Research Article

Maximizing Treatment Efficiency in Developmental Language Disorder: Positive Effects in Half the Time

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Purpose: When a behavioral treatment is generally efficacious, the central research questions shift to optimized dose delivery. In this study, we determine whether a validated treatment method can be made more effective or efficient by increasing the dose density employed.

Method: Twenty children were treated with Enhanced Conversational Recast methods to treat morphological errors. Half received 24 doses per session within a half hour (approximately 1 dose/1.25 min), and the other received the same number of doses within 15 min (approximately 1 dose/38 s). Generalization of morpheme use was probed throughout treatment and at a 6-week follow-up. Spontaneous use of treated morphemes was also tracked.

Results: Although the treatment was effective overall, there were no significant differences between treatment conditions on any of the outcome measures. Follow-up performance correlated significantly with performance at the end of the treatment period.

Conclusion: Minimal between-groups differences suggest that performance does not suffer when dose rates are compressed into half the time during treatment, making the high-density dose delivery method a more efficient delivery method. This could make time available within a treatment session to address other goals or allow for more classroom instructional time for the child.

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In the last decade, there has been a shift in treatment research toward careful specification of specific treatment parameters (Hoffman et al., 2014; Ludemann, Power, & Hoffman, 2017; Schultz, Altman, Moher, & the CONSORT Group, 2010; Turkstra, Norman, Whyte, Dijkers, & Hart, 2016; Warren, Fey, & Yoder, 2007) and manipulation of these parameters to understand their impact on treatment outcomes. Considerable attention has been paid to the dose form (the specific action(s) thought to have therapeutic benefit),¹ the dose number within a session, and the schedule on which the dose number is delivered. The parameter of “dose schedule” contains several separate issues. These include the density of doses delivered within the session, the frequency of those sessions, and how those sessions are distributed across time. Although any of these can influence treatment outcomes, little has been done to tease apart their separate influences.

Dose Schedule

Within cognitive learning, the topic of dose schedule is typically discussed in terms of spaced and massed distribution. Spaced distribution, the putative superior schedule for cognitive learning (e.g., Eisenberg, 2014; Justice, Logan, Schmitt, & Jiang, 2016; Yoder, Fey, & Warren, 2012), and massed distribution have been explored within a variety of language domains, including phonology (Bowen & Cupples, 1999; Ukrainetz, Ross, & Harm, 2009), semantics (Childers & Tomasello, 2002; Goossens, Camp, Verkoeijen, Tabbers, & Zwaan, 2012; Riches, Tomasello, & Conti-Ramsden, 2005; Vlach & Sandhofer, 2012; Vlach, Sandhofer, & Kornell, 2008), and morphosyntax (Ambridge, Theakston, Lieven, & Tomasello, 2006; Bellon-Harn, 2012; Meyers-Denman & Plante, 2016; Smith-Lock, Leitao, Lambert, & Nickels, 2013).

Investigations into the relative benefit of spaced versus massed distribution have often confounded manipulations of dose schedule with differences in other intervention

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¹Warren et al. (2007) defines *dose* as “the number of properly administered teaching episodes during a single intervention session” (p. 71). Here, we use the term to refer to a single therapeutic event. We use the term *dose number* to refer to the number of therapeutic events per session.

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components. This has been the case for three studies that have found a spaced dose advantage. In Riches et al. (2005), the massed conditions included conditions with either 12 or 18 doses occurring in a single day, and the spaced conditions included conditions with either 12 or 18 doses spread across 4 days. Their treatment conditions differed in terms of dose schedule, but also in total treatment duration. The design used by Ambridge et al. (2006) used 10 doses in a single day (massed), two doses per day for 5 days (distributed-pairs), or one dose per day for 10 days (distributed). These conditions also differed in dose schedule and total dose duration. In Smith-Lock et al. (2013), children with developmental language disorder² (DLD) were provided either with 8 days of treatment over 2 weeks (massed) or 1 day of treatment per week for 8 weeks (spaced). As with the previous two studies, both dose schedule and total intervention duration varied across conditions. In addition, no information was provided regarding how many doses were administered per session or within each condition. A variant of this theme occurred in the study of Barratt, Littlejohns, and Thompson (1992), who also reported superior results for a spaced treatment condition. They did hold the number of treatment sessions and total intervention duration constant. One group received treatment once per week across 6 months (spaced). The other group received treatment four times per week for two 3-week periods (massed). The first period occurred in the first 3 months of treatment, and the second occurred during the second 3 months of treatment, with 3 months of no treatment between. This gap provided a longer interval for children to forget previous training that did not occur for the spaced condition. The methodological differences in each of these studies qualify conclusions about differences between massed and spaced dose delivery.

In contrast to these studies, two studies reported no difference between massed and spaced treatment. Bellon-Harn (2012) treated one group in four sessions per week for 6 weeks and another group two times per week for 12 weeks. This represents a similar confound of spacing and total duration seen in earlier studies. For Meyers-Denman and Plante (2016), all treatment variables but dose schedule were kept constant. Data collected immediately posttreatment and 6 weeks posttreatment revealed no differences in children's performance on treated morphemes between groups receiving massed versus spaced treatment. This study indicates that when dose number and total intervention duration are both held constant, the previously reported difference between massed and spaced effects can disappear.

These earlier studies identify their different treatment conditions as massed versus spaced. Of note, however, presentations of learning targets occurred during play-based interactions, allowing natural conversation and pauses to occur between learning episodes. Thus, the massed conditions were not truly "massed" in the traditional sense, in which

little to no time passes between learning episodes. Therefore, these treatment conditions represent a continuum of dose spacing, more or less spaced relative to each other, rather than as massed versus spaced.

Dose Density

Although the issue of spacing doses across days has been considered in previous studies, the converse situation of the spacing of doses within a session has not yet been addressed in a treatment context. Optimizing the dose density or number of intervention doses administered per unit of time within a session may increase the overall efficiency of treatment. In a school setting, being able to increase the density within treatment sessions could decrease time pressures on clinicians with large caseloads. It could allow clinicians to spend less time on a single target, leaving either more time to target other communication needs or more classroom instructional time for the child. Shortened sessions would be especially advantageous for children who do not tolerate longer sessions well, such as those who have poor attention, are fidgety, or have a general apathy for therapy. Furthermore, children who are uncooperative or disruptive in groups could more easily be scheduled for an individual session without loss of treatment effectiveness.

There are potential concerns related to high-density dosage. There may be a rate at which the treatment no longer is beneficial. This idea assumes an inverted U-shape relationship between dose rate and treatment outcome, where dose rates that are either too low or too high result in suboptimal treatment outcomes, while a midrange dose rate results in the best treatment outcomes. Given the limited knowledge we currently have related to optimal dosage rates, this concern remains unexplored. Another concern, voiced by Proctor-Williams (2009), was that recasts presented at too high a rate might prove annoying to children, interfering with learning.

Evidence for the effect of dose density within language intervention sessions is scarce, in part because few studies include details of dosage rates (Cleave, Becker, Curran, Van Horne, & Fey, 2015). Studies that manipulated dose density suffer from similar design problems as those discussed earlier in studies manipulating dose schedule. In Julien and Reichle's (2016) study on vocabulary learning in children with autism spectrum disorder, children were either exposed to one dose per minute (low dose) or three doses per minute (high dose). However, both total intervention duration (7.5 vs. 3.5 weeks) and the total number of doses per condition (135 vs. 210 doses delivered across all sessions) differed. The manipulation of variables beyond dose density weaken the conclusions that can be drawn as to which density is more effective.

To our knowledge, only one experimental study has explored the effect of dose rate on morphosyntactic learning. Proctor-Williams and Fey (2007) explored recast density of novel irregular past tense verbs in children with DLD and typical language within sessions that also included models of the learning target (a second dose form). Children in

²A recent international consensus process (Bishop, Snowling, Thompson, Greenhalgh, & CATALISE-2 Consortium, 2017) recommended the use of the term *developmental language disorder*, which we have used in place of *specific language impairment*.

both conditions heard an equal number of doses (10 recasts and 31 models for each of six novel verbs) during five sessions over 5 days. Half the novel verbs were trained under a high-density condition, and half were trained under a low-density condition. Verbs were taught in blocks that alternated between the two conditions. The rate (doses per target per minute) varied under each condition. In the high-recast density condition, five recasts per verb per day were administered only during the last two sessions. This translates to a rate of one recast verb per minute for those 2 days. In the low-density condition, two recasts per verb per session were administered for a rate of 0.4 recast verbs per minute across all 5 days. In both conditions, a sufficient number of models were also given to bring the combined number of models and recasts to seven exposures to each verb in the first three sessions and 10 per verb in the last two. Children with DLD showed no difference for the two recast dose schedules, suggesting high- and low-density doses are equally effective. One potential caveat for this study concerns the use of two dose forms. Although total treatment duration was held constant in this study, the effectiveness of recasting may be moderated by the concurrent use of models. So, if both dose forms benefitted the learner, it is difficult to isolate the source of benefit just to recast density.

What we do know is that, in order for children with DLD to learn grammatical targets specifically through recast treatment, rate of dose input must greatly exceed that found in conversation (Proctor-Williams, Fey, & Loeb, 2001). In their review, Cleave et al. (2015) suggest that beneficial recast rates for treatment may be around 0.8–1 per minute, which is more than three times as dense as rates found in nontreatment contexts (Fey, Krulik, Loeb, & Proctor-Williams, 1999). Despite the clearly demonstrated need for knowledge of the optimal treatment density within sessions (Cleave et al., 2015; Eisenberg, 2014; Warren et al., 2007; Yoder et al., 2012), significant gaps still exist in the literature, especially with regard to morphosyntactic treatment for children with DLD.

There is reason to think that very high dose densities might actually benefit learning in treatment. In statistical learning studies, many exemplars of grammatical forms (either from real or artificial languages) are presented per minute. Each of the auditory presentations used in these experiments are analogous to a treatment dose. These studies use dose rates much higher than those described above in treatment studies. After mere minutes of exposure to highly dense input, infants and adults alike demonstrate learning of linguistic stimuli (e.g., Friederici, Mueller, & Oberecker, 2011; Gómez, 2002; Kabdebon, Pena, Buiatti, & Dehaene-Lambertz, 2015; Pelucchi, Hay, & Saffran, 2009; Rüsseler, Gerth, & Münte, 2006; Saffran, Aslin, & Newport, 1996; Saffran, Newport, & Aslin, 1996; van den Bos, Christiansen, & Misyak, 2012; Vuong, Meyer, Christiansen, 2016).

Because individuals with DLD have demonstrated deficits in statistical learning (Lammertink, Boersma, Wijnen, & Rispens, 2017), some might argue that it is problematic to use results from statistical learning tasks to justify the potential effectiveness of high-density dosage in language

treatment. However, statistical learning can be normalized, even for learners with DLD, with certain structural adjustments to the treatment input. Such adjustments include increased exposure to the target form (Evans, Saffran, & Robe-Torres, 2009) and increased variability around the target form (e.g., Plante et al., 2014; Torkildsen, Dailey, Aguilar, Gómez, & Plante, 2013). Both of these variables are easily incorporated in sessions for language treatment.

The Current Study

Enhanced Conversational Recast treatment served as the dose form in the current study. This particular treatment has resulted in successful treatment outcomes in a number of recent studies (e.g., Eidsvåg, Plante, Oglivie, Privette, & Mailend, 2019; Encinas & Plante, 2016; Meyers-Denman & Plante, 2016; Plante, Tucci, Nicholas, Arizmendi, & Vance, 2018). Enhanced Conversational Recast treatment is based on traditional Conversational Recast treatment (e.g., Camarata & Nelson, 1992; Camarata, Nelson, & Camarata, 1994; Cleave et al., 2015) in which the child attempts the form targeted for treatment (spontaneously or after the clinician elicits its use) and the clinician restates the child's attempt using grammatically correct forms. The "enhanced" component consists of two additional elements (Meyers-Denman & Plante, 2016). First, 24 doses must be administered using 24 unique recasts (Plante et al., 2014), and second, clinicians must use an attentional cue prior to each recast (e.g., pointing to their own lips, touching the child). The attentional component was incorporated based on earlier observations that children did not always attend to—or even actively turned away from—the source of the treatment dose (i.e., the clinician's face), as well as on findings illustrating the crucial role attention plays in learning (Toro, Sinnett, & Soto-Faraco, 2005). Even for children appearing to exhibit "joint attention," it was not clear that they were actually attending auditorily to the recast in addition to maintaining the focus of their visual attention. Given the repeated findings of attentional problems in children with DLD (see Ebert & Kohnert, 2011; Kapa & Plante, 2015, for reviews), limited attention during treatment is of concern. Therefore, the dose form for Enhanced Conversational Recast is an attentional cue plus the clinician's unique recast to the child. The required number of doses in this treatment method is 24 doses per treatment session. The dose context is child-friendly activities that encourage conversation between the child and the adult.

The goal of the current study was to determine the effects of dose density on acquisition of morphosyntactic forms in preschool children with DLD. Specifically, children received either high-density or low-density input of Enhanced Conversational Recast treatment. Children attended 30-min treatment sessions 5 days per week for just over 5 weeks. Following the findings of Plante et al. (2014), all children received 24 unique recasts of their target morpheme during each treatment session. For this study, in the high-density ("Dense") condition, all 24 recasts were administered during the first 15 min of each session. During

the second 15 min of each session, the child remained with the clinician and participated in child-directed activities but without additional targeted input or recasts. For this condition, recasts occurred at a rate of 1.6 per minute. In the low-density ("Sparse") condition, the 24 recasts were spread across the full 30 min of each session. For this condition, recasts occurred at a rate of 0.8 per minute. We hypothesized that the Dense treatment condition would result in greater treatment efficacy, effectiveness, or both for the children's morphological targets than the Sparse condition.

Method

Participants

Twenty children (12 boys, eight girls) diagnosed with DLD participated in treatment. Their demographic data are reported in Table 1. Their mean age was 5;0 (years; months), ranging from 4;1 to 5;11, at the start of treatment. The diagnosis of DLD involved standardized testing and clinical judgment. Children had to pass a pure-tone hearing screening to rule out hearing loss and have normal non-verbal cognitive skills ($70 + 1$ SEM on the Nonverbal Scale of the Kaufman Assessment Battery for Children, Second Edition; Kaufman & Kaufman, 2004). In addition, they had to receive a standard score of 87 or less on the Structured Photographic Expressive Language Test–Preschool 2 (SPELT-P2; Dawson et al., 2005). The language cut score was validated for children with DLD (Greenslade, Plante, & Vance, 2009). A certified and licensed speech-language pathologist also had to detect difficulty in spoken language (e.g., morpheme errors, comprehension breakdowns, limited vocabulary) during conversational speech and informally judge that child to be impaired based on these errors.

Additional testing was administered to describe other language skills. The Peabody Picture Vocabulary Test–Fourth Edition (Dunn & Dunn, 2007) was given to measure single-word receptive vocabulary. The Goldman-Fristoe Test of Articulation–Second Edition (GFTA-2; Goldman & Fristoe, 2000) was used to index articulation. The Shirts and Shoes Test (Plante & Vance, 2011) was used to test receptive morphosyntactic skills in a "following commands" format. This test was locally normed on 283 typically developing 4- and 5-year-olds.

To assure that we had a representative sample, we asked about mother's education level, which averaged 14.3 years with a range of 13–16 years. We also collected racial and ethnic data. Eleven children were White, one was Native American, one was Asian, and one was multiracial, by parental report. There was no race reported for six children. Fourteen were Hispanic by parent report. All children were reported to be native English speakers and attended day cares or preschools where the language of instruction was English. All parents reported their children did not speak another language, and there was no evidence of a second language during testing or treatment sessions.

All children were treated using Enhanced Conversational Recasting. Within this base treatment, we manipulated

dose density such that one group (Sparse) received their doses spread over 30 min. The other group (Dense) received the same number of doses administered within 15 min. Children were assigned to either a Sparse or Dense treatment condition. Children were not assigned randomly but were assigned to provide an optimal gender balance (six boys and four girls per group) and to provide the best balance of target morphemes (the morpheme treated) across groups (see Table 2). Although random assignment can control known and unknown influences across groups, it does not work well when sample sizes are relatively small. Our use of matching was intended to control for the possible influences of sex and morpheme difficulty across groups to the extent possible. We checked for possible between-groups differences on other demographic variables. There were no differences for age, $t(1, 18) = 0.215$, $p = .832$, $d = 0.123$, or mother's education level, $t(1, 18) = 0.174$, $p = .864$, $d = 0.081$. Most test scores also did not differ between groups: Kaufman Assessment Battery for Children, Second Edition, $t(1, 18) = 1.997$, $p = .0611$, $d = 0.352$; SPELT-P2, $t(1, 18) = 0.694$, $p = .496$, $d = 0.185$; Peabody Picture Vocabulary Test–Fourth Edition, $t(1, 18) = 0.941$, $p = .359$, $d = 0.267$; Shirts and Shoes Test, $t(1, 18) = 0.000$, $p = 1.000$, $d = 0.122$. The GFTA-2 scores did differ between groups, favoring better articulation for the children in the Sparse condition, $t(1, 18) = 2.146$, $p = .023$, $d = 0.590$. However, this difference was mitigated by assigning all children target and control morphemes for treatment that were within their speech repertoire. This was done by assuring that the child could produce the morphological sounds in nonmorphological contexts, including on the GFTA-2 and in an informal conversational context.

In addition to the 20 children reported on here, there was one additional child who was tested but excluded from this study. This child had significant exposure to Spanish by parent report, and he did speak at least some Spanish in addition to English.

Materials and Procedures

General Treatment Context

Treatment was administered during daily 30-min individual treatment sessions over a 6-week period (25 treatment days in total). This design does not require that children will master their treatment targets within the treatment period but is instead designed to determine (a) which of two treatments is more efficacious and efficient and (b) how many children master their targets or at least show a clinically meaningful response within that time frame. A period of 6 weeks was allocated because we reasoned that if most children do not show clinically meaningful treatment response within this time frame, a more efficacious treatment is probably needed.

Treatment was provided at a preschool that included clinical facilities associated with the University of Arizona. Seven research clinicians who were students in speech-language pathology delivered the treatment. Each clinician administered treatment under both the Sparse and

Table 1. Demographic information for children in the Sparse and Dense treatment conditions.

Participants	Sex	Age (months)	KABC-II	SPELT-P2	PPVT-4	Shirts and Shoes	GFTA-2
Sparse dose delivery (24 recasts in 30 min)							
S-1	F	56	95	70	90	103	69
S-2	M	55	93	61	88	55	82
S-3	M	71	102	78	93	83	65
S-4	M	58	109	77	118	103	89
S-5	F	52	87	65	74	55	99
S-6	M	60	85	65	87	58	98
S-7	M	60	96	68	84	61	72
S-8	M	67	85	65	87	57	98
S-9	F	49	109	76	85	85	67
S-10	F	69	85	56	88	96	80
<i>M</i>		59.7	94.6	68.1	89.4	75.6	81.9
<i>SD</i>		7.3	9.5	7.2	11.2	20.5	13.5
Dense dose delivery (24 recasts in 15 min)							
D-1	M	68	103	69	92	96	73
D-2	M	60	95	76	100	58	88
D-3	M	67	97	79	109	90	40
D-4	F	62	112	53	128	91	48
D-5	F	62	121	61	97	67	58
D-6	M	64	105	45	88	61	78
D-7	F	60	100	72	93	58	74
D-8	M	55	91	53	75	58	61
D-9	M	55	102	65	85	70	63
D-10	F	53	100	63	96	82	65
<i>M</i>		60.6	102.6	63.6	96.3	73.1	71.7
<i>SD</i>		5.1	8.6	14.6	14.4	15.22	17.3

Note. Test scores are standard scores (mean of 100 and an *SD* of 15). The Shirts and Shoes Test norms are based on local norms for Tucson, Arizona. KABC-II = Kaufman Assessment Battery for Children, Second Edition, Nonverbal scale; SPELT-P2 = 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.

Dense conditions to counterbalance any effect of clinician across treatment conditions. Treatment was supervised by a clinically certified and licensed speech-language pathologist.

All children were concurrently enrolled in a half-day summer preschool program held in the university-affiliated preschool and clinic. The half-day program was staffed by undergraduate students and supervised by a clinically certified and licensed speech-language pathologist. The preschool staff did not participate in the treatment in any way, were blind to the individual children's treatment goals, and were explicitly instructed not to correct children's grammatical errors, as children were already receiving grammatical treatment during the research sessions. Instead, the staff were asked to focus on the language goals of the preschool curriculum. These focused on a number of activities intended to build vocabulary and to strengthen pre-literacy and numeracy skills. Since all children receiving treatment participated in this program, this source of language enrichment was constant across the two treatment conditions. All but four children (two in each condition) were also receiving concomitant articulation treatment at the preschool. No child received therapy from an additional source.

Overview of Experimental Procedures

The study consisted of four components: pretreatment probes, Enhanced Conversational Recast procedures,

generalization probes that were used as the dependent variable, and retention probes obtained approximately 6 weeks after treatment ended.

Regardless of their treatment condition, each child received 24 treatment doses (i.e., actions thought to promote change) per session in the form of an Enhanced Conversational Recast. The dose frequency (i.e., the number of times the dose is administered) was 24 times per session. Session frequency was once per day, five times per week. The modal number of treatment days was 24 (range: 22–25 days). The specific number of treatment days per child is reported in Table 2. The treatment was administered over a period of 5 weeks, for a total intervention duration of up to 25 days. This yielded a cumulative intervention intensity (Dose Number $\times$ Session Frequency per Day $\times$ Total Intervention Duration in Days) of 528–600 across children ($M = 566.4$). There was no significant difference between groups for the number of treatment days, $t(1, 18) = 1.342, p = .196, d = 0.571$. The only treatment parameter that did differ by group was the dose spacing, with the Sparse group receiving 24 doses over 30 min and the Dense group receiving 24 doses within 15 min.

Pretreatment Baseline

The pretreatment baseline was established over three consecutive days immediately prior to the treatment

Table 2. Treatment information for children in the Sparse and Dense treatment conditions.

Participant	Target morpheme	Control morpheme	Treatment days	Different affixed words recast
Sparse dose delivery (24 recasts in 30 min)				
S-1	3rd person –s	She	24	281
S-2	Possessive	Aux. is	23	343
S-3	–ed	Aux. is	23	281
S-4	3rd Person –s	–ed	23	349
S-5	Aux. is	–ed	24	281
S-6	–ed	3rd Person –s	22	203
S-7	–ed	3rd Person –s	23	215
S-8	–ed	3rd Person –s	24	327
S-9	3rd Person –s	–ed	24	263
S-10	–ed	3rd Person –s	24	273
M			23.4	281.6
SD			0.7	48.8
Dense dose delivery (24 recasts in 15 min)				
D-1	3rd Person –s	Aux. is	25	340
D-2	3rd Person –s	–ed	23	264
D-3	3rd Person –s	Aux. is	23	294
D-4	3rd Person –s	Wh-questions	24	319
D-5	Aux. is	3rd Person –s	24	330
D-6	–ed	3rd Person –s	24	330
D-7	–ed	She	24	248
D-8	Possessive	–ed	24	274
D-9	–ed	3rd Person –s	24	258
D-10	–ed	Possessive	23	317
M			23.8	297.4
SD			0.6	34.1

Note. 3rd Person –s = third-person singular verb marking; Aux. is = Auxiliary verb “is”; –ed = regular past tense; Wh-questions = wh-question forms including interrogative reversal.

phase. The grammatical forms probed came from data from the SPELT-P2 and from notes taken by the speech-language pathologist who engaged in conversation with the children during testing. During 45-min probe sessions, clinicians elicited grammatical forms from the children. Clinicians planned free-play and book-reading contexts and made notes about which grammatical forms could be elicited in context for each activity. Ten instances of each grammatical form were recorded by clinicians after elicitations, spontaneous attempts, or correct use of these occurred.

Clinicians probed up to six forms per session. Forms selected for treatment for each child were ones that were used for less than 30% of the time either spontaneously or in elicited contexts that obligated use of the morpheme. After the third pretreatment probe day, children were assigned to treatment conditions such that gender was matched across groups and the morphemes targeted for treatment (the target morphemes) were balanced to the greatest extent possible. A second morpheme, also used less than 30% of the time, was assigned as a control morpheme. Use of the control morpheme was tracked during additional probe sessions (described below) but not treated. There was no significant difference between groups for the pretreatment use of either target morphemes, $t(1, 18) = 0.180$, $p = .859$, $d = 0.008$, or control morphemes, $t(1, 18) = 0.483$, $p = .634$, $d = 0.275$. Table 3 contains individual data for pretreatment use.

Treatment

Children were treated individually during 30-min sessions in small treatment rooms. Children in the Sparse condition received 12 treatment doses during the first 15 min of treatment and 12 doses during the second 15 min. Children in the Dense condition received all 24 doses in the first 15 min of the treatment sessions. They remained engaged with the clinician during a second 15 min but received no treatment doses during this time. This was to control for the possible influence of one-on-one time with the clinician as contributing to the outcome. Clinicians used kitchen timers, set in 15-min increments, to assure the proper number of doses was provided per unit of time. Clinicians kept track of the dose number and form on a paper record used in each session. They also recorded the children's accuracy for both elicited use of the target morpheme and any correct spontaneous use.

Clinicians prepared two to four activities per session in which there were opportunities to elicit the target grammatical morpheme. These always included dialogic book reading, along with other activities such as games, crafts, building activities, and free-play with toys. The specific materials used in the treatment session were typically used just once during the 5-week treatment period. These activities provided a context in which the child was likely to use the grammatical form (called the *platform utterance*). Immediately following the child's attempt or correct use of the morpheme, the clinician repeated the child's utterance,

Table 3. Treatment results.

Subject	Target forms						Control forms		
	Pretreatment use (%)	End-treatment use (%)	Effect size (<i>d</i>) ^a	Follow-up use (%)	Total spontaneous productions	Unique spontaneous productions	Pretreatment use (%)	End-treatment use (%)	Effect size (<i>d</i>) ^a
Sparse dose delivery (24 recasts in 30 min)									
S-1	3.3	83.3	13.9	50	15	12	0.0	0.0	0.0
S-2	6.7	95.0	12.3	60	42	38	3.3	0.0	-0.6
S-3	10.0	90.0	8.0	90	11	11	3.3	13.3	0.7
S-4	13.3	90.0	7.7	70	12	12	16.7	16.7	0.0
S-5	0.0	90.0	5.2	90	127	68	0.0	0.0	0.0
S-6	10.0	73.3	4.1	80	7	6	3.3	0.0	-0.6
S-7	6.7	80.0	2.8	10	78	25	0.0	0.0	0.0
S-8	6.7	13.3	1.2	10	79	36	0.0	0.0	0.0
S-9	0.0	30.0	0.9	70	17	13	6.7	13.3	1.2
S-10	6.7	13.3	0.6	10	38	26	20.0	3.3	-2.9
<i>M</i>	6.3	65.8	5.7	54.0	42.6	24.7	5.3	4.6	-0.2
<i>SD</i>	4.3	33.3	4.7	32.7	39.9	18.8	7.2	6.9	1.1
Dense dose delivery (24 recasts in 15 min)									
D-1	0	100.0	17.3	100	8	7	3.3	10.0	1.2
D-2	3.3	93.3	15.6	80	77	45	6.7	3.3	-0.6
D-3	3.3	93.3	11.3	70	2	1	16.7	0.0	-2.9
D-4	3.3	83.3	7.9	90	18	14	3.3	0.0	-0.6
D-5	13.3	90.0	7.7	80	7	5	3.3	0.0	-0.6
D-6	10	73.3	5.5	60	12	10	0.0	3.3	0.6
D-7	6.6	63.3	2.5	90	137	70	0.0	0.0	0.0
D-8	10.0	40.0	1.1	30	16	7	0.0	3.3	0.6
D-9	0.0	0.0	0.0	0	0	0	3.3	6.7	0.6
D-10	10.0	3.3	-0.9	20	3	3	3.3	0.0	-0.6
<i>M</i>	6.0	64.0	6.8	62.0	28.0	16.2	4.0	2.7	-0.2
<i>SD</i>	4.7	37.3	6.4	39.9	44.4	22.9	4.9	3.4	1.1

^aTreatment *d* is calculated as (mean end-treatment use – mean pretreatment use)/the end-treatment standard deviation.

correcting any ungrammatical elements (the recast). As this implies, recasts may be corrective (i.e., the child's morpheme use was incorrect and the recast corrected it) or noncorrective (i.e., the child's morpheme use was correct and the recast confirmed this). The balance of corrective and noncorrective recasts shifts naturally as the child begins to learn the target morpheme. Platform utterances could be produced spontaneously by the child or occur after elicitation by the clinician, as either are equally effective (Hassink & Leonard, 2010).

Clinicians were required to use a different noun (for possessive *-s*) or main verb (for verb morphology) for each of the recasts provided within a session so that each of the 24 recasts was linguistically unique (Plante et al., 2014). Clinicians recorded their use of either the noun (for noun bound morphemes) or verb (for pronouns or verb morphemes) during the recast so they could track words already used in recasts to assure 24 linguistically unique recasts. Some clinicians prerecorded these words and simply marked them as used during the treatment session. In addition, clinicians were discouraged from repeating other words within their recasts. Therefore, if the child repeatedly used some element (e.g., a particular pronoun or verb), the clinician was encouraged to vary that element in the recast (e.g., Child: "He get it." Clinician: "He gets it."; Child: "He get it up." Clinician: "Superman lifts the rock up."; Child: "He get one." Clinician: "The superhero takes one."). Clinicians were advised to think up alternative ways to name the same action (e.g., cut, snip, clip) or toy (e.g., Superman, superhero, Clark Kent, that man, the good guy, this dude) to avoid repeated use of the same verb or pronouns across recasts. Input variability was naturally enhanced by clinicians using different materials each day, which increased the range of nouns and verbs that were appropriate to the treatment context. There was no restriction of repeating words across days (only within days), but new materials naturally led to high variability in terms of the total number of unique recasts heard. This is reported in Table 2. There were no group differences in the number of different words that the morphemes co-occurred with, $t(1, 18) = 0.839$, $p = .412$, $d = 0.324$.

To facilitate the child's production of platform utterances that contained different stem words, the clinician created a context that called for use of a particular noun or verb. The clinician was encouraged to model the verb stem, either alone or with nontarget inflections about three times each (e.g., Clinician: "This pony will run away. He's kinda naughty and he likes to run. Make him run away!"). Note that none of these clinician utterances modeled the target morpheme itself, as this could promote simple repetition rather than effortful recall of the target morpheme by the child. The lack of clinician models of the target morpheme, apart from the recasts that followed the child's platform utterances, differentiates conversational recast procedures from other methods such as direct modeling or focused stimulation. The clinician then elicited a platform utterance (e.g., "What is that pony doing?"). In cases where modeling the word stem (without modeling the target morpheme)

did not elicit an attempt or use of the target morpheme, the clinician's recast included the modeled word (e.g., Child: "He go away." Clinician: "He is running away."). This was necessary for some children who used a very narrow range of verbs on their own (e.g., Child: "He go like this." "He go over." "He go now.") to assure that the recasts used in each session met the variability criteria of Enhanced Conversational Recast.

Attentional cueing consisted of any of a number of possible clinician actions that cued the child to look at the clinician's face during the recast and particularly during clinician's use of the target morpheme. Clinicians typically began with a visual cue for attention (e.g., pointing to their own lips as they produced the target morpheme during the recast). For some children, this was more effective when a visual attractor was placed on the clinician's fingertip (e.g., a sticker or faux gemstone). Not all children responded to this cue, so other tactile cues (e.g., touching the child's arm or chin or physically turning the child's head toward the clinician) or auditory cues (e.g., "watch!") were used to train attention. Cues used for each child ultimately depended on what worked to draw their visual attention to the clinician's face at the proper time. These cues were faded as children began to orient to the clinician's face on their own.

Treatment Fidelity

Establishing treatment fidelity began with 2 days of training on administering both Enhanced Conversational Recast treatment and probes. To assure fidelity during actual sessions, the research clinicians were supervised by a certified speech-language pathologist who reinforced use of correct treatment and probe procedures. Two additional observers coded 43 (18%) of the sessions in the Sparse condition and 45 (19%) in the Dense condition. These observers coded live during the treatment session, as we found that live coding was more accurate than coding from video because a live coder could reposition themselves to provide an unobstructed view of the child's face, no matter what activities were underway (e.g., child and clinician on the floor, at a table, child's back to camera). Sessions were selected for coding such that each child's sessions were coded at least four times, and these sessions were distributed evenly across the entire experimental period. The observers also coded whether the sessions included exactly 24 recasts (Sparse: 99.7% [96%–100%]; Dense: 99.0% [91.7%–100%]), that each recast included a unique inflected lexical item and that these words were not repeated within a session (Sparse: 99.7% [91.7%–100%]; Dense: 99.2% [91.7%–100%]). None of the recast words could be words reserved for probe sessions (Sparse: 100%; Dense: 99.7% [95.8%–100%]). In addition, clinicians were not allowed to model the inflected lexical item before the child attempted its use (100% for both Sparse and Dense conditions), and the recast had to occur immediately after the child's attempted use of the morpheme (Sparse: 100%; Dense: 99.4% [91.7%–100%]). Finally, coders recorded whether the clinician cued or had the child's attention at the time the recast was delivered (Sparse: 99.0%

[83.3%–100%]; Dense: 98.6% [75%–100%]). The modal percent accuracy was 100% for the attentional component.

Probe Sessions

Kamhi (2014) has pointed out that what a child is able to do within a treatment session is not as indicative of learning as generalization of the treatment target to untreated contexts. Accordingly, we probed morpheme use with untreated words three times a week (Monday, Wednesday, and Friday) to track changes in generalization. Probe sessions of 15 min each were conducted immediately before that day's treatment session so that performance reflected learning and retention from prior treatment, rather than training from that same day. Clinicians had six sets of materials reserved solely for use during probe sessions. These included a farm kit, an ocean kit, and a zoo kit. Each included site-appropriate animals, one or more human figures, and various other related items (e.g., toys, seaweed, hay, animal feed, fencing, rocks, trees). In addition, there was a Play-Doh kit with Play-Doh, shape forms, and rollers. Finally, there were two laminated paper cutout kits (a race car-themed kit and a soccer kit). Clinicians were asked to rotate between kits so that every child was probed using every kit. Furthermore, some kits were quite extensive in the items included, and clinicians were encouraged to use different subsets of items each time those kits were used.

Using these kits, clinicians elicited use or accepted spontaneous use of the child's target morpheme and control morpheme. The clinician was free to elicit each as a separate block of items or intermixed during the probe session. Elicitation was required to obligate the child's use of the morpheme. If the child used or attempted to use either morpheme spontaneously during the probe session, that spontaneous use could be counted toward the required number of probes. Clinicians were required to obtain 10 child attempts to use their target form and their control form (elicited or spontaneous) for each probe session.

Elicitations used a list of words that were reserved for probe sessions and could be used with multiple probe kits (e.g., "roll" could be used with Play-Doh, soccer balls, tires from the race kit, animals from the remaining kits). The list contained 20 verbs specifically withheld from treatment for use during probe sessions. These words were taped to the walls of the treatment rooms and on clipboards used to record treatment data as reminders of their special status. Clinicians could use any 10 to elicit the target or control forms during each probe session. The list of probe words used could overlap for eliciting target and control forms and did overlap across probe days. Because these probe kits and materials like them (e.g., books about farms, activities with molding clay) could not be used during the treatment sessions, clinicians were also able to avoid use of nouns that were particular to the probe kits during treatment (e.g., shark, calf, mechanic, referee). Therefore, these nouns were also available for probes of the possessive *-s*.

We also conducted a probe session after treatment had ended (mean of 42 days later, range: 35–49 days). All children were administered the probes described above to

track learning during treatment, using the same probe materials. However, they were tested in a different building, reducing the likelihood of place-specific encoding boosting recall. Hupbach, Gómez, and Nadel (2011) showed that recall is significantly better for 5-year-olds when they are retested in familiar surroundings (the summer camp facility in this study) than when they are retested in less familiar surroundings (a university space in this study). Other cues to encoding (the same or different testers, a reminder question) did not confer benefit beyond that conferred by familiar surroundings (Hupbach et al., 2011). Therefore, we used the same clinicians for each child, unless they were unavailable to retest.

Probe Fidelity and Scoring Reliability

The fidelity of probe sessions was tracked by coders who also tracked treatment fidelity. Thirty-eight sessions (12%) were coded for the Sparse condition, and 28 sessions (9%) were coded for the Dense condition. The observers recorded whether materials were restricted to the probe kits (100% fidelity for both groups). Conversely, the fidelity observers recorded whether probe kit materials were used during treatment (this never occurred). Coders also recorded whether the 10 target and control probe items were obtained (Sparse: 98.2% [70%–100%]; Dense: 99.9% [65%–100%]) and whether the morpheme was obligated by the clinician's prompt (Sparse: 99.7% [95%–100%]; Dense: 99.6% [95%–100%]). Note that children's spontaneous uses of probe words during a probe session were not required to be obligated. The coders also noted whether the clinician avoided modeling the morphemes prior to the child's attempt (Sparse: 100%; Dense: 99.9% [98%–100%]) and whether the clinician avoided providing feedback of any kind (Sparse: 100%; Dense: 99.6% [95%–100%]). The modal percent accuracy for all fidelity metrics was 100%.

Scoring reliability during probe sessions was coded by an individual who was blind to the assignment of target and control morphemes and who never observed treatment sessions. Thirty-one probe sessions (21%) were coded for both the Sparse and Dense conditions. Point-to-point reliability was 97.6% for the Sparse (range: 82%–100%) and 95.4% for the Dense condition (range: 80%–100%).

Results

Treatment Efficacy

The pretreatment probe data indicated low use of target morphemes for both the Sparse ($M = 6.3$, $SD = 4.3$) and Dense ($M = 6.0$, $SD = 4.7$) conditions. Pretreatment use of the control morphemes was also low (Sparse: $M = 5.3$, $SD = 7.2$; Dense: $M = 4.0$, $SD = 4.9$). Posttreatment values for the target morphemes were notably higher for both groups (Sparse: $M = 65.8$, $SD = 33.3$; Dense: $M = 64.0$, $SD = 37.3$). This was not true for the control morphemes, which remained low at the end of treatment (Sparse: $M = 4.6$, $SD = 6.9$; Dense: $M = 2.7$, $SD = 3.4$). Values for individual children are provided in Table 3, and group

means are displayed in Figure 1. As this figure suggests, there was a marked and statistically significant difference between pretreatment and end-treatment use of the target forms (Sparse condition: Wilcoxon $T = 0.00$, $p = .005$, $z = 2.80$; Dense condition: $T = 1.00$, $p = .011$, $z = 2.55$), which was not paralleled for the control forms (Sparse condition: Wilcoxon $T = 7.00$, $p = .893$, $z = 0.135$; Dense condition: $T = 20.50$, $p = .813$, $z = .237$). A nonparametric test was used for these comparisons because the very low pretreatment variance coupled with the much larger end-treatment variance precluded use of a parametric test.

Treatment Condition Effects

We calculated an effect size statistic for each child that included the three pretreatment baseline probe data points, performance across the final three end-treatment probes, and the variability around the three end-treatment probes, as follows:

$$d = \frac{M \text{ end-treatment} - M \text{ pretreatment}}{SD \text{ of end-treatment performance}}. \quad (1)$$

We did not include the pretreatment variance in the formula because this was often very low (or absent), given the selection criterion of 30% or less morpheme use. Doing so would have artificially inflated the effect size estimates. However, there was occasionally no variance in the end-treatment use (e.g., the child was at 100% accuracy on all 3 days). To avoid dividing by zero in the equation, we substituted the minimum possible variance (a difference involving one item passed or failed over the 3 days).

Despite the slight advantage for the Dense condition seen in Table 3 and Figure 1, there was no statistically significant between-conditions difference in performance for children in the Dense versus Sparse treatment conditions, $t(1, 18) = 0.45$ (two tailed), $p = .909$, $d = 0.18$. Given that the majority of children showed a strong treatment effect, it is not surprising that there was no significant difference

Figure 1. Group treatment effects for the Sparse and Dense treatment conditions. Target morphemes were those treated, and control morphemes were untreated but tracked over the course of treatment. Error bars indicate the standard error of the mean.

between treatment conditions. Indeed, the small between-groups effect size suggests that the difference would have little practical importance even with a larger sample size.

We also examined spontaneous use of the target form for between-conditions differences. There was no significant difference in the total number of correct spontaneous uses between conditions, $t(1, 18) = 0.77$ (two-tailed), $p = .45$, $d = 0.33$. We also looked at the total unique spontaneous uses. This metric was intended to guard against inflation of spontaneous use by children who might have a high rate of spontaneous use, but also a highly restricted number of individual words they were able to inflect. The total unique spontaneous use also did not differ by condition, $t(1, 18) = 0.91$ (two-tailed), $p = .37$, $d = 0.37$.

Long-Term Retention

A final probe session was conducted between 5 and 7 weeks posttreatment (mode = 6 weeks). All children were administered the probes described above to track learning during treatment, using the same probe materials. Performance on these follow-up probes is reported in Table 3. A Mann-Whitney U ($U = 40.5$, $p = .496$, $z = 0.680$) indicated no significant between-groups difference for follow-up performance. There was a statistically significant relationship between end-treatment performance and their performance at follow-up (see Figure 2). The correlation was slightly higher for those in the Dense condition ($\rho = .73$, $p = .016$, $\rho^2 = .53$) than the Sparse condition ($\rho = .54$, $p = .108$, $\rho^2 = .29$). The lower correlation reflected a greater propensity for children to show greater change across time in the Sparse condition, both in terms of gains and losses since their end-treatment performance.

Given that the GFTA-2 scores did differ significantly for the two treatment groups, we asked whether articulation scores impacted treatment results. We did not expect an impact, given that we verified that all children could produce the sounds that composed their own target morpheme, as noted in the Method section above. Indeed, there was no significant correlation between the children's GFTA-2 scores and either their end-treatment d ($\rho = -.01$, $p = .96$, $\rho^2 = .0001$) or their follow-up d scores ($\rho = -.12$, $p = .68$, $\rho^2 = .0144$).

Individual Treatment Response

Figure 3 displays the individual children and their progress on generalization probes for target and control morphemes. This figure provides information on how long it took individual children to begin to generalize their treatment targets (our metric for learning) and their retention at follow-up.

Given that the study used a predefined treatment period (rather than training to a criterion), it is useful to gauge how many children showed a response to treatment during the treatment period. The criteria for treatment response used in this study were twofold. Children were classified as treatment responders if (a) they demonstrated an effect size (d) of 1.0 or greater and (b) they achieved

Figure 2. Posttreatment follow-up performance by children in Sparse and Dense treatment conditions.

performance of at least 50% correct at some point during treatment. The $d \geq 1.0$ criterion reflects the ability to detect change from baseline, despite possible differences in baseline across children. It also accounts for children who show large treatment responses (i.e., change from 0% to 100%) over just the last three treatment days. The 50% criterion reflects the concept of clinically meaningful change, as d values of 1.0 can be obtained with small amounts of change if the day-to-day variance in performance is low or nonexistent. Seven of 10 children in the Sparse condition were classified as treatment responders. Eight out of 10 children in the Dense condition also met these criteria for treatment response.

We note here that the criteria used here to gauge treatment response is different than the criterion used in our previous studies (a $d > 1.0$; Eidsvåg et al., 2019; Meyers-Denman & Plante, 2016; Plante et al., 2014, 2018). We provide a justification for this change and a reanalysis of the number of treatment responders in this and the previous studies in Supplemental Material S1.

Discussion

This study assessed the potential benefit of high-density dose delivery of Enhanced Conversational Recast treatment for preschool children with DLD. There was no significant difference in treatment outcomes between the Sparse treatment group (24 recasts in 30 min) and the Dense treatment group (24 recasts in 15 min). These results suggest that high-density dose delivery does not offer significant

increase in the effectiveness of this treatment over lower density delivery. The small effect size found after group comparison ($d = .18$) suggests that the N required for any effect to be detected would be so large that the practicality of any detected effect would be negligible. However, both treatment conditions proved to be effective for remediating grammatical morpheme errors produced by preschool children with DLD (Sparse mean $d = 5.7$; Dense mean $d = 6.8$).

The data collected at follow-up testing 5–7 weeks after the end of the treatment period suggest that children retained gains made during treatment but did not improve on their target morpheme use independently outside treatment. These results are consistent with the findings of our other studies of Enhanced Conversational Recast treatment (Eidsvåg et al., 2019; Meyers-Denman & Plante, 2016). Clinicians must decide what are appropriate and meaningful criteria for skill mastery based on their individual clients' needs and abilities but be aware that independent progress should not be assumed even for children who are performing at relatively high levels at the end of treatment (e.g., 70%–90% accuracy).

The results of this study suggest that Enhanced Conversational Recast treatment can be delivered in 15-min sessions with results that are generally similar to those that have been found in 30-min sessions, providing evidence for the increased efficiency of the more rapid dose delivery rate. This rapid dose rate does compress the number of conversational exchanges in a way that is less naturalistic than doses spread over 30 min. However, the results suggest that the relative “naturalness” of the conversational exchanges did not drive the treatment outcomes, else the 30-min condition would have proven superior. Instead, the results suggest that it is the clinician input, in proximity to the child's attempts, that is the likely mechanism of change in this treatment method. The lack of a statistical difference between the Sparse and Dense conditions likely reflects the effectiveness of the base treatment, Enhanced Conversational Recasting (Eidsvåg et al., 2019; Meyers-Denman & Plante, 2016; Plante et al., 2014, 2018). The primary effects on children's outcomes in this treatment appear to involve both input variability and child attention. The Plante et al. (2014) study demonstrated that children responded significantly better to treatment with high levels of variability. This manipulation has been carried forward in all subsequent studies from our group. The positive effect of high-variability input has been repeatedly demonstrated in studies of statistical learning (e.g., Gómez, 2002; Torkildsen et al., 2013) and studies of morphosyntactic priming in children with typical language skills (Krok & Leonard, 2018).

Attention has not been manipulated as a within-study variable. However, there was an important methodological change between Plante et al. (2014) and Meyers-Denman and Plante (2016). In the former study, clinicians were *encouraged* to gain children's attention prior to dose delivery, though this was not specifically required. The Meyers-Denman and Plante (2016) study, however, *required* clinicians to attempt to gain and maintain children's attention

Figure 3. Generalization data for individual children in the Dense and Sparse treatment conditions. Data reflect performance on generalization probes collected during the treatment period and collected 5–7 weeks posttreatment. Gaps in the line charts indicate absences during treatment or the time between treatment and retention testing.

as part of every treatment dose. The average treatment effect sizes for children increased substantially between studies (1.92 on average in Plante et al., 2014; 7.61 on average in Meyers-Denman & Plante, 2016). This increase in effect sizes from the Plante et al. (2014) study has been replicated in Plante et al. (2018) and Eidsvåg et al. (2019) in which children's average treatment effect sizes were 3.75 and 6.7, respectively, when the variables of attention and variability were both incorporated into what we now call *Enhanced Conversational Recast* treatment (Meyers-Denman & Plante, 2016). The effect sizes in this study (Sparse: $d = 5.7$; Dense: $d = 6.8$) are also in line with these previous studies. This suggests that the combined manipulations of variability and attention may account for a large proportion of variance in children's response to this particular treatment. Therefore, additional positive gains in the effectiveness of Enhanced Conversational Recast treatment may well be incremental.

Treatment efficiency, or whether one treatment works better in a shorter amount of time (Olswang, 1990), has received limited study in the realm of interventions for language disorders. There is a small body of literature on treatment efficiency for phonological disorders. These studies often focus on the comparisons of different treatment methods (Gierut, 1998) and the total length of time spent in treatment (Campbell & Bain, 1991). By comparing different presentation rates of the same treatment, we were able to assess the relative efficiency of Enhanced Conversational Recasting in various densities of dose delivery. The similar treatment outcomes for dense and sparse treatment are good news for clinicians. These results suggest that Enhanced Conversational Recast treatment can be delivered in half the time that it has previously been shown to be effective (Eidsvåg et al., 2019; Meyers-Denman & Plante, 2016; Plante et al., 2014, 2018) without a clinically meaningful cost to effectiveness.

The presentation of 24 unique recasts in 15 min seems to be a more *efficient* treatment option and leaves clinicians with opportunities to address language goals in a limited amount of time. This may help clinicians who have large caseloads and do not have time to spend 30 min with each of their children on a single goal. This could also help address the growing prevalence of group treatment in schools that, at best, provides no clear advantage over individual treatment (Eidsvåg et al., 2019; Law, Garret, & Nye, 2010) and may in fact present distractors that prevent some children from attending to treatment doses (Eidsvåg et al., 2019). By increasing the density of treatment delivery, it would be possible for clinicians to break their group sessions up into multiple short individual sessions when needed. This would promote delivery of Enhanced Conversational Recast treatment in a highly individualized context. Clinicians could choose one or two short activities tailored to a specific child's interests (e.g., a picture book, quick craft activity, superhero toys) and target their language goals in ways that are highly engaging and efficient. This could take place during an individual pullout session or in situations where clinicians push into children's classrooms, provided the

clinician is able to maintain their child's attention during dose delivery. Clinicians could also choose to implement a higher density form of recasting treatment with children who have difficulty attending to a task for longer periods of time, whether in groups or seen individually, or with children who quickly grow bored with activities in treatment.

Dose Schedule and Dose Density

Previous research exploring the manipulation of dose schedules has often conflated this treatment parameter with total intervention duration and dose frequency. The introduction of these confounds makes it difficult to accurately assess the efficacy and effectiveness of a given intervention. We sought to eliminate these issues by manipulating elements of dose delivery at the level of the individual treatment sessions and holding all other aspects of intervention constant. Thus, the total number of doses, the time a child was with the clinician, and the total intervention duration were invariant. Our results are similar to the only other study (to our knowledge) that also held these parameters constant while manipulating the dose schedule (Meyers-Denman & Plante, 2016). Neither study found differences between dose delivery schedules that were more spaced or more condensed relative to a spacing over a 30-min session. These combined findings suggest that the dose form and number are more important than the session time over which those doses are delivered.

Individual Response to Treatment

To translate research findings such as this to clinical practice, it is up to the clinician to correctly implement the treatment with high fidelity and to assess the effectiveness of evidence-based treatments for their individual clients. However, it is also important to recognize that even treatment responders respond to treatment in a variety of ways (see Figure 3). Some children, such as S1 and D1, made consistent upward progress as the treatment was delivered. Other children, such as S5 and D6, seemed to have difficulty grasping their target until well into the treatment period. Therefore, despite the growing body of literature that shows that Enhanced Conversational Recast treatment is an effective intervention for preschoolers with DLD (Eidsvåg et al., 2019; Meyers-Denman & Plante, 2016; Plante et al., 2014, 2018), there are clearly individual differences in how fast and how well children respond to the treatment. Across studies, the majority of children do show a positive response to Enhanced Conversational Recasting (see Supplemental Material S1), but some do not. Clinical decisions concerning whether to persist or discontinue treatment with any given child can be enhanced by understanding both the overall rate of treatment response and the time it takes for responders to begin showing change. We examined the individual child data from our previous studies of Enhanced Conversational Recast treatment (Eidsvåg et al., 2019; Meyers-Denman & Plante, 2016; Plante et al., 2014, 2018) and found that children who were labeled as responders

under our new criteria ($d \geq 1.0$ and 50% correct probes at least once) reached or exceeded the 50% correct mark at an average of 7.75 probe sessions. This means that children were achieving this mark following approximately 12 treatment sessions on average. It is important to note, however, that children achieved or exceeded this 50% correct mark as early as their third probe session in some cases and as late as their 15th probe session in others. Clinician decisions to persist or discontinue this treatment will rely heavily on each individual client's needs and performance relative to the ways in which treatment schedules are structured in a given setting.

Conclusion

This early efficacy study of the benefits of high-density dose delivery of Enhanced Conversational Recast treatment suggests that this treatment can be delivered to children with DLD in 15-min sessions with a significant effect on children's morphological abilities. The results of this study suggest that clinicians can deliver highly effective treatment to their clients in shorter time increments, allowing for greater flexibility in the handling of large caseloads, behavioral challenges, and the individual needs of their clients.

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