the word using a cloze procedure of the modeled phrase. Both treatments were effective for all participants; no consistent advantage of one treatment technique over the other was noted. Two participants produced denser words than sparse words, one in early sessions and one in later experimental sessions, but a consistent pattern was not present across all participants. This study provided support for focused vocabulary intervention with late talking toddlers. Receptive language skills and word form characteristics may help explain individual variations in response to treatment for late talkers.

Keywords birth to 3 years, age, intervention strategies, language/linguistics, delays/disorders, research, single subject, methodology, research

There is limited evidence to discriminate appropriate, effective types of language intervention techniques within the disparate population of late talking children (Desmarias, Sylvestre, Meyer, Bairati, & Rouleau, 2008; Tsybina & Eriks-Brophy, 2007). In a recent review of treatment outcomes for late talkers' expressive language abilities, Cable and Domsch (2010) found a range of treatment outcomes they ascribed to the heterogeneity of the late talking population. For example, in a word learning study involving 20 late-talking participants, Wilcox, Kouri, and Caswell (1991) found positive treatment outcome for most participants, but three children did not demonstrate expressive target word use. In addition, Girolametto, Pearce, and Weitzman (1995) found no significant differences in number of different words reported by parents before and after a parent-coaching intervention technique, but in a later study examining the same intervention technique (Girolametto, Pearce, & Weitzman, 1996), the same authors found a significant difference in number of words reported before and after treatment.

Most of the research that has addressed treatment of late talkers included only late talkers identified with expressive-only language delay; consequently, little is known about treatment responses and outcomes of those with expressive and receptive language delays. In a meta-analysis of treatment outcomes for late talkers, Desmarias et al. (2008) noted that only 50 of 500 late-talking participants showed expressive and receptive language delays. Although Desmarias et al. found an overall positive treatment effect for the late-talking population, the positive effect was found in a population largely represented by expressive-only late talkers. The presence of receptive language impairment might serve as an uncontrolled source of variation and limit interpretations of treatment outcomes (Cable & Domsch, 2010). For evidence-based treatment, speech-language pathologists (SLPs) need to know not only which treatment techniques are effective but also which techniques are effective for subgroups of late talking children.

Limited evidence comparing and contrasting the relative impact of individual treatment techniques, such as modeling, on late talker language outcomes restricts the foundation of evidenced-based practice (Cable & Domsch, 2010). Modeling, when combined with focused stimulation, resulted in improvements on formal language measures, increased mean length of utterance (MLU) in conversation, and acquisition of specifically targeted words (Girolametto et al., 1995, 1996; Lederer, 2001). However, investigators examining modeling as a treatment approach used a combination of focused stimulation and modeling. Consequently, it was "not possible to disentangle the effects of the two" (Cable & Domsch, 2010, p. 14). To select an appropriate course of treatment for a late-talking child, SLPs need information on the efficacy of specific techniques to determine whether each technique provides effective language intervention for late talkers independently, not just in combination with other techniques.

Two distinct forms of modeling have been identified: modeling with an evoked production and modeling with an expectant pause (Ellis Weismer & Murray-Branch, 1989; Ellis Weismer, Murray-Branch, & Miller, 1993). In modeling with an evoked production, an adult first models a target word and then expects the child to imitate that model within a structured prompt to respond verbally (e.g., "What's this?"; Hancock & Kaiser, 2006). Typically, the target words are selected to reflect sounds that are within the child's phonetic repertoire.

In contrast, modeling with expectant pause involves a spoken adult model of the target word followed by a pause with the adult looking expectantly at the child, not an explicit request for a child response (Ellis Weismer et al., 1993; Ellis Weismer & Murray-Branch, 1989). Modeling with expectant pause lessens the verbal response burden for the child compared with modeling with evoked production because no child response is requested, although spontaneous child productions receive responses. This less demanding approach may be appropriate for certain children "because of a potential inability or unwillingness on the part of some children to respond to imitative prompts or elicitation attempts by a clinician" (Kouri, 2005, p. 159).

Although the two types of modeling are similar, one group of previous investigators found differences in treatment responses to each. Ellis Weismer et al. (1993) taught single words to three late talkers contrasting modeling with an expectant pause and modeling with an evoked child response. Each participant demonstrated a different response pattern for these two treatments. One of the three late talkers learned more target words in response to modeling with expectant pause; however, a second late talker learned more words with a prompted child response (i.e., evoked production), while the third did not respond to either treatment condition. The primary conclusions drawn from the late talker literature about the relative effectiveness of modeling techniques for learning new word is that individual variability in response to treatment should be expected (Cable & Domsch, 2010; Ellis Weismer et al., 1993).

Some individual variability can be explained by child language characteristics or treatment strategy; however, variability among word form characteristics may also influence the speed and ease of word learning for children (MacRoy-Higgins, Schwartz, Shafer, & Marton, 2012; Storkel, 2009). The word form characteristic of neighborhood density has had demonstrable effects on word learning for adults and children (Hoover, Storkel, & Hogan, 2010; Storkel, Armbruster, & Hogan, 2006). Neighborhood density refers to the number of words phonologically similar to a particular word based on single-sound additions, substitutions, or deletions (Vitevitch & Luce, 1999). Words can be characterized as inhabiting either “dense” or “sparse” neighborhoods. For example, Hoover et al. (2010) cited “coat” and “cat” as belonging to dense neighborhoods because they had many similar sounding words in English. In contrast, the word “these” belongs in a relatively sparse neighborhood because it has few similar sounding words. Storkel (2009) found that children aged 1.4 to 2.6 learned real (i.e., familiar, not novel or nonsense) words from dense neighborhoods at an earlier age than real words from sparse neighborhoods. Explanations for faster initial word learning of dense words include that words from dense neighborhoods were better held in working memory than words from sparse neighborhoods (Thomson, Richardson, & Goswami, 2005) and that dense words tended to form many links with word representations already established to enhance new word representations (Hoover, Storkel, & Rice, 2012). Consequently, when targeting words already in a child’s receptive lexicon (e.g., words the child understands), but not yet produced, neighborhood density would be expected to influence the child’s number and rate of words learned.

The purpose of the present study was threefold: (a) to expand the evidence base for the relative effectiveness of modeling plus evoked production and modeling with expectant pause for word learning outcomes in late-talking children, (b) to compare responses to treatment for late-talking children who vary in receptive language skills, and (c) to compare word learning outcome performance between words with dense versus sparse neighborhood density for late-talking children. The following research questions were addressed:

> **Research Question 1**: Which treatment method, modeling plus evoked production or modeling with expectant pause, resulted in a greater number of different target words produced by late-talking toddlers?
>
> **Research Question 2**: Were individual differences observed in the number of target words produced by individual children with expressive language delay versus individual children with expressive and receptive language delay?
>
> **Research Question 3**: When learning to produce new vocabulary words, were more words learned from dense neighborhoods than from sparse neighborhoods for late-talking toddlers?

Method

Participants

Participants included three monolingual English-speaking children (two males, one female) ranging in age from 25 to 33 months and identified as language delayed (i.e., late talkers). All participants were recruited through clinical agencies that provided services for young children in two Midwestern cities.

All mothers of the participants had at least some college-level education. One participant's mother completed some post-graduate work, and one completed a 4-year college degree. Two mothers described their occupations as "stay at home mother," and one reported being a teacher. Of primary wage earners in each family, two held college degrees (bachelor's or master's degrees) and one had a high school degree with some college education. Two parents identified their child as Caucasian (LT1 and LT2), and one parent identified her child as Asian/ Caucasian (LT3). Two of the participants were first-born children in two-child homes (LT1 and LT2), and one was the third of four children (LT3).

The participants all demonstrated the use of at least three different representational gestures for a communicative purpose (e.g., point, wave, reach) during an initial screening visit. All three participants' parents reported that the primary form of communication for each child at home was a combination of verbal and gestural signals. In addition, all three participants, during interaction with familiar (e.g., parent) and unfamiliar (e.g., researcher) adults in the home, demonstrated that the use of joint attention and pragmatic skills were informally noted by the researcher to be age appropriate. According to LT1's parent, he was assessed twice by a local Early Childhood Special Education (ECSE) service provider and did not qualify for services on either occasion. During the second evaluation, 3 months before his participation in the present study, the interventionist noted expressive language concerns but reported that his standardized assessment scores were not within the agency's qualifying range. According to LT2's parent, she had been receiving home-based ECSE services through a local educational agency (different from LT1) for 1 year prior to her participation in the present study. Her parent reported monthly parent-coaching sessions in the home during which the targeted therapy objectives were (a) responding to questions and (b) listening skills. LT3's parent reported that she had not sought speech-language services of any kind and the family was not involved with any local public education agencies. LT3's two older sisters were home-schooled.

Child Inclusion and Exclusion Criteria

Eligible participants were identified with an expressive language delay based on the following criteria: (a) expressive vocabularies at or below the 10th percentile for their age on the *MacArthur-Bates Communicative Development Inventory: Words and Sentences* (Fenson et al., 2006; for participants older than 30 months the extension, CDI-III [Fenson et al., 2006] was also administered), (b) few/no multiword utterances based on parental report and two 15-min language samples obtained in the participant's home, one with the parent and one with the researcher. Two participants (LT1 and LT3) qualified as expressive-only late talkers and had typical receptive language skills within one standard deviation from the mean on the *Preschool Language Scale–Fourth Edition* (PLS-4; Zimmerman, Steiner, & Pond, 2002). One participant (LT2) scored below one standard deviation below the receptive language mean on the PLS-4 and was identified as having expressive and receptive language delay. In addition, the children demonstrated no evidence of risk of autism, intellectual or motor delay, or hearing impairment (see Table 1). To demonstrate no evidence for risk of autism, participants obtained a passing score on the Modified-Checklist for Autism in Toddlers (M-CHAT; Robins, Fein, Barton, & Green, 2001). To demonstrate no evidence for risk of intellectual or motor delay, participants scored greater than 1.5 standard deviations below the mean on the Battelle Developmental Inventory–2 (BDI-2; Newborg, 2005) cognition and motor subtests. To demonstrate no evidence for risk of hearing impairment, participants' parents reported no ear infections in the past 3 months, and no tubes placed at all or tubes placed at least 2 weeks prior to the initial visit to the home. Parents reported no vision or hearing concerns.

Setting

All sessions took place in the child's home. Each family received two screening visits when the child's eligibility for the study was evaluated and information for determining individualized target words was collected. Parents were invited to be in the room during all sessions and were not encouraged or discouraged from discussing targeted words with their children between sessions. All sessions were videotaped using a digital video camera (i.e., JVC Hard Disk Camcorder HDD with 30GB). The researcher (first author) and participant were situated in the camera frame with experimental materials arranged between them.

Experimental Design

An alternating treatments design repeated across three participants was used (Martella, Nelson, & Marchand-Martella, 1999). Different sets of words were taught using modeling with expectant pause and modeling with evoked production (analogous to the "modeling only" vs. "modeling plus evoked production" conditions used by Ellis Weismer et al., 1993). A third set of control words was not explicitly taught but probed for child production during baseline and every other treatment session. Each participant received both treatments during a session, but only one treatment method was used at any given time. To control for order effects, the researcher alternated which treatment condition began and concluded each session. Target word presentation was randomly ordered within each treatment condition.

Dependent Measures

The dependent measure was the number of target word productions spoken by each participant (including spontaneous and probed productions of target words) per session. Spontaneous and probed productions of target words were included to account for participant performance across multiple experimental conditions (i.e., treatment and probe conditions). For spontaneous and probed productions, correct productions were those words containing two of three target phonemes in the appropriate sequence.

Target Word Selection

Two 15-min child language samples (one with caregiver and one with researcher) during the initial assessment session involved semi-structured play with opportunities to play independently while having toys readily accessible. The resulting language samples were analyzed for MLU and Type-Token Ratio (TTR). The child's phonological repertoire and percent consonants correct (PCC-R; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997) were computed to aid in the selection of target words.

A pool of potential target words was selected individually for each participant using target word criteria similar to those in Ellis Weismer et al. (1993). These criteria were selected so as to provide procedural similarities for an appropriate comparison of the present study results to the Ellis Weismer et al. findings. A child's pool of potential target words consisted of words that met the following criteria: (a) were reported to be understood but not produced by the child based on the CDI, (b) consisted of sounds in the child's phonological repertoire (i.e., "in-phonology" words), and (c) had consonant-vowel-consonant (CVC) or consonantvowel-consonant-vowel (CVCV) syllable shape. The child's "in-phonology sounds" were operationally defined as wordinitial consonants, intervocalic consonants, word-final consonants, or consonant clusters that the child was observed to produce accurately in more than 50%

of his or her attempts at adult words containing these consonants (Ellis Weismer et al., 1993; Leonard et al., 1982). Parents did not provide input regarding words they wanted their children to learn or felt their children needed to learn. Parent input for word selection was based solely on their report of whether their children understood words listed on the CDI.

From this pool of potential target words, 14 words were selected for treatment with each child, 7 each from sparse and dense neighborhoods. Neighborhood density, the number of words that sound similar to a particular target word, was operationally defined as the number of words that varied from a particular target word by only one sound substitution, addition, or deletion at any word position (Luce & Pisoni, 1998; Storkel, 2009). Neighborhood density word classification was calculated using the online child calculator developed by Storkel and Hoover (2010a) using the same algorithm for computing neighborhood density as used by Hoover et al. (2010) and Storkel and Hoover (2010b). A median split was used to classify the words within the child's pool of potential target words as either sparse or dense. CVC or CVCV words that had more neighbors than the median value of the child's pool of potential target words were considered inhabiting dense neighborhoods, and CVC or CVCV words that had fewer neighbors than the median value of the stimuli pool were considered inhabiting sparse neighborhoods (Hoover et al., 2010). Words were defined as either residing in dense or sparse neighborhoods without consideration for the target word's meaning or semantic class. For this study, dense word neighborhood means ranged from 17.50 to 19.67 across participants and sparse word neighborhood means ranged from 7.67 to 9.50 (see Table 3).

The 14 target words were selected and distributed as follows: 4 (2 dense, 2 sparse) were randomly assigned to serve as control words, 4 (2 dense, 2 sparse) were randomly assigned to each of the treatment conditions for a total of 8 treated words, and 2 alternate words (1 dense, 1 sparse) was selected to be substituted into any group if the participant demonstrated use of a target word during baseline (see Table 3). Corresponding objects or play schemes were identified for each target word. The researcher provided the objects used in word training and planned a variety of ways the objects or actions could be incorporated into naturalistic play to facilitate the modeling and opportunity for elicitation of each word. For example, with "duck," a toy duck was used in play while the researcher modeled and provided opportunities for the child to produce the word "duck." For "nap," the researcher identified play schemes during which the action "nap" could be described and shown, for example, "Shhh! Baby nap."

Production Probes

Probes of target words were collected during baseline, at the end of each treatment session, and at the follow-up visit to evaluate the child's spoken production of each word using the same procedures for each condition. During each production probe, participants were asked, "What's this?" or "What am I doing?" in the context of play as the objects were shown or the action was demonstrated. Initially, each question was asked one time. If the child responded appropriately by producing the target word or used a target word spontaneously, the researcher used nonspecific praise as reinforcement (e.g., "Wow!" "Cool!" or "Oh!") or repeated the word one time for clarification. If the child did not respond or responded incorrectly, the probe question was repeated. After two attempts, the researcher moved on to the next target word. When control words were probed, the same procedures were used.

Treatment Conditions

Although the treatment conditions were conducted in the participants' homes, the sessions were not considered solely child-oriented. According to Fey's (1986) continuum of naturalness, the treatment conditions included in the present study would likely be classified as "hybrid" interventions because attempts were made by the researcher to develop intervention activities that were natural, but that simultaneously provided the researcher with opportunities to use procedures designed to facilitate the speed and generalization of learning. Each treatment condition included three common characteristics Fey (1986) noted for this type of approach. Namely, the researcher had at least one specific goal addressed in each treatment condition, the researcher selected activities and materials to be highly conducive to the spontaneous use of the target words, and the researcher modified her own language input to emphasize target word use.

The following treatment conditions were used: modeling with expectant pause and modeling with evoked production.

Modeling With Expectant Pause (Expectant Pause Condition)

During this condition, the examiner provided an expectant pause after modeling each target word within the context of a play scheme, by looking at the child in anticipation and waiting several seconds. For instance, for the target word "hide," the researcher said, "Let's hide," as she moved two toy cars in the toy garage. Then, she repeated the play action and looked at the child in anticipation and waited several seconds. Praise was allowable in researcher responses to participant target word productions during both treatment conditions. Therefore, if the child used the target word, the research said, "That's right! Cars hide!" If the child did not respond during the expectant pause, the researcher used the target word again in a short sentence (i.e., "Cars hide.") and continued with modeling and play activities.

Modeling With Evoked Production (Evoked Production Condition)

During this condition, a child's verbal response was directly prompted to elicit a verbal response from the child with instructions of "You say" and a cloze procedure of the modeled phrase. For instance, for the target word "cat," the researcher said, "Oh! Where is cat?" as she moved the toy cat into a toy barn. Then she repeated the play action and said to the child, "You say. Oh, where is ___." If the child used the target word, the researcher said, "That's right! Cat!" If the child did not respond after the direct prompt, the researcher used the target word again in a short sentence (i.e., "Where is cat?") and continued with modeling and play activities.

Procedures

Experimental sessions included a baseline visit, weekly home-based treatment sessions for 8 weeks during which the researcher alternated use of the two treatment approaches such that each approach was used during each weekly session, and a follow-up visit 2 weeks after the last treatment session. The first author conducted all screening, baseline, treatment, and follow-up sessions for each participant.

Baseline

During one visit, three baseline samples were collected for each participant in three 10-min unstructured play sessions. In each unstructured play session, the researcher and child played with toys representative of each potential target word. The researcher did not model any of the potential target words, and the child was not prompted to verbally produce them. After each unstructured play session, all 14 potential target words were probed 3 times using the same production probe procedures used during treatment and follow-up sessions. At the end of baseline, the researcher eliminated any target words the child spontaneously said during any unstructured play session or production probes. One participant (LT3) used the potential target words “watch” (sparse) and “bus” (dense). These words were eliminated from his potential pool of target words and replaced by alternative words, “wipe” (sparse) and “beach” (dense). No other words were eliminated for any participants. After the baseline procedures, the potential target words that the child did not produce were randomly assigned to the two treatment and the control condition such that each condition (a) was made up of four words for a total of eight target words with four additional words used as controls and (b) included an equal number of dense and sparse words. See Table 2 for the complete list of target and control words for each participant.

Treatment

Participants received eight treatment sessions, each of which included both interventions. During the treatment sessions, the expectant pause and evoked production techniques were counterbalanced across sessions. Each treatment session began with one treatment for 15 min, switched to the alternative treatment method for an additional 15 min, and finished with 5to 10 min for a production probe. Based on treatment condition protocols used in the Ellis Weismer et al. (1993) and Ellis Weismer and MurrayBranch (1989) studies, both treatment methods included repetitions of the target words provided by the researcher with an opportunity for verbal productions of target words by the participants during play.

For both treatments, the researcher presented five successive models of each target word along with five successive opportunities for the child to spontaneously produce each word. The researcher also said the word once after each production opportunity regardless of whether the child actually produced the word. Feedback for appropriate spoken productions consisted of general praise or knowledge of correctness, for example, “That’s right! It’s a ______.” For incorrect productions or no reply, feedback included, “It’s a ____.” If the child spontaneously produced a target word outside specific production opportunities, the researcher responded with a neutral response such as, “Oh, I see.” or “Oh, really?” The target word modeling occurred during play with the researcher (e.g., playing with a farm set including barn, animals, and people or a car set with various vehicles and people) during which the child’s nonverbal participation was expected.

Target word production probes were conducted after each treatment session. To maintain consistency with Ellis Weismer et al. (1993), participants’ use of control words was regularly monitored. Control words were included in target word production probes every other session for a total of four samples of control words throughout the study. These words were probed using the same criteria as noted for the target words.

Follow-Up

The follow-up session was conducted 2 weeks after the last treatment session and included an additional treatment session including all eight target words, a final production probe including all eight target words and the four control words, and a caregiver–child language sample. Data regarding target word productions were gathered during the treatment session and production probe administration. The caregiver–child language sample was re-administered and scored in the follow-up session to assess general gains in expressive production during the targeted intervention times. For the follow-up caregiver–child language sample, MLU and TTR were re-analyzed and the child's PCC-R were also re-evaluated (see Table 3).

Treatment Fidelity

Coded researcher behaviors included acceptable and unacceptable prompt and response behaviors, number of models provided for each target word, number of opportunities provided for child response, and production probe presentation consistent with protocol. For example, each participant heard each target word modeled by the researcher 10 times for each treatment condition (5 stimulus models and 5 feedback models). Researcher behaviors were coded from videotape for all baseline, treatment, and follow-up sessions by graduate students trained on the coding scheme by the first author. Fidelity was computed using point-by-point agreement between the first author and the graduate student coders. Fidelity was 99% during baseline, treatment, and follow-up sessions for all researcher behaviors.

Interobserver Agreement

Point-by-point agreement was calculated for correct child responses to production probes obtained at the conclusion of each session and any spontaneous child productions of target words during each treatment condition. A child production was coded acceptable if coders agreed on at least two of three phonemes in the target word in the appropriate sequence. Graduate student coders were trained using video collected from a pilot participant. Each coder was trained to 90% agreement with the first author for production probes and spontaneous productions. Each trained coder conducted a phoneme-by-phoneme transcription of all production probe and spontaneous production data and a word-byword transcription of the child language samples. Point-by-point agreement was calculated for 20% of the transcripts by dividing the number of transcription agreements by the total number of transcription agreements and disagreements between the graduate student coders and the first author. Interobserver agreement was 92% for child productions during baseline production probes, 89% for child productions during production probes, and 94% for child target word productions during treatment sessions.

Nonoverlap of All Pairs (NAP; Parker & Vannest, 2009) was used to provide an estimate of effect size. NAP allows the computation of a z score along with confidence intervals for assessment of the magnitude of effects. NAP is equivalent to the data overlap between each pair of points in a baseline phase and a treatment phase. A nonoverlapping pair has a treatment phase that is higher than the baseline counterpart. NAP is equal to the number of pairs of baseline and treatment points showing no overlap divided by the total number of comparisons. NAP values range from .50 to 1.00. Values of .50 indicate that data from different phases cannot be reliably distinguished separate from chance; values of 1 indicate that data from different phases can be perfectly distinguished. NAP was calculated using the online calculator available at http://www.singlecaseresearch.org/ calculators/nap (Vannest, Parker, & Gonan, 2011).

Results Number of Different Words

Figure 1 shows the number of different words produced by the children. Regardless of technique, all three participants showed higher production of treated words than untrained control words. No child produced any of the untrained control words during treatment sessions. Table 4 shows the NAP values for participant performance for all treated words, treated words by condition, and treated words by neighborhood density. For all participants, both treatment techniques resulted in high NAP values (range =.81–1.0) supporting the effectiveness of both treatment conditions over the baseline condition.

There were no consistent differences across the three children between the treatment techniques. LT1 showed a slight advantage of evoked production over expectant pause, with three points with higher numbers of different words for evoked production, and LT2 showed a slight advantage of expectant pause over evoked production with three points higher for expectant pause, but these differences were not maintained across all treatment sessions. LT3 showed an advantage for expectant pause in the first session only.

Dense Versus Sparse Words

Figure 2 shows the total number of different dense and sparse words produced across treatment types. Although there were no consistent differences for dense or sparse words across participants, two participants showed a slight advantage for dense words (LT1 and LT2). LT1 showed a late advantage for dense words in Sessions 4, 5, 6, and 8. LT2 showed an early advantage for dense words in the first four experimental sessions. For LT2, dense words showed a relative advantage over sparse words across all but one experimental session; however, differences were small. LT3 showed no discernable difference between sparse and dense words beyond a short-term early advantage of sparse words. For all participants, words from dense and sparse neighborhood densities were produced and had high NAP values (range = .75–1.0) indicating a large effect for production of both.

Discussion

In this study, modeling with expectant pause and modeling with evoked production were both effective in increasing target word productions across all participants. Although this provides additional evidence that both of these techniques are appropriate for addressing word learning with these late talkers, the small number of participants does limit the generalization of the results. However, the effectiveness of modeling in the present study is consistent with the results of other group studies research literature for other populations including 19- to 36-month-old children with language delay and/or developmental disabilities (Kouri, 2005) and 4- to 4.5-year-old children with autism (Drager et al., 2006). Given that there were no consistent differences between baseline and generalization scores on overall MLU among any of the children, the improvement in performance on the targeted words can be attributed to treatment effects for these single subjects rather than overall developmental improvement in language skills. No participants produced any control words at any session except LT1 who produced one instance of a control word at a follow-up session, which is a small change attributable to chance.

Although the single-subject results from the present study do not generalize to the population of late talkers, the contrast in results from various single-subject and group studies is important to begin to determine a pattern in results across multiple small n studies. In contrast with Ellis Weismer et al. (1993), results from the present study showed treatment effectiveness for all three participants; it is important to compare and contrast the results of these two different single-subject design studies to effectively interpret the potential reasons for the results of the present study. For Ellis Weismer et al., two of the three participants responded to treatment; however, for the third participant, neither treatment technique was effective. The differential participant response pattern between the two small-case design studies may be attributable to many possible factors such as participant age, differing treatment delivery settings, and/or inherent child characteristics. All of the Ellis Weismer et al. participants were 25 to 26 months old as was LT1, whereas the other two of the current study participants were older (33 and 31 months, respectively). Although the youngest participant in this study, LT1, did exhibit effective word learning with treatment, the older participants, LT2 and LT3, produced more target words overall. In addition, the Ellis Weismer et al. treatment consisted of bi-weekly sessions, 1 individual and 1 group in a clinical setting, for a total of 24 sessions across 3 months. The current study was shorter, consisting of 8 weekly individual, home-based sessions across 2 months, allowing children to show progress in fewer sessions than 24 sessions in a clinical setting. Further research regarding outcome differences for vocabulary treatment provided in the home versus clinical setting is needed for this population. Finally, the participants in the Ellis Weismer et al. (1993) study had different linguistic profiles than the current study participants, most notably in receptive language skills. Receptive language skills were generally within typical limits for the Ellis Weismer et al. group (i.e., 1- to 6-month delay based on standardized measures conducted at intake). However, the current study included one participant (LT2) who demonstrated substantial receptive language deficits and exhibited different word learning patterns than the other participants with expressive-only language delay. LT2 showed a modest advantage for the expectant pause technique for the majority of sampling visits. The expectant pause technique might have been more advantageous for this late talker because of its relatively low reliance on comprehension of a verbal direction (i.e., "You say."). It is possible that the increased demand of the evoked production technique taxed underlying language resources (a phenomenon proposed by Rescorla, 2002, 2005, 2009) and was enough to render the evoked production technique less effective for LT2 who had receptive as well as expressive delays.

LT2 was different from the other two participants in three other potentially important developmental characteristics: cognitive skill, age, and gender. First, although her cognitive skills were lower relative to age than the other children, LT2 produced more total words than LT1 across all sessions and produced as many words as LT3 in the first session. Further research exploring the relationship between cognitive skills and word learning performance of late talkers is needed. Second, she was slightly older than the other two participants and may have had longer exposure to language input. Finally, the other two participants were male. Potential gender differences on word learning as they relate to late talking have not been explored in the literature on late talkers.

Effects of neighborhood density on word learning were not consistent across participants, indicating that these single subjects did not benefit differentially from word characteristics in the word learning tasks. Other researchers, using group comparison designs, also found that expressive-only late talkers showed no differences in word learning performance between high- and low-density target words (MacRoy-Higgins et al., 2012). Two participants in the present study, LT1 and LT2, showed a slight short-term advantage for dense words. In a different group study, Storkel's (2009) hypothesized that that high-density words strengthen newly formed word representations for typically developing young children. Because targeted words for the present study were ones participants were already reported to understand, this would suggest the possibility of an internal linguistic representation for the target words before treatment. However, some word representations may have been stronger and more frequently reinforced than others. Because parents reported comprehension using a forced choice (e.g., yes/no) for each word, it is possible that some words were comprehended better or worse relative to other words. More research is needed regarding the influence of word form characteristics during different word learning stages or word comprehension levels for late talkers with expressive-only and expressive and receptive language delays.

Limitations and Future Directions

A number of factors limit the potential for generalization of these results including the single-case design with a small number of participants, individual communication characteristics of the participants, potential for carryover by parents in the home environment, target word selection procedures, and relatively little differences in neighborhood density categories. Although, the single-case alternating treatment design repeated across a small number of participants is often used to make comparisons between treatment conditions and allows experimental control of threats to internal validity (Martella et al., 1999), there is limited generalization possible from a single-case design to the entire population of late-talking children. Future research should include group designs with participants randomly assigned to condition. Future research contrasting a modeling approach with other treatment approaches is also needed for a more comprehensive view of relative therapeutic success with late talkers, including contrasting techniques with more distinct differences in procedures.

This study differed from other late talker word learning studies in that it included a participant (LT2) with expressive and receptive language delay. This individual participant was a member of a late-talking subgroup historically underrepresented in research (Desmarias et al., 2008). Although the finding from a single participant cannot be further generalized, her inclusion in the study illustrated the need for additional research to determine possible systematic differences in word learning tasks and individual variability in response to treatment among subgroups of late talkers. In addition, other participant variables such as cognitive skills, age, and gender require further group comparison research to determine effects on treatment outcomes in late talkers.

Different performance results among treatment conditions may result from external variations in the children's exposure to the words such as parent usage of the target words. That was not possible to control in a home environment. The researcher did not monitor parent use of target or control words but parents were not encouraged to use target or control words outside experimental sessions. Direct comparison of clinical versus home-based learning of words is needed to account for these kinds of uncontrollable variables in a home environment.

Because the authors were interested in findings in comparison with Ellis Weismer et al. (1993), the target word selection criteria were based on the target word selection criteria used by the aforementioned researchers. However, an extension to the present study could include modifications to these criteria by considering additional factors when selecting target words such as communicative salience, word meaning, or word function.

Finally, the relatively little difference based on neighborhood density categories limited the generalization of the present study to words beyond the small sample taught to the participants. The final categorization of words was relative to each child rather than absolute across the population because of the need to teach words within an individual child's comprehension and phonetic repertoire. The procedural control extended for standardizing each participant's potential target word pool limited the number of possible words and, consequently, restricted flexibility in creating neighborhood density category groupings. Future researchers may reconsider the stringent word pool criteria to further distinguish neighborhood density groupings of selected target words.

Clinical Significance

The findings from this study provide further justification for the efficacy of modeling intervention for word learning with late talkers. For clinicians working in a setting using a consultative-coaching approach with caregivers, this evidence suggests that providing instruction to caregivers on modeling target words is appropriate. In the present study, both treatment techniques resulted in children effectively learning to produce target words. However, neither expectant pause nor evoked production showed a clear advantage for word learning across participants. This evidence suggests that within the context of a comprehensive intervention program, teaching caregivers either (or both) modeling technique would be appropriate. Clinicians may describe and demonstrate both techniques and assist caregivers in identifying natural routines throughout the day during which either of the techniques may be included for capitalizing on word learning opportunities. In addition to routinebased considerations, the advantage of coaching caregivers in different types of modeling techniques is that caregivers have the flexibility to choose the technique better suited for their individual style of interaction. In addition, two of the three participants exhibited a slight short-term advantage for spoken production of dense words over sparse words. The present study does not yet provide clear clinical guidelines for matching techniques to specific child or word form characteristics; however, clinicians should consider the role of comprehension in treatment technique selection as well as neighborhood density because dense words that are understood, but not yet produced by a child, may exhibit a slight short-term therapeutic advantage for word learning.

Declaration of Conflicting Interests

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Table 1. Participant Initial Screening Outcomes.

	Participant		
	LT1	LT2	LT3
Chronological age	2.1 (25 months)	2.9 (33 months)	2.7 (31 months)
Vision/Hearing	Pass	Pass	Pass
Language sample analysis			
MLU	1.64	1.57	1.38
Type-Token Ratio	0.40	0.45	0.57
% Consonants Correct–Revised	0.24	0.70	0.50
No. of Sounds in Phonetic Inventory	8	17	13
Preschool Language Scale–4(PLS)			
Auditory comprehension	SS: 94 (34th percentile)	SS: 59 (1st percentile)	SS: 110 (75th percentile)
Expressive communication	SS: 85 (16th)	SS: 79 (8th)	SS: 74 (4th)
Total language	SS: 89 (25th)	SS: 66 (1st)	SS: 91 (27th)
Battelle Developmental Inventory–2 (BDI-2)			
Motor subtest	SS: 100 (50th)	SS: 93 (32nd)	SS: 105 (63rd)
Cognitive subtest	SS: 91 (27th)	SS: 78 (7th)	SS: 98 (29th)
CDI/CDI III	RS: 50 (<10th)	SS: 215/12 (<5th)	RS: 275/5 (<10th)
M-CHAT	Pass	Pass	Pass

Note. MLU = mean length of utterance; CDI = *Communicative Development Inventory*; M-CHAT = Modified-Checklist for Autism in Toddlers.

Table 2. Control Words and Treatment Target Words Across Participants.

	Treatment target words		
Treatment target words	LT1	LT2	LT3
Control words	Bath (D; 13)	Carry (D; 17)	Bite (D; 26)
	Bite (D; 26)	Sit (D; 24)	Beach (D; 14)
	Bunny (S; 11)	Couch (S; 5)	Dish (S; 10)
	Wipe (S; 10)	Give (S; 3)	Mouse (S; 9)
Expectant pause	Bird (D; 12)	Pen (D; 16)	Bead (D; 22)
	Wet (D; 13)	Fall (D; 18)	Hug (D; 14)
	Nose (S; 4)	Bib (S; 8)	Jar (S; 11)
	Door (S; 6)	Comb (S; 10)	Nail (S; 9)
Evoked production	Duck (D; 19)	Hit (D; 24)	Chin (D; 12)
	Bed (D; 22)	Bowl (D; 19)	Bowl (D; 19)
	Mouth (S; 5)	Feed (S; 14)	Wipe (S; 10)
	Nap (S; 10)	Pour (S; 14)	Chase (S; 8)
Mean dense	17.50	19.67	17.83
Mean sparse	7.67	9.00	9.50

Table 3. Participant Follow-Up Measurement Outcomes.

	Participant		
	LT1	LT2	LT3
Language sample analysis			
MLU	1.75	2.51	1.76
TTR	0.34	0.43	0.55
PCC-R	0.40	0.87	0.57
No. of sounds in PI	12	20	19

Note. MLU = mean length of utterance; TTR = Type-Token Ratio; PCC-R = percent consonants correct–revised.

Table 4. NAP Values for Participant Performance for Treatment Condition and Neighborhood Density.

Participant	NAP	90% confidence interval	*Z* score
Treatment condition			
Evoked production			
LT1	0.87	[0.078, 1.422]	1.84
LT2	1.00	[0.328, 1.672]	2.45
LT3	1.00	[0.328, 1.672]	2.45
Expectant pause			
LT1	0.81	[0.047, 1.213]	1.53
LT2	1.00	[0.328, 1.672]	2.45
LT3	1.00	[0.328, 1.672]	2.45
Neighborhood density			
Dense			
LT1	0.88	[0.078, 1.422]	1.84
LT2	1.00	[0.328, 1.672]	2.45
LT3	1.00	[0.328, 1.672]	2.45
Sparse			
LT1	0.75	[−0.172, 1.172]	1.22
LT2	1.00	[0.328, 1.672]	2.45
LT3	1.00	[0.328, 1.672]	2.45

Note. NAP = Nonoverlap of All Pairs.

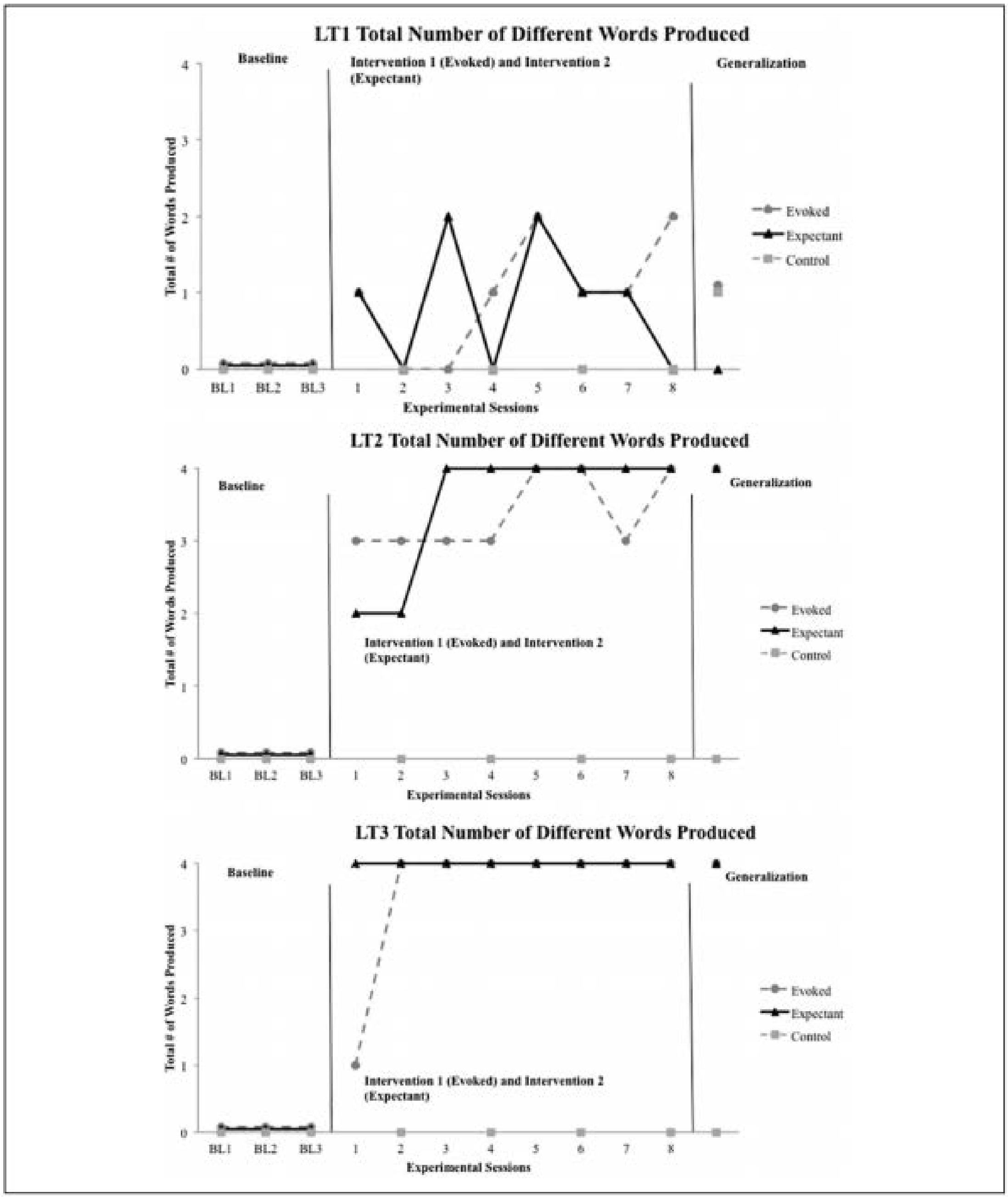

Figure 1. Total number of different words produced across participants.

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