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Research Article

The Effects of Parent-Focused Slow Relaxed Speech Intervention on Articulation Rate, Response Time Latency, and Fluency in Preschool Children Who Stutter

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Purpose: This study investigated the effects of an intervention to reduce caregivers' articulation rates with children who stutter on (a) disfluency, (b) caregiver and child's articulation rates, and (c) caregiver and child's response time latency (RTL).
Method: Seventeen caregivers and their preschool children who stuttered participated in a group study of treatment outcomes. One speech sample was collected as a baseline, and 2 samples were collected after treatment. Posttreatment samples were of caregivers speaking as they typically would and using reduced articulation rates.
Results: Caregivers reduced articulation rates significantly in the 2 posttreatment samples, and a significant decrease of stuttering-like disfluencies (SLD) was found in the children in those 2 samples. No direct relationship was found between the caregiver's articulation rate and RTL, and there was a small correlation of RTL with the lower levels of SLD found postintervention. No significant relationships were found between the reduced levels of SLD and articulation rates for either caregivers or children.
Conclusions: Results suggest caregivers can be trained to slow their speech, and children increased their fluency at the end of a program designed to slow caregiver articulation. The intentionally slower rate of the caregivers, however, was not significantly related to fluency.

It has become standard practice among speech-language pathologists to provide some level of parent counseling for the treatment of stuttering in preschool children. Intervention strategies aimed at parents may range from counseling parents about concerns regarding their child's speech to providing instructions to alter aspects of their communication styles (Ambrose, 2006; Richels & Conture, 2007; Rustin & Cook, 1995; Yairi & Ambrose, 2005; Yaruss, Coleman, & Hammer, 2006). The American Speech-Language Hearing Association's (1995) Special Interest Division on Fluency and Fluency Disorders has developed guidelines for speech-language pathologists to help parents facilitate fluency in their preschool children who stutter, which include reduction of parental speaking rate and interruptions. Despite clinicians' enthusiasm for parent counseling (Cooper & Cooper, 1996), however, there is an astonishing lack of empirical evidence from outcome-based studies for some of the current recommendations made to parents regarding changes in their communication styles. Rather, many studies have been based primarily on observation instead of intervention (Bernstein Ratner, 2004). This fundamental lack of research limits the confidence with which clinicians can recommend speech output changes to parents of preschool children who stutter.

A number of studies have investigated aspects of the interactions of caregivers with their preschool children and the effects on stuttering or disfluency (see Bernstein Ratner, 2004, for a review). The impetus for these studies lies, in part, in the Demands and Capacities Model (DCM; Adams, 1990; Starkweather, 1987; Starkweather & Gottwald, 1990) of the development of stuttering, which holds that the linguistic, emotional, motoric, and environmental demands on some children surpass their capacities to produce fluent speech. Thus, parental communication that is less hurried and matches the child's linguistic abilities will place fewer demands on the child's speech and fluency. A faster speaking rate or a tendency to talk over or interrupt the child may put pressure on a child's fluency.

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Entire therapies for preschool children who stutter have focused, in part, on the verbal interactions of parents and children. Therapies designed to alter the communication styles of caregivers have been found to reduce stuttering in preschool children. The Rotterdam Evaluation Study of Stuttering Therapy in preschool children was a randomized study of almost 200 children who stutter (de Sonneville-Koedoot, Stolk, Rietveld, & Franken, 2015). Some of the participants were enrolled in indirect therapy on the basis of the DCM, and others were placed into a direct treatment program, the Lidcombe Program (Bonelli, Dixon, Bernstein Ratner, and Onslow, 2000). One of the components of the DCM program was to minimize demands on the children by having parents reduce their speaking rate. Treatment was individualized, but the primary goals of treatment were to reduce demands on the child in the areas of cognition, linguistics, motor skills, and emotion. Parents were instructed to practice at home with their children in 15-min segments for a minimum of five times per week. Treatment gains were measured in terms of percentage stuttered syllables and stuttering severity from baseline to 18 months post-treatment. The DCM was found to be as equally effective as the Lidcombe Program in increasing fluency over 18 months, while the Lidcombe Program led to higher gains in fluency in the short term.

Another preschool treatment program that focuses on interactions between parents and children is the Palin Parent–Child Interaction (PCI; Millard, Edwards, & Cook, 2009). With the help of clinicians, caregivers select interaction strategies designed to facilitate fluency in their children who stutter. The program is individualized, but some strategies include caregiver reduction of speaking rate and an increase in pausing. Like the DCM, PCI involves parents setting aside time to practice strategies with the child at home, in this case during 5-min play sessions three to five times per week. In addition to changing the parents' style of interaction, PCI includes strategies to help families accept stuttering and build confidence in the child. A study of six children enrolled in PCI showed that the decrease in stuttering of four of the children could be attributed to treatment, and all parents gained confidence in managing stuttering in their children over the course of treatment (Millard et al., 2009).

The interaction between the parents and their children who stutter is the main focus of PCI and is a component in the DCM. Both programs have been shown to help young children be more fluent, but because the programs have multiple components, the mechanisms by which stuttering is reduced are not clear. Linguistic and paralinguistic behaviors, in addition to affective and cognitive factors, might play a part in reducing or exacerbating stuttering and are variable across environments, conversations, and speaking partners. One study examined the complexities of several paralinguistic behaviors in mother and father–child conversations. Savelkoul, Zebrowski, Feldstein, and Cole-Harding (2007) addressed coordinated interpersonal timing in the interactions of 10 children who stutter with their mothers and fathers and compared them to those of 10 typically fluent children and their parents. Coordinated interpersonal timing is a measure of the correlation of the timing of vocal behaviors, which include the length of vocalizations, interruptions, simultaneous speech, and pauses. The 20-min conversational speech samples of the children playing separately with their mothers and fathers were recorded in the home setting. Parents and their children who stutter were found to be more attuned to each other's conversations than the typically fluent controls were in the behaviors of interruptions, durations of vocalizations, and turn-switching pauses. Savelkoul et al. (2007) suggested that sensitivity to conversational timing in children who stutter provides evidence that parent-directed changes in conversational style may help children become more fluent.

The Relationship Between Parents' Articulation Rate and Children's Fluency

Studies on the basis of observations of conversations of parents with their preschool children have shown mixed results on the relationship between parental articulation rate and children's fluency. Equivocal findings may be attributed to different methodologies or individual differences in participants. Some studies have measured speaking rate, which is an overall output of speaking and includes pauses and disfluencies, and others have measured articulation rate, which reflects the speed of the articulators, with pauses over 250 ms deleted (see Chon, Sawyer, & Ambrose, 2012, for a review). Tools used to measure rates have included stopwatches, time code generators on videotape, and acoustic measurements. Some studies have measured rate on as few as 10 utterances, whereas others have measured entire conversations. Only perceptually fluent utterances have been measured in some studies, while others have included stuttered utterances, deleting the length of the disfluencies from the signal. The type of measurement has been found to affect results. Hall, Amir, and Yairi (1999) found that differences in articulation rate in children who stutter and typically fluent children were realized only when measuring rate in phones, rather than syllables per second (sps). Flipsen (2002) found that the finer measure of phones per second was needed to show articulation rate differences in children with and without disordered phonology. The methodologies used in a selected group of studies measuring speech and articulation rate are presented in the Appendix.

A few studies have compared speaking or articulation rates of parents with children who stutter and parents of typically developing children. Most of these studies have shown that parents of children who stutter do not speak any faster than parents of children who do not stutter (Kelly, 1994; Ryan, 2000; Yaruss & Conture, 1995). Kelly and Conture (1992) found no significant differences in overall speech or articulation rate between groups of children who stutter and typically fluent children, mothers of children who stutter and mothers of typically fluent children, or between children who stutter and their mothers. Mothers of typically fluent children, however, did have significantly faster speech and articulation rates than both groups of children.

One observational study did find that mothers of children who stutter had a statistically significant faster articulation rate than mothers of children with typical fluency (Meyers & Freeman, 1985b). Articulation rate was calculated for the 15 longest utterances from each speaker. Not only did the mothers of children who stuttered have a faster articulatory rate than other mothers, but all mothers tended to speak at a faster rate to the children who stuttered. The authors speculated that the mothers' faster rates might be a response to stuttering. Articulation rates were negatively correlated, so the slower the child's articulation, the faster the mother's. No correlations were found between the mothers' rates and the children's disfluency, however.

Some studies have found correlations between the speech or articulation rate of the parent and the frequency of stuttering in the child. Guitar, Schaefer, Donahue-Kilburg, and Bond (1992) measured speaking rate in a single-participant study examining the effects of a parent–child interaction treatment program. The mother's speaking rate was the only one of six variables significantly correlated with the child's stuttering, with a decrease in child disfluency associated with a decrease in maternal rate. Ryan (2000) found a significant correlation in the articulation rates of 20 mothers and their children who stuttered. A multiple regression analysis of several variables, including linguistic measures, child's age, and articulation rates, found the mother's articulation rate was the strongest predictor of the child's stuttering, with faster maternal rates predicting higher rates of stuttering.

Some correlations have been found between dyadic rates and stuttering. Dyadic rate has been defined as the difference in speaking rate between two speakers (Meyers & Freeman, 1985b). Yaruss and Conture (1995) found no correlations between mothers' rate and stuttering in the 10 dyads they studied but did find that stuttering severity was correlated with the difference in rate between the mother and child, with larger differences associated with more severe stuttering. Kelly (1994) had a similar finding in her study of 11 fathers and their sons who stuttered. Dyadic overall speaking rates and stuttering severity were positively correlated, with children who presented with severe stuttering having greater dyadic rate differences than those whose stuttering was milder.

Effects of a Deliberately Slower Articulation Rate on Child Fluency

There have been a few reports that a reduction in caregiver or clinician's articulation rate may result in a decrease in disfluency for some children. Zebrowski, Weiss, Savelkoul, and Hammer (1996) studied five mother–child pairs to investigate the efficacy of slow speech training for mothers as a means to improve fluency in their children who stuttered. Mothers were trained to produce a slower rate of speech, as well as increase the amount of time before responding during interactions with their children. Mothers were able to carry over the slower articulation rate to two posttraining sessions. All mothers exhibited a statistically significant decrease in articulation and overall speaking rate and an increase in response time latency (RTL). The speech of three of the five children showed a reduction in the frequency of speech disfluency, which included both within- and between-word disfluencies. The slower maternal rates were not fluency facilitating for two of the children.

There have been two other single-participant design studies that examined the effects of reduced maternal rate on disfluency in children who stutter. Stephenson-Opsal and Bernstein Ratner (1988) observed two dyads of mothers and their children, each participating in five instructional sessions over 10 weeks. The number of sessions was determined by the mothers' indication that the slow speech technique had been mastered. The mothers' articulation rate decreased, and their children's stuttering decreased in the posttraining condition. The children's rates did not entrain to their mothers, and actually increased during the posttraining session.

Cardman and Ryan (2007) taught a mother to reduce her rate to 100 syllables per minute or fewer, by "pausing slightly between words" (p. 461). The intervention was conducted over a 10-week period, in an ABA design. The B phase was a continual base rate, in which the mother conversed with the child as she typically would for 10 min, averaging approximately 232 syllables per minute, and then switched into her reduced rate for 10 min. During the mother's slow rate, both the child's speaking rate and number of stuttered words per minute were reduced.

Another single-participant study investigated clinician's use of a slower articulation rate with six children who stuttered, three of whom had disordered phonology (LaSalle, 2015). The children were 49–54 months old. The study was an ABAB design, with two 1-hr long sessions of baseline, where the clinicians used a natural rate of speech, and two 1-hr long sessions of treatment, where the clinicians modeled an articulation rate of two to three sps. Articulation rate for the children and clinicians was measured acoustically in phones per second, on perceptually fluent utterances, and effect sizes were computed. Articulation rates in 40 adjacent pairs of clinician and child utterances were analyzed across the baseline and treatment conditions. The children with typical phonology were able to entrain their articulation rate to the clinicians' in the treatment conditions. The children with disordered phonology were slower talkers than the children who did not have disordered phonology, both in the baseline and treatment phases, and did not entrain their rates to the clinicians' rates. Four of the six children improved their fluency during the treatment phase. The two children who did not improve were males with disordered phonology. A female with disordered phonology was able to improve her fluency. The effect size for stuttering reduction was greater for the children who did not have a phonological disorder.

Effects of Parents' Reduced Articulation or Speaking Rates on Children's Rates

The outcomes of reduced parent articulation rate, or in some studies, speaking rate on the articulation or speaking rate of children who stutter are inconsistent. Though not to a significant degree, all five child participants included in Zebrowski et al. (1996) demonstrated a reduction in articulation rate after their mothers received instruction to speak at a slower rate. In contrast, other research has indicated a resultant increase in child articulation rate (Stephenson-Opsal & Bernstein Ratner, 1988).

Two studies have been conducted that examined the influence of maternal speaking rate on the speech of typically fluent children, with equivocal results. In a study of six mothers and their typically fluent 3-year-old children, Guitar and Marchinkoski (2001) measured speech rate, which was speaking time minus pauses and disfluencies, and found that five children reduced their speech rate when their mothers spoke more slowly. In contrast, Bernstein Ratner (1992) found that successful reduction in speaking rates on the part of 20 mothers did not lead to measurable changes in the children's speaking rates. *Speech rate*, which was not specifically defined, was measured with a stopwatch and measured in words per minute. The mothers were instructed to talk more slowly to their children, without formal instruction on how to reduce rate, during a play session. Mean speech rate, measured in words per minute, was significantly slower after instruction to slow speech rate as compared with baseline measures. Not all women, however, were able to reduce their rate. In addition, there was no change in fluency in the children across baseline and after training sessions.

Effects of Response Time Latency on Speaking Rate and Disfluencies in Preschool Children

In addition to recommendations for parents to slow their speaking or articulation rates, another component of therapy for preschool children who stutter is the recommendation for caregivers to increase their RTL to facilitate fluency (Conture, 2001; Guitar, 1998; Richels & Conture, 2007; Yaruss et al., 2006). RTL has been defined as "the time between speaker turn exchanges" (Newman & Smit, 1989, p. 636). The clinical focus on increasing RTL has arisen despite that very few studies have investigated the relationship of RTL and stuttering.

Two studies of typically fluent preschool children investigated the relationship of a slowed maternal speaking rate and RTL. One study showed there was no significant change in RTL when parents spoke more slowly (Bernstein Ratner, 1992), and another showed no difference in overall speaking rate across three different conditions when experimenters systematically increased their RTL (Newman & Smit, 1989). Bernstein Ratner's (1992) study found mothers had a tendency for a longer RTL when deliberately slowing their rate of speaking, but the latencies were not statistically significant. Half of the mothers in the study were instructed to simplify their language in addition to slowing rate, and this group had longer RTL than the group that only slowed their rate. Newman and Smit (1989) found that children lengthened their RTL in response to a lengthened RTL in a conversational partner. Experimenters manipulated their RTL in 15-min conversations with four children. The RTL was 1, 2, and 3 s long in each of three conversations. The children's RTL was significantly longer when the experimenter's RTL was 3 s, and children tended to interrupt more during the shorter 1-s RTL condition. No differences were found in speaking rate, measured in syllables per minute, either for the children or the experimenters across the speech samples. In addition, the level of children's disfluencies was found to be inconsistent and idiosyncratic across the different RTL conditions.

Investigations of the effects of RTL on the speech of children who stutter have been mixed, largely due to different research purposes and designs. Yaruss (1997) wanted to determine whether a child's RTL and articulatory speaking rate would influence stuttering in a single utterance. His examination of 12 boys revealed no relationship in these two parameters and no effect of either variable on stuttering.

Some studies of RTL in children who stutter have incorporated specific teaching strategies to parents designed to reduce interruptions. Winslow and Guitar (1994) taught the parents of their child who stuttered a structured turn-taking task. The child's disfluencies decreased during turn taking, relative to a baseline condition in the single-participant study. The Zebrowski et al. (1996) study of stuttering and maternal speaking rate also provided instructions to mothers to increase their pause duration after their children spoke. All of the mothers were able to increase pause duration after instructions to slow their speech, as well as decrease their speaking rate, but the intervention was not fluency facilitating for two of the five children.

In an effort to investigate the mechanisms behind the reported success of the Lidcombe Program, Bonelli et al. (2000) examined various language measures in addition to articulation rate and RTL in nine mother–child pairs in a single-participant study. The pairs were recorded shortly before and after (1 week to 1 month) treatment began. The length of time between pre- and posttreatment recordings was 3.5 to 8 months. All children increased fluency in the posttreatment sessions. No measurable change was evident in RTL for the mothers or the children over the course of the study. Measures of rate revealed no significant change in child articulation rate; however, a trend towards increased articulation rate was apparent for the mothers. The authors concluded that changes in parental behavior, such as articulation rate may not necessarily be responsible for improved fluency in preschool children who stutter in the context of the Lidcombe Program.

Kelly and Conture (1992) examined interruptions and RTL in addition to speaking rate in their study of mothers and children who did and did not stutter. There were no significant relationships found between RTL and stuttering. There was a positive correlation between the length of the mother's interruption (simultalk) and stuttering severity; however, longer simultalk was positively correlated with more severe stuttering. Overall, mothers were found to have longer RTL than their children. In addition, there was a positive correlation between overall speaking rate, measured in words, and RTL for all participants combined.

There has been one study of fathers and their sons who stutter, which revealed different behavior in regard to RTL. Kelly (1994) found that the two groups of fathers in her study had shorter RTL than their sons, 11 of whom stuttered and 11 with typical fluency. Both groups of fathers also interrupted more frequently than their sons did. No correlations were found for RTL and stuttering or speaking rates. The children in the two studies had differing age ranges. The age of participants in the Kelly and Conture (1992) study was 3:3–4:8, and in the Kelly (1994) study, 2:7–10:1. The age range differences, along with the gender of the parent, may have accounted for the differences in findings.

In summary, the relationships among RTL, articulation rates, and stuttering are far from clear. The few studies investigating the effects of slower speaking rates of caregivers on their children's stuttering have been mixed, with two single-participant design studies showing a decrease in the child's stuttering (Cardman & Ryan, 2007; Stephenson-Opsal & Bernstein Ratner, 1988), and two others showing that decreases in parental or clinician's speaking and articulation rates do not always result in less stuttering in the children (LaSalle, 2015; Zebrowski et al., 1996). Children who stutter may not entrain to their caregivers' rates; one study revealed children reduced their rates when their mothers slowed their speech (Zebrowski et al., 1996), and another showed that children increased their rates (Stephenson-Opsal & Bernstein Ratner, 1988).

The particular characteristics of slow speech that might facilitate fluency have not been identified. A slower parental rate might give children a sense that they have more time to talk or may serve as a model as an easier way to talk. Slower rate may also bring changes in the interaction between parents and child, such as an increase in RTL.

To our knowledge, there have been no investigations of the relationship of RTL with a slower articulation rate taught to caregivers to use with their children who stutter. Thus, recommendations for caregivers to increase RTL come without benefit of empirical research involving children who stutter to support them. Furthermore, there is limited outcome-based empirical evidence for the efficacy of treatment protocols for caregiver counseling to change articulation rate. Three of the single-participant design studies were with a small number of participants and crude measuring instruments, such as time code generators or stopwatches. These studies observed that caregivers could reduce rates, and when they did, levels of stuttering or stuttering-like disfluencies (SLD) decreased for the one participant in the Cardman and Ryan (2007) study, for the two participants in the Stephenson-Opsal and Berstein-Ratner (1988) study, and in three of five children participating in the Zebrowski et al. (1996) study. These studies did not use significance testing and did not explore factors in their treatment protocols that may have led to reduced stuttering in the children. LaSalle's (2015) single-participant study, in contrast, used a finer metric, phones per second, to calculate articulation rate, and did find statistical significance that the treatment program reduced stuttering in four of the six participants.

The purpose of this study was to investigate the effects of training caregivers to reduce articulation rate on children's fluency, RTL in caregivers and children, and children's and caregivers' articulation rates. Conversational speech samples were collected before the intervention and twice afterwards. Postintervention, the caregivers were asked to speak as they typically would and then to use their slower articulation rate. The caregivers' and children's articulation rates and RTL were measured in each of the three conversations, as was the children's level of stuttering, measured in percentage of SLD. The primary research questions were the following.

1. Does the children's level of disfluency change across the visits?
2. Are caregivers able to reduce their articulation rate as a result of the intervention?
3. Is there a relationship between the caregivers' articulation rates and RTL?
4. Do the children's articulation rates match the caregivers' rates?
5. Does the children's RTL match the caregivers' RTL?

A secondary purpose was to determine the effect of the independent variables: caregiver articulation rates, caregiver RTL, child articulation rate, and child RTL, on the dependent variable, the children's level of SLD.

Methods

Participants

Participants were 17 children who stutter and their caregivers. There were 15 boys and 2 girls, ranging in age from 31 to 66 months (M = 47.9; SD = 9.8). The adult conversational partner was identified as the caregiver who spent the most time during the day talking to the child, and the group included 15 mothers, one grandmother, and one father. Participants were recruited from flyers given to speech-language pathologists at the Eckelmann-Taylor Speech and Hearing Clinic at Illinois State University. The children were regarded as stuttering by the caregiver and a certified speech-language pathologist. The children displayed a minimum of three SLD per 100 syllables of speech at the initial period of data collection. SLD are part- and single-syllable word repetitions and disrhythmic phonation, which include blocks and prolongations (Yairi & Ambrose, 2005). Caregivers reported the children had no history of atypical development or neurologic disorders. Three of the children had been previously diagnosed with a concomitant phonological disorder by a speech-language pathologist and had received treatment at the clinic before participating in the current study. One participant had received therapy for stuttering at a different clinic a few months before entering the current study but terminated stuttering therapy because the mother felt the clinician "did not understand childhood stuttering." During the 3-week period of the study, no children received any type of speech-language services.

Stuttering severity was assessed using a weighted scale, determined by multiplying the number of disrhythmic phonations per 100 syllables by 2 and adding that to the number of part- and single-syllable word repetitions per 100 syllables multiplied by the mean number of repetition units (Yairi & Ambrose, 1999). The scale reflects the impact of the extent of repetitions, as well as disrhythmic phonation on the perception of the severity of stuttering (Costello & Ingham, 1984; Zebrowski & Conture, 1989). Nine children were rated as having mild stuttering, seven, moderate, and one, severe.

Demographic information is found in Table 1 and includes the family history of stuttering and time that had elapsed from the onset of stuttering until participation in the study. A positive family history of stuttering was reported for nine children. Two of the children were adopted, so history was unknown. The time since stuttering from onset ranged from 1–40 months, with a mean of 16.4 months (*SD* = 11.2). Each participant provided informed consent to participate in the study, which was approved by the Institutional Review Board at Illinois State University.

Procedure

Intervention

The study involved a three-visit program conducted in 1-hr sessions over 3 weeks carried out by a graduate student clinician who was supervised by the first author, a licensed speech-language pathologist. Treatment sessions took place around a table in the laboratory of the first author.

Visit 1

A 15-min play interaction between the caregiver and child was video- and audio-recorded as a baseline session for later analysis of the child's disfluency and the caregiver's and child's articulation rates and RTLs. The child was taken to a separate playroom by an undergraduate student who was blind to the objectives of the study. The caregiver was interviewed about the development of the child's stuttering and overall language and motor development.

Following the interview, the caregiver was instructed to produce slow, relaxed speech, described as speech produced with slightly elongated vowel sounds and preserving suprasegmental features. It was explained that studies have shown a potential relationship between a decrease in caregiver speaking rate and an increase in child fluency, and that the clinician would teach the caregiver the *slow, relaxed speech* to use with the child. No mention of pausing was made, as one of the study's objectives was to determine the relationship between a slower articulation rate and RTL. It was felt that deliberate pausing to slow articulation rate might carry over into pauses at the ends of utterances.

The first author and graduate student modeled slow, relaxed speech and asked the caregiver to imitate. Speech was modeled with appropriate prosody, so as not to sound *sing-songy*. Practice with slow, relaxed speech included book reading and conversational speech. Articulation rate was not objectively measured; rather, achievement was based on the perceptions of the clinicians. Because one of the objectives of the study was to determine the relationship between a slower articulation rate and the length of RTL, there were no instructions to the parents to try to avoid interrupting the child.

The child was brought to the room and the graduate student used slow, relaxed speech with the child while playing a game of "memory," using carrier phrases, while the

Table 1. Participant demographic information.

Participant	Age in months (*M* 47.9, *SD,* 9.8)	Gender	Family history of stuttering	Months since onset (*M* 16.4, *SD,* 11.2)	Stuttering severity	Other speech or language disorder	Conversational partner
1	60	M	Unknown	28	Mild	No	Mother
2	61	M	No	40	Mild	No	Mother
3	54	M	Yes	27	Moderate	No	Mother
4	66	M	Yes	10	Moderate	Yes (phonological disorder)	Mother
5	44	M	Yes	1	Moderate	Yes (phonological disorder)	Mother
6	45	M	Yes	21	Mild	No	Grandmother
7	46	M	Yes	10	Mild	No	Mother
8	44	M	Unknown	5	Moderate	No	Father
9	48	M	Yes	5	Mild	No	Mother
10	47	M	No	9	Moderate	No	Mother
11	54	F	Yes	13	Moderate	Yes (phonological disorder)	Mother
12	35	M	Yes	22	Mild	No	Mother
13	57	M	No	33	Moderate	No	Mother
14	31	M	No	3	Severe	No	Mother
15	33	F	Yes	12	Mild	No	Mother
16	45	M	No	21	Mild	No	Mother
17	44	M	No	9	Mild	No	Mother

Note. M = male; F = female.

caregiver watched. After a few minutes, the caregiver joined the game, practicing slow, relaxed speech with the child, with the graduate student observing and providing feedback. The final activity was a less structured activity of free play with blocks. The caregiver was asked to continue similar activities at home, with the following instructions:

> Please set aside three to five times each week where you and your child play together while you practice using slow relaxed speech. Your child should choose an activity and you should find a quiet place to talk. Listen to what your child is saying and focus on your use of the slow relaxed speech style. Relax and have a good time playing with your child. Each play session should last between 5 to 10 min. At the end of the time, record a brief description of the activity and reflection of how you felt doing it.

Caregivers were given a recording sheet, which included space to note the date, a description of the activity, and any comments and feelings. The design and directions for the home interactions were based on a case study published by Mallard (1991). Caregivers reported practicing between five to 12 times per week, with a mean of 6.7 times per week (*SD* = 2.02).

Session 2

One week later, the caregiver and child returned to meet with the graduate student clinician and first author. The child was taken to a playroom by an undergraduate student, the caregiver's reflections were examined, and the clinicians answered questions and reviewed the use of slow relaxed speech. The child was brought in, and the caregiver was asked to use slow, relaxed speech with the child in the play activities used in Visit 1. The clinicians provided models and feedback on the caregiver's use of slow, relaxed speech. The goals of Session 2 were to verify that caregivers were implementing slow, relaxed speech in the home setting, monitor performance, and provide feedback. Research suggests that monitoring is helpful in ensuring attainment of the slow, relaxed speech style (Bernstein Ratner, 1992). No recorded speech samples were collected in Session 2.

Session 3

The final session, a posttreatment session, took place 1 week after Session 2. The clinicians obtained video and audio recordings of two interactions (approximately 15 min each) between the caregiver and child.

Visit 2. For the first recording of Session 3, the caregiver was told to interact with the child as he or she typically would. For data collection purposes, this part of Session 3 was labeled Visit 2. After the recording, there was a 20–30 min break when the child was taken to a room to play, and the graduate student clinician and first author examined reflections, provided feedback, and answered any questions regarding stuttering or the intervention.

Visit 2 slow. For the second recording, the child came back to the room, and the caregiver was asked specifically to use slow, relaxed speech. This part of Session 3 was labeled Visit 2 slow for data collection purposes. At the end of the recording, the caregiver was thanked for participation and given a resource packet of information regarding stuttering in preschool children.

Audio- and Video-Recording Procedures

All recorded interactions took place in a sound-treated room adjoining the first author's laboratory, with participants seated across from each other at a child-sized table working with Play-Doh. Each participant wore a Yamaha Pockettrak 2G recorder (Yamaha Corporation, Shizuoka, Japan) approximately 10 in. from the face to capture the audio signal. A simultaneous audio CD was made with an HHB CD recorder (HHB Communications Ltd, London, England) by using a Shure Omnidirectional boundary microphone (Shure Incorporated, Niles, Illinois). Participants were videotaped by using a Canon GL2 Mini DV camera (Canon Inc., Tokyo, Japan) and a JVC Mini DV/S-VHS dual video recorder (JVC, Yokohama, Japan). The camera was positioned approximately 1 m away from the participants and captured a clear image of their heads and upper torsos.

Analysis of Speech Samples

Undergraduate project staff, who did not participate in the intervention and were blind to the objectives of the study, transcribed all speech samples orthographically, by using the Systematic Analysis of Language Transcripts (SALT; J. F. Miller & Chapman, 1996) to facilitate counting of disfluencies. The samples were the first baseline visit (Visit 1) and the posttherapy visits, where the caregivers were asked to use their natural speech (Visit 2), and then their slow, relaxed speech (Visit 2 slow). For the children, the speech sample at Visit 1 ranged from 306–859 syllables (*M* = 656, *SD* = 162.2). For Visit 2, the syllables ranged from 285–853 syllables (*M* = 644, *SD* = 141.3), and for Visit 2 slow, 272–1,007 syllables (*M* = 641, *SD* = 218.3).

Two types of disfluencies were coded for the children, following Yairi and Ambrose (2005): (a) SLD, which included part- and single-syllable word repetitions, and dysrhythmic phonation, consisting of blocks and prolongation, and (b) other disfluencies (OD), which included interjections, revisions, and phrase repetitions plus multisyllabic word repetitions. The percentage of SLD per 100 syllables at each visit was calculated. OD were coded, as they were removed to determine articulation rate, but the percentage was not calculated, as these types of disfluencies have been shown to have little value in stuttering assessment (Sawyer & Yairi, 2010; Yairi & Ambrose, 1999; Yairi, Ambrose, & Niermann, 1993). Trained project staff coded the disfluencies, with any discrepancies resolved by relistening and revising with the first author, who has had extensive experience with disfluency analysis.

Articulation Rate

Articulation rate was defined as the number of perceptually fluent sps with instances of SLD, OD, and pauses greater than 250 ms removed, following previously established procedures (Hall et al., 1999; Kelly & Conture, 1992; J. L. Miller, Grosjean, & Lomanto, 1984; Sawyer, Chon, & Ambrose, 2008; Tumanova, Zebrowski, Throneburg, & Kayikci, 2011; Yaruss, 1997). Each utterance analyzed was at least three words in length, and simultalk and unintelligible speech was excluded (Chon et al., 2012; Hall et al., 1999; Logan & Conture, 1995; Yaruss & Conture, 1995). The participants' speech was analyzed by using speech playback and the combined waveform and digital wideband (300 Hz) spectrogram generated by TF32 (Milenkovic, 2002). Project staff trained in acoustic analysis by the first author measured articulation rate by putting the cursor on the onset and offset points of each utterance, guided by the spectrogram and acoustic signal. Following procedures outlined in Chon et al. (2012), pauses longer than 250 ms were deleted by subtracting the length of the pause from the length of the utterance.

For the caregivers, articulation rate was calculated on only perceptually fluent utterances. Disfluent utterances were relatively rare, comprising an average of 6.1% of the speech sample for Visit 1, 5.5% of the sample for Visit 2, and 4.6% of the sample for Visit 2 slow.

The number of syllables that the caregivers produced that could be analyzed for articulation rate ranged from 577–1,879 (M = 1,263, SD = 369.7) in Visit 1. During Visit 2, caregivers produced between 398–1,352 syllables (M = 1,001, SD = 245.2), and for Visit 2 slow, the range was 367–1,174 syllables (M = 678, SD = 245.9).

For the children, the length of both SLD and OD were measured by putting the cursor on the onset and offset of each disfluency, and subtracting the duration from the length of the utterance. If a word contained a stuttered sound or syllable, the stuttered syllable or sound was removed, and the word was kept in the analysis. If disfluencies were within the utterance, any pause following the disfluency up to 250 ms was included in the articulation rate. Pauses over 250 ms were excluded. Pauses following utterance initial disfluencies were not included in articulation rate. Pauses between repetitions were excluded, as well as pauses occurring in disfluency clusters.

For the children, the number of syllables that could be analyzed for articulation rate at Visit 1 ranged from 167–655 syllables (M = 326, SD = 119.6). For Visit 2, the syllables ranged from 129–645 syllables (M = 443, SD = 156.1), and for Visit 2 slow, 164–800 syllables (M = 462, SD = 196.4).

Response Time Latency

Response time latency was defined as the duration between the end of one speaker's utterance and the beginning of the next speaker's utterance, following previous investigations (Kelly, 1994; Kelly & Conture, 1992; Newman & Smit, 1989; Zebrowski et al., 1996). Acoustically RTL appears as a period of silence between utterances (Beattie, 1983; Kelly, 1994). RTL was assigned to the speaker who initiated speech following the silent pause. The cursor was placed at the end of one speaker's utterance and at the beginning of the second speaker's utterance, and the silence between the utterances was measured in seconds, out to nine decimal places. Measures were subsequently rounded to four decimal places.

RTL was not measured in the instances of simultalk, sound effects, and nonspeech acts, such as burping or banging on the table. A few previous investigations of RTL have included simultalk, with estimations of the length of the simultalk made by looking at the audio signal and listening (Kelly, 1994; Kelly & Conture, 1992; Yaruss, 1997). In one study, simultalk was not measured but recorded as zero (Bonelli et al., 2000). As the acoustic signals from both speakers overlap in simultalk, accurate measure of the duration is difficult, so the length of simultalk was not calculated in the current study.

For the caregivers, simultalk accounted for a mean of 9% of the speech sample in Visit 1 (SD = 0.04, range 3%–18%). The 9% represents the number of responses the caregiver made that overlapped the child's speech divided by the number of total responses the caregiver made. Percentages of simultalk were similar over the next two visits, with Visit 2 having a mean of 10% (SD = 0.06, range 2%–21%), and Visit 2 slow with a mean of 9% (SD = 0.06, range 1%–25%). For the children, simultalk increased over each visit and represented a mean of 10% of the child's total utterances in Visit 1 (SD = 0.08, range 2%–30%), 12% in Visit 2 (SD = 0.10, range 1%–32%), and 15% in Visit 2 slow (SD = 0.12, range 2%–45%). The percentage of the simultalk of the children was calculated in the same way as was the caregivers, by dividing their overlapped responses by their total responses.

Reliability for Measures of Disfluency, Syllable Counts, Articulation Rate, and RTL

Following a period of approximately 4 months, a random sample of 12 of the 51 transcripts was relistened to for inter- and intrarater reliability on the type and frequency of disfluencies. In total, 7,391 of the total 33,001 syllables were reanalyzed.

The interrater reliability assessment was performed by the first author. The chance-corrected agreement of Cohen's kappa was used for stuttering identification, and it was .85, indicating very good agreement (Cordes, 1994). For intrarater reliability, the kappa value for agreement for stuttering identification was .91, indicating excellent agreement. Interrater reliability for syllable counts was also high at .99.

To determine intrarater reliability for articulation rate and RTL, a random sample of approximately 20% of the utterances for each visit was reanalyzed after a period of approximately 4 months. The first author assessed the interrater reliability after a period of approximately 6 months. As RTL and articulation rate were ratio scale measurements, reliability was calculated by using Pearson product–moment correlations. For articulation rate, the correlation coefficients were .97 for interjudge and .95 for intrajudge reliability. For RTL, the coefficients were for .96 interjudge and for .94 intrajudge reliability.

Statistical Analyses

Data analysis was generated by using SAS software, Version 9.3 for Windows (SAS Institute, Cary, North Carolina). The Shapiro–Wilks's test was performed to test the normality of the distribution of SLD, and the children's and caregiver's articulation rate and RTL in each of the three visits, with $\alpha = .05$. Results revealed that the SLD in Visit 1 were not normally distributed, so the nonparametric Friedman test by ranks for repeated measures was used to investigate whether the SLD varied across Visit 1, Visit 2, and Visit 2 slow. Generalized linear mixed models were used to evaluate whether the articulation rate and RTL varied for the caregivers and children across the three visits. The independent variables were visit (three levels = Visit 1, Visit 2, and Visit 2 slow), role (two levels = caregivers and children), and interaction between visit and role. The dependent variables were the articulation rate and RTL for each model. Correlation analyses were performed to determine the existence of a linear relation between the caregivers' articulation rates and their RTL, between the caregiver's and children's articulation rates, and between the caregivers' and children's RTL. Multiple linear regression models were applied to investigate the effects of the predictor variables, the children's and caregiver's articulation rate and RTL on the response variable, and the level of SLD in Visit 2 and Visit 2 slow.

Results

Children's Disfluency

For 12 of the children, the highest frequency of SLD per 100 syllables was during Visit 1. As shown in Table 2, three children had their highest SLD counts during Visit 2, and two had their highest counts when their caregivers used slow speech in Visit 2 slow. The results from the Friedman test revealed significant differences between visits ($\chi^2 = 9.94$, $df = 2$, $p = .0069$). The results revealed that the SLD Visit 1 mean was significantly different from both SLD Visit 2 (mean difference = 0.88; 95% confidence interval [CI] with Tukey adjustment, 0.16–1.61, with a moderate effect size of $r^2 = .585$) and SLD Visit 2 slow (mean difference = 0.97; 95% CI with Tukey adjustment, 0.25–1.70), and there was no significant difference between SLD Visit 2 and SLD Visit 2 slow (mean difference = 0.09; 95% CI with Tukey adjustment, −0.64–0.81).

Just as levels of stuttering are highly variable in preschool children, reductions of SLD for individual children in the current study were idiosyncratic. Approximately 70% of the children had their highest levels of SLD in Visit 1. Forty-seven percent of the children had their lowest levels of SLD in Visit 2, and another 47% had their lowest level in Visit 2 slow. For those 16 children, SLD decreased by at least 19%. Postintervention, three children had SLD levels that were typical of children who do not stutter. Participant 3, however, did not reduce SLD levels postintervention but increased SLD over time.

Articulation Rates

Table 3 shows the mean articulation rates for the caregivers and children across the three visits. For the caregivers, the range of mean articulation rates was 4.32–6.32 sps in Visit 1. In Visit 2, the range was between 3.45–6.00 sps and for Visit 2 slow, the range was 2.07–4.36 sps. The caregivers' rates were generally fastest in Visit 1, which was the pretreatment baseline measure, and slowest in Visit 2 slow. An

Table 2. Individual stuttering-like disfluency counts per 100 syllables, group means, and standard deviations for Visits 1, 2, and 2 slow, along with percentage change of SLD from Visits 2 slow to 1

Participant	Visit 1 (*M* 8.31, *SD,* 6.18)	Visit 2 (*M* 5.29, *SD,* 2.15)	Visit 2 slow (*M* 5.44, *SD,* 2.97)	% Change in SLD from Visits 2 slow to 1 (*M* 28.65, *SD,* 29.57)
1	**6.19**	1.13	0.074	98.80
2	4.49	**5.74**	3.29	26.73
3	6.96	**8.58**	7.66	–10.06
4	**10.96**	7.02	9	17.88
5	**8.06**	5.97	6.94	13.90
6	3.77	**4.62**	3.52	6.63
7	**4.28**	2.91	2.63	38.55
8	**7.83**	7.83	4.55	41.89
9	**4.44**	3.34	3.29	25.90
10	10.01	9.06	**11.32**	–13.09
11	**7.6**	3.79	4.87	35.92
12	**7.85**	5.26	4.8	38.85
13	**8.47**	4.9	5.06	40.26
14	**30.72**	7.44	8.04	73.83
15	**4.14**	3.92	1.93	53.38
16	5.93	3.89	**6.11**	–3.04
17	**9.54**	4.57	9.47	0.73

Note. Boldface type represents the highest SLD level.

Table 3. Group means and standard deviations (in parentheses) for caregivers' and children's AR and RTL for Visits 1, 2, and 2 slow.

Group	Visit 1	Visit 2	Visit 2 slow
Caregiver AR	5.57 (0.58)	4.92 (0.67)	3.27 (0.64)
Child AR	3.48 (0.38)	3.65 (0.44)	3.41 (0.39)
Caregiver RTL	0.52 (0.13)	0.58 (0.18)	0.74 (0.24)
Child RTL	0.77 (0.21)	0.80 (0.15)	0.82 (0.26)

Note. AR = articulation rates (syllables per second); RTL = response time latency (seconds).

examination of individual data for the caregivers revealed 15 had their fastest mean rates in Visit 1, and two had their fastest mean rates in Visit 2. The mean difference in rate for these two caregivers in Visits 1 and 2 was only 0.01 sps. All caregivers had their slowest rates during Visit 2 slow. The difference in mean articulation rate between Visits 1 and 2 was 0.65 sps, while the difference between Visits 1 and 2 slow was 2.3 sps. The generalized linear mixed model found main effects for visit, $F(2, 95) = 48.18$; $p < .0001$); role, $F(1, 95) = 106.48$; $p < .0001$; and interaction, $F(2,95) = 39.41$; $p < .0001$. For caregivers' articulation rates, significant differences with Tukey–Kramer adjustment were found for all three pairwise visits (Visit 1–Visit 2, $p = .006$, with a large effect size of $d = 1.04$; Visit 1–Visit 2 slow, $p < .0001$, with a large effect size of $d = 3.77$; Visit 2–Visit 2 slow, $p < .0001$, with a large effect size of $d = 2.51$).

The children's articulation rates were relatively similar across visits. The mean rate was the slowest in Visit 2 slow, when caregivers also had their slowest articulation rates. The largest difference in articulation rates was between the last two visits, when the children's mean articulation rates were 0.24 sps slower in Visit 2 slow than in Visit 2. No significant differences were found with Tukey–Kramer adjustment for all three pairwise visits (all adjusted $p > .05$). Results of a comparison between the caregivers' and children's articulation rates suggested the caregivers' rates were significantly faster than the children's at Visits 1 and 2 (both adjusted p values < .0001), but not at Visit 2 slow (adjusted $p = .97$).

To determine whether there was linear relationship between the caregivers' and the children's articulation rates, a Pearson correlation was used. The coefficients were weak, with no significance for any of the visits (all $r < .2$, all $p > .05$). The results revealed that there was no linear relationship between the child's articulation rate and the caregiver's rate for the study across the three visits.

RTL

As shown in Table 3, the caregivers' RTL became progressively longer over time, with the longest mean RTL in Visit 2 slow almost 0.25 s longer than in Visit 1. The range of RTL for the caregivers was 0.33–0.95 s in Visit 1, 0.33–0.87 s in Visit 2, and 0.33–1.17 s in Visit 2 slow. A Pearson correlation was used to determine whether there was a relationship between the caregivers' RTL and their articulation rates for each visit. No significant relationships were found (all $r < .36$, all $p > .05$).

Like the caregivers, the children's RTL became longer over time, but the changes were fairly small. The range of RTL for the children was 0.47–1.12 s in Visit 1, 0.53–0.98 s in Visit 2, and 0.45–1.3 s in Visit 2 slow.

The generalized linear mixed model was used to determine differences in RTL across visits for the caregivers and children and differences in RTL between the groups. Main effects were found for visit, $F(2, 95) = 4.20$; $p = .02$ and role, $F(1, 95) = 21.37$; $p < .0001$. The interaction was not significant, $F(2, 95) = 1.66$; $p = .20$. The RTL between Visits 1 and 2 slow was significant across caregivers and children, $t(95) = -2.86$; adjusted $p = .014$, but it was not significant between Visits 1 and 2 or between Visits 2 and 2 slow (adjusted $p = .58$ and .16, respectively).

Results indicated that the length of the caregivers' and children's RTL was significantly different, $t\ (95) = 4.62$; adjusted $p < .0001$. To determine whether there was linear relationship between the child's RTL and the caregiver's RTL, Pearson correlation coefficients were determined. The coefficients were moderately high, with significance for both Visit 1 ($r = .58$, $p = .014$) and Visit 2 slow ($r = .68$, $p = .025$).

The Influence of Variables on SLD Levels in Visits 2 and 2 Slow

Two multiple linear regression models were used to determine the effect of predictor variables on the response variable, the level of SLD, in Visits 2 and 2 slow. The role of language was not a variable in this study, but it has been shown that longer, more complex utterances have been shown to affect fluency in young children (Bernstein Ratner & Sih, 1987; Gaines, Runyan, & Meyers, 1991; Logan & Conture, 1995; Sawyer et al., 2008; Yaruss, 1999). If the children's language was more complex in Visit 1 as compared with the postassessment visits, that might explain the reduction of SLD in Visits 2 and 2 slow. The caregivers may also have simplified their language in Visit 2 slow. As a group, they produced 46% fewer syllables in that visit as compared with Visit 1. Language was not a focus of the current study, but one measure of language complexity, mean length of utterance (MLU), was made to determine whether to include language as a predictor variable in the regression model. The children's MLU was calculated in morphemes and the caregivers' in words. The caregivers' MLU was 3.08 ($SD = 0.52$), 3.4 ($SD = 0.52$), and 3.46 ($SD = 0.64$) in Visits 1, 2, and 2 slow, respectively. A repeated measures analysis of variance revealed the difference in these means were not significant, $F(2, 15) = 3.18$; $p = .07$. The children's MLU was 3.3 ($SD = 0.56$), 3.63 ($SD = 0.56$), and 3.74 ($SD = 0.74$). These means were not found to be significantly different, $F(2, 15) = 2.99$; $p = .08$. Because the differences in MLU across the visits were not significantly different for the participants, MLU was not entered into the model. The predictor variables that were examined were the caregivers' and children's articulation rates and RTL. The response variables were the children's SLD in Visits 2 and 2 slow. The model for Visit 2 included SLD levels for Visit 1, so as to investigate the effect of SLD in Visit 1 on SLD in Visit 2. In similar fashion, the model used for Visit 2 slow included SLD in Visit 1.

The two models were fitted to the total of 17 observations, and one case, participant 14, was found to be an outlier with respect to the response variables. The inclusion of the outlying case led to a decrease in the estimated regression coefficient of SLD Visit 1 for the Visit 2 model by nearly three times the estimated standard deviation of the coefficient of SLD in Visit 1. The focus of the regression analysis is the sign and magnitude of the estimated coefficient of each predictor variable in the regression model. Therefore, inclusion of the influential outlier could lead to dramatic effect on the estimated coefficient of SLD in Visit 1. A test for the significance of the model without the outlier estimated the coefficient of SLD Visit 1 as .6346, $t(10) = 3.60$; $p = .0049$, which was greater than the coefficient estimated with the outlier. The size of the differences between the two coefficients was .2574. Considering the other predictor variable in the regression model, the magnitude of the differences in the coefficients between the models with and without the outlier is minimal, and the range of the differences was .0029 (children's articulation rate) −.0131(caregiver's RTL). The regression model fitted with the outlying case was chosen because the variability of stuttering is not unusual case for the young children.

The results of the regression models appear in Table 4. The model for Visit 2 was significant, $F(5, 11) = 3.93$; $p = .0273$, and explained nearly 50% of the variability of SLD Visit 2, adjusted $R^2 = .4782$. The model for Visit 2 slow was not statistically significant, $F(5, 11) = 1.72$; $p = .2115$, and explained only 18% of the variability of SLD Visit 2 slow, adjusted $R^2 = .1828$. The only predictor variable that was significant was the level of SLD for Visit 1. The model for Visit 2 slow showed that the predictor variables of caregivers' and children's rate and RTL had no effect on the response variable, SLD 2 slow.

Table 4. Regression coefficients and results of significance tests.

Variable and model	Coefficient	*SD*	*t*	*p*
Visit 2 model				
SLD Visit 1	0.3772	0.0993	3.798	.0030*
Child rate	0.0133	0.0098	1.362	.2004
Caregiver rate	0.0187	0.0088	2.132	.0564
Child RTL	−0.1121	0.0332	−3.374	.0062*
Caregiver RTL	0.0845	0.0288	2.935	.0136*
Visit 2 slow model				
SLD Visit 1	0.33867	0.1281	2.643	.0229*
Child rate	0.0206	0.01835	0.113	.9124
Caregiver rate	0.00596	0.01199	0.497	.6292
Child RTL	0.00021	0.03736	0.006	.9956
Caregiver RTL	−0.05457	0.04045	1.349	.2045

Note. SLD = stuttering-like disfluencies; RTL = response time latency.

*Statistically significant at α = .05. Visit 2 model, adjusted R^2, 0.4782, $F(5, 11) = 3.932$; *p* value of the model: .0273. Visit 2 slow model, adjusted R^2, 0.1828, $F(5, 11) = 1.716$; *p* value of the model: .2115.

In the Visit 2 model, the coefficient of SLD in Visit 1 is .3772, and it is statistically significant, $t(11) = 3.798$; $p = .003$. This implies that SLD in Visit 2 will decrease to .3772 if SLD in Visit 1 was increased one unit when the other predictor variables are held constant. The effect of the SLD Visit 1 on the response variable, SLD Visit 2, is fairly large. This would be expected, as stuttering remains in Visit 2. The coefficients of the articulation rates of children and caregivers were not statistically significant, and these results imply that they did not have an effect on the response variable. Both the caregivers' and children's RTL were shown to have a small influence on the children's percentage of SLD for Visit 2. For the children, the coefficient for RTL was negative, meaning the longer the RTL, the fewer SLD. The coefficient was approximately −.11, $t(11) = -3.37$; $p = .006$, which means that for each unit that the child waited to respond to the caregiver, the SLD would decrease by .11, holding constant all other predictor variables in the model. For the caregivers, if the caregiver waited too long before responding, there was a likelihood of more SLD. The coefficient for the caregivers' RTL in the model was approximately .08, $t(11) = 2.94$; $p = .014$. The average RTL for both caregivers and children combined was less than three fourths of a second, so the effect of RTL on SLD was small.

Discussion

This study examined the relationship of caregivers' reduced articulation rates on children's fluency and on the paralinguistic variables of RTL and children's articulation rates. The principal findings were that caregivers were able to reduce their rates after training and that most children did increase their fluency, as measured in the percentage of SLD in their speech. There was no direct relationship found between the caregiver's articulation rate and their RTL, and RTL was mildly correlated with the lower levels of SLD found postintervention. Children did not entrain to their caregivers' reduced articulation rates, but there was some entrainment to RTL.

SLD

For the children as a group, mean levels of SLD decreased significantly between Visits 1 and 2 and between Visits 1 and 2 slow. There were no significant differences in mean SLD levels between Visits 2 and 2 slow, even though the caregivers were speaking significantly more slowly during Visit 2 slow as compared with baseline, due to Visits 2 and 2 slow samples being collected on the same day, less than an hour apart.

That almost all children decreased the frequency of SLD is consistent with the findings of four previous studies

(Cardman & Ryan, 2007; LaSalle, 2015; Stephenson-Opsal & Bernstein Ratner, 1988; Zebrowski et al., 1996). The current study is the largest to date to examine the effect of a deliberately slower articulation rate on stuttering. The Zebrowski et al. (1996) study and the LaSalle (2015) study found that 60% and 66%, respectively, of their participants increased fluency when mothers or caregivers talked slowly. In the current study, 94% of the children increased their fluency postintervention.

The rates of reduction in disfluencies are comparable to those reported in two previous studies. Zebrowski et al. (1996) reported a decrease in disfluency from baseline to the slow speech condition of approximately 22%–77% for three children. Stephenson-Opsal and Bernstein Ratner (1988) reported reductions of disfluency of 28% and 45% for the two children in their study.

The LaSalle (2015) study reported large reductions of stuttering (over 91%) in children who did not have a phonological disorder when clinicians slowed their rate. For the children who had a phonological disorder, however, reductions were much lower, 25.9% and 25.9%, and in line with the current study and previous studies.

Articulation Rates of Caregivers and Children

Although the caregivers were able to reduce their articulation rates in Visit 2 slow and the children decreased their SLD, there was no statistically relevant relationship between the two variables, suggesting that reduced rate was not associated with a reduction in SLD. In addition, there was no statistical difference between the level of SLD in the children when the caregivers were using their *typical* rate in Visit 2 and their *slow, relaxed rate* in Visit 2 slow.

For the caregivers, mean articulation rates were significantly slower across time. All had the slowest rates in Visit 2 slow, and 15 caregivers had slower rates in Visit 2 than in Visit 1. The father in the study had the fastest mean articulation rate of all caregivers in both Visit 1 (6.32 sps) and Visit 2 slow (4.36 sps). Kelly's (1994) study of articulation rates of 11 fathers of children who stutter showed a mean rate of approximately 4.81 sps, which is considerably slower than the baseline mean of the father in the current study.

The caregivers slightly decreased their rates in Visit 2 compared with Visit 1; the means in Visit 2 were 11.67% slower than at Visit 1, with a range of −0.7% to 31%. Seven caregivers reduced their rates by at least 16%, but for most, the rate difference between Visits 1 and 2 was small. That rates for most were slightly slower at Visit 2, when the caregivers were asked to speak as they typically would, may point to some influence or carryover of the slower speech intervention for some of the participants.

At Visit 2 slow, all caregivers were speaking considerably more slowly than they were at Visit 1; the mean articulation rate decreased by 41.19%, as compared with the baseline, with a range of 24%–65%. The reductions in rate are comparable to those in previous research. In the Zebrowski et al. (1996) study, mothers decreased their articulation rates by a range of 15%–43%, and in Stephenson-Opsal and Bernstein Ratner (1988), the mothers decreased their articulation rates by approximately 28% and 36%. In the LaSalle (2015) study, clinicians reduced their rates by 38%, and three of the children also reduced their articulation rates. The Cardman and Ryan (2007) study had the mother deliberately reduce her rate by 56%, a dramatically slower rate, and the child reduced both articulation rate and the level of stuttering.

The mean articulatory rate for the children was not different across the visits, and individually, rates were variable. Ten children had their slowest articulation rate in Visit 2 slow, and seven had their slowest rate in Visit 1. The children's articulation rates did not appear to have an influence on their levels of SLD in Visits 2 and 2 slow, which is consistent with findings of previous studies (Logan & Conture 1995; Sawyer et al., 2008, Yaruss, 1997; Yaruss & Conture 1995). Measuring articulation rate more finely, in phones per second, as LaSalle (2015), Hall et al. (1999), and Flipsen (2002) did, could reveal slower articulation rates for the children in the current study.

The current study expands upon the results of previous studies of the effects of a deliberate reduction of articulation rate in mothers or clinicians on children's fluency. Previous single-group design studies found that children increased fluency while their mothers or clinicians were using slower articulation rates (Cardman & Ryan, 2007; LaSalle, 2015; Stephenson-Opsal & Bernstein-Ratner, 1988; Zebrowski et al., 1996). LaSalle (2015) and Zebrowski et al. (1996) found that not all children could reduce stuttering after intervention. The current study found that most, but not all, children could reduce stuttering, and the group design enabled an examination of the relationship between articulation rate and the reduction of SLD. Neither the current study nor previous studies have determined that slowed rate was the cause of the increase in fluency when caregivers slow articulation rates. In the current study, the children decreased their levels of SLD even when the caregivers were speaking at a slightly reduced rate.

The Relationship Between Articulation Rate and RTL

RTL for the caregivers was significantly longer when they were reducing articulation rate in Visit 2 slow as compared with Visit 1, but no significant relationship was found between a slower rate of articulation and an increase in RTL. The finding that articulation rate was not correlated with RTL is consistent with the results in Bernstein Ratner's (1992) study of typically fluent children, in Yaruss' (1997) study of children who stutter, and in Kelly's (1994) study of fathers and their children who stutter. Kelly and Conture (1992), on the other hand, found a positive correlation of rate and RTL. The discrepant findings may be due to different measures and populations, as Kelly and Conture calculated overall speaking rates measured in words, and their findings applied to mothers of typically fluent children, as well as children who stuttered.

The RTL of both the caregivers and children was found to be only slightly correlated with the level of SLD in the children in Visit 2. As the range of RTL across the participants was typically less than 1 s, the coefficients in the regression model likely represented a very small effect.

The Entrainment of Caregivers' and Children's Articulation Rates and RTL

The children's and caregivers' articulation rates did not entrain to each other. This finding is consistent with Stephenson-Opsal and Bernstein Ratner (1988), who found the two children in their study did not match their mother's slower articulation rates, but not with Ryan (2000), Meyers and Freeman (1985b), or with the clinicians in LaSalle (2015). Meyers and Freeman (1985b) found the slower the children talked, the faster the mother talked. Ryan (2000) found that faster articulation rates of mothers were highly correlated with more severe stuttering.

In the LaSalle (2015) study, rate reduction for children without a phonological disorder was 20% when the clinicians slowed their rates. Children with a phonological disorder did not align their rates to the clinicians, and their average rate reduction was 1.3%, with a range of 1.2%–16%. The rate reduction for all the children in the current study averaged 1.3%, but not all children reduced their rates in Visit 2 slow, with a range of −22% to 24%. The children in the current study who had a phonological disorder all reduced their rates in Visit 2 slow, as compared with Visit 1, with a range of 4%–10%.

The measurement of articulation rate in previous studies was different from the current study, which may have accounted for the different findings. In the Ryan (2000) study, the articulation rate for the children was measured with a stopwatch and calculated on only 15 utterances per child. Meyers and Freeman (1985b) measured overall speaking rate in the longest utterances, and LaSalle (2015) measured articulation rate more finely in phones per second.

The caregivers' mean RTL was significantly shorter than the children's at all three visits, which is consistent with the findings of Kelly's (1994) study of fathers and sons who stuttered, but not with Kelly and Conture (1992), whose mothers had longer RTL than their children who stuttered. The children's RTL did entrain to the caregivers' at Visits 1 and 2 slow. In Visit 2 slow, the mean difference in RTL between the children and caregivers was only 0.08 s. This result is consistent with previous findings for children who stutter (Kelly & Conture, 1992) and for typically fluent children (Newman & Smit, 1989).

Limitations

SLD were significantly reduced in Visits 2 and 2 slow, and the mechanisms that may have contributed to this were not revealed. The mechanisms by which children reduce stuttering in both indirect and direct therapy are far from settled (Bonelli, et al., 2000; de Sonneville-Koedoot, et al., 2015). Multiple components come into play, including the attention a caregiver gives to a child in a one-on-one setting. In the current study, caregivers focused attention on the children both during therapy and in practice sessions at home. A child may feel more confident just by knowing the caregiver is focused on him or her in a short play session, and a lack of time pressure may be evident. The attention given to the child may be fluency facilitating (Bernstein Ratner & Guitar, 2006).

Several aspects of caregiver communication may support more fluent speech in children, such as simplifying language, shortening the duration of vocalizations, limiting simultalk, or increasing pauses (Savelkoul et al. 2007). Such efforts were not studied in this investigation but could have played a role in the increased fluency postintervention. For each child, components that may make a difference in fluency interact in complex ways. Some children may be more responsive than others to particular efforts of caregivers to reduce conversational demands.

Another potential confound to the children's becoming more fluent postintervention was the support the caregivers received from the clinicians. The clinicians modeled the reduced articulation rate and took time to help the caregivers use the slower rate effectively with the children. They also answered questions about stuttering and helped the caregivers gain confidence in using the slower articulation rate.

SLD were reduced in all but one of the children after participation in the intervention, and 12 of the children showed reductions of over 35%. The children were not followed long term; the mechanisms at work here to increase fluency could also be due to natural recovery. Participant 14 was only 3 months postonset and entered the study with the highest level of SLD. The decrease in SLD for this child could have been due to processes of natural recovery, as there was no history of stuttering in the family, and the prognosis for recovery for a child with this profile is favorable (Yairi & Ambrose, 2005). As stuttering in preschool children is fluctuating and idiosyncratic, reduction in SLD postintervention could simply be due to the day-to-day variability of stuttering in preschool children.

The number of participants in the study was relatively small, and the results of the study may not be generalizable to other children who stutter and their caregivers. Only one child presented with severe stuttering; a larger group that included more severe stuttering would be more representative of young children who stutter.

All caregivers reported practicing slower relaxed speech at home, but it is not known what their articulation rates were in the home setting. Collecting speech samples in the home setting or asking caregivers to bring in recorded samples would help to determine if the slightly slower rates found in Visit 2 were more pervasive.

Future Research

It was beyond the scope of the study to examine dyadic rate and interrupting behaviors of the participants. These two parameters have been found to influence fluency in young children (Kelly, 1994; Meyers & Freeman, 1985a; Newman & Smit, 1989), and including them in the study would have given a larger picture of the effects of paralinguistic behaviors on the children's speech.

The influence of language was not examined in this study. It has been shown that longer, more complex utterances can affect fluency in young children (Bernstein Ratner & Sih, 1987; Gaines, Runyan, & Meyers, 1991; Logan & Conture, 1995; Sawyer et al., 2008). The MLU of both caregivers and children did not vary across the visits, but an examination of other linguistic parameters, such as complexity, number of different words, and total utterances, might determine whether language had an effect on the children's stuttering.

More research of the effects of RTL on stuttering is needed. The study showed that the caregivers' and children's RTL had a small but significant relationship to the reduced levels of SLD in Visit 2. A manipulation of caregivers' RTL with children who stutter, similar to the design of Newman and Smit (1989), might reveal lengths that would be more fluency facilitating than others.

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References

Adams, M. (1990). The demands and capacities model: I. Theoretical elaborations. *Journal of Fluency Disorders, 15,* 135–141.

Ambrose, N. (2006). Early stuttering: Parent counseling. In N. B. Ratner & J. Tetnowski (Eds.), *Current issues in stuttering research and practice* (pp. 87–98). Mahwah, NJ: Erlbaum.

Ambrose, N. G., & Yairi, E. (1995). The role of repetition units in the differential diagnosis of early childhood incipient stuttering. *American Journal of Speech-Language Pathology, 4*(3), 82–88.

American Speech-Language-Hearing Association. (1995). *Guidelines for practice in stuttering treatment*. Retrieved from www.asha.org/policy

Beattie, G. (1983). *Talk: An analysis of speech and non-verbal behavior in conversation*. London, England: Open University Press.

Bernstein Ratner, N. (1992). Measurable outcomes of instructions to modify normal parent-child verbal interactions: Implications for indirect stuttering therapy. *Journal of Speech and Hearing Research, 35,* 14–20.

Bernstein Ratner, N. (2004). Caregiver-child interactions and their impact on children's fluency: Implications for treatment. *Language, Speech, and Hearing Services in Schools, 35,* 46–56.

Bernstein Ratner, N., & Guitar, B. (2006). Treatment of very early stuttering and parent-administered therapy: The state of the art. In N. Bernstein Ratner & J. A. Tetnowski (Eds.), *Current issues in stuttering research and practice* (pp. 99–124). Mahwah, NJ: Erlbaum.

Bernstein Ratner, N., & Sih, C. (1987). The effects of gradual increases in sentence length and complexity on children's dysfluency. *Journal of Speech and Hearing Research, 52,* 278–287.

Bonelli, P., Dixon, M., Bernstein Ratner, N., & Onslow, M. (2000). Child and parent speech and language following the Lidcombe Programme of early stuttering intervention. *Clinical Linguistics and Phonetics, 14,* 427–446.

Cardman, S., & Ryan, B. (2007). Experimental analysis of the relationship between speaking rate and stuttering during mother-child conversation II. *Journal of Developmental and Physical Disabilities, 19,* 457–469.

Chon, H. C., Sawyer, J., & Ambrose, N. G. (2012). Differences of articulation rate and utterance length in fluent and disfluent utterances of preschool children who stutter. *Journal of Communication Disorders, 45,* 455–467.

Conture, E. (2001). *Stuttering: Its nature, diagnosis, and treatment*. Boston, MA: Allyn and Bacon.

Cooper, E., & Cooper, C. (1996). Clinician attitudes towards stuttering: Two decades of change. *Journal of Fluency Disorders, 21,* 119–135.

Cordes, A. (1994). The reliability of observational data: I. Theories and methods for speech-language pathology. *Journal of Speech, Language, and Hearing Research, 37,* 264–278.

Costello, J., & Ingham, R. (1984). Assessment strategies for stuttering. In R. Curlee & W. Perkins (Eds.), *Nature and treatment of stuttering* (pp. 303–334). San Diego, CA: College-Hill Press.

de Sonneville-Koedoot, C., Stolk, E., Rietveld, T., & Franken, M.-C. (2015). Direct versus indirect treatment for preschool children who stutter: The RESTART randomized trial. *PloS One, 10,* e0133758.

Flipsen, P. (2002). Longitudinal changes in articulation rate and phonetic phrase length in children with speech delay. *Journal of Speech, Language, and Hearing Research, 45,* 100–110.

Gaines, N., Runyan, C., & Meyers, S. (1991). A comparison of young stutterers' fluent versus stuttered utterances on measures of length and complexity. *Journal of Speech and Hearing Research, 34,* 37–42.

Guitar, B. (1998). *Stuttering: An integrated approach to its nature and treatment* (2nd ed.). Baltimore, MD: Williams & Wilkins.

Guitar, B., & Marchinkoski, L. (2001). Influence of mothers' slower speech on their children's speech rate. *Journal of Speech, Language, and Hearing Research, 44,* 853–861.

Guitar, B., Schaefer, H., Donahue-Kilburg, G., & Bond, L. (1992). Parental interactions and speech rate: A case study in stuttering. *Journal of Speech and Hearing Research, 35,* 742–754.

Hall, K., Amir, O., & Yairi, E. (1999). A longitudinal investigation of speaking rate in preschool children who stutter. *Journal of Speech, Language, and Hearing Research, 42,* 1367–1377.

Kelly, E. M. (1994). Speech rates and turn-taking behaviors of children who stutter and their fathers. *Journal of Speech and Hearing Research, 37,* 1284–1294.

Kelly, E. M., & Conture, E. (1992). Speaking rates, response time latencies, and interrupting behaviors of young stutterers, nonstutterers, and their mothers. *Journal of Speech and Hearing Research, 35,* 1256–1267.

LaSalle, L. R. (2015). Slow speech rate effects on stuttering preschoolers with disordered phonology. *Clinical Linguistics and Phonetics, 29,* 354–377.

Logan, K., & Conture, E. (1995). Length, grammatical complexity, and rate differences in stuttered and fluent conversational utterances of children who stutter. *Journal of Fluency Disorders, 20,* 35–61.

Mallard, A. R. (1991). Family intervention in stuttering therapy. *Seminars in Speech and Language, 12,* 265–278.

Meyers, S., & Freeman, F. (1985a). Interruptions as a variable in stuttering and disfluency. *Journal of Speech and Hearing Research, 28,* 428–435.

Meyers, S., & Freeman, F. (1985b). Mother and child speech rates as a variable in stuttering and disfluency. *Journal of Speech and Hearing Research, 28,* 436–444.

Milenkovic, P. (2002). *Time-Frequency Analysis Software Program for 32-Bit Windows (TF32)* [Computer software]. Madison: University of Wisconsin.
Millard, S. K., Edwards, S., & Cook, F. M. (2009). Parent-child interaction therapy: Adding to the evidence. *International Journal of Speech-Language Pathology, 11,* 61–76.
Miller, J. F., & Chapman, R. (1996). *Systematic Analysis of Language Transcripts* [Computer software]. Madison: University of Wisconsin–Madison, Waisman Center, Language Analysis Laboratory.
Miller, J. L., Grosjean, F., & Lomanto, C. (1984). Articulation rate and its variability in spontaneous speech: An analysis and some implications. *Phonetica, 41,* 215–225.
Newman, L., & Smit, A. (1989). Some effects of variations in response time latency on speech rate, interruptions, and fluency in children's speech. *Journal of Speech and Hearing Research, 32,* 635–644.
Richels, C. G., & Conture, E. (2007). An indirect treatment approach for early intervention for childhood stuttering. In E. Conture & R. F. Curlee (Eds.), *Sutttering and related disorders of fluency* (pp. 77–99). New York, NY: Thieme.
Rustin, L., & Cook, F. (1995). Parental involvement in the treatment of stuttering. *Language, Speech, and Hearing Services in Schools, 26,* 127–137.
Ryan, B. (2000). Speaking rate, conversational speech acts, interruption, and linguistic complexity of 20 pre-school stuttering and non-stuttering children and their mothers. *Clinical Linguistics & Phonetics, 14,* 25–51.
Savelkoul, E. M., Zebrowski, P., Feldstein, S., & Cole-Harding, S. (2007). Coordinated interpersonal timing in the conversations of children who stutter and their mothers and fathers. *Journal of Fluency Disorders, 31,* 1–32.
Sawyer, J., Chon, H. C., & Ambrose, N. G. (2008). Influences of rate, length, and complexity on speech disfluency in a single-speech sample in preschool children who stutter. *Journal of Fluency Disorders, 33,* 220–240.
Sawyer, J., & Yairi, E. (2010). Characteristics of disfluency clusters over time in preschool children who stutter. *Journal of Speech, Language, and Hearing Research, 53,* 1191–1205.
Starkweather, C. W. (1987). *Fluency and stuttering*. Englewood Cliffs, NJ: Prentice Hall.
Starkweather, C. W., & Gottwald, S. R. (1990). The demands capacities model II: Clinical implications. *Journal of Fluency Disorders, 15,* 143–157.
Stephenson-Opsal, D., & Bernstein Ratner, N. (1988). Maternal speech rate modification and childhood stuttering. *Journal of Fluency Disorders, 13,* 49–56.
Tumanova, V., Zebrowski, P., Throneburg, R., & Kayikci, M. (2011). Articulation rate and its relationship to disfluency type, duration and temperament in preschool children who stutter. *Journal of Communication Disorders, 44,* 116–129.
Winslow, M., & Guitar, B. (1994). The effects of structured turn-taking on disfluencies: A case study. *Language, Speech, and Hearing Services in Schools, 25,* 251–257.
Yairi, E., & Ambrose, N. G. (1999). Early childhood stuttering: I. Persistency and recovery rates. *Journal of Speech, Language, and Hearing Research, 42,* 1097–1112.
Yairi, E., & Ambrose, N. G. (2005). *Early childhood stuttering*. Austin, TX: Pro-Ed.
Yairi, E., Ambrose, N., & Niermann, R. (1993). The early months of stuttering: A developmental study. *Journal of Speech and Hearing Research, 36,* 521–528.
Yaruss, J. S. (1997). Utterance timing and childhood stuttering. *Journal of Fluency Disorders, 22,* 263–286.
Yaruss, J. S. (1999). Utterance length, syntactic complexity, and childhood stuttering. *Journal of Speech, Language, and Hearing Research, 42,* 329–344.
Yaruss, J. S., Coleman, C., & Hammer, D. (2006). Treating preschool children who stutter: Description and preliminary evaluation of a family-focused treatment approach. *Language, Speech, and Hearing Services in Schools, 37,* 118–136.
Yaruss, J. S., & Conture, E. (1995). Mother and child speaking rates and utterance lengths in adjacent fluent utterances: Preliminary observations. *Journal of Fluency Disorders, 20,* 257–278.
Zebrowski, P. M., & Conture, E. (1989). Judgments of disfluency by mothers of stuttering and normally fluent children. *Journal of Speech and Hearing Research, 32,* 625–634.
Zebrowski, P. M., Weiss, A. L., Savelkoul, E. M., & Hammer, C. S. (1996). The effect of maternal rate reduction on the stuttering, speech rates and linguistic productions of children who stutter: Evidence from individual dyads. *Clinical Linguistics & Phonetics, 10,* 189–206.

Appendix

Methodologies of Selected Studies Measuring Speaking and Articulation Rate in CWS and/or CWNS

Authors	Participants	Age range	Sample	Measurement tools	What was measured*
Bernstein Ratner (1992)	20 CWNS	3–5	15-min conversation	Stopwatch	Speech rate minus pauses in wpm
Bonelli et al. (2000)	9 CWS	2:10–5:4	45 utterances	Time codes on video	AR in spm
Cardman & Ryan (2007)	1 CWS	3:8	10-min conversations	Stopwatch using STRR	Speaking rate in spm
Guitar & Marchinkoski (2001)	6 CWNS	3–4	10-min conversations	Stopwatch	Speech rate minus pauses in spm
Guitar et al. (1992)	1 CWS	5	Five 2-min segments from six interactions	Videotape	OSR in spm
Kelly (1994)	11 CWS, 11 CWNS	2:7–10:1	300 words	Acoustic analysis	OSR and AR in spm
Kelly & Conture (1992)	13 CWS, 13 CWNS	3:3–4:8	300 words	Acoustic analysis	OSR and AR in wpm and spm
LaSalle (2015)	6 CWS, 6 CWS with disordered phonology	3:6–4:6	Four sets of 40 adjacent utterance pairs	Acoustic analysis	AR in pps
Meyers & Freeman (1985b)	12 CWS, 12 CWNS	4:0–5:11	15 longest utterances	Video time code	OSR minus pauses in SPS
Newman & Smit (1989)	4 CWNS	4:3–4:11	15-min conversations	Digital spectograph	OSR in spm
Ryan (2000)	20 CWS, 20 CWNS	2:10–5:9	60 turns in a 10-min conversation	Stopwatch	AR in wpm and spm
Stephenson-Opsal & Bernstein-Ratner (1988)	2 CWS	3:3 and 6:2	100 utterances	Audio signal	AR in sps
Winslow & Guitar (1994)	1 CWS	5:0	300 words	Stopwatch	Speaking time minus pauses in spm
Yaruss (1997)	12 CWS	4:3–5:6	75 utterances	Video frame by frame	AR in sps
Yaruss & Conture (1995)	10 CWS, 10 CWNS	4:0–5:10	10 pairs of mother and child utterances	Video frame by frame	AR in sps
Zebrowski et al. (1996)	5 CWS	2:10–7:5	300-word conversation	Time codes on video	OSR in wpm, AR in spm

Note. CWS = children who stutter; CWNS = children who do not stutter; wpm = words per minute; AR = articulation rate; spm = syllables per minute; STRR = stuttering treatment rating recorder software; OSR = overall speech rate; pps = phones per second; sps = syllables per second.