AN INVESTIGATION INTO STUTTERING DEVELOPMENT: A LONGITUDINAL

APPROACH

by

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ABSTRACT

The purpose of this study is to examine the relation between daily emotions and stuttering. A longitudinal design was used to evaluate changes in the relation between emotions and stuttering over the fall and spring semesters of the 2015-2016 school year. The study participant consisted of child who was three years old when enrolled in the study. The child's caregiver provided daily information regarding the four greatest emotional events and associated emotional arousal and speech disfluency. Conversational samples of speech were collected on weekly visits to the clinic, which were transcribed and coded for speech disfluencies. It was hypothesized that emotional arousal would be related to the child's stuttering. It was also hypothesized that routine would impact longitudinal change in emotional arousal and associated stuttering. Results showed that intensity of emotional arousal was predictive of parent-observed stuttering when emotion was negative. However, stuttering did not significantly change over the duration of the study, and change in routine was not related to longitudinal change in emotion and stuttering.

DEDICATION

This thesis is dedicated to the child who participated in this study, as well as his family. Without their consistent efforts contributing to this study, this thesis would not have been possible. A sincerest thank you to you all.

ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

Today in the United States 30 million Americans stutter, but the cause of stuttering remains unknown, and there is no known cure (Yairi & Seery, 2015). Stuttering, characterized by syllable repetitions and syllable prolongations, typically begins in early childhood, and most children recover without treatment. Important factors thought to contribute to stuttering development, besides a genetic predisposition, include language acquisition and emotional reactivity and regulation (Conture & Walden, 2012). Of the children who begin stuttering, about 75% to 80% recover, and do so typically within 12 to 24 months post onset (Yairi & Ambrose, 1992, 1999).

Despite consensus among researchers and clinicians that stuttering is a developmental disorder (e.g., Ward, 2013), relatively few developmental studies have been undertaken. Of those developmental studies that have been undertaken, investigations involving preschool-age children near onset of stuttering are the most common (Yairi & Lewis, 1984, Weiss & Zebrowski, 1992; Zebrowski & Conture, 1989). Many of these developmental factors have often been investigated within cross-sectional designs (e.g., Anderson, Pellowski, & Conture, & Kelly, 2003; Anderson, Pellowski & Conture, 2005), in which children who stutter (CWS) are compared to children who do not stutter (CWNS). Such studies that use preschool-age children near the onset of stuttering can be problematic, however, as such children are sometimes fussy or unwilling to participate in study activities, potentially compromising the integrity of empirical data. Thus, it makes more sense to acquire data across several occasions.

Data acquired over time (i.e., longitudinal) is perhaps more appropriate to assess developmental factors. However, such studies are less frequent. One reason for this is that studies require more resources from investigators, including time and money, and a greater commitment from study participants. Thus, longitudinal studies of developmental stuttering that have been undertaken to date typically acquire information at increments of several months. Such studies are typically designed to identify risk factors that lead to persistence of stuttering beyond the preschool-age years (Yairi & Ambrose, 1992, 1999). However, an increment of several months is bound to miss important information about development.

This thesis aims to expand the scope of research in developmental stuttering by acquiring information at a much more frequent timescale, specifically at daily and weekly time points. Such a frequency allows for more direct assessment of stuttering behaviors and the social and emotional circumstances associated with them. This study aims to investigate: 1) the relation between magnitude of emotionally arousing events as rated by parents with magnitude of associated stuttering as rated by parents, 2) longitudinal change in magnitude of emotionally arousing events as rated by parents with longitudinal change in magnitude of stuttering as rated by parents, and 3) longitudinal change in magnitude of emotionally arousing events as rated by parents with severity of stuttering as rated by investigators.

Developmental Stuttering

Stuttering in preschool-age children has been systematically investigated since the 1940s from reports produced by parents (e.g., Johnson, 1942; Johnson & Associates, 1959). However, longitudinal studies investigating stuttering as a developmental disorder did not occur until the 1980s and 1990s (Yairi & Ambrose, 1992, 1999). Prior to this period, the dominant theory used

to explain childhood stuttering was Wendell Johnson's diagnosogenic theory (Johnson & Associates, 1959). This theory posited that stuttering in a young child originated with the diagnosis of stuttering. Johnson and colleagues posited that stuttering at onset was relatively mild, but social feedback from a parent (usually the mother) was perceived negatively by the child, and the motivation to talk without being disfluent resulted in stuttering behaviors. A contemporary theory explaining early stuttering behaviors was the anticipation-struggle hypothesis (Bloodstein, 1972), which posited that the effort to avoid stuttering changed how a person produced speech, resulting in excessive muscle tension, increasing the likelihood of stuttering. Consequently, parents were often advised *not* to talk about stuttering with their children in hopes that they would avoid causing their children to stutter (Johnson, 1942).

The notion that stuttering originated in the "ear of the parent" began to fall from favor in the 1980s, when Yairi and colleagues studied the types of disfluencies produced by preschool-age children at onset (Yairi & Lewis, 1984). They reported evidence that not only did stuttering often onset very abruptly, but that stuttering disfluencies at onset were often associated with a great deal of struggle and muscle tension. Contacting and then recruiting parents of children whose stuttering onset was very recent allowed Yairi and colleagues to identify characteristics of stuttering at its earliest manifestation. This enabled investigators to obtain retrospective data regarding onset when it was still relatively fresh in the minds of caregivers.

With the increasing recognition that stuttering is best thought of as a developmental disorder, Yairi and colleagues, among other investigators, began to investigate the time course of preschool-age stuttering subsequent to its onset. To this end, Yairi and colleagues (1992, 1999) initiated a longitudinal research paradigm to identify risk factors for persistent stuttering. Whereas cross-sectional studies examine aspects of stuttered speech at a point in time, often by a

comparison of people who stuttered to those who did not stutter (e.g., Anderson et al., 2003; Anderson et al., 2005), these longitudinal studies investigate change in aspects of stuttering over months or years. Such studies also expanded the scope of investigation and acquired developmental data regarding language development and language use to investigate a possible causal relation between language and stuttering (Paden, Yairi, and Ambrose, 1999; Watkins, Yairi, and Ambrose, 1999). These types of data were acquired by transcribing and analyzing conversational speech from children, and by acquiring standardized language measures of phonology, vocabulary, and grammar.

A primary design feature of these studies was bringing a child into a study as soon after onset as possible, and acquiring data related to characteristics of stuttering as well as language at 4-6 month increments until the child recovered from stuttering or persisted (Yairi & Ambrose, 1999). Such a design allows investigators to compare children who recover and children who persist on factors acquired soon after onset. Any factors at onset that differ between later persistent versus later recovered children would have important diagnostic value in predicting whether a child might recover or persist. To this end, treatment could potentially be focused on specific risk factors. Such studies typically include a control group of children, matched for age and gender, who do not stutter for comparison to children who persist and recover.

In general, findings from studies of Yairi and colleagues have found little difference at onset between children who later recover versus those who persist other than stuttering (Yairi and Ambrose, 1999; Watkins et al., 1999). The one difference that appears to be consistent across several studies, however, is that children who later persist are observed to exhibit delayed phonological development compared to children who later recover or children who do not stutter (Paden et al., 1999).

More recent developmental studies have added measures associated with temperament and emotion (Anderson et al., 2003; Eggers, De Nil, & Van den Bergh, 2010; Karrass et al., 2006). Such measures have typically been addressed in cross-sectional studies and include questionnaire data from parents regarding their child's temperament, with some focusing on physiological measures of emotional reactivity and/or emotion regulation (Jones et al., 2014). One other type of evidence regarding the temperaments and emotional arousal of children who stutter is that changes in frequency or severity of stuttering are often reported by parents to co-occur with changes in emotional arousal, including the observation that the onset of stuttering often occurs when a child has experienced elevated emotion, whether that emotion is negative or positive (e.g., Yairi & Ambrose, 2005). However, empirical investigations within the laboratory have yet to bear this out.

Some empirical studies have reported that various aspects of emotional arousal and emotion regulation differ between children who do and do not stutter, as reported by parents on standardized questionnaires (e.g., Behavioral Style Questionnaire; Child Behavior Questionnaire). Three dimensions in particular include less adaptability, less distractibility, and less rhythmicity (Anderson et al., 2003; Eggers et al., 2012). Such studies have also revealed for children who stutter increased emotional reactivity and greater difficulty regulating emotions (Karrass et al., 2006), and lower inhibitory control (Eggers, et al., 2010). Thus, an accumulating body or research shows that CWS may be more emotionally reactive and/or have difficulty regulating their emotions (e.g., Anderson, et al, 2003; Karrass et al., 2006).

According to Eggers et al. (2010), children who stutter score higher than their peers who do not stutter in terms of anger and frustration on interrupted tasks, positive excitement when anticipating a forthcoming pleasurable activity, and exhibit excess motor movements like nail

biting, fidgeting and blinking. According to Seery, Watkins, Mangelsdorf, & Shigeto (2007), in their summary of temperament and linguistic contributors to developmental stuttering, CWS exhibit lower adaptability, lower attention span, more negative quality of mood, and higher activity levels compared with their non-stuttering peers. Thus, CWS appear to differ in multiple aspects of temperament, and such differences could potentially contribute to the onset and/or persistence of stuttering.

Daily Developmental Changes

Although longitudinal study designs are the most appropriate for investigating a developmental disorder such as stuttering, the longitudinal studies that have been undertaken in the area of stuttering have typically acquired data at several 4-6-month intervals (e.g., Yairi & Ambrose, 1992, 1999). While such a frequency might be appropriate for assessing factors related to persistence versus recovery, it is less appropriate for understanding factors that relate to daily or weekly changes in the frequency or severity of a child's stuttering. Stuttering is also known to be highly variable, as reports of both adults and parents of children who stutter note changes that take place across a day, a week, or season (Yairi & Ambrose, 2005; Yaruss, 1997). In other words, current longitudinal paradigms might be ill-equipped to address critical factors associated with stuttering development, as such factors might change at a much more rapid rate than the sampling methods typically employed.

Many aspects of development already thought to be related to developmental stuttering change at timescales of days or weeks, including linguistic, cognitive, or emotional development. One example of the rate by which preschool children's language develops is that from ages 1 ½ to 6 years old, a child learns 5 new words a day. In addition, around 2-3 new words are acquired through fast mapping, or quickly creating a link between a word and its relation, before later

refining the word's meaning (Owens 2012). This shows how a child encounters new experiences on a daily basis, and how it affects language acquisition.

The rapid acquisition of vocabulary translates to greater flexibility in language use. For example, 3-year-olds typically have a vocabulary of 900-1,000 words and use close to 12,000 words per day, while 4-year-olds' vocabulary typically consists of 1,500-1,600 words, and they use about 15,000 words per day. Furthermore, a 4-year-old child utilizes twice the number of utterances as 3-year-olds to discuss feelings and emotions (Owens 2012). This specific age range is crucial to stuttering research because 85% of stuttering onsets occur before the child is 3 ½ years old, where the mean age of onset is 33.38 months (Yairi & Ambrose, 2005). Taking such evidence into consideration, it would seem to be most beneficial to study a child whose lexicon is developing at such a rapid pace at daily intervals rather than monthly or every few months, as changes in language and fluency will occur just as quickly as the child gains experiences.

Child Experience

An aspect of development that to date has largely been unexamined is the experiences and perspectives of a child who stutters. Although a preschool-age child is typically unable to communicate self-perspectives to other people, even when asked, children do have perspectives on the world (Harter, 2012). A child encounters a variety of social experiences on a daily basis, some of which are familiar and some of which are unfamiliar. However, a child often has little power or control over daily encounters. What might be perceived as relatively familiar to an adolescent or an adult might be perceived as quite unfamiliar to the child. To this end, a child is often required to adapt to change. For example, for a new situation that is social in nature, a child would be required to adapt social skills to that situation. Furthermore, for an unfamiliar situation that elicits emotional arousal, a child would be required to regulate that arousal.

Finally, during the preschool years a child's self-identity is developing, and this entails relatively more sophisticated cognitive skills such as imagining the perspectives of other people (e.g., Tomasello, 2009).

Unfamiliar situations that yield emotional experiences and that require a child to talk would present a distinct challenge to preschool-age children. It would therefore seem that experiencing more familiar than unfamiliar situations would facilitate the acquisition of speech fluency. This idea is consistent with recent theories of developmental stuttering that implicate both a genetic predisposition (e.g., linguistic, emotional) and the possibility of activation by environmental stressors (e.g., Conture & Walden, 2012). This idea is also consistent with research suggesting that daily routines are important for development in that they provide predictability for a child. To this end, a stable routine would be of direct benefit for a child. One common indirect form of therapy for preschool-age children who stutter is working with parents to establish a stable routine (e.g., Millard, Nicholas, & Cook, 2008; Yairi & Ambrose, 2005).

Emotion

A critical factor that influences to what extent a child is able to regulate emotion, particularly in socially unfamiliar situations, is temperament. All children are born a temperament. Temperament can be defined as "constitutionally based individual differences in reactivity and self-regulation," (Rothbart, Ahadi, Hershey, & Fisher, 2001). With respect to child development, this means that some children have a relatively easy time managing novel social situations, whereas other children have a relatively difficult time. A common way of evaluating temperament is by parent report. A parent is in a unique position to evaluate the emotional reactivity of their child and to assess the ability of the child to regulate their emotions. Anecdotal reports that the onset of stuttering often coincides with elevations in emotional arousal is

consistent with existing empirical data regarding parent reports of their child's temperament. One scale that is often used is the Behavioral Style Questionnaire (McDevitt & Carey, 1978). This instrument assesses a child's temperament and asks a parent to state how their child responds to particular situations. A more recent instrument is the Children's Behavior Questionnaire (Rothbart et al., 2001). Previous studies have used each of these instruments to assess the temperaments of children who stutter (e.g., Anderson et al., 2003; Eggers, et al., 2010; Karrass, et al., 2006).

Other research techniques are also available to assess change at a relatively short timescale. For example, direct behavioral observations can be used to assess a child's emotions, such as facial expression or self-soothing behaviors that function as emotion regulation for a child (e.g., Frankel et al., 2012). A more objective measure of emotional arousal is a measure of physiological response, including indicators of the sympathetic or parasympathetic nervous system (Jones et al., 2014). It is also possible to ask a parent to observe a child's behavior on a daily basis, for example, during emotionally arousing events. Thus, for children who stutter in particular, gathering information about emotional experiences might be an appropriate means to better understand the circumstances in which a child stutters. Although preschool-age children typically often do not have the skills to express their feelings with sophisticated language skills, children of this age can be aware of stuttering and the emotional feelings it can bring about (Clark, Conture, Frankel, & Walden, 2012; Vanryckeghem & Brutten, 2007). Better understanding of the experiences that lead to these feelings might be critical in understanding developmental stuttering.

If much anecdotal information from parents seems to indicate that children's stuttering is related to emotion, at either the onset of daily variability, and if most longitudinal studies are

designed to acquire data at the level of several months, there would seem to be a need for the acquisition of data of both emotion and stuttering on a daily basis. In other words, it would seem appropriate to acquire data about factors that change at the same timescale as stuttering, both across a day and a week. In the present study, a preschool-age child was assessed at a daily and a weekly timescale. Information gathered at the daily timescale included parent identification of emotional arousing events and associated stuttering. Information gathered at a weekly timescale consisted of weekly visits to Speech and Hearing Center for conversational samples of speech. Such information provided for the evaluation of the relation between emotional arousal and associated stuttering at both a daily and a weekly timescale. The specific aims for the study are as follows:

Specific Aims

1. Investigate the relation between emotional arousal and stuttering during emotionally arousing events within a day.

2. Investigate the relation between longitudinal change of emotional arousal and stuttering across several weeks.

3. Investigate the influence of daily and weekly routine in the longitudinal change of emotional arousal and associated stuttering.

CHAPTER 2

METHODS

Participant

A preschool-aged child (aged 3:4) near the onset of stuttering was identified for

participation in this study. At the time of the study, this child appeared to exhibit both language

and emotional contributors (Conture & Walden, 2012: Seery, et al., 2007) and a family history of

stuttering (i.e., potential genetic predisposition), making him an ideal candidate for the study.

According to initial clinical evaluation, this child was precocious in terms of language and

exhibited a temperament that is relatively sensitive to changes in environment and routine, often

marked by episodes of emotional arousal (Eggers, 2010). The study duration was 24 weeks

during the 2015-2016 academic year. Parents visited the clinic at the University of Alabama for

one hour each week. Participants were provided a gift card with a value of $30 on a weekly basis

for their efforts.

Table 1. Participant's standardized speech and language scores.

Exam	PPVT-2	EVT-2	CAAP-2	GFTA-2	TELD-3
Standard Score	104	104	109	116	81
Percentile	61	61	69	81	10

Note: PPVT-2: *Peabody Picture Vocabulary Test, Second Edition*; EVT-2: *Expressive Vocabulary Test, Second Edition*; CAAP-2: *Clinical Assessment of Articulation and Phonology, Second Edition*; GFTA-2; *Goldman-Fristoe Test of Articulation, Second Edition*; TELD-3: *Test of Early Language Development, Third Edition*.

Procedures

At each weekly visit, a parent-child conversation and a clinician-child conversation were audio-video recorded. These recordings were uploaded into a computer, from which InqScribe (Inquirium, LLC) software was used for transcription and coding of speech disfluencies. A total of 48 videos were transcribed for speech samples. Speech disfluencies were coded according to a variety of types (i.e., syllable prolongations, part-syllable repetitions, whole syllable repetitions, and revisions). A team of undergraduate students made two or more passes through transcription and coding. Emotions (happy, sad, angry and neutral) were coded for all utterances containing disfluencies, as well as the utterance occurring before and after utterances containing disfluencies. This was done in order to gain a full picture of the emotions surrounding moments if disfluencies, rather than to see emotions only during an utterance where stuttering occurred. A subset of transcriptions was used for coding reliability. A Pearson correlation coefficient was $r=$ .85, indicating high reliability among coders.

The participant's language development and temperament was examined with a variety of standardized instruments. The Peabody Picture Vocabulary Test, Fourth Edition (Dunn &Dunn, 2007), and the Expressive Vocabulary Test, Second Edition (Williams, 2007), were administered to test receptive and expressive vocabulary skills, respectively. The Goldman-Fristoe Test of Articulation, Second Edition (Goldman & Fristoe, 2000) and the Clinical Assessment of Articulation and Phonology, Second Edition (Secord & Donohue, 2013), tested for articulation skills and phonological processes, respectively. The Test of Early Language Development, Third Edition, measured the child's language skills (Hresko & Reid, 1999). For evaluation of temperament, parents completed the Children's Behavior Questionnnaire (Rothbart

et al., 2001). Finally, the child was administered the KiddyCat to assess the child's attitude regarding his speech production (Vanryckeghem & Brutten, 2007).

Speech therapy was begun in the spring 2016 semester. The Lidcombe approach was used to treat the child's stuttering (NEED CITATION AND BRIEF DESRIPTION OF WHAT THIS ENTAILS). The family was also trained in this procedure and encouraged to utilize it at home for generalization. This program is intended for children aged 2-6 years, and includes praising the child's fluent speech five times for each single time disfluent speech is remarked upon. When disfluent speech was mentioned to the child, no negative connotation or suggestions concerning how to produce fluent speech were used. In this program, the caregiver or examiner may ask the child to try a stuttered word or utterance again alone or with the conversation partner.

Materials

Upon consent to participate in the study parents first completed a novel intake questionnaire (Appendix A). In addition, a novel questionnaire was designed specifically for this study to assess daily emotional events and associated stuttering (Appendix B). Caregivers chose four emotional events each day and provided ratings of 1) the intensity of the emotion, 2) how long the emotion lasted, 3) the level of any accompanying stuttering, and 4) the extent of child's frustration with stuttering, all on a 1-7 scale, with 7 as the highest level indicated. Caregivers were also required to report aspects of routine in this questionnaire, which included morning, evening, mealtime and social routines. The caregiver indicated whether the child followed routine in each of the aforementioned four categories. Questionnaires were completed each day and returned to the clinic each week. For the purposes of this study, only parent-observed emotion intensity and parent observed stuttering were used to examine the specific aims.

Data Analysis

Data from both the questionnaires and weekly observations of the child were entered into a spreadsheet. Mixed models using R statistical software (R Development Core Team, 2009) with the statistical package lme4 (Bates & Mächler, 2009) were used to evaluate the specific aims. Degrees of freedom were calculated based on the Satterthwaite approximation using the statistical package lmerTest (Kuznetsova, Brockhoff, & Christensen, 2012). For each model, independent variables of interest were used in the base model to predict the dependent variable. Interactions were also considered and were maintained in a model if significant. For the lme4 package, the null distribution is a t-distribution showing a t-statistic, approximated by the regression parameter (estimate) divided by the standard error (SE) of the estimate. Bates, Mächler, Bolker, and Walker (2015) state that degrees of freedom can be problematic for models with random factors, and therefore must be approximated.

CHAPTER 3

RESULTS

Results were organized according to each specific aim. Specific Aim 1 evaluated the

relation between parent-observed stuttering and emotion intensity. Specific Aim 2 evaluated

longitudinal change in emotion and stuttering. Finally Specific Aim 3 evaluated the potential

impact of routine on longitudinal change in emotional and stuttering.

Specific Aim 1. Figure 1 depicts the relation between parent-observed emotional intensity

and parent-observed stuttering. As is evident in the figure, most of the ratings fall into the middle

of each of the ranges. A mixed model showed that emotion intensity during an emotional event

was not related to observed stuttering $t(697) = 0.177$, $p = .859$. However, an interaction between

emotional intensity and valence was found, indicating that emotional intensity was related to

observed stuttering for negative emotions only $t(695) = 3.100$, $p = .002$. This effect was also

significantly greater at the beginning of the study, as negative emotional intensity became less

predictive of stuttering as the study progressed. It was also found that the general emotional

intensity throughout the day was predictive of stuttering.

Specific Aim 2. Figure 2 depicts change in examiner measures of stuttering across the

duration of the study. In addition, Figure 3 depicts mean length of utterance in words across the

duration of the study. A mixed model showed that emotional intensity became less predictive of

stuttering as the study progressed. Results revealed no significant change in stuttering rate

(percentage of stuttered syllables) over the course of the study. This is shown in Table 3.

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Further, this means the child did not systematically increase or decrease his rate of stuttering over the months the study was conducted. When the mean length of utterance (MLU) was examined, it was found that there is a statistically significant relation between MLU and rate of stuttering, only when data was taken from the child's interactions with his caregiver $t(37)=$ 2.171, $p=.036$. There was not a significant relation between MLU and rate of stuttering from observed speech between the examiner and the child.
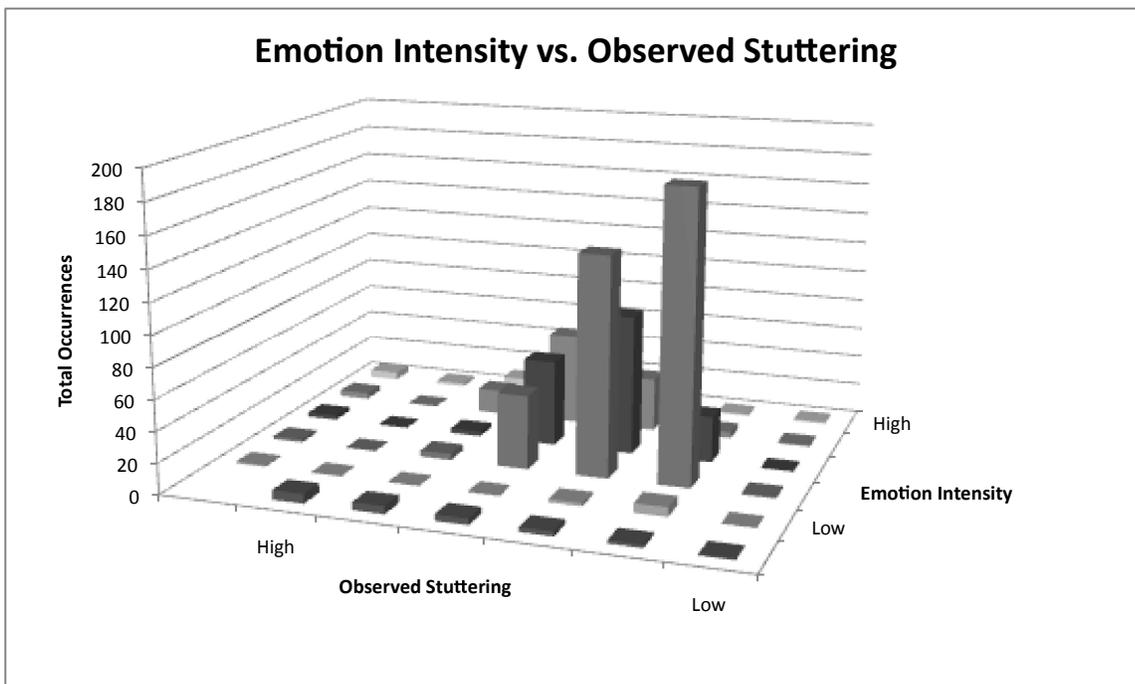
Figure 1. Parent-reported emotion intensity and associated stuttering.

Emotion coding depicted emotions the child presented in the single utterances before, during, and after disfluencies during weekly speech samples. The overwhelming majority (89%) of those coded utterances showed the child's emotions to be neutral in the moments before, during and after stuttering. Happy (positive) emotions accounted for 9% of the emotions coded, while sad and angry (negative) emotions represented 2% of the total emotions coded. This indicates no longitudinal change of examiner-observed emotions across the course of the study.
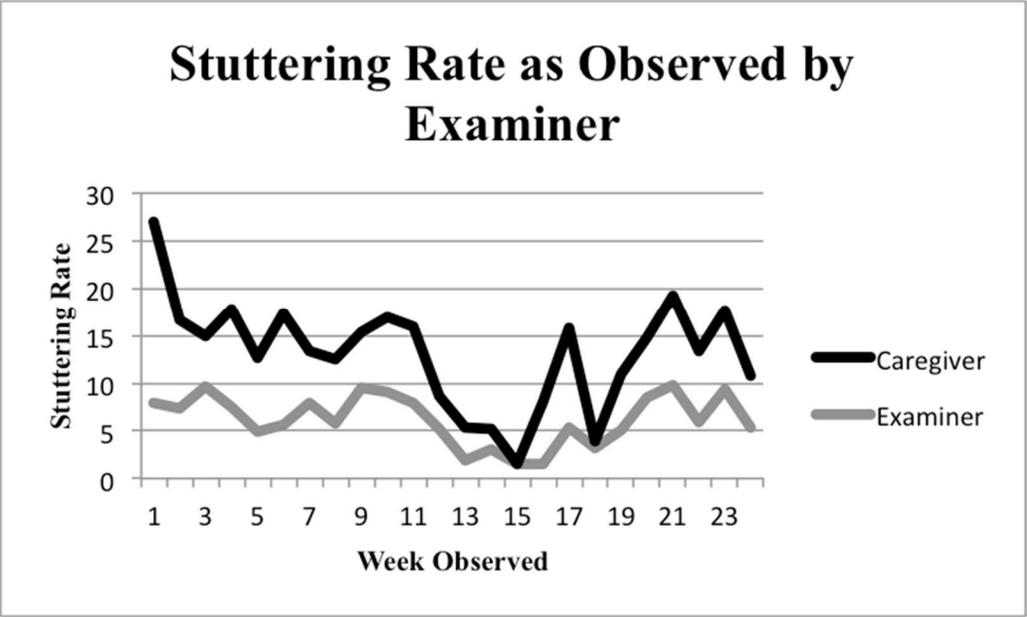
Figure 2. Stuttering rates across 24 weeks.
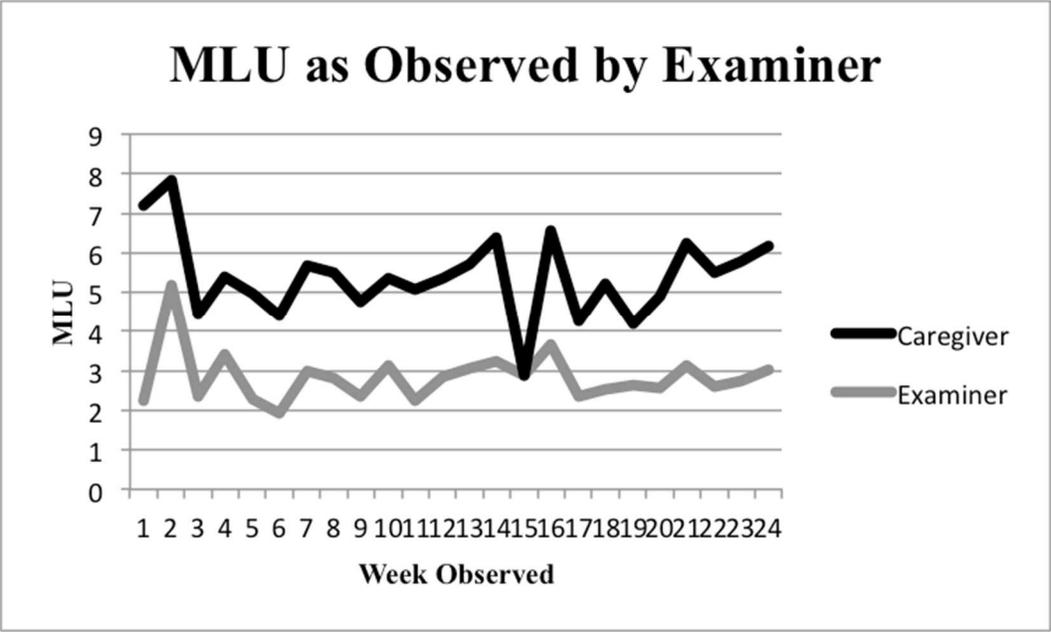
Figure 3. MLU across 24 weeks.

Observer measures of emotions revealed that the large majority of emotions exhibited relative to occurrences of stuttering in overt speech were neutral. As can be seen in Table 2,

Table 2. Occurrences of emotions.

Emotion	Total Occurrences
Neutral	924 (89%)
Happy	93 (9%)
Sad	18 (2.7%)
Angry	3 (0.2%)

Specific Aim 3. Parent perception of routine was not found to be related to specific emotional events where stuttering occurred. Morning routine $t(274)= 1.696, p=.0911$, evening routine $t(273)= 1.164, p=.245$, and mealtime routines $t(272)= .323, p=.747$ did not predict emotional events. Deviation from the typical individuals the child interacted with each day approached a statistically significant relation between this change in routine and individual emotional events $t(276)= 1.761, p=.079$.

Summary. Results showed higher intensities of emotion were predictive of stuttering when the emotion presented was negative. There was no significant change to the rate of stuttering over the progression of the study, however intensity of negative emotion became less predictive of stuttering as the study progressed. It was also shown that MLU was positively related to rate of disfluencies when the caregiver and child conversed. Finally, results did not show aspects of routine to be significantly related to emotional arousal.

CHAPTER 4

DISCUSSION

This study revealed three main findings. First, results were consistent with the widely

held anecdotal assumption that emotions are related to stuttering. From parent report, there was a

significant relation between negative emotions and stuttering. This was particularly true in the

beginning months of the study. In addition, disfluennt utterances were associated with most

neutral emotions. Second, longitudinally, there was too much variation in examiner-observed

stuttering rates each week to uncover a significant change over time. Furthermore, a relation

between mean length of utterance (MLU) and stuttering rate was apparent when the child was

interacting with his mother. Third, strong evidence that routine was related to stuttering rate was

not found. Mealtime, morning, evening, and social routines were not significantly related to

observed stuttering.

Specific Aim 1

Data provided by the child's caregiver reporting his four daily emotional events showed a

relation between only negative emotional intensity and stuttering. This may have occurred for a

number of reasons. First, the child's caregiver may have given her attention to the child more

often during negative emotional events as compared to her attention during positive emotional

events. This may have been exacerbated by the child reacting with negative emotions in order to

gain his caregiver's attention. Second, stuttering may have been more apparent to the caregiver,

who was not trained to recognize more subtle disfluencies, during negative emotional events.

Specific Aim 2

a. Longitudinal Changes in Emotions and Stuttering

From the caregiver's reports negative emotional intensity became less predictive of stuttering as the study ran its course. The change in temperament across this study may have affected the child's stuttering itself. Research has shown that children who stutter present with difficulty regulating emotions, less adaptability and less distractibility (Anderson et al., 2003; Eggers et al., 2012; Karrass et al., 2006). They also show excess motor tasks such as fidgeting and higher levels of anger and frustration as compared to peers who do not stutter (Eggars et. al, 2010). According to the caregiver's reports, differences in these elements of emotional control became less prominent throughout the study.

During the spring of 2016, the Lidcombe program for stuttering was administered by the examiner and was highly suggested for home use. Each week, clinicians and researchers counseled the caregiver regarding her child's stuttering. This possibly changed her view on stuttering from guilt that she, someone who had recovered from developmental stuttering, had potentially passed on the possibly genetic trait to her child, to focusing on the child's ability to convey intentional messages. Examiners trained the caretakers in the Lidcombe methodology specifically, where the child's fluent, "smooth speech" was praised five times more often than disfluent, "bumpy speech" was remarked upon. This is a drastic change from placing negative emphasis on stuttering, or avoiding the mention of stuttering as was advised in earlier theories on fluency therapy (Johnson 1942). A notable change that occurred after the Lidcombe program began with this child was a reduction in muscle tension of the participant's neck. According to the anticipation-struggle hypothesis, muscle tension in those who stutter may be caused by an effort not to stutter (Bloodstein, 1972). This indicates the possibility that the methodology used

in speech therapy helped the child to focus less on forced fluency. As this method causes caregivers to attend to fluent as well as disfluent speech, the Lidcombe program may have also changed the caregiver's bias toward noticing disfluencies during negative emotional events. It may have lessened the child's own negative emotions towards stuttering, possibly causing fewer negative emotional events.

b. Subjective Observations by the Examiner and Clinicians

Two of the conditions related to stuttering onset applied to the child. These conditions were genetic predisposition and emotional reactivity and regulation (Conture and Walden, 2012), where the mother stuttered and recovered. In terms of temperament, Conture et al. predicted "children who stutter who exhibit high levels of reactivity will differ, from other children who stutter, in terms of various aspects of stuttering, such as frequency and type of stuttering," (2005). Data gathered from parent reports showed that negative emotional events stopped predicting stuttering. Thus, the child's level of reactivity did appear to decrease across the timespan of the study. As this perceived change in temperament was occurring, after four months of the study, the child began to present with a different type of stuttering: repetitions and concomitant behaviors that seemingly changed weekly such as tongue clicking, kicking, and sharply drawn breaths. According to Wolk, Edwards and Conture, developing repetitions, such as whole-word repetitions, is consistent with children who show no delay in phonological development, such as the participant in this study (1993). Further, children who show no delay in phonological development are more likely to recover from stuttering than those who present with a phonological delay (Paden et al., 1999).

Changes in the child's levels and incidences of stuttering during the first year post-onset of stuttering are consistent with subsequent significantly lowered levels of stuttering and

eventual recovery (Yairi & Ambrose, 1999). Examiner's observations of the child's stuttering further supported this variation in stuttering rates across the timeline of the study. In the months after this study's conclusion, the child appeared to begin the gradual stages of recovering from stuttering. This information was derived from the clinician who continued Lidcombe therapy techniques with the participant in summer 2016. This clinician reported a significant reduction in the child's rate of stuttering. Sixth months after the study's conclusion, parent reports indicated that the child stuttered occasionally, but significantly less than during the study's duration.

c. Mean Length of Utterance and Stuttering Rate

The result of variations in stuttering rates, both observed and reported, showed no longitudinal change in stuttering. Changes in stuttering rates may take place in as little time as a day or week (Yairi & Ambrose, 2005; Yaruss, 1997), therefore differences in stuttering rates were expected. Furthermore, the child's MLU was only positively related to child's stuttering rate when he spoke with his mother. This does affect longitudinal stuttering rates, as the child's MLU was variable across the course of the study, with both his caregiver and the examiner. The child's MLU was expected to grow throughout the study. This is due to the stage in the child's language development as a three-year-old. On average, during that year a child increases the number of words uttered in a day by 3,000 (Owens, 2012). On average, the child had a greater MLU when speaking with his mother than the examiner. This alone may not have caused an increased rate of stuttering. According to Zackheim and Conture (2003), both complexity of utterance and the length of utterance determine possible resulting speech disfluencies. The participant's speech appeared more naturalistic when speaking with his mother, which may have had an impact on both MLU and complexity utterances during those speech samples. Simply put, the child produced more disfluencies as he produced more speech. This was consistent across the

course of the study, where he had a higher rate of stuttering on days when he spoke more freely. Emotion and attention may have also played a role in these speech samples, as the child's sister often joined him and his mother. This created an environment where attention was not necessarily focused on him, unlike when the child spoke with examiners, which might have increased the child's MLU when speaking to his mother and sister in child/caregiver speech samples as compared to child/examiner speech samples.

d. Emotions Coded During Observed Disfluencies

Clinician-observed emotional changes were not found across the span of the study. The child's emotions remained neutral in 89% of disfluent moments and those utterances before and after, while he was markedly happy during 9% of the times he was recorded stuttering. This may have been altered by the activities planned for the child: they were meant to encourage speech production and not elicit emotional reactions. The mother's observations of the child's emotions are what became significant in terms of this study's specific aims as over time, where negative emotions became less predictive of stuttering.

Specific Aim 3

Routine was focused on in the spring of 2016, where most routine changes appeared not to be related to stuttering. Changes in the people the child interacted with on a given day were not highly predictive of stuttering, but moderately predictive. It is anticipated that if data had been gathered for a longer span of time than the four months data was collected for this aspect of the study, such as eight months, this particular routine change would have been shown to be more predictive of stuttering. During this time in the child's life, a child is thought to develop a self-identity as well as to begin to imagine others' perspectives of him and his speech (Tomasello, 2009). The child can also develop a sense of when he stuttered and how he feels

about the disfluencies (Clark, Conture, Frankel, & Walden, 2012; Vanryckeghem & Brutten, 2007). As this child's language was growing and he became more aware of his stuttering, speaking with new conversation partners may be related to some anxiety for the child. This may be why the relation between emotional events and the introduction people who weren't part of his daily routine approached statistical significance. This in turn could have an effect on stuttering rate, as these may be related to environmental stressors (Conture & Walden, 2012).

While routine as a whole was not shown to be predictive of stuttering, the caregiver reporting and reflecting upon aspects of daily routines may have caused adherence to routine. As the child was a speech therapy client during the spring, part of this therapy was counseling the caregiver on the importance of routine. Establishing a stable routine is a common form of indirect fluency therapy (Millard, Nicholas, & Cook, 2008; Yairi & Ambrose, 2005). This, along with the accountability of recording which routines were followed, could have had a positive affect on the caregiver keeping a routine for the child. The child's daily routine also became more stable when he began a local Head Start program. This began during the fall 2015 semester. It was reported that routine was strictly adhered to during school hours. The child's caregiver also reported that the child's teacher claimed to never hear the child have significant disfluencies during the school day. It is possible that this adherence to routine throughout the day altered the frequency of the child's intense emotional events both while at school and at home.

Conclusions, Limitations and Future Directions

In conclusion, this longitudinal analysis of one child's emotional events and fluency showed relations between emotions and stuttering. This became less relevant as his language grew and negative emotions became less predictive of stuttering. There were many limitations to these findings, however. First, and most apparently, the application of these results is limited due

to there being one participant in this study. Also, the parent's bias was another limitation, as the parent could have been more likely to notice emotional arousal when stuttering occurred. This might be better measured by choosing fixed time periods each day. Next, the child's sibling often accompanied him and his mother to sessions where speech samples were taken, during which the two children often competed for their caregiver's attention. One final limitation was the time of day the child was observed. Ideally, examiners would observe the child weekly at the time of day most conducive to speech production. Due to the schedules of all parties involved in the recorded speech samples, the time of day in which these samples were recorded was the late afternoon. This may not have been ideal for a most accurate gauge of the child's fluency in speech.

Future studies are planned to expand the number of participants as well as the aim of finding a relation between stuttering and routine. The daily questionnaire for caregivers will include more detail regarding routine and more comprehensive ranking systems for judging the child's emotion intensities and disfluencies. These future studies will utilize a longitudinal format to generate more generalizable data revealing the relations between emotions, routine, and stuttering.

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APPENDIX

A. University of Alabama   **Client ID: _____**

Intake Checklist

"Contributing factors to stuttering development in preschool-age
and school-age children"

Instructions: Please circle the answer that best completes the statements below:

1. The current date: year_____ month _____ day_____

2. My child's birth date: year_____ month _____ day_____

    Chronological age: year_____ month _____ day_____

3. To the best of my knowledge, I first noticed my child's stuttering:

    year_____ month _____ day_____

4. In my opinion, the onset of my child's stuttering was affected by the following event(s):

    a. _____
    b. _____

5. Other members of my immediate family who stutter now or have stuttered in the past include:

    a. _____
    b. _____
    c. _____
    d. _____
    e. _____

6. If your child has received stuttering treatment from stuttering in the past, please provide the dates corresponding to the beginning and end of treatment:

    From: year_____ month _____ day_____

    To: year_____ month _____ day_____

B. University of Alabama – *Daily Events Checklist*   Client ID: _____   Date: _____

Instructions: Fill out the table below with at least 4 specific emotional events for the past 24 hours. *Please fill out this table the same time every day*. In addition, consider for today only your child's *general level* of emotional arousal and stuttering, and whether routine was typical:

1. My child's general level of *emotional arousal* in the last 24 hours, on a scale of 1-7, from no arousal to peak arousal is: _____.

2. My child's general level of *stuttering* in the last 24 hours, on a scale of 1-7, from no stuttering to peak stuttering, is: _____.

3. Routine today was typical: **Morning?** *Yes   No*   **Evening?** *Yes   No*   **Meals?** *Yes   No*   **People?** *Yes   No*

	Event that led to arousal	Positive or negative? (circle one)	Intensity of event Rate 1-7	Observed emotion(s)	Intensity of emotion Rate 1-7	Duration of emotion Rate 1-7	Observed amount of stuttering Rate 1-7	Frustration about stuttering Rate (1-7)
Event 1		Positive Negative						
Event 2		Positive Negative						
Event 3		Positive Negative						
Event 4		Positive Negative						
	Examples ***Minor*** Not get treat Woke from nap ***Major*** Birth in family Death in family		1-very minor 2-somewhat minor 3-minor 4-not sure 5-major 6-somewhat major 7-very major	**Examples** Crying Laughter Anger Disgust Anxiety Agitated	1-no arousal 2-little arousal 3-some arousal 4-not sure 5-much arousal 6-high arousal 7-peak arousal	1-few seconds 2-several seconds 3-half minute 4-full minute 5-few minutes 6-several minutes 7-nearly an hour	1-no stuttering 2-little stuttering 3-some stuttering 4-not sure 5-much stuttering 6-high stuttering 7-peak stuttering	1-no frustration 2-little frustration 3-some frustration 4-not sure 5-much frustration 6-high frustration 7-peak frustration

C. University of Alabama Internal Review Board Approval Letters

ALABAMA Institutional Review Board for the Protection of Human Subjects

July 28, 2016

Anthony P. Buhr, Ph.D.
Assistant Professor
Department of Communicative Disorders
College of Arts & Sciences
The University of Alabama
Box 870242

Re: IRB # 12-OR-282-ME-R5 "Contributing Factors to Stuttering Development in Preschool-Age and School-Age Children"

Dear Dr. Buhr:

The University of Alabama Institutional Review Board has granted approval for your renewal application. Your renewal application has been given expedited approval according to 45 CFR part 46. Approval has been given under expedited review category 7 as outlined below:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your application will expire on July 27, 2017. If your research will continue beyond this date, complete the relevant portions of the IRB Renewal Application. If you wish to modify the application, complete the Modification of an Approved Protocol Form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, complete the appropriate portions of the IRB Study Closure Form.

Please use reproductions of the IRB approved informed consent form to obtain consent from your participants.

Should you need to submit any further correspondence regarding this proposal, please include the above application number.

Good luck with your research.

Sincerely,

Carpantato T. Myles, MSM, CIM, CIP
Director & Research Compliance Officer
Office of Research Compliance

UNIVERSITY OF ALABAMA
INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS
REQUEST FOR APPROVAL OF RESEARCH INVOLVING HUMAN SUBJECTS

I.   Identifying information

	Principal Investigator	Second Investigator	Third Investigator
Names:	Anthony Buhr		
Department:	Communicative Disorders		
College:	Arts and Sciences		
University:	Alabama, Tuscaloosa		
Address:	Speech and Hearing Clinic		
Telephone:	205-348-1413		
FAX:			
E-mail:	anthony.buhr@ua.edu		

Title of Research Project: Contributing Factors to Stuttering Development in Preschool-Age and School-Age Children

Date Submitted: April 13, 2012
Funding Source: NA

Type of Proposal	☐ New	☐ Revision	☒ Renewal Please attach a renewal application	☐ Completed	☐ Exempt
			Please attach a continuing review of studies form		
			Please enter the original IRB # at the top of the page		

UA faculty or staff member signature: ████████████████

II. NOTIFICATION OF IRB ACTION (to be completed by IRB):
Type of Review: _____ Full board ___✓___ Expedited

IRB Action:
___ Rejected   Date: _____
___ Tabled Pending Revisions   Date: _____
___ Approved Pending Revisions   Date: _____
___ Approved-this proposal complies with University and federal regulations for the protection of human subjects.
      Approval is effective until the following date: 7-27-17 as
      Items approved: ___ Research protocol   (dated_____)
                          ___ Informed consent   (dated_____)
                          ___ Recruitment materials   (dated_____)
                          ___ Other   (dated_____)

Approval signature ████████████████   Date 7/28/2016