Research Article

Effective Use of Auditory Bombardment as a Therapy Adjunct for Children With Developmental Language Disorders

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Purpose: Modeling of grammatical forms has been used in conjunction with conversational recast treatment in various forms. This study tests the relative effect of providing bombardment prior to or after recast treatment.

Method: Twenty-eight children with developmental language disorder participated in daily conversational recast treatment for morpheme errors. This treatment was either preceded or followed by a brief period of intensive auditory bombardment. Generalization to untreated lexical contexts was measured throughout the treatment period to assess the degree of learning and how quickly the onset of measurable learning occurred.

Results: There were no significant differences in elicited use of morphemes for the groups of children who

received auditory bombardment before or after enhanced conversational recast treatment.

However, there was a difference in the number of children who could be considered treatment responders versus nonresponders, favoring those who received auditory bombardment after recast treatment.

Conclusion: A brief period of auditory bombardment is a relatively low cost addition to recast treatment methods, given how little time it takes. There is a small but measurable advantage to following recast treatment with a period of auditory bombardment.

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Language treatment procedures have long included clinician models of linguistic elements provided to children (e.g., Leonard, 1975). *Modeling* is defined here as the provision of one or more canonical examples of a linguistic form targeted for treatment. Modeling procedures have been used in various forms that expose children to multiple exemplars of a given linguistic target (Ellis Weismer, Venker, & Robertson, 2017). These include models that are distributed within a conversation between the parent or clinician and the child during structured play (e.g., Alt, Meyers, Oglivie, Nicholas, & Arizmendi, 2014; Fey, Cleave, Long, & Hughes, 1993; Hadley & Walsh, 2014; Kouri, 2005), during dialogic reading activities (Leonard, Camarata, Brown, & Camarata, 2004) or as massed, high-density presentations of target morphemes in short sentences

(i.e., auditory bombardment; e.g., Encinas & Plante, 2016). This intervention method has resulted in positive outcomes for children with developmental language disorder (Fey et al., 1993; Leonard et al., 2004; Leonard, Camarata, Pawtowska, Brown, & Camarata, 2006), language disorder secondary to hearing loss (Encinas & Plante, 2016), and children with phonological difficulties (Tyler, Lewis, Haskill, & Tolbert, 2002). The technique of modeling has been used by itself (e.g., Courtright & Courtright, 1976; Ellis Weismer & Murray-Branch, 1989; Kouri, 2005) or in combination with other treatment elements (e.g., Ellis Weismer & Murray-Branch, 1989; Encinas & Plante, 2016; Fey et al., 1993; Leonard et al., 2004; Long, Olswang, Brian, & Dale, 1996). Across studies, there are noteworthy differences in the number of exposures, their density within a treatment session, and naturalness of the context. Despite the variation in its implementation, all forms of modeling share the common property that children are not required to produce targets themselves, although children are not prevented from doing so.

Evidence has been drawn from multiple theoretical frameworks in order to support the incorporation of modeling in language treatment for children with language deficits. Initial justification for the use of modeling was drawn from

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social learning theories, such as Bandura's (Bandura, 1977; Bandura & Harris, 1966) discussion of the role of observation in the learning of behavior, and social constructionist theories that highlight the importance of adult-child interactions in the development of skills and behavior (Bruner, 1983). Early forms of modeling activities capitalized on these social components of learning in order to facilitate language growth. Currently, the most widely accepted theoretical basis for the use of modeling is that of statistical learning theory, which has been frequently cited in the literature related to speech and language acquisition (e.g., Kuhl, 2004; Plante, Vance, Moody, & Gerken, 2013; Romberg & Saffran, 2010; Saffran, Aslin, & Newport, 1996) and treatment of child language disorders (Alt et al., 2014; Encinas & Plante, 2016; Plante et al., 2014). The idea that children recognize statistical regularities from high-density modeling in experimental work motivates its use in treatment.

Modeling Before Recasting

In studies involving the use of a period of modeling with conversational recast treatment, the child is presented with periods of modeling before conversational recast activities (Fey et al., 1993; Leonard et al., 2004, 2006). One possible theoretical basis for this treatment configuration is that of structural priming or the tendency to reproduce language output with structural characteristics of input that has been recently received (Pickering & Ferreira, 2008). Although the reasons for this treatment sequence are not explicitly stated in the treatment literature, Leonard's (2011) discussion on structural priming provides a possible justification for the presentation of modeling activities prior to recasting activities in previous studies of the effectiveness of these treatments. If a child's verbal output is, as Leonard argues, influenced or "primed" by the input they have received, then providing models first and recasting second would be a logical order of treatment procedures. This is because modeling is inherently less interactive than recasting activities. In other words, the child is not expected to respond with the target form during modeling. During recasting, however, the tasks shift to incorporate reciprocal discourse between the child and the adult with the goal of the child producing, or at least approximating, the target forms.

Further justification for the presentation of models prior to recasting comes from the fact that, as outlined by Cohen et al. (2015), most of the literature on encoding and consolidation of memories focuses on the conditions prior to encoding. Much of what we know about these encoding processes, however, does not extend beyond the frame of the seconds before presentation of stimuli to be encoded (Cohen et al., 2015). This may weaken the justification for the use of modeling prior to a block of recasting treatment. In this arrangement, the obligatory stimulus productions (i.e., child attempts and recasting responses) do not occur until several minutes or longer after modeling, which may be too long for modeling to positively impact later recasts.

Modeling After Recasting

The argument could be made that the presentation of models after recasting activities may be an effective way of enhancing encoding of the target information. Due to the nature of typical recasting activities (i.e., play based and time between recasts), there are consistently intervening stimuli between the doses (i.e., recasts). According to Dudai (2004), effective recall of target materials is worsened by the presentation of intervening stimuli. Intervening input can erode fragile representations contained in each recast due to its incomplete representation in the child's memory as he or she is attempting to acquire a new form. If intervening stimuli are avoided to the extent possible as new memories are formed, then these memories will be less susceptible to interference. After a period of minutes to hours, depending on the task, reactivation could serve to strengthen these new memories (Dudai, 2004). A brief period of high-density modeling (auditory bombardment) without intervening stimuli occurring after recasts could function in this way. If a treatment pairing of auditory bombardment and conversational recasting is viewed as an example of a "training + recall" procedure, it could then be argued that the presentation of auditory bombardment after recasting would result in higher accuracy of later recall and use of a trained form.

This reasoning is based upon findings related to the effectiveness of repeated recall in the improvement of performance. In a study of word learning, Karpicke and Roediger (2008) found that long-term preservation of learned Swahili-English word pairs was better for college students who were given a repeated recall study paradigm. These findings were corroborated in a functional magnetic resonance imaging study by Hashimoto, Usui, Taira, and Kojima (2011), which suggested that repeated recall increased the efficiency of neural processing during a word-learning task, such that word recall became easier with repeated recall. Again, acknowledging that recall during auditory bombardment is a passive process, repeated recall studies suggest that this technique may lend itself to greater long-term retention of the target forms.

If auditory bombardment is presented first and is considered a "pretraining" activity, then this would, following Dudai's discussion, result in less-effective consolidation of the target materials but may possibly function as a prime. Conversely, if the auditory bombardment activities are used as the "posttraining" input, then it could be argued that this would be more likely to strengthen consolidation because rapid presentation of models would eliminate the occurrence of intervening stimuli. Although modeling does not result in active recall of the target forms on the part of the child, models of treatment targets may result in passive reactivation of related forms in the child's memory.

Purpose

The purpose of this study is to systematically evaluate the use of a period of auditory bombardment, as a form of modeling, in conjunction with a conversational recast

procedure for the remediation of grammatical morpheme errors for children with developmental language disorder (DLD). Specifically, we aimed to determine whether an initial block versus a final block of auditory bombardment, paired with a block of enhanced conversational recast treatment, would differentially affect treatment outcomes. We used an early efficacy study to identify the impact of this manipulation (Fey & Finestack, 2009). This approach is consistent with a call for programmatic approaches to improving treatment research. Fey and Finestack (2009) noted that the relative scarcity of effective evidence-based treatment may relate, in part, to a lack of small-scale studies designed specifically to identify the relative effects of specific treatment components. These types of studies would precede randomized clinical trial studies. This study directly addresses this need. We hypothesize that, when auditory bombardment occurs as part of a recast-based intervention, the timing of stimulation relative to recast treatment will matter in terms of children's progress in treatment. However, because there is an *a priori* rationale for auditory bombardment to either precede or follow recasting, our hypothesis is nondirectional.

Method

Participants

Twenty-eight children diagnosed with DLD participated in the experiment. We use the term *DLD* here (Bishop, Snowling, Thompson, Greenhalgh, & CATALISE consortium, 2016) as equivalent to the classic definition of specific language impairment in which language deficits occur that are not explained by other handicapping conditions. Their demographic information and test scores are provided in Table 1. Children were between the ages of 4;3 (years;months) and 6;2 ($M = 5;3$). All received enhanced conversational recast treatment along with a brief period of auditory bombardment. For 14 children (11 boys, three girls), auditory bombardment preceded recasting (Bombardment First). For the other 14 children (five boys, nine girls), bombardment followed recasting (Bombardment Last). The clinicians who provided treatment to children were also balanced across the Bombardment First and Last conditions so that their effect was distributed across both conditions.

Because this study is an early efficacy study (Fey & Finestack, 2009), involving a relatively small n , we did not use true random assignment of children to groups. At small sample sizes, random assignment is unlikely to balance groups for known factors that could affect interpretation of the results. Children were initially divided into subgroups on the basis of sex and age (4-year-olds vs. 5-year-olds) and overall language severity. Children were alternately assigned, without regard to other factors (e.g., articulation scores and second language exposure), to each condition to achieve an initial balance across groups for age and sex. Three of the originally enrolled children did not complete the study. Each of these children was replaced by the next available child, regardless of their demographic background. This system of replacement created a slight gender imbalance between the

two groups. Data from children who did not complete the experiment were not included. The total days of treatment for those retained in the study are reported in Table 2. There was no significant group difference for the number of treatment days, $t(1, 26) = 0.763$; $p = .45$; $d = 0.03$.

The three children who were initially enrolled in the study were excluded due to excessive absences. These children missed half the treatment days. For two of the children, absences were spread throughout the treatment period due to recurring illnesses. The third was withdrawn from the study by his parents.

No child was receiving outside language therapy during the period of this study. However, all but six children (three in Bombardment First, three in Bombardment Last) were receiving articulation therapy concurrently with the morphology treatment. Four also received concomitant vocabulary treatment (two in each treatment condition).

Demographic information is reported in Table 1. The diagnosis of DLD was confirmed through a pure-tone hearing screening, normal nonverbal cognitive skills ($70 + 1\text{ SEM}$ on the Nonverbal Scale of the Kaufman Assessment Battery for Children–Second Edition; Kaufman & Kaufman, 2004) and a score of 87 or less on the Structured Photographic Expressive Language Test–Preschool 2 (SPELT-P 2; Dawson et al., 2003). The language cut score was validated for children with DLD by Greenslade, Plante, and Vance (2009). Articulation skills were free to vary and were documented using the Peabody Picture Vocabulary Test–Fourth Edition (Dunn & Dunn, 2007) and the Goldman-Fristoe Test of Articulation–Second Edition (Goldman & Fristoe, 2000), respectively. There were no significant differences on any of the demographic variables for children in the two groups ($p < .05$, two tailed in all cases).

All children were native speakers of English. Eight children (four children per group) were also exposed to Spanish at home. In each case, English was the child's primary language, and the child spoke little to no Spanish as reported by their parents. These children attended English-speaking schools and day care centers. They also had sufficient sounds in their speech sound inventory to produce morphemes that were assigned to them for the experiment (described below).

Materials and Procedure

General Treatment Context

Treatment was administered during 30-min sessions in the clinical facilities at The University of Arizona. Treatment consisted of two phases. The enhanced conversational recast phase lasted approximately 26–28 min. The auditory bombardment phase lasted 2–4 min. The order of these two phases differed between the two treatment groups. Treatment was administered by eight research clinicians who were undergraduate and graduate students in speech-language pathology. Each clinician administered treatment under the Bombardment First and Bombardment Last conditions to counterbalance any effect of clinician across treatment conditions. Treatment was supervised by a clinically certified and licensed speech-language pathologist.

Table 1. Demographic and treatment targets for child participants.

Subject	Sex	Age (years;months)	K-ABC-II	SPELT-P 2	PPVT-4	Shirts & Shoes	GFTA-2
Bombardment First (before Enhanced Conversational Recast)							
B1-1	m	5;2	87	84	113	76	64
B1-2	m	4;6	102	85	114	99	70
B1-3	f	4;6	98	70	79	97	107
B1-4	m	4;3	89	68	102	95	66
B1-5	f	5;2	98	70	84	89	112
B1-6	m	5;2	83	82	89	89	78
B1-7	m	5;0	91	58	73	89	81
B1-8	m	4;8	116	75	112	85	78
B1-9	m	5;4	124	45	87	103	56
B1-10	m	5;8	124	53	105	95	96
B1-11	m	5;6	79	67	88	89	76
B1-12	f	4;8	109	72	109	107	100
B1-13	m	5;0	102	61	92	91	79
B1-14	m	5;5	115	67	85	87	86
<i>M</i>		5;0	101.2	68.4	95.1	92.2	82.1
<i>SD</i>		0;6	14.7	11.5	13.7	7.9	16.5
Bombardment Last (after Enhanced Conversational Recast)							
B2-1	f	4;7	116	85	114	105	100
B2-2	f	4;8	93	78	93	93	90
B2-3	m	5;8	95	61	104	101	76
B2-4	f	5;8	91	42	62	76	71
B2-5	f	5;1	115	82	97	93	113
B2-6	m	5;2	98	77	99	87	72
B2-7	m	6;2	102	40	62	89	57
B2-8	m	4;10	87	53	77	76	74
B2-9	f	4;4	93	53	94	76	93
B2-10	f	5;9	100	64	102	85	61
B2-11	f	5;9	97	59	79	83	108
B2-12	m	5;8	77	53	91	93	68
B2-13	f	4;4	107	60	98	83	71
B2-14	f	5;5	96	79	88	108	60
<i>M</i>		5;2	97.6	63.3	90.0	89.1	79.6
<i>SD</i>		0;7	10.3	14.7	15.2	10.4	18.1

Note. All test scores are standard scores with a mean of 100 and an *SD* of 15. Scores from the Shirts & Shoes Test (Plante & Vance, 2011), a test of receptive morphosyntax, are based on local norms for Tucson, AZ. K-ABC-II = Kaufman Assessment Battery for Children–Second Edition, Nonverbal scale; SPELT-P 2 = Structured Photographic Expressive Language Test–Preschool 2; PPVT-4 = Peabody Picture Vocabulary Test–Fourth Edition; GFTA-2 = Goldman-Fristoe Test of Articulation–Second Edition; f = female; m = male.

Children were concurrently enrolled in a half-day summer preschool program held in the university clinic. The program permitted parents to leave their children in the program for a half day. Because parents did not stay, they remained blind to the grammatical targets until after the treatment period. The half-day preschool program was staffed by undergraduate students who were blind to the children's treatment goals. The preschool staff were explicitly instructed not to address or correct children's grammar. The preschool program focused on thematic activities designed to build vocabulary, preliteracy, and numeracy skills. Because all children participated in this program, this source of language enrichment was constant across the two treatment conditions.

Overview of Experimental Procedure

The study consisted of four components: pretreatment probes, enhanced conversational recast procedures, auditory

bombardment, and generalization probes used to track learning. In addition, spontaneous use of the children's target morphemes during the treatment period was tracked. The procedures related to each component are detailed below. The procedures are represented graphically in Figure 1.

It has been suggested that variation in treatment effectiveness may be related to treatment parameters, including the number of treatment doses, the treatment intensity, and treatment duration (Warren, Fey, & Yoder, 2007). In this study, each of these parameters was held constant across the two treatment conditions. Each child received 48 treatment doses (i.e., actions thought to remediate morpheme errors) per session. Twenty-four of these were presented as recasts, and 24 occurred during auditory bombardment. The dose frequency (i.e., the number of times the treatment is administered) was once per day, five times per week. Given that some children were absent for some days, the specific number of treatment days per child is

Table 2. Treatment specifications for children in the Bombardment First and Bombardment Last treatment conditions.

Subject	Target form	Control form	Treatment days	Unique verbs bombarded	Unique platform words recast
Bombardment First (before Enhanced Conversational Recast)					
B1-1	Doesn't	He	25	335	368
B1-2	3 ps	—ed	21	131	203
B1-3	3 ps	—ed	20	138	200
B1-4	Aux. is	Poss —s	23	263	231
B1-5	—ed	Wh ?	24	111	77
B1-6	—ed	She	23	381	317
B1-7	3 ps	—ed	25	150	238
B1-8	3 ps	—ed	21	273	238
B1-9	—ed	She	23	275	267
B1-10	3 ps	She	22	208	205
B1-11	He	3 ps	21	188	141
B1-12	—ed	Wh ?	23	228	178
B1-13	—ed	3 ps	25	188	262
B1-14	Aux. is	3 ps	20	182	144
	<i>M</i>		23.5	217.9	219.2
	<i>SD</i>		1.8	79.4	74.0
Bombardment Last (after Enhanced Conversational Recast)					
B2-1	—ed	3 ps	23	269	231
B2-2	3 ps	Wh ?	17	206	190
B2-3	3 ps	—ed	17	121	199
B2-4	She	—ed	23	281	214
B2-5	—ed	3 ps	25	359	270
B2-6	3 ps	Wh ?	23	269	240
B2-7	—ed	3 ps	25	132	210
B2-8	—ed	3 ps	25	143	209
B2-9	—ed	Wh ?	21	266	231
B2-10	—ed	Aux. is	24	316	281
B2-11	3 ps	—ed	25	395	328
B2-12	—ed	She	18	190	174
B2-13	—ed	3 ps	25	183	263
B2-14	Aux. is	She	21	339	224
	<i>M</i>		22.3	247.8	233.1
	<i>SD</i>		3.0	87.3	40.8

Note. Platform words are words that occur in association with the target morpheme (i.e., verbs used with pronouns, *wh*-questions, or verb morphology; nouns used with possessive forms). 3 ps = third-person singular verb marking; Aux. is = auxiliary verb “is”; Poss. —s = possessive —s marking; Wh ?s = *wh*-question forms, including interrogative reversal.

reported in Table 2. The treatment was administered over a period of five weeks, for a total intervention duration of up to 25 days. This yielded a cumulative intervention intensity (Dose Number $\times$ Dose Frequency/Day $\times$ Total Intervention Duration in Days) of 408 to 600 across children ($M = 552$). None of these treatment variables were significantly different between groups (two-tailed *t* test at $p < .01$).

Pretreatment Baseline

Pretreatment probes were used to elicit morpheme use by children over 3 days immediately prior to the first day of treatment in order to identify at least two morphemes that were used less than 30% of the time in obligatory contexts. For each child, five to six morphemes were probed each day during a 45-min session that involved free play with a variety of toys. Morphemes probed included those listed in Table 2 along with additional pronouns and auxiliaries and

plural —s. Clinicians created up to 10 opportunities for use in which the clinician’s linguistic input obligated the use of each morpheme by the child. Clinicians recorded whether the child used the morpheme correctly in that context, provided a response that omitted the morpheme or substituted another morpheme (e.g., him for she/he/her), or gave no response at all despite the obligatory context. They also noted spontaneous use of the possible morpheme targets so that a minimum of 10 attempts for each morpheme were recorded for each child.

Of morphemes showing 30% or lower average use during probes, one was selected for treatment (the target morpheme), and a second was tracked but not treated (the control morpheme). When more than two morphemes were used with low accuracy, preference was given to those with the lowest use and to morphemes that would best balance treated and control morphemes across children and across treatment condition. The target and control morphemes

Figure 1. A schematic of the experimental components, including pretreatment probes (in the first 3 days), the order of presentation for auditory bombardment and enhanced conversational recast components (5 days per week), and generalization probes (3 days per week).

Daily Schedule Each Week for 5 Weeks						
	First 3 Days	Monday	Tuesday	Wednesday	Thursday	Friday
Bombardment First	Pretreatment probes (45 min)	Generalization Probes (15 min)		Generalization Probes (15 min)		Generalization Probes (15 min)
		Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)
		Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)
Bombardment Last	Pretreatment probes (45 min)	Generalization Probes (15 min)		Generalization Probes (15 min)		Generalization Probes (15 min)
		Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)	Enhanced Conversational Recast (26-27 min)
		Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)	Auditory Bombardment (3-4 min)

assigned for each child are reported in Table 2. Pretreatment use of these morphemes is reported in Table 3.

Treatment

Treatment consisted of enhanced conversational recast and auditory bombardment, which was provided one-on-one, in 30-min treatment sessions. Clinicians were provided with paper record forms on which they recorded the accuracy of each child's attempts at using the target morpheme, along with the verb that the clinician used with each recast, each verb used during auditory bombardment, and any correct spontaneous uses of the target morpheme by the child during the treatment session. Spontaneous use by the child was defined as correct use of their target morpheme with a verb that was not modeled by the clinician.

Auditory Bombardment

Auditory bombardment consisted of presenting 24 short clinician utterances (e.g., noun + verb, noun + negative + verb, article + noun + verb + adverb), lasting approximately 2 to 4 min. Examples of utterances include "Joe tripped." "The boys raced." "That girl scared him." Each utterance was unique in that different nouns and verbs were used in each. Although both nouns and verbs varied, we tracked the variability of verbs used because these elements always co-occurred with the target morphology. Clinicians were directed to use different words

across days so that the nouns and verbs also varied across, as well as within, treatment days.

The total number of unique verbs heard by each child during bombardment is reported in Table 2. The total number of unique verbs is potentially important because other work has demonstrated that high variability input results in better learning than low variability input (Plante et al., 2014). The number of different verbs used was derived from the clinician's daily written record of the words he or she used during the bombardment phase. Verbs used on multiple days were represented only once in this count so that the values represented in the table are the total number of unique words used during the treatment period. There was no significant group difference in the number of unique verbs bombarded, $t(1, 26) = 0.95$, $p = .35$, two tailed. The total verbs used were equal to the number of sessions $\times$ 24 items bombarded for each child.

Clinician utterances were presented in the context of a short activity meant to hold the attention of the child. Examples of these activities included having the child turn over flashcards while the clinician referred to the actor and action pictured, a walking path for which each utterance was a step, slips of paper that were read by the clinician and then thrown in the trash by the child, and picking up picture cards from the floor. Clinicians were encouraged to use a wide variety of bombardment activities during the weeks of treatment. Clinicians were asked to present each utterance when they felt that they had the child's attention (operationally

defined as the child looking at the clinician), but to keep the overall duration of the bombardment period as brief as possible.

Enhanced Conversational Recast

Sessions included two to three activities that were designed to elicit use of 24 different verbs for recasting. These activities provided semantic support during morphological learning. Different activities were used on consecutive treatment days, with few repeats over the entire treatment period. This facilitated use of a wide variety of unique words used in recasts across the treatment period in that different verbs naturally suggested themselves for different activities (e.g., crafts: cut, glue, fold, snip... kitchen play: cook, stir, flip, bake...). Every treatment session included dialogic book reading, with a different book used each session. Other activities included crafts, free play with a variety of toys, building materials, and board games. Children's utterances during these activities served as the basis for clinician recasts. Utterances could be spontaneously generated by the child, but a majority were elicited by the clinician. (e.g., Clinician: "Here's a saw for Bob. What does he do with that?" Child: "He saw." Clinician: "He saws."). Previous work indicates that recasting elicited utterances is as effective as recasting spontaneous utterances (Hassink & Leonard, 2010). *Recasts* were defined as a clinician utterance that followed a child's utterance that mirrored the content of that utterance but corrected ungrammatical elements when they were used. Recasts could follow either incorrect or correct child use of the target morpheme (e.g., Child: "Guy jumped there." Clinician: "The guy jumped there."; Child: "He kick it." Clinician: "He kicked it.>").

Enhanced conversational recast includes two components not typically described in conversational recast studies. The first is the clinician's use of 24 unique platform words that are recast during each treatment session. A platform word consists of the main verb that co-occurs with the target grammatical morpheme. For pronouns and negatives, it is the verb that directly follows these elements (e.g., Doesn't: "Carrie doesn't go," "Grover doesn't like it."; He: "He yells," "He tripped that one."). In contrast, a platform utterance is the child's utterance that serves as the basis for the recast. The number of different unique platform words recast is reported in Table 2. This total was derived as described for the number of unique words presented during auditory bombardment, using the clinician's record of inflected words used during recasts. This total did not differ by group, $t(1, 26) = 0.62$; $p < .54$, two tailed.

The requirement of unique platform words for each recast follows from earlier treatment research demonstrating that children who heard 24 unique words in recasts outperformed children who received the same number of recasts but heard only half the number of unique words (Plante et al., 2014). Accordingly, here, clinicians recast 24 unique platform words that occurred in relation to the target morphemes during each treatment session. Clinicians were free to use any verb that fit semantically with the planned activities and worked grammatically with the target morpheme,

with the exception of 20 verbs that were specifically withheld from treatment. These excluded verbs were withheld from treatment in order to test generalization of learning and are described below. Although clinicians were not restricted from repeating platform words across days, Table 2 indicates that most children heard a large number of different platform words across treatment days. Clinicians were also discouraged from repeating other words across platform utterances (e.g., Recast of "He runs." "He jumps." "He swings." vs. "He runs." "This one jumps." "Spiderman swings.") to increase overall input variability around the target morpheme.

To ensure that the child understood which specific word the clinician was attempting to elicit with their utterance, the clinicians could model the noun or verb (either with bare stems or with nontarget morphology) up to three times in conversation before eliciting utterances from the child that obligated the target morpheme (Clinician: "The cat can meow for dinner. Make her meow. I heard Ginger meowing. What did she do? Child: "Meowed." Clinician: "The cat meowed.>"). The modeled platform words were always presented without the target morpheme. One child had very little spontaneous language at the start of treatment (Subject B2-7, Bombardment Last group) but, instead, used a limited number of routinized utterances for most of his spontaneous language ("oh!" "ok."). This child was also asked to say the uninflected verb stem prior to the clinician elicitation, simply to ensure that the child could produce the verb at all.

The second component of enhanced conversational recast is the use of attentional cues to draw the child's attention to the recast. The principle underlying this is that children with DLD can exhibit subclinical deficits in attention (see Ebert & Kohnert, 2011, or Kapa & Plante, 2015, for reviews). Attentional breaks at the time of the recast could have the effect of reducing the effective number of recast doses provided to the child. Therefore, clinicians attempted to gain the child's attention (operationalized as looking at the clinician) at the time of the recast. Attentional cues that were effective varied widely across children. Some responded to the clinician using an anticipatory pause before the recast; others required a touch to the hand or arm or even manually orienting the child's face to the clinician just before the recast and holding back the recast until visual attention was established. Because the effective prompt for any given child was not always obvious, training the child to consistently attend during recasts could require days or weeks to establish as a routine child behavior.

Probe Sessions

Generalization to untrained verbs was probed three times per week by the treating clinician. In addition, performance on the control morpheme was tracked during probe sessions. Probe sessions lasted approximately 15 min and preceded the day's treatment session. This ensured that probe performance reflected retention from previous treatment sessions rather than immediate training effects. Probe activities centered around one of five probe kits, which included thematic sets of toys (a farm set, an ocean set, and a zoo set), playdough kits, and two sets of cutout figures

(a race car set and a soccer set). Each kit included a large number of pieces, and clinicians selected a subset of these materials for each probe session. Clinicians cycled through both the probe kits and the materials within each probe kit over the course of the probe sessions so that children were probed with a diverse set of materials and verbs. This was intended to reduce boredom with the probe procedures, despite their frequency during the treatment period. However, it was the case that children saw some of the probe materials more than once over the course of the experiment. Probe materials and materials like them (e.g., farm toys and books about farms) were withheld from treatment.

Probes involved 10 elicitations each of the target and control morphemes. Clinicians elicited use of the morphemes with a subset of 20 regular verbs that were withheld from treatment so that generalization to untrained verbs could be assessed. The 20 probe words were selected because they could be used with multiple probe kits (e.g., roll could be used for a race car tire, a dolphin doing tricks, a soccer ball pass, or a pig in a mud puddle). Likewise, regular verbs can be obligated in parallel ways in order to test multiple verb morphology errors targeted in treatment. The clinician was free to select any 10 of the 20 probe words for any given probe session, and clinicians were encouraged to use all 20 across probe sessions. Clinicians were free to probe target and control morphemes in blocks or intermixed during the probe session. Clinicians were also free to probe words in any way they liked, as long as the prompt obligated the child's use of the target morpheme. This variability in probe forms reduced the likelihood of children developing a set response to a standard set of probe items. Spontaneous use of a probe word during the probe session was also counted as one of the 10 responses, as long as that particular probe word had not already been elicited during that probe session.

Procedural Fidelity

Prior to the start of data collection, all clinicians were trained on probe, auditory bombardment, and recast procedures during two half-day sessions. During the experiment, they were supervised by a certified speech-language pathologist who reinforced use of correct treatment and probe procedures, particularly in the first week of treatment. To evaluate procedural fidelity, a second observer coded the treatment and probe activities. These individuals did not provide treatment to any of the children. A total of 46 (15%) of Bombardment First sessions and 65 (20%) of Bombardment Last sessions were coded for fidelity. These were coded live during the treatment sessions. Live coding permitted the coders to move within the room so that they could clearly see and hear the clinician-child interactions. We have found that this is not always possible with video from fixed-mounted cameras. Sessions were coded from the first to last weeks and scheduled so that each child was observed at least twice. Observers noted the activities used for each probe or treatment session, the number and variety of words used during recasts and elicited probes, and whether probe words and materials were used only for probe sessions.

Procedural fidelity was considered in terms of (a) the number of doses administered, (b) that each dose within the recast and the bombardment phase included a unique verb, (c) that no probe words were elicited during treatment, (d) that only probe words were elicited during probe sessions, and (e) that the correct number of probe words were elicited. Fidelity was calculated as the number of deviations from the session's base number of activities (24 recasts, 24 bombardment items, and 20 probe words). The average fidelity for the Bombardment First condition was 98.7% (range = 88%–100%) and 99.2% (range = 90%–100%) for the Bombardment Last condition.

Scoring Reliability

Scoring reliability was obtained for both coding of treatment and probe responses. These were coded live during the treatment and probe sessions. Live coding was preferred to video recordings because children's movements during sessions often led to camera angles that were sub-optimal for coding (i.e., visual speech was obscured). With live coding, coders could position themselves within the treatment room to maximize access to both auditory and visual speech information. A total of 65 (20% of) Bombardment First sessions and 64 (20% of) Bombardment Last sessions were coded. These were evenly distributed across the weeks of the study, and sessions for each child were coded a minimum of twice. We calculated point-to-point reliability for agreement concerning whether the clinician and an independent reliability coder indicated whether the child's platform utterances and elicited probe utterances were correctly or incorrectly produced with regard to the treatment target only. Therefore, if the treatment target was *-ed*, both "Him jumped" and "He jumped" would both be recorded as correct responses, but "He jump" would not. Point-to-point reliability was calculated as the one-to-one agreement or disagreement for each probe item. The average coding reliability for the Bombardment First condition was 96.9% (range = 83.0%–100%) and 96.6% (range = 83%–100%) for the Bombardment Last condition.

Results

The results for the two treatment conditions are presented in Table 3. Individual graphs of child progress are available as Supplemental Material S1. We first determined if a treatment that paired auditory bombardment and enhanced conversational recast would produce significant treatment effects for children with language impairment. The dependent measure for this purpose was the number of items correct on generalization probes. Thus, our dependent measure tapped learning that generalized to untrained words rather than performance on trained words. Answering this question required comparison of pretreatment to post-treatment probe performance. Because many of the children had little or no variance in their pretreatment performance, we used a nonparametric within-subject comparison (Wilcoxon T). The prediction is that end-treatment performance (performance during the final three probe sessions)

Table 3. Group and individual child results.

Subject	Target forms					Control forms		
	Pretreatment use	End-treatment use	Effect size (<i>d</i>)*	Total spontaneous productions	Unique spontaneous productions	Pretreatment use	End-treatment use	Effect size (<i>d</i>)*
Bombardment First (before Enhanced Conversational Recast)								
B1-1	10.0%	100.0%	15.6	12	10	0.0%	0.0%	0.0
B1-2	10.0%	100.0%	15.5	6	6	19.0%	0.0%	-3.3
B1-3	21.1%	100.0%	13.6	6	6	7.0%	3.0%	-1.2
B1-4	12.7%	80.0%	4.3	21	16	7.0%	8.0%	1.2
B1-5	26.7%	73.3%	3.1	123	64	0.0%	0.0%	0.0
B1-6	0.0%	43.3%	2.8	9	9	3.3%	76.7%	4.8
B1-7	3.3%	26.7%	1.6	33	14	3.3%	10.0%	0.7
B1-8	14.6%	23.3%	0.6	2	2	20.0%	0.0%	-2.6
B1-9	0.0%	26.7%	0.5	10	8	0.0%	3.3%	0.6
B1-10	5.7%	10.0%	0.3	8	6	0.0%	0.0%	0.0
B1-11	5.7%	3.3%	0.0	13	11	28.0%	3.3%	-4.2
B1-12	33.3%	26.7%	-1.2	57	32	14.0%	10.0%	-0.8
B1-13	10.0%	3.3%	-1.2	2	2	0.0%	0.0%	0.0
B1-14	25.3%	3.3%	-3.8	44	26	5.7%	3.3%	-0.4
<i>M</i>	12.7%	44.3%	3.7	24.7	15.1	7.7%	8.4%	-0.4
<i>SD</i>	10.3%	38.3%	6.2	32.7	16.5	9.1%	20.0%	2.2
Bombardment Last (after Enhanced Conversational Recast)								
B2-1	16.1%	87.6%	12.2	47	33	3.3%	3.3%	0.0
B2-2	9.7%	76.7%	11.6	60	43	23.0%	0.0%	-3.9
B2-3	6.7%	90.0%	8.3	12	12	0.0%	0.0%	0.0
B2-4	11.9%	76.7%	5.6	37	33	9.4%	3.3%	-1.1
B2-5	15.3%	56.7%	2.7	25	22	0.0%	0.0%	0.0
B2-6	15.0%	80.0%	2.5	40	32	3.0%	7.0%	0.3
B2-7	6.7%	13.3%	2.3	1	1	13.3%	13.3%	0.0
B2-8	6.7%	26.7%	1.8	51	25	0.0%	10.0%	0.6
B2-9	9.4%	67.7%	1.8	12	12	25.0%	13.0%	-1.0
B2-10	0.0%	43.3%	1.7	21	17	0.0%	0.0%	0.0
B2-11	3.0%	43.3%	1.6	15	14	67.0%	0.0%	-1.2
B2-12	22.7%	46.7%	1.5	50	29	13.0%	0.0%	-2.8
B2-13	0.0%	3.3%	0.6	1	1	0.0%	0.0%	0.0
B2-14	6.1%	0.0%	-1.0	11	11	28.0%	0.0%	-4.8
<i>M</i>	9.2%	50.9%	3.8	27.3	20.3	13.2%	3.6%	-1.0
<i>SD</i>	6.5%	30.8%	4.1	19.8	12.7	18.5%	5.1%	1.7

*Treatment-related change (*d*) is calculated as (mean end-treatment use – mean pretreatment use) / the end-treatment standard deviation.

would be better than pretreatment performance (performance on the three pretreatment probes), but a similar change should not occur for untreated (control) morphemes. The combined treatment produced significant effects overall, Wilcoxon $T = 27.0$, $p = .00001$, $z = 4.01$. This significant treatment effect was found for both conditions individually as well, Bombardment First: Wilcoxon $T = 14$, $p = .016$, $z = 2.42$; Bombardment Last: Wilcoxon $T = 14$, $p = .0015$, $z = 3.17$. This treatment effect was not accompanied by significant change in control morpheme use by the full set of participants, Wilcoxon $T = 44$, $p = .96$, $z = -1.81$, the Bombardment First group, Wilcoxon $T = 20$, $p = .78$, $z = -0.76$, or the Bombardment Last group, Wilcoxon $T = 4$, $p = .97$, $z = -1.96$. Indeed, although performance on the control morphemes was variable across children, the overall trend was a small reduction in control morpheme use from pretreatment to end treatment. This effectively rules out overall

maturation (even within the 6-week study period) or general language stimulation as an explanation for positive treatment results.

We also verified that results were not due to differences in pretreatment morpheme use across groups. There was no significant between-groups difference in the rate of pretreatment use of target morphemes, Mann–Whitney $U = 83$, $p = .49$ two tailed, $z = 0.69$. Likewise, there was no difference in pretreatment use of control morphemes, Mann–Whitney $U = 89$, $p = .70$ two tailed, $z = 0.39$.

The main purpose of this study was to determine if an initial versus final period of auditory bombardment would differentially affect treatment outcomes. Our primary measure for this purpose was the gain in morpheme use from pretreatment levels on generalization probes. To do this, we needed to represent pre- to end-treatment performance as a single number for each child for statistical

analysis. We calculated a treatment effect (d) for each child. We used the formula from Plante et al. (2014): (mean end-treatment use – mean pretreatment use) / standard deviation of end-treatment use. The mean pretreatment use is based on the mean of the three pretreatment probe sessions. Likewise, the mean end-treatment use is based on the mean of the child's last three generalization probe sessions. The end-treatment standard deviation is also based on data from the last three probe sessions. This was used rather than data from the pretreatment probes, or a pooled standard deviation, because the pretreatment probes typically showed little variance due to our selection criteria of 30% use or less. This constrained variance in pretreatment performance reduces (or eliminates) pretreatment variance. This, in turn, greatly inflates the estimate of treatment-related change when the pretreatment performance is used to calculate the standard deviation. In cases where there was no end-treatment variance (e.g., ceiling performance across the three final probes), the minimum possible standard deviation was used (i.e., the standard deviation associated with a one-utterance difference in performance in one end-treatment probe out of three end-treatment probes). As this calculation demonstrates, the d statistic takes into account both pretreatment morpheme use and accounts for the variability at the end of treatment to provide an estimate of the treatment effect.

The d statistics associated with both target and control morphemes for individual children are reported in Table 3. Group results are represented graphically in Figure 2. As this figure shows, there was a slight advantage for the Bombardment Last condition, but the variation (standard error) around both group means was large. Accordingly, there was no statistically significant difference between the Bombardment First and Bombardment Last conditions, $t(1, 26) = 0.19$, $p = .85$ two tailed, $d = 0.06$. The effect size indicates that the average effect for this comparison was negligible.

We considered secondary measures of treatment progress, including spontaneous production of target forms. This information is presented in Table 3. The total number of spontaneous target morpheme uses did not differ significantly

between groups, $t(1, 26) = 0.26$, $p = .80$ two tailed, $d = 0.08$. We also considered how many of these spontaneous uses were unique. This avoids the potential problem of children using a single form (e.g., He jumped) or a very limited number of forms, but repeating these frequently. Accordingly, we calculated the number of unique utterances containing the target morpheme for each child. However, this number also did not show a group difference, $t(1, 26) = 0.94$, $p = .36$ two tailed, $d = 0.08$.

A final method of considering the data is in terms of treatment response by individual children. Every treatment method has both responders and nonresponders, with successful treatments having more of the former than the latter. However, this information is masked by a sole reliance on group statistics. We used an index of treatment response as showing a treatment effect (d) of greater than 1.0 to determine treatment responders and nonresponders from Table 3. We arrived at this cut-point because it represents the effect for a child who changed from 0% to 100% performance in the last 3 days. Although we do not have examples this extreme in the current data set, we do have examples in which dramatic, near-ceiling gains occurred in the final days (see B2-9 & B2-11 for examples in the Supplemental Material). This criterion also captures less dramatic gains, as when children's end-treatment average is above their baseline average, but this performance was consistently below ceiling (a more moderate response). Examples from the Supplemental Material include subjects B2-8 and B2-12. This criterion excludes children whose end-treatment average is the same or worse than their pretreatment average and children for whom two out of three end-treatment data points are no better than their pretreatment levels (e.g., B1-9 and B1-10). Examples from the Supplemental Material assist visualization of how this criterion plays out for individual children in this study.

Eight of the 14 children in the Bombardment First condition (57%) showed this minimum treatment response. However, one of these children (B1-6) also showed progress on his control morpheme, suggesting a more general effect of language stimulation during the 6-week experiment rather than a true treatment effect. In the Bombardment Last condition, 12 of 14 children (86%) showed a minimum treatment response. The chi-square comparison of these frequencies was statistically significant ($\chi^2 = 4.09$, $p = .043$). Therefore, at the level of the individual child, more children showed a response to treatment in the Bombardment Last condition than in the Bombardment First condition.

Discussion

Replicating previous treatment studies that have employed various forms of conversational recast treatment, children in this study showed significant progress in their use of grammatical morphemes. This adds to the evidence that recast procedures can be an effective approach for the remediation of morpheme errors in preschool children, used either alone (Camarata, Nelson, & Camarata, 1994; Meyers-Denman & Plante, 2016; Nelson, Camarata, Welsh,

Figure 2. Effects expressed as the average of individual child effects sizes (d) for target and control morphemes. Error bars are the standard error of measure.

Butkovsky, & Camarata, 1996; Plante et al., 2014) or with a period of modeling in addition to recast treatment (Encinas & Plante, 2016; Fey et al., 1993; Leonard et al., 2004, 2006). This study further confirms that the effect was not due to global change for the full set of children, as change on untreated morphemes was not comparable for most children during the same period (Plante et al., 2014; Meyers-Denman & Plante, 2016). Although one child (B1-6) did show progress on both treated and control morphemes, he was the sole exception to this pattern.

The main purpose of the study was to assess the relative effectiveness of using a period of auditory bombardment, a form of modeling, before or after recasting procedures. Although there was a small group advantage for the Bombardment Last condition for the average treatment effect size and for the two metrics of spontaneous use, neither reached statistical significance. This is likely due to the high variability in individual child performance, in combination with the relatively small *n* of an early efficacy study (Fey & Finestack, 2009).

The treatment effects can also be considered in terms of how many individual children made progress. Although conversational recast treatment produces positive group results across multiple published papers, every treatment study includes both responders and nonresponders. This is not unique to recast treatments but is true of treatment studies in general. This reality is often masked by the traditional sole focus on group-level results. To apply research to practice, clinicians must evaluate treatment results, not at the level of groups, but for each child they treat. An individual treatment response metric provides a way for clinicians to disentangle individual responses from group results in treatment studies. A focus on individual differences may also allow clinicians to determine how likely a treatment is to produce measurable results and, possibly, when a treatment approach may be appropriate for one child but not for another. Such information could be key to helping clinicians improve the rate of treatment response they achieve with the children they serve.

We developed a criterion of $d > 1.0$ for distinguishing responders from nonresponders. This particular criterion could be arguable, given that opinions concerning what constitutes “treatment response” could vary across individuals. We grounded this metric in the mathematics of a hypothetical response that goes from baseline to ceiling in 3 days, but the criterion will also capture less-extreme cases in which end-treatment performance exceeds the average pretreatment performance. Given that all treatment response reflects generalization to untrained toys and verb contexts, even modest generalization levels can be important indicators of change beyond what occurs within the treatment session (Kamhi, 2014). For our samples, more children met the change criterion when auditory bombardment followed recasting than when the same amount of bombardment preceded recasting. This is consistent with the idea that a final period of auditory bombardment may serve to consolidate the child’s internal representation of the treated morpheme and its use.

We elected to present a period of auditory bombardment of 24 unique exemplars because work by others has demonstrated that high variability input benefits learning for both learners who are normal (Gómez, 2002) and who have language impairment (Grunow, Spaulding, Gómez, & Plante, 2006; Plante et al., 2014; Torkildsen, Dailey, Aguilar, Gómez, & Plante, 2013). We presented the bombardment tokens consecutively within a very short period, rather than spaced within the context of a longer activity (e.g., embedded in a story; Leonard et al., 2004, 2006; interspersed with recasts; Fey et al., 1993) to avoid the presence of intervening stimulation thought to create interference with encoding (Dudai, 2004). Because conversational recast procedures naturally entail intervening conversation and activity between recasts, a consolidated block of input may help individual children consolidate their representations of previously heard exemplars. This is also consistent with the idea that repeated recall (in this case, using clinician examples to reactivate the child’s representation) can help improve performance. Logically, both groups had an opportunity for repeated recall. Recasting could serve to reactivate representations heard during an initial bombardment phase as easily as bombardment could reactivate recast examples. However, it appears that blocked stimulation is more effective for consolidating previous spaced presentations than when the order is reversed.

One potential limitation of a priming function for an initial period of auditory bombardment is that priming only works if the listener has a rule to begin with. An important difference between adult structural priming studies (Pickering & Ferreira, 2008) and this child treatment study is that the adults enter priming studies as competent native speakers with well-established grammatical rules. Children with DLD enter treatment with absent, fleeting, or unstable representations of rules. In fact, the criterion for selecting a morpheme to be targeted in this study is that the child shows no use or low average use over 3 consecutive days. Therefore, an initial period of auditory bombardment may not function, at least at first, as a robust prime for children with disordered language.

Conversely, it is possible that bombardment administered last could serve a priming role, but in a very different way. Language models continue after the treatment session, in the child’s daily life. When children leave treatment after hearing the final auditory bombardment phase, they may be primed, for an unknown amount of time, for incidental occurrences of their target morpheme after the treatment session. Thus, the priming mechanisms may also occur with children with DLD who first need a prerequisite training session through conversational recasting to form an initial, and initially weak, representation of the grammatical form and, then, are primed through auditory bombardment for language production after the session. Follow-up studies could be designed to test the likelihood that posttreatment priming does, in fact, occur. This would involve tracking input and child productions that occur after a session to determine whether the presence or absence of final auditory bombardment differentially affects posttreatment

productions and to map the period before priming decay occurred.

Of further interest is whether the inclusion of a bombardment phase produces noteworthy gains relative to studies that are associated with enhanced conversational recast procedures alone. We can compare the results of this study with those of the most similar published studies. Two other published studies have used the enhanced conversational recast treatment used here (Meyers-Denman & Plante, 2016; Plante et al., 2014). Because these studies also came from our research group, the number and type of doses provided, the outcome measures, and even the treatment setting and presence of the same preschool program outside of therapy were identical across studies.

The first study (Plante et al., 2014) contrasted enhanced conversational recast with an otherwise equivalent treatment that lacked the high input variability component. Children who received the enhanced conversational recast treatment in that study ($n = 9$) showed an average treatment effect (d) of 1.92, and just over half (56%) showed a treatment effect of > 1.0 . The second (Meyers-Denman & Plante, 2016) examined the effect of administering enhanced conversational recast in massed or spaced administrations ($n = 8$ per condition). There was no significant difference for these two conditions, and the effect sizes for each condition were very comparable (spaced: 7.38; massed: 7.85). At the individual level, six of eight (75% of) children in each group showing a treatment effect (d) of > 1.0 .

The average treatment effect size from this study (Bombardment First: $M = 4.0$, $SD = 6.4$; Bombardment Last: $M = 3.8$, $SD = 4.1$) falls between the average treatment effect sizes of 1.92 from the Plante et al. (2014) and 7.85 for the massed treatment condition in the Meyers-Denman and Plante (2016) studies. The percent of responders in the Bombardment First condition of this study (57%) is comparable to the 56% responder rate in Plante et al. (2014). It is well below the 75% responder rate of Meyers-Denman and Plante (2016). This raises the question whether an initial period of bombardment offers any advantage over enhanced conversational recast alone at the group level.

The average effect size in this study for Bombardment Last also falls between that of the Plante et al. (2014) and Meyers-Denman and Plante (2016) studies. However, the percent responders under the Bombardment Last condition (86%) is a substantial improvement over the Plante et al. (2014) study rate of 56% and marginally better than the 75% achieved in the Meyers-Denman and Plante (2016) study.

There are no obvious additional reasons for the differences in the average treatment effects among the three studies (e.g., the research group is becoming progressively more skilled with each study, the pretreatment use of targeted morphemes differed substantially, and the types of morphemes trained were highly different). It is also important to note that group characteristics were balanced within each study, but not across studies. Therefore, there is the potential for sampling differences across studies that could mediate the effect size and treatment response comparisons. Although determining how individual subject characteristics relate

to treatment response is beyond the scope of this study, one or more subject or clinician factors may be playing a role in the relative effect sizes across treatment studies, despite their methodological similarities. On the whole, the comparisons among the available studies suggest that a period of auditory bombardment before enhanced conversational recast does not provide a strong advantage over recasting alone. However, a final period of bombardment benefits more individual children than bombardment preceding recast treatment and at least slightly more than recasting alone. Although gains at the individual level are incremental (75% responders in Meyers-Denman & Plante, 2016, vs. 86% in this study), this might be expected given that recasting procedures already provide substantial benefit across multiple samples of children (Cleave, Becker, Curran, Van Horne, & Fey, 2015).

In summary, there is now substantial evidence of treatment efficacy for conversational recast treatments in general (Cleave et al., 2015) and its superiority to alternative therapy methods (e.g., Camarata et al., 1994). However, there continues to be a need to identify parameters that enhance the effects of this treatment (e.g., Fey et al., 1993, 1994; Meyers-Denman & Plante, 2016; Plante et al., 2014). This study suggests that auditory bombardment (a form of modeling), as an adjunct to recast treatment, appears to produce better effects than recast alone with the matched groups studied here. However, other children can obtain equally positive effects without additional auditory bombardment (Meyers-Denman & Plante, 2016). If a clinician chooses to incorporate a bombardment phase, it is more likely to provide a boost for individual children who receive bombardment after receiving a recast treatment phase than before. This relative benefit comes at little cost to the child in that it takes only minutes of their total session but comes at a slightly higher cost to clinicians who must gather materials and plan for this extra activity.

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