ABSTRACT

Title of Thesis: TIMES ARE CHANGING: TEMPORAL FEATURES OF SPEECH TO CHILDREN WHO STUTTER

Allison Godsey, Master of Arts in Speech Language Pathology, 2025

Thesis Directed By: Doctor, Nan Bernstein Ratner, Hearing and Speech Sciences

Purpose: Treatments for stuttering often offer advice that parents modify temporal features of speech during conversational interaction to assist the child who stutters (CWS) and entrain them to a less demanding model of speech. Advice includes but is not limited to increasing turn-taking/response-time latencies (RTL), reducing interruptions, and slowing adult speech. We looked specifically at RTL and parental speech rate as well as adherence to advice in a longitudinal data set that included behaviors before and after advice were made specifically to alter speech behaviors.

Method: We used data from one-year follow-up recordings (N=12 CWS persistent; 18 CWS recovered) of the Illinois International Stuttering Research Project (IISRP) at FluencyBank, using CLAN software with audio linkage to PRAAT (Lieshout, 2003).

Results: Overall, mothers of CWS-P increased their response time latency and decreased their speech rate more than mothers of CWS-R a year following intake. Both children who persisted and recovered decreased their weighted stuttering-like disfluency score by the year follow-up.

Conclusions: This is a retrospective, observational study, and caution must be used in interpreting our findings. Current results continue not to add evidentiary support that parental

adjustments in temporal parameters of speech impact short or long-term fluency in CWS. The results of the study led us to re-evaluate the widely circulated notions that parental speech behaviors may influence the persistence of stuttering. We discuss how these findings can guide clinical decision making at the counselling level.

BREAK

TIMES ARE CHANGING: TEMPORAL FEATURES OF SPEECH TO CHILDREN WHO STUTTER

By
Allison Godsey

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Advisory Committee:
Dr. Nan Bernstein Ratner, Chair
Dr. Shelley Brundage
Dr. Jared Novick
Eusebia Mont

Background

Parental Role in Stuttering Intervention

In speech-language pathology, caregiver counseling continues to be considered a crucial part of intervention for many disorders. However, parent counseling plays an especially vital role in early childhood stuttering. The continued importance of parent counseling may be attributed to the ideology of early theories, which suggested that parenting style and features of parent-child interaction may contribute to the onset and persistence of stuttering.

All early contributors to the field of stuttering hypothesized that parents and conversational partners played a role in the development and persistence of stuttering. Johnson's "Diagnosogenic" theory of stuttering (1942) hypothesized that responses to a child's typical developmental disfluencies could lead the child to develop an atypical speech fluency profile. In addition to Johnson, Van Riper, often viewed as one of the "fathers" of modern speech-language pathology, stated that "The way to treat the young stutterer in the primary stage is to leave him alone but to treat his parents and teachers." (Van Riper, 1982). Bloodstein suggested that "how stuttering is managed at home may have a great deal to do with whether stuttering is a transient episode or persists into adulthood as a chronic problem" (Bloodstein, 1993, p.151).

It is important to note that very few researchers and therapists today believe that parents' beliefs or behaviors cause the onset of stuttering. Although views on the origin of stuttering have changed through years of innovation and research, parent counseling remains fundamental in stuttering intervention. Studies have repeatedly shown that speech-language pathologists prefer to treat stuttering "indirectly" and believe parent counseling to be the most important component in treating early stuttering (Cooper & Cooper, 1996; Gregg, 2015).

As noted, current views on parent counseling could be partly due to popular approaches to treatment of early stuttering. One frequently employed framework is the "Demands and Capacities Model" (DCM; Adams, 1990; Starkweather, Gottwald, & Halfond, 1990). In the Demands and Capacities Model, it is hypothesized that children who stutter do not have the capacity to meet the language and conversational demands placed on them. Insufficient capacity may hinder the child's ability to produce fluent speech in specific settings. Hence, in the DCM, parents are offered advice on how to change their speech behaviors to reduce the demands placed on the child. Parents are told to slow their speech rate, increase the length of time between speaking turns, and reduce linguistic complexity, among other suggestions (DCM; Starkweather, Gottwald, & Halfond, 1990).

In the DCM method, there are some underlying tones that parents may initiate the onset and persistence of stuttering through their interaction styles. One of the founding fathers of DCM, Starkweather (2002) examines parents' role in stuttering further. He discussed that mothers of children who persist often have "intervening styles" and use more complex language. He also discusses how parent reactions to disfluency may lead to increases in stutter-like disfluencies and behaviors, stating: "Such forcing and struggle only makes matters worse and increases the likelihood that the parents, sharing the same genetically influenced tendency to be impatient, would be likely to react in such a way as to increase the child's forcing and struggle."

RESTART-DCM (Franken & Laroes, 2021) shares many similar components to the original DCM. In this approach, parents are advised to demonstrate desired speech models when interacting with the CWS. Parents utilize desired speech models in hopes that the child will mimic (entrain to) the parents' slower, more relaxed speech style and, in theory, this will improve fluency. The model recommends parental behavior changes that include "speaking with

calm, relaxed and fluent speech movements in a natural manner with the child." For turn-taking behaviors they suggest "Implementing long response time latency (approximately 1–2 seconds), definitely no overlapping in speech turn-taking." (p. 21). The reason these behaviors in particular are encouraged is to "decrease the chance that the child's planning and execution of his speech and language production will outpace the scope of his Capacities at such moments." (p. 20).

Palin Parent-Child Interaction (PCIT; Kelman & Nicholas, 2020) is another model that advocates parental involvement in early stuttering. Unlike the DCM's philosophy, PCI focuses on counseling parents to create a positive communication environment for young stutterers. Only a portion of this therapy model is devoted to having parents of CWS alter temporal components of their speech. Some recommendations made include "giving the child time" and modeling "pausing and rate of speech".

In addition to these commonly employed treatments, recommendations to adjust parents' speech style are readily available for both clinicians and parents on the Internet. ASHAWire has posted "5 Tips to Share with Parents of Preschoolers Who Stutter". The first of many suggestions is that parents "Increase the length of pauses between speaking turns." The reasoning behind this suggestion, as stated in the article, is that "children might feel pressure to get their words out before somebody else begins talking" (Whelan, 2019). The suggestion to increase the length of time between speaking turns is first on ASHA's list of suggestions to parents and fourth in the Stuttering Foundation of America's article "7 Tips for Talking with Your Child".

Although the suggestion to slow down and increase the length of pauses between speaking turns is readily available and often prescribed, a relatively small body of research exists on the effectiveness of these indirect therapy approaches. Additionally, no empirical evidence exists regarding whether slowing down and increasing RTL affects longitudinal recovery and

persistence outcomes in stuttering. Because so many children recover from early stuttering (up to 75% by most estimates (Bloodstein et al., 2021)), it is tempting to attribute successful outcomes following advisement of parents to the mechanism of action for the recovery. But what evidence supports this reasoning?

Studies on Speech Rate, Interruption, and Turn-Taking

As practitioners, lecturers, and members of the field, we stress the importance of evidence-based practice (EBP). One would assume that advice to change temporal features of parental speech is rooted in a strong evidence base, especially given the potential feelings of parental guilt and inadequacy that can result from advising parents to alter ways in which they have been interacting with their child. However, the evidence for such advice has historically stemmed from non-longitudinal "small n" studies. Here, we review both observational studies of parental speech to CWS and studies that manipulated speech rate or turn-taking as forms of evidence for indirect treatment approaches.

Before delving into the studies that discuss such behaviors, definitions and a discussion about the relationship between interruption and Response-Time Latency (RTL) are necessary—parental interrupting behaviors and RTL contrast. An interruption results in negative response time latency (e.g., talking over the child's speech). For this reason, we discuss studies that targeted interrupting behaviors as well as observed or manipulated speech rate and turn-taking. By asking parents to decrease the frequency of interruptions, we are thus asking them to increase response time latency or extend the amount of time between speaking turns. Short RTLs can suggest a competitive speaking environment, which, in theory, increases the conversational pressure placed on a speaker. In turn, shorter utterance preparation time should increase the likelihood of fluency breakdown in the child's speech.

Observational Studies

Some studies have concluded that indirect therapy advice to adjust temporal features of parent-child interactions successfully reduces disfluency through observing parental interactions with children who stutter. Egolf et al. (1972) and a linked report by Kasprisin-Burelli, Eglof, and Shames (1972) were likely the first researchers to analyze the impact of turn-taking on the fluency of CWS. To do so, they observed a cohort of 9 children ranging from six to thirteen years of age. While conducting a more extensive evaluation of parent-child interaction, they noted that interruption by parents appeared to increase a child's disfluency. If interrupting behaviors were seen frequently in observations of specific individual parent-child interaction, parents were instructed to alter their turn-taking behaviors to increase the child's fluency. In many of the cases followed, therapy was deemed successful; however, it is important to note that decreasing interruption was the only pacing advice provided together with numerous other suggested adjustments to parent-child interactions.

A series of observational studies that supports the notion that reducing parental speech rate and interrupting behaviors can decrease disfluency was conducted by Myers and Freeman (1985). They performed a quantitative analysis of parent-child conversational pacing and interrupting behavior. The analysis led to two distinct reports. In their first report, Meyers and Freeman (1985a) found that mothers of children who stutter spoke faster than the mothers of children who did not stutter when speaking to either CWS or CWNS. In their second report, Meyers and Freeman (1985b) evaluated parent-child interactions between 12 CWS and their mothers and a matched group of non-stuttering counterparts. They found that both mothers of CWS and CWNS interrupted their child's disfluent speech more than their fluent speech.

In these observational studies, a stuttering severity score was commonly used to indicate increased disfluency. Both Kelly and Conture (1992) and Ryan (2000) found a relationship between interruption and disfluency when using the stuttering severity score as a measurement. Ryan examined simutalk (the duration of overlapping segments of mothers' and children's speech during free play) in 13 pairs of CWS and their mothers. Kelly and Conture (1992) analyzed response time latency by analyzing parent-CWS interactions in 13 boys who stutter and 13 who did not. Ryan found that stuttering severity scores strongly correlated with the average proportion of simutalk occurrences. In addition, Kelly and Conture obtained a positive correlation between scores on the Stuttering Severity Instrument (Riley, 1980) and the duration (in seconds) of interruption by their mothers.

These observational studies further contributed to the evidence base that reducing interruptions might decrease disfluencies in stuttering children. However, none of these studies specifically manipulated turn-taking or speech rate.

Studies that Manipulated Speech Rate or Turn-Taking

A handful of studies have gone further to manipulate variables such as speech rate or turn-taking to evaluate the impact on young children's fluency. Some studies instructed parents to alter their speech behaviors, while others had the investigators change temporal features of their speech to determine the effect on fluency. Additionally, a new variable was introduced by many of these studies—whether or not children mirrored the modified speech behaviors of their mothers or adult interlocutors. As noted, the concept that children will model parental speech behaviors stems from the beliefs of influential text authors such as Van Riper and Bloodstein. Their stated hope was that children would be more fluent after slowing down their own speech rate when following parental speech models.

Stephenson-Opsal and Bernstein Ratner (1988) and Guitar et al. (1992) addressed children modeling parental speech models. Stephenson-Opsal and Bernstein Ratner examined how maternal speech rate impacted fluency by having mothers of two CWS slow their speech rate using a counter-balanced individual baseline design Disfluencies decreased when a slowed adult speech rate was employed. Similarly, Guitar et al. found that when the mother of a single 5-year-old girl used a slower speech rate, the child's disfluencies decreased.

Unlike the studies above, Newman and Smit (1989) and Guitar and Marchinkoski (2001) examined the impact of temporal changes on speech with a cohort of children who did not stutter. Also, unlike the previous studies, they found that children did respond to and "mimic" (entrain to) adult speech models. In Newman and Smit's study, the experimenter was instructed to utilize either a 1-second or a 3-second response time latency when responding to the child. Under the 3-second condition, they found that children mirrored the experimenter's speech by demonstrating longer RTLs. When the 1-second RTL was employed, three of the four children increased "stutter-like" disfluencies. However, contrary to Newman and Smit's findings, Guitar and Marchinkoski observed no fluency change due to slowed maternal speech rate.

Another study also analyzed the effect of changes in temporal features of speech on children who do not stutter. Bernstein Ratner (1993) examined the temporal parameters of non-stuttering children's conversations with their mothers. After observation of baseline interaction styles, one group of mothers was advised to use a slow speech rate, and one group was advised to use a slow speech rate and to simplify language style (ostensibly to measure impacts on children's play behaviors). Approximately 25% of the child participants did not mirror the change in their mother's speech behaviors. There was a non-significant increase in maternal RTL in both groups. In addition, there was a non-significant increase in RTL for the children, showing

some minimal degree of entrainment. In all conditions, levels of typical disfluency were low. However, there was a slight increase in child disfluency when mothers were asked to change their conversational pacing as well as its linguistic complexity and children began to interrupt their mothers. This study similarly suggests that increased conversational demand may elicit disfluencies, at least in typically developing children.

Some speech behaviors discussed (e.g., interruption, speech rate, and response time latency) have been theorized to increase the conversational pressure placed on the child. Thus, suggestions to change parental speech behaviors are often made with the more general goal to decrease conversational pressure within the environment. Yaruss (1997) analyzed conversational pressure using a subject pool of forty-five preschool-age children who stutter. Fluency was examined in a variety of specific speaking contexts. In the "play with pressure" situation, the clinician was instructed to interrupt the child and to increase time pressure. As anticipated, the "play with pressure" situation elicited an increase in stuttering-like disfluency. The findings of this study have been used to inform the advice that increasing the time between speaking turns could create a more comfortable speaking environment and hence reduce conversational pressure placed on a CWS.

In addition to parental speech rate, the “dyadic speech rate” gap has been considered a factor in the fluency of CWS. This measure is the difference between an adult's and their child conversational partner’s speech rate (LaSalle, 2015). Kelly (1994) initially introduced this notion when she noticed that the fathers in her study spoke much faster than their children. When fathers did this, the children's stuttering appeared to become more severe. Zebrowski et al. (1993) added to this notion of dyadic rate when they found that a greater disparity in speech rate

between parent and child was correlated with increased disfluency rate. These studies all emphasized the role of "temporal congruence" in facilitating fluency.

Limitations of the evidence base for advice to parents

In evaluating the "state of the art" in working with families of children who stutter, Bernstein Ratner and Guitar (2006) discussed the impacts of speech rate and turn-taking on children's fluency. In doing so, they cited many of the same articles above and noted the relatively small body of evidence. Few studies have since analyzed the specific effects of parent counseling on fluency; however, a large number of intervention approaches continue to emerge that utilize parental pacing adjustments alongside other therapy "tools" to facilitate fluency of CWS. The number of children whose fluency has been examined as a function of adult speech rate and turn-taking continues to be somewhat limited, which is striking given the frequency and pervasiveness with which such recommendations are made.

The field requires a more substantial evidence base to continue making recommendations to adjust parent-child interactions in stuttering. In recent years, limited studies have even analyzed whether advice to parents can be linked to even short-term fluency profiles of children who stutter.

Before leaving this section, it is also important to note that most of these studies defined optimal outcomes as improved fluency. This concept itself has come under reconsideration, particularly in working with older children and adults who stutter (Hart et al., 2021). Regardless, many parents and clinicians still, understandably, seek to improve their children's fluency. We analyze whether or not modifying temporal aspects of parental speech appears to accomplish this goal.

Parent Perceptions of Stuttering

Many researchers now consider stuttering that persists past the early school years to be a chronic condition, not “cured” as much as managed (Byrd et al., 2024; Norman et al., 2023), Given this profile, some have proposed that it be viewed as parallel to other childhood-onset chronic diseases such as diabetes or asthma (Bernstein Ratner & Guitar, 2006). In these chronic diseases, the parent plays little role in the onset but is critical in managing symptoms. However, in stuttering, unlike those diseases, parental counseling may suggest that parental behaviors might not only remediate the symptoms, but prevent stuttering from becoming persistent (Bloodstein, 1993). While most recommendations are made with good intentions, they may inadvertently place blame on parents of children who stutter. Suggestions to change parental speech can directly or indirectly imply that the parent's way of talking to the child is “wrong.” It is impossible to know parents’ reactions when, after trying to implement such advice, the child’s stuttering does not improve or go away; however, we imagine that it could create a sense of frustration or guilt.

Speech-language pathologists are taught to consider the role of caregiver burden when providing intervention for individuals with various conditions. The American Psychological Association defines caregiver burden as “the stress and other psychological symptoms experienced by family members and other non-professional caregivers in response to looking after individuals with mental or physical disabilities, disorders, or diseases” (APA Dictionary of Psychology, 2018). While limited, some studies have investigated the role of caregiver burden in stuttering.

The impact of childhood stuttering on parental health and well-being is not a novel concept. Both Goodhue et al. (2010) and Langevin et al. (2010) analyzed parental perceptions of stuttering. Goodhue et al. did so through interviews with 16 mothers of CWS up to 6-years-of-

age spanning over six months. Langevin et al. did so by surveying parents of 77 preschoolers (3-6 years of age) who stutter. Both found that the majority of parents reported that they were significantly affected by their child's stuttering. Goodhue (2010) found that parents often reported feelings of "failure" if therapy was unsuccessful, given their involvement in the management of their child's stuttering. In contrast, Langevin et al. (2010) found that parental self-blame was rooted in a fear that they had done something to cause their child's stuttering. Both studies found that stuttering caused parental feelings of self-blame, guilt, anxiety, and worry. These studies highlight that when parents are made to feel that they are a determining factor in their child's "success" (e.g., resolution of disfluency), it can lead to feelings of failure or guilt.

Further, Plexico and Burus (2012) conducted a qualitative study to investigate how families cope with having a child who stutters. The study included twelve participants; all had children who stuttered. The interview questions were designed to elicit how stuttering affects the parent physically, emotionally, and cognitively. Parents expressed some guilt stemming from feeling that they had done something to cause their child stuttering. In addition, Plexico and Burus found that parents felt guilty about not completing the treatment correctly and blamed themselves when the child's stuttering did not improve. They concluded that clinicians need to provide more information on the cause of stuttering, optimal responses to teasing, and bullying and offer support groups. A logical conclusion is that parents of CWS need to obtain a more complete education on the current research findings related to origin and persistence of stuttering to aid in avoiding feelings of parental guilt and caregiver burnout.

Throughout these studies, common themes re-emerge guilt, failure, and inadequacy. More recently, Carey et al. (2023) investigated the mental health of parents of young CWS. The

investigators administered a survey gathering quantitative and qualitative information about symptoms of stress, potential depression, anxiety, psychological distress, and the emotional effect of stuttering to 82 parents of CWS. Stress, anxiety, and depression were present in one of six parents; distress was present in one of five parents. In addition, half of the parents reported experiencing a negative emotional effect of stuttering, and many reported that it influenced their communication with their child. The authors concluded that therapists should provide parents with support services to reduce worry and anxiety related to negative emotions.

Studies such as the ones detailed above led to the development of the Caregiver Burden Scale for Parents of Children who Stutter (CBS-PCWS) (Behtash et al., 2022). The CBS-PCWS includes five factors to rank how the parent is impacted by the stutter based on common themes identified in a literature review and interviews with fifteen parents of CWS. The five factors that parents are asked to rank are as follows: Psychological and emotional impact, personal and physical impact, support for caregiving (facilities, financial, and knowledge), culpability, and socio-communicative isolation. This scale was developed to identify ways in which stuttering negatively affects parents so that these impacts could be addressed as part of the child's therapy process.

As reviewed previously, nearly all programs for early stuttering incorporate parental involvement. As a result, most therapists see the involvement of parents as a crucial component in managing early stuttering (Cooper & Cooper, 1996; Gregg, 2015). However, another theme less frequently discussed is parental perceptions surrounding such advice. Given the inherent feelings of inadequacy, guilt, and blame that parents of CWS are shown to experience (Langevin et al., 2010; Goodhue et al., 2010; Plexico & Burrus, 2012), clinicians need to practice caution in the counseling process, ensuring not to insinuate that parents have contributed to the onset or

persistence of stuttering. Proper counseling and education are crucial to avoid parental feelings of inadequacy. More critically, we should ensure that advice we provide to parents is based in strong evidence of its effectiveness.

Revisited - What the IISRP can contribute:

In our initial publication describing phase one of our project (Godsey & Bernstein Ratner, 2024), we provide an overview of the Illinois International Stuttering Research Project (IISRP) conducted by Ehud Yairi, Nicoline Ambrose, and colleagues. In phase two, we emphasize the unique opportunity it gives us to analyze the efficacy of indirect therapy advice on stuttering in the short and long term.

The IISRP produced valuable information regarding factors affecting persistence and recovery from stuttering. For full details about the IISRP, please see Yairi and Ambrose (2005).

The speech samples collected by the IISRP researchers are now available at the open-access FluencyBank project (fluency.talkbank.org; Bernstein Ratner & MacWhinney, 2018). The entire IISRP database contains 440 samples from 88 children who stutter. Children were seen five times each, six months apart.

The IISRP, by its design, provides an interesting and unique natural experiment in the relationships among parent and child speech rates and turn-taking profiles. What makes it unique is the nature of the parent counseling conducted. Parents were not given any advice during the baseline sample collection. Given the years during which the study was conducted (the mid-1990s), there was limited access to the World Wide Web, limiting parental access to information typically provided in indirect interventions before counseling. However, following the baseline sample, the investigators made uniform, scripted suggestions (see chapters 7 and 11 in Yairi & Ambrose, 2005) to increase the length of time between speaking turns and increase speech rate,

which enables us to look at adherence to advice given and their impact on child fluency. The longitudinal manner in which these files were collected, together with the inclusion of parent-child interactions, both before and following advisement that parents make speech rate and turn-taking changes, has the unique potential to strengthen or diminish the evidence base for indirect therapy advice given to parents of children who stutter.

Findings on temporal features of parental speech to CWS from phase one of the study

Our previous research focused on analyzing these temporal features of parental speech to CWS at the baseline sample before parents were advised to modify their speech behaviors. The results below are broadly summarized from Godsey and Bernstein Ratner's (2024) phase one analysis of parent-child baseline profiles.

Results did not strongly support historical advice to parents. For example, for response time latency, findings showed a slight but non-significantly higher parental response time latency (more time between turns) for children who recovered as compared to those who became persistent. In the 20 turn-taking interactions analyzed for each mother-child dyad, we found that parents of children who stutter-recovered (CWS-R) used mean RTLs of .55 seconds, whereas parents of children who stutter-persistent (CWS-P) used average RTL times of .43 seconds. Additionally, parents of children who do not stutter (CWNS) showed average RTL times of .62 seconds. These differences were non-significant ($F = 2.35$, df (2,59), $p = .10$, ns). In contrast, differences in response time latency across individual parent-child interactions (within-group variability) were highly significant ($F = 2.58$, df (2,59), $p = .00005$). Results suggest marked differences across parent-child dyads in conversational tempo, regardless of group membership.

For CWS-mother dyads only, a linear regression determined whether the child's weighted SLD score was correlated with the average mother-child RTL in the completed files. The

relationship between mean RTL and weighted SLD was marginal (r= .019, p = .9058, ns). This finding suggests that the length of parents' time between speaking turns did not relate to children's fluency profiles within the same interaction. We also examined whether the predictability of turn-taking latencies might assist the child's fluency by plotting the standard deviation of the mothers' RTLs against the fluency profiles of the CWS. This relationship also was not significant; r = 0.1017, p = 0.527.

We computed the average speech rate for both the children and their mothers (in words/minute) to assess speech rate. Data violated assumptions of normal distribution and variance homogeneity; therefore, we utilized a Kruskal-Wallis one-way ANOVA on ranks. For both maternal and child average speech rate, mothers and children in the recovered CWS group spoke more quickly than participants in the other two groups; for mothers, chi^2 =29.567, p < .0001; for children, chi^2= 13.205, p = .0014. A Fisher's LSD multiple comparisons test showed that mothers of recovered CWS spoke significantly more *quickly* than the mothers in the other two groups. The same was found for child speech rate: recovered CWS spoke more rapidly than either typically fluent children or CWS who became persistent.

Because all advice is predicated upon reducing differences in speech rate between parents and children, we computed an average difference score for each child-mother dyad. Contrary to expectations, speech rate differences were highest for the dyads in which a CWS went on to recover and lowest in interactions between non-stuttering children and their mothers. These profiles were significantly different, chi^2= 15.286; p = .0005. The Fisher's LSD multiple comparisons test showed dyads where the CWS recovered had *significantly* greater disparities between child and maternal speech rate than dyads involving typically fluent children and their mothers, but not significantly greater than those seen between CWS-P and their mothers.

Our previous findings from the baseline sample established a need for future research investigating similar questions in follow-up samples of the IISRP to determine whether speech behaviors changed after advice and what impact such changes had on facilitating short- and long-term fluency.

Sample Three Questions and Hypotheses

Given our findings from phase one of the study, we posed the following questions for phase two:

- Do parents of CWS adhere to therapeutic advice provided by SLPs to change the temporal features of their speech?
    - How does parental adherence to therapeutic advice impact the short and long-term fluency of the CWS?
    - Following therapeutic advisement, are there differences between the temporal features of speech (e.g., turn-taking and speech rate) in parents of children who recover as opposed to parents of children who persist?
    - How did the predictability of parental RTL use change due to any changes to temporal features?
- Do CWS show indications of mirroring (entraining to) maternal speech behaviors?

Based on the research discussed previously, one might assume that if parents change the temporal features of their speech, the child may become more fluent both/either in the short and long term. Since parental speech behaviors are believed to impact fluency, one might also assume that if parents practice long-term adherence to the advice given, their children will be more likely to recover.

Methods

Participants

As a first-phase project, we analyzed all mother-child play interactions collected during sample one (the baseline sample) of the Illinois International Stuttering Research Project (see Yairi & Ambrose, 2005; now publicly available at FluencyBank (www.fluency.talkbank.org)). Sample one was defined as the intake (baseline) sample in which the children were seen for the first time. As an analysis of archival, de-identified behavior, Phase one and Phase two of this project were determined to be exempt from Human Subjects protections by the University Institutional Review Board (IRB).

Sample one of the IISRP data contains 80 files consisting of a mother-child play interaction with matched audio files. Thirty-nine were with children who recovered from stuttering (CWS-R), while fourteen of the files were interactions with children who remained persistent (CWS-P). Additionally, twenty-seven of the files were from children who did not stutter (CWNS). In Sample One, 62 were determined fit for analysis (28 CWS-R, 13 CWS-P, and 21 CWNS). All files are in TalkBank CHAT format, with audio linkage that enables immediate PRAAT analysis to measure the timing of selected acoustic segments. Although only children's speech was transcribed initially by IISRP personnel, University of Maryland researchers augmented files with transcription of the children's conversational partners.

Following the completion of Sample One (baseline), the one-year follow-up interactions (labeled within the IISRP corpus as Sample Three) were transcribed to include children and their conversational partners. Children were seen three times in the first year: first for intake, six months later, and at the one-year mark. The highest recovery rate was observed during this time

(Yairi & Ambrose, 2005), making the analysis of the one-year follow-up sample particularly interesting.

For follow-up, we analyzed only files from CWS to focus on the impact of indirect therapy approaches recommended following the baseline sample. Due to missing audios, and differing parent, only 30 longitudinal files were analyzed (18 CWS-R, 12 CWS-P). These files were directly compared with their corresponding intake files to examine changes in speech behaviors and fluency patterns from baseline. It also allowed for comparison of parental speech behaviors before and after professional advisement). To analyze these variables, we calculated the difference scores between mean RTL, maternal speech rate in words per minute, child words per minute, weighted SLD, and standard deviation of maternal RTL.

Data Selection

To draw direct comparisons, we followed the same guidelines as used for baseline to analyze Year 1 follow-up. For all Sample One files in which there was a mother-CWS play interaction, we examined 20 consecutive child utterances and 20 mother utterances. The utterances measured for RTL were the first 20 eligible utterances in the file. For the utterance to be considered eligible for analysis, the child needed to perform a meaningful speech act. Fillers such as *uh* and *um,* one-word responses, and sound play (e.g., pretending to be a race car or animal) were not considered. Additionally, to account for differences in paternal and maternal communication, we only examined mother-child interactions (Berko Gleason, 1975; see VanDam et al., 2022 for review). Thus, for follow-up samples, we implemented the same parameters.

Acoustical analysis

Utilizing CLAN software, we aligned the files to include the target mother and child utterances in a single “bullet” or paired transcript/sound segment. Then, we utilized the "send to sound analyzer" feature on CLAN to transfer the segment to PRAAT (Lieshout, 2003). Using CLAN sonic mode, we could identify the response-time latency between the end of the child's utterance and when the mother began speaking. Response-time latency was measured in seconds; any parent overlap/interruption was coded as negative response-time latency.

Fluency Analysis

We then ran FluCalc, a function available through CLAN, which provides a detailed disfluency profile proportioned over words in the sample, including the weighted SLD score (Ambrose & Yairi, 1999). We analyzed all eligible mother-child dyads in the one-year follow-up sample for the fluency score of all utterances within that file (not just the 20 selected for RTL analysis).

In baseline analysis, we also hypothesized that parents who used more predictable RTL would foster fewer disfluencies in their child’s speech because the child might better predict how much time was available to formulate their response; allowing insufficient time for a child to plan an upcoming utterance is in fact mentioned in numerous discussions of parent counseling in early stuttering (Kelly & Conture, 1992; Newman & Smit, 1989). Thus, for follow-up, we took the mean and standard deviation of RTL for each individual parent-child interaction. This enabled us to look at the parental speech “predictability.”

Speech rate computation is done automatically in FluCalc once a transcript appropriately aligns with the speaker audio. We utilize the Batchalign utility (https://github.com/talkbank/batchalign) to abstract a generalized speech rate (words per minute)

derived by tallying the length of an utterance in words or syllables, divided by the duration of the extracted audio signal.

Statistical analysis

The primary interest of Phase Two of the project was adherence to therapeutic advice and how changes to temporal features of parent speech impacted short and long-term fluency. Accordingly, we now had a new variable to analyze: change from the baseline sample. To answer our previously stated questions, a repeated measures ANOVA was conducted on multiple response variables (mean latency, weighted SLD, child WPM, and the difference between mother and child speech rate) across two-time points, with a between-subjects factor of group (CWS-P vs. CWS-R).

In addition, to address whether CWS and mothers become more consistent in speaking style, we obtained the difference in the score between mother and child speech rate in words per minute. We then ran an ANOVA on this to determine the change from the baseline sample. One measurement not addressed in our ANOVA but addressed in phase one was the predictability of maternal RTL. We conducted a t-test on standard deviation scores collected from each mother-child dyad in Year 2 follow-up to measure this.

We also found it important to analyze the direct impact of advice to increase RTL and decrease speech rate on fluency directly. To do so we regressed the difference score for sample one and sample three maternal speech rate, and RTL, on changes in the child's weighted-SLD.

Results

As noted, to address our questions regarding adherence to advisement and the impact of changes to temporal features of parental speech, we ran a repeated measures ANOVA on multiple response variables (Mean Latency, Weighted SLD, Child WPM, Mother WPM, and

Mother-Child difference in WPM) across two-time points, with a between-subjects factor of Group (Persistent vs. Recovered).

Response time latencies at one year follow-up

For mean latency (RTL; the amount of time between speaking turns), we found that, on average, at one year follow-up, mothers of CWS-R used mean RTLs of 0.58 seconds, whereas mothers of CWS-P used mean RTLs of 0.56 seconds. Across samples, mothers of CWS-R used slightly longer RTL times. However, this finding was not statistically significant ($F=0.13$, $p=0.721$). Across samples, we found that overall, parents used longer latencies one year later than at baseline. The mean latency used by mothers in sample one for both CWS-P and CWS-R was 0.52 seconds. A year later, the mean latency used by mothers for both CWS-P and CWS-R was 0.62 seconds. This finding was significant ($F=5.40$, $p= 0.028$), demonstrating an overall latency increase over the course of the year following advice to the parents of the CWS. This appears to suggest that parents attempted to follow guidance provided by IISRP personnel.

The last variable we analyzed for mean response time latency was the interaction between group and time. For the files analyzed, at baseline, mothers of CWS-P used mean RTLs of 0.44 seconds. One year later, they used mean RTLs of 0.67 seconds. At baseline, mothers of CWS-R used mean RTLs of 0.59 seconds, and one year later, they used mean RTLs of 0.56 seconds. This finding was significant ($F=8.43$, $p=0.007$), demonstrating that mothers of CWS-P seemingly followed therapeutic advisement to increase RTL. In contrast, mothers of CWS-R slightly decreased RTL but remained relatively consistent in their turn-taking profiles. (see Figure 1)

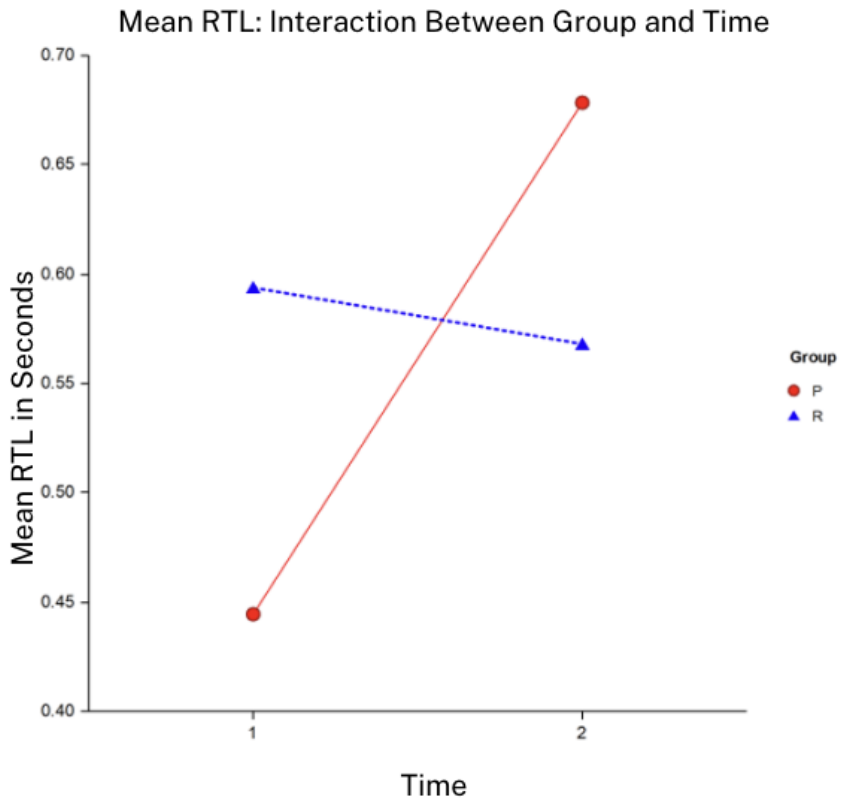

Figure 1. *Mean latency in seconds for group (CWS-P and CWS-R) and sample (Time 1= baseline, Time 2= one-year follow-up)*

Speech Rate - Mothers' Words Per Minute

We analyzed the effect of group (CWS-P and CWS-R) on speech rate, irrespective of time. We calculated each group's mean speech rate across both samples. On average, mothers of CWS-P, used a speech rate of 122.26 words per minute. In contrast, mothers of CWS-R had an average speech rate of 162.94 words per minute. This finding was significant (F=10.45, p= 0.003), demonstrating that, in general, mothers of CWS-R spoke faster than mothers of CWS-P.

We then looked at the average maternal speech rate for each sample period. For both groups (CWS-R and CWS-P) at baseline, the average speech rate in words per minute was 159.26. A year later, the average speech rate in words per minute was 125.95. This finding was

significant (F=20.75, p=0.00009). This finding suggests an overall decrease in speech rate across mothers from baseline to one year follow-up.

The last variable we analyzed for speech rate was the interaction between group and time. At intake, mothers of CWS-P displayed an average speech rate of 123.044 words per minute and this decreased minimally a year later to an average of 121.486 words per minute. At intake, mothers of CWS-R produced an average of 195.476 words per minute. At follow-up, mothers of CWS-R decreased their average speech rate to 125.946. This change was significant (F=18.86, p=0.00017). As noted in our initial report, mothers of CWS-R spoke far faster than mothers of CWS-P when observed before counseling. As time progressed, both groups slowed, but mothers of CWS-R slowed their speech rate more obviously. However, the speech rate of mothers of CWS-R was still faster than that of CWS-P. (See Figure 2)

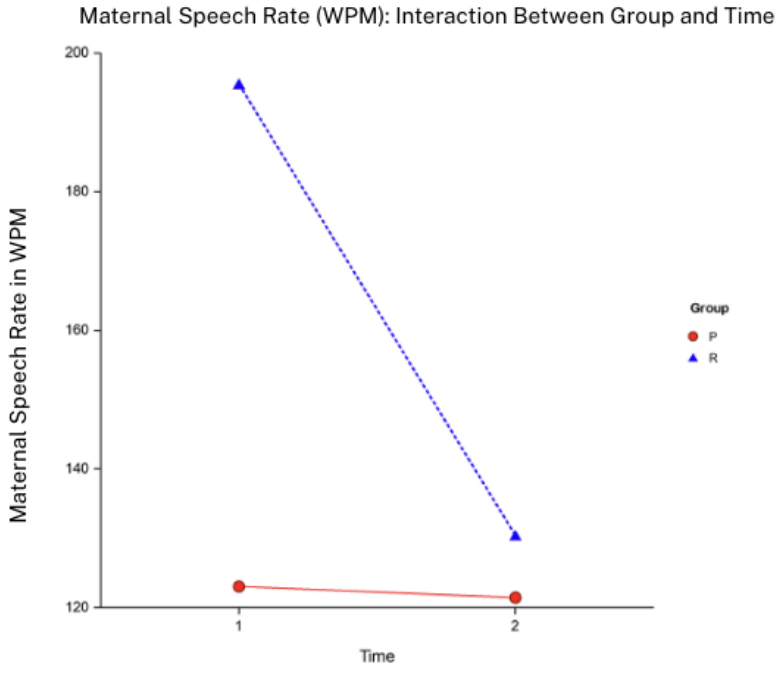

Figure 2. *Mean speech rate in words per minute by group across sample (Time 1= baseline, Time 2= Year 1 follow-up)*

Speech Rate - Child Words per Minute

One concept discussed in our coverage of earlier research was the belief that children would mirror parental speech behaviors. We also examined the child's speech rate in words per minute to assess this assumption.

At baseline, CWS-P used an average speech rate of 70.801 words per minute. One year later, the average speech rate for CWS-P increased to 87.5996 words per minute. CWS-R at baseline employed an average speech rate of 89.0384 words per minute, which decreased to 70.927 words per minute one year later. This interaction between speech rate, time and group was significant (F=7.98, p=0.009).

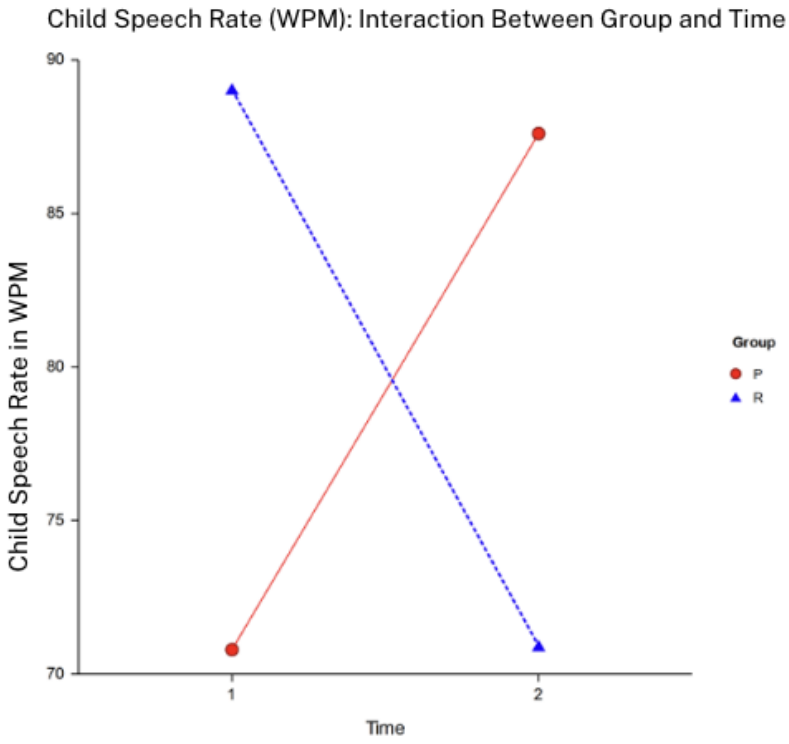

Figure 3. *Mean child speech rate in words per minute by group across sample (Time 1= baseline, Time 2= one year follow-up)*

Mother-Child Difference in Speech Rate

As mentioned previously, there has been a persistent assumption that children will model parental speech behaviors. Hence, parents are frequently advised to slow their speech to encourage the child to mirror this behavior. To measure whether or not children are adopting the speech modeled by their mothers, we computed a difference score by subtracting mother words per minute from child words per minute. Hypothetically, if there is less of a difference, then the mother and child's speech rates are similar, indicating that either the mother matches the child, or the child mirrors the mother.

We first analyzed the mean difference in child and mother speech rates by group. When combining baseline and follow-up samples, the mean difference for the mother/CWS-P dyads was 9.741 words per minute. The mean difference for the mother/CWS-R dyad was 14.587, indicating greater mismatch. However, this finding was not significant ($F=0.49$, $p=0.490$).

Between observations, there was a significant decrease in the overall speech rate difference of both groups. For baseline, the mean difference in speech rate between mothers and children was 76.968. A year later, the mean difference in speech rate was -52.641. This finding was highly significant ($F=192.93$, $p < 0.001$). This finding demonstrated that mothers and their children developed more similarity in speech rates across baseline, counseling and follow-up sessions.

Finally, we analyzed the interaction between group and time. For the CWS-P dyads, at baseline, there was a mean difference of 65.284 words per minute between parents and children, while the CWS-R dyads showed a mean difference of 88.652 words per minute. At follow-up,

the CWS-P dyad decreased the mean difference between mother and child speech rate to -52.641 words per minute, and the CWS-R dyad decreased their mean difference to -59.479 words per minute, showing that both groups reduced the difference in speech rate between mother and child over time, with a trend suggesting that the CWS-R dyad reduced the difference slightly more. This finding approached significance (F=3.94, p=0.057). (see Figure 4)

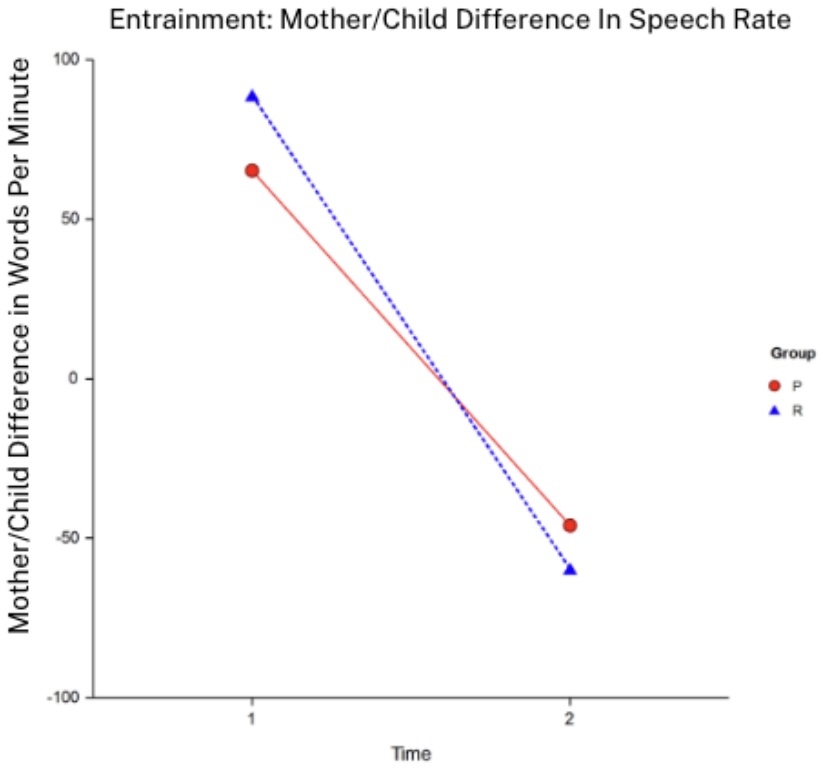

Figure 4. *Mean mother/child difference in speech rate by group across samples (Time 1= baseline, Time 2= one-year follow-up)*

Weighted Stuttering Like Disfluencies (SLD)

To analyze the impact of changes in parental speech patterns on the fluency of CWS, we looked at the weighted stuttering-like disfluency score (W-SLD). Hypothetically, if

modifications to temporal features of parent speech increased fluency, we would see a decrease in W-SLD from baseline to follow-up.

First, we analyzed the mean W-SLD scores by group (CWS-P and CWS-R). We found that CWS-R demonstrated slightly lower W-SLD scores across both samples than CWS-P. CWS-P had a mean SLD of 13.92 across samples one and three, while CWS-R had a mean W-SLD score of 11.94. However, this finding was not statistically significant ($F=0.33$, $p=0.568$).

Next, we analyzed the effect of time on W-SLD scores. We found that at baseline, as might be expected in a sample that would include children who experienced spontaneous recovery, W-SLD scores were significantly higher. For both groups, the mean W-SLD score during sample one was 18.926, whereas one year later, it was 6.943. These are findings which we would expect given that the most recovery reportedly occurred between these samples (Yairi & Ambrose, 2005). This finding was significant ($F=13.02$, $p=0.001$).

The last item we analyzed with W-SLD was its interaction across groups and time. For sample one, we found that CWS-P demonstrated mean W-SLD scores of 17.403. In sample three, CWS-P had mean W-SLD scores of 10.44. For CWS-R, we found that they demonstrated mean W-SLD scores of 20.448 during sample one. In sample three, CWS-R had mean W-SLD scores of 3.445, demonstrating that across samples, disfluencies decreased for both groups. Interestingly, on average, W-SLD scores for CWS-R were higher in sample one and decreased more substantially in one year later. However, these findings were not statistically significant ($F=2.29$, p- 0.142). See Figure 5.

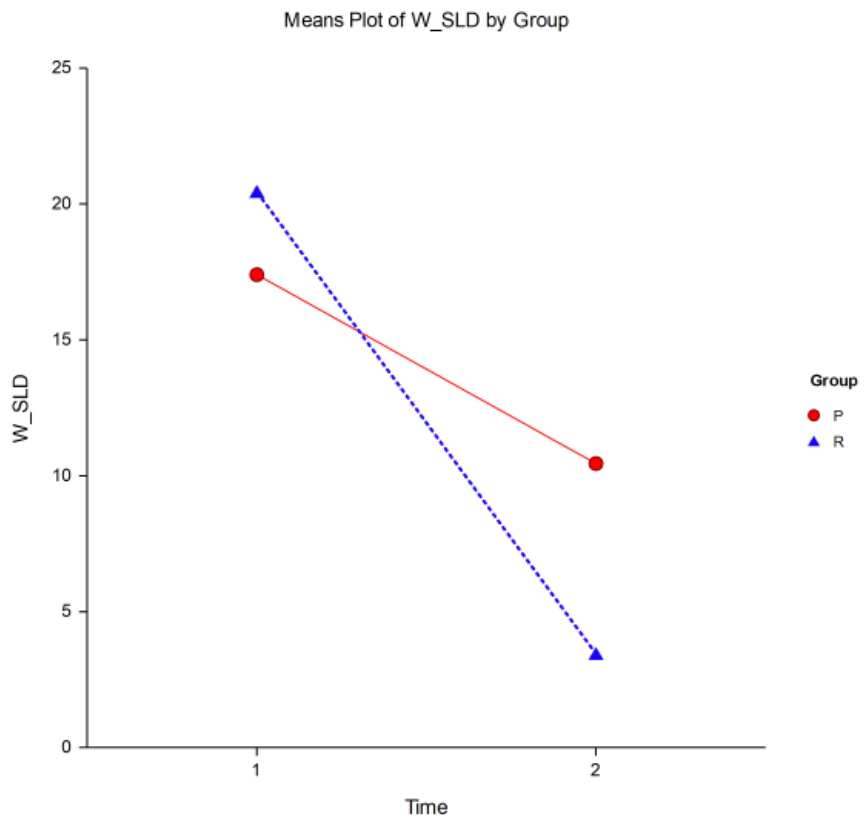

Figure 5. *Mean W-SLD scores by group across sample (Time 1= sample one, Time 2= sample three)*

Parental speech predictability

In our final analysis, we conducted a t-test using standard deviations of RTL to determine the variability and predictability of parent speech at follow-up. Maternal RTL in the CWS-P dyad group had a mean standard deviation of 0.724 seconds, whereas mothers in the CWS-R dyad had a mean standard deviation for their RTL use of 0.501 seconds. These findings were significant ($t(28) = 2.364$, $p=0.025$). This finding demonstrated that mothers in CWS-P showed significantly greater variability in RTL use than mothers in CWS-R. The variability in RTL demonstrated by mothers of CWS-P may suggest more inconsistency in use of response time

latency. More inconsistency in the RTL use of mothers of CWS-P would indicate less predictability (See Figure 6).

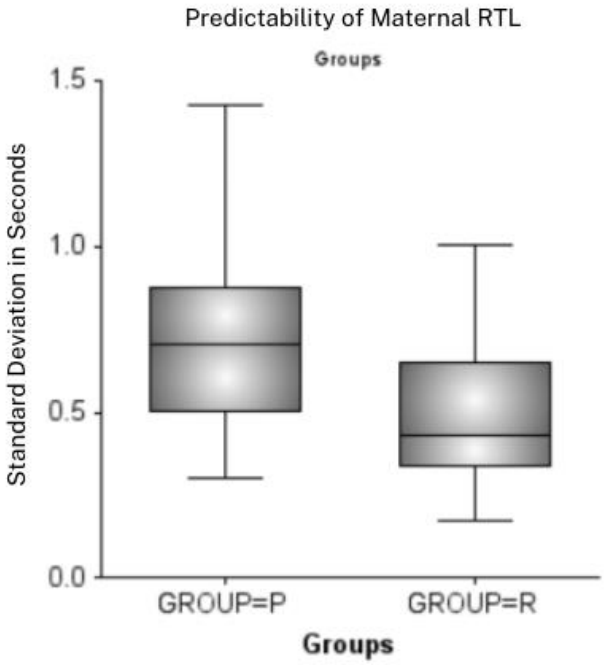

Figure 6. *The plot of t-test results for standard deviation for the group.*

Relating changes in maternal rate and RTL to changes in the child's fluency

To examine how any changes in maternal speech rate and RTL were related to changes in the child's fluency, we employed a simple linear regression using the difference between sample one and sample three maternal RTL to observe any relationships to the child's change in fluency profile. The obtained correlation was 0.0356 and indicated no significant (or observable) relationship between variables (r^2= 0.0013, p=0.8520, ns) (See Figure 7). For maternal speech rate and W-SLD score, we observed a very slight but non-significant positive correlation of 0.1455 (r^2= 0.0212, p=0.4430, ns) (See Figure 8). In sum, changes in maternal conversational timing between Times 1 and 2 did not appear to relate to observed changes in the child's frequency of SLDs.

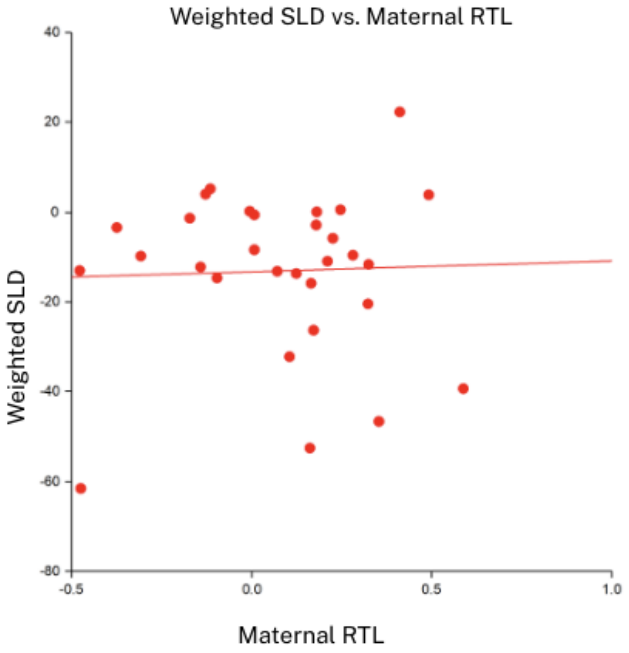

Figure 7. *Correlation of weighted SLD score for sample's one and three with maternal RTL.*

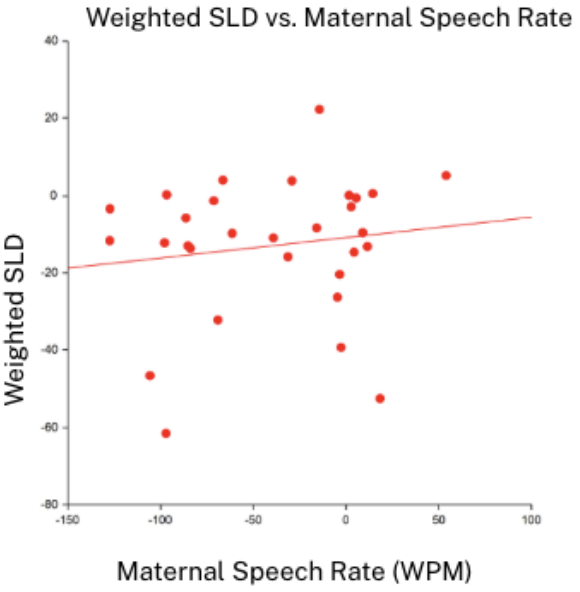

Figure 8. *Correlation of weighted SLD score for sample's one and three with maternal speech rate in words per minute.*

Discussion

First, we would like to acknowledge both the original contributions of the IISRP project (Yairi & Ambrose, 2005) as well as its invaluable donation to TalkBank. The IISRP database has, among other major influences on stuttering research and practice, allowed us to evaluate recommendations made to parents of CWS. To this date, this is the first study to look at indirect therapy's role on longitudinal outcomes of recovery and persistence in such a large sample. While some inevitable complications diminished the follow-up sample size (which we will discuss in limitations), this sample is still large when compared to previous studies that have endeavored to evaluate the impacts of parental speech style on children's fluency (e.g., Newman & Smit, 1989; Winslow & Guitar, 1994; Meyers & Freeman, 1985). In addition, it is unique in that it allows us to draw comparisons before and after advice to change temporal features of parent speech. Finally, given the time frame during which the IISRP started its work, we probably will never again have the ability to examine parents' typical speech profiles when speaking to their CWS before receiving large amounts of Internet-mediated advice. In this sense, the IISRP is truly a unique natural experiment.

Overall, in the IISRP parents appeared to implement therapeutic advisement to slow speech and increase the time between speaking turns, albeit when observed back in the laboratory setting where they were first evaluated. Contrary to expectations, mothers of CWS-P increased their response time latency and slowed their speech rate more than mothers of CWS-R. Mothers of CWS-R slowed their speech rate more dramatically; however, they still demonstrated faster speech rates and smaller RTLs when compared to mothers of CWS-R, leading us to re-evaluate the widely circulated notions that parental speech behaviors may influence the persistence of stuttering.

In addition, the difference between mother and child speech rate in words per minute was reduced for both groups, which could indicate two things: Mothers attempted to match the speech rate of their child, or children slowed their speech to mirror the temporal features of their mother's speech. However, the latter is less likely when examining child speech independent of mothers. While CWS-R slowed down, CWS-P sped up. We have hypothesized several reasons for this increase in speech rate. One may be that CWS-P's language encoding skills further developed, increasing their speech rate. Another factor to consider in this matter is the predictability of parental speech for both groups. Mothers of CWS-P demonstrated more variability in their RTL than did parents of CWS-R. One might hypothesize that increased parental variability may increase children's speech rate as the child tries to avoid interruption.

As expected, across both groups, stuttering rate (the W-SLD score) was lower at follow-up than at first encounter. However, when separating by eventual persistence and recovery, there was a non-significant finding that both groups demonstrated a decrease in disfluency, CWS-R, slightly more. A reduction of overall disfluency rates is expected, given that the IISRP researchers found that the highest recovery rates occurred during this time (Yairi & Ambrose, 2005). However, the more interesting finding is that the W-SLD score also decreased for the CWS-P group. In addition, we found that there was no correlation between W-SLD scores and maternal speech rate/RTL at the time of the samples (concurrent evidence) or between changes and maternal speech rate/RTL and changes in children's fluency profiles.

At this time, we are unable to conclude whether parental intervention aided in decreased disfluency or recovery from stuttering. While parents of CWS-P increased their overall RTL, mothers of CWS-R decreased their mean RTL. Regardless, the CWS-R group demonstrated a lower W-SLD score. Given this finding, it is more likely that the decrease in W-SLD score, for at

least recovered children, can be attributed to the 70-80% spontaneous recovery rate as discussed in *A Handbook on Stuttering* (Bloodstein et al., 2021).

Given the results provided, one cannot reasonably conclude that changes in temporal features of parent speech contribute to recovery and persistence rates in early childhood stuttering. In addition, one cannot conclude that slowed speech or increased RTL results in changes to short-term fluency, given that mothers of CWS-R decreased RTL, but CWS-R still demonstrated a decrease in fluency.

Limitations

As mentioned as a primary limitation in our first publication, demographic information from the population analyzed is limited (e.g., family history and initial language skills; see Yairi & Ambrose, 2005). While sex and age are known, we did not add these factors to the analysis. Though some group demographics are available, they do not provide data at the individual case level.

In addition, we had no control over how the samples were collected and whether they were truly representative of the typical parent-child interaction for the family. The investigators in IISRP gathered the speech samples in a less familiar environment with an unfamiliar audience, which could increase potential child and parent anxiety and influence speech behaviors. These samples were intended to be proxies of what occurs in the home environment, but such an assumption is likely false in some respects.

In addition, there were study-specific limitations in this sample. Some files were not considered eligible for analysis due to alternating caregivers, missing audio, or missing files, cutting our sample size for follow-up by half. This is a durable problem for all post-hoc analyses

of past research data and does amplify concern that prospective research is warranted in this topic area.

Future Directions

Ideally, this study would be replicated in the future using naturalistic observations of parent-child speech, ideally in the home, using more ecologically valid measures such as LENA recordings (LENA Foundation, 2007). In a prospective design, the researcher would record interactions before and after parental advice was given. However, given the advancement of technology, it may be nearly impossible to control for advice that parents had previously received through the Internet.

The follow-up sample was collected a year after the intake visit. As previously mentioned, the IISRP study followed these children for several years. Further samples must be analyzed to examine the continued use of indirect therapy techniques and changes in child speech profiles. Most children have samples for a Year 2 follow-up visit; we recommend that it be the next set of files analyzed.

Concluding Thoughts

Given our work to date, it is possible to conclude that the evidence base remains too weak to consider recommendations of indirect therapy to be “evidence-based practice” if the therapeutic goal is elimination of stuttering, especially given the potential adverse consequences on parents' well-being and mental health if this goal is not met. Hence, as emphasized in the studies on caregiver burden and parental guilt, we, as practicing clinicians and educators, need to be cautious in providing advice to change the dynamics of parent-child interaction. When indirect therapy advice is given, as is common, it is crucial to include components of education about stuttering. In particular, the implied success of indirect therapy advice as means to obtain

recovery from stuttering may be a tenuous starting point if we cannot align well-implemented advice with reliable outcomes. We note that parents in the IISRP did appear to follow some of the advice they were given, but it did not statistically differentiate group follow-up status.

We are not saying that advice to change the temporal features of parental speech is "bad" or "wrong." We are simply saying that the evidence does not strongly support its use as a tool to facilitate short- and long-term fluency, barring critically needed follow-up work using prospective design and additional cohorts of children and families. Based on our research, we cannot conclude that changes in parental speech rate or turn-taking play a role in either the onset or persistence of stuttering. Educating parents on this matter has become increasingly important, especially given a recent systematic review of the literature (Nonis et al., 2021) that found that parents expect a total cure from stuttering therapy. These expectations still align with the medical model where the goal remains to "fix" or "cure" the problem. If parents enter therapy with expectations of a total cure, feelings of failure are likely inevitable when guidance doesn't align with outcomes.

In addition to educating parents, we urge clinicians to have parents to engage in problem-solving with their child who stutters. In order to diminish situations that aggravate the child's stuttering, the SLP and parents should work together to discover situations that promote or stress fluency. Once identified, problem solving to ease conversational stress, which could include some traditional advice, can be tried and evaluated. For instance, none of us enjoys being interrupted while speaking. If the child stutters more when conversations do not allow the child time to express themselves, managing this situation can lead to more comfort in speaking, even if some stuttering can be expected to remain. This shifts the goal from resolving disfluencies to increasing feelings of communicative confidence in stressful or competitive speaking scenarios.

Furthermore, as society shifts, we must change with it to remain culturally competent and responsive. In recent years, the neurodiversity movement has emerged in stuttering as well as other developmental conditions. Historically, the primary means of "helping" children who stutter was to eliminate stuttering altogether and "fix" the child. Kristal Kubart, a stutterer, CCC-SLP, and activist who helped to create the stuttering pride flag, defines stuttering pride as "a belief that stuttering voices are valid and important. It is a hope for a future in which people who stutter are respected and included. It is a movement to create this change and celebrate stuttering culture" (Kubart, 2023).

When providing advice and suggestions to parents at the point of first contact, we must also acknowledge that fluency is no longer the primary goal of therapeutic intervention; communicative confidence is. We must emphasize the importance of communicative confidence to parents who frequently blame themselves for their child's stutter. Stuttering is not something to be cured; the insecurity and uncertainty surrounding it must first be addressed.

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