A BEHAVIORAL STUDY OF EMOTIONAL REACTIVITY AND EMOTION REGULATION IN PRESCHOOL-AGE CHILDREN WHO STUTTER

By

Aikaterini Ntourou

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the Degree of

DOCTOR OF PHILOSOPHY

in

Hearing and Speech Sciences

August, 2011

Nashville, Tennessee

Approved:

Professor Edward G. Conture

Professor Tedra A. Walden

Professor Daniel H. Ashmead

Professor Ellen M. Kelly

This dissertation is dedicated to …

My mother, Nana, who has always been an endless source of love, power, wisdom, motivation, generosity, and inspiration for my sister and me

My sister, Eleni, for her unconditional love, support, friendship, and encouragement

My baby niece, Myrto, whose presence, at difficult times, gave me hope and optimism for the future

But most of all, I dedicate this dissertation to my late father, Dimitris, to whom I owe everything, and who I love and miss tremendously.

ACKNOWLEDGEMENTS

This study would not have been possible without the financial support from the following National Institute of Health Grants: DC000523-14A1, 2R56DC000523-14A1, and DC006477-01A2. First, I wish to express my deep and sincere gratitude to my advisor and mentor, Dr. Edward G. Conture, for his continuous and patient guidance, support, and encouragement throughout my doctoral training. His tireless dedication as a mentor and a teacher-scholar is truly inspiring. I am also especially thankful to Dr. Tedra Walden for her insightful and thought-provoking comments as well as her constructive criticisms at different stages of this study.

I am also grateful to each of my other committee members, Drs. Daniel Ashmead and Ellen Kelly, for their scholarly insight and guidance towards the development of this study. I would also like to sincerely thank Dr. Carl Frankel for his substantial assistance with the statistical analyses of this study, Dr. Brian Verdine, Robin M. Jones, and Elizabeth Will for inter-judge reliability, and Chagit Edery Clark for making sure I had enough time to dedicate to the completion of my dissertation. Also special thanks to Jared Sinclair for his love, encouragement, and support.

Furthermore, I extend my appreciation to the many children and their families who participated in this study without whom this research would not have been possible.

Finally, there are no words to describe the love, appreciation and gratitude for my family and close friends who have been a tremendous source of encouragement, support and inspiration throughout my life.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

The contribution of emotion to the onset, maintenance and exacerbation of developmental stuttering has long been discussed (e.g., Glauber, 1958; Johnson, 1955, 1959; Sheehan, 1953). Alongside such discussion, numerous empirical studies of the relation of emotional processes to stuttering have been reported, with most of these studies involving adults who stutter (e.g., Baumgartner & Brutten, 1983; Caruso, Chodzko-Zajko, Bidinger & Sommers, 1994; Dietrich & Roaman, 2001; Weber & Smith, 1990). Recently, however, more attention has been paid to the relation between emotion and stuttering in children who stutter (e.g., Anderson, Pellowski, Conture, & Kelly, 2003; Arnold, Conture, Key & Walden, 2011; Johnson, Walden, Conture, & Karrass, 2010; Karrass et al., 2006; Eggers, de Nil, & van den Bergh, 2010). This increased attention to children is noteworthy because stuttering typically begins in early childhood, a period of time prior to extensive experience with well-established learned reactions to the disorder. Due to this fact, the study of stuttering in preschool-age children who stutter may help us better understand the directionality of effect between emotion and stuttering, something often debated but still poorly understood.

As discussed by Treon (2010), the directionality effect has led some to suggest that stuttering and/or instances of stuttering play a causal or contributing role in the creation of emotion (i.e., stuttering → emotion). In contrast, others have proposed that emotion play a causal or contributing role in the onset and development of stuttering (i.e., emotion → stuttering). Still others (e.g., Frankel, Walden, & Conture, 2011) view emotions and stuttering as "bidirectionally influencing each other through complex, dynamic emotional and communicative processes" (p.4) (i.e., emotion ↔ stuttering).

It is, of course, challenging to determine which, if any, of these perspectives best accounts for the directionality of effect between emotion and stuttering. As suggested above, however, one possible means to disentangle antecedent contributions to versus subsequent consequences of stuttering is to study young children who stutter. In the present study, therefore, we experimentally investigated the relation between emotional processes (emotional reactivity, emotion regulation) and developmental stuttering in young children who do stutter (CWS) and do not stutter (CWNS). To do so, the present author employed the Dual Diathesis-Stressor (DD-S) model of stuttering (Conture & Walden, in press) as a conceptual framework.

DD-S Model of Stuttering

Conture and Walden's (in press, see Figure 1) DD-S model of stuttering provides one means to conceptualize and empirically test emotional and speech-language contributions to developmental stuttering. According to this conceptual framework, speech-language and emotional diatheses or vulnerabilities are made manifest, in the form of stuttering, by interactions with "external" (environmental) or "internal" stressors (see Monroe & Simons, 1991 for an overview of diathesis-stressor models). It is speculated that these diatheses contribute to both the onset of developmental stuttering as well as actual instances of stuttering.

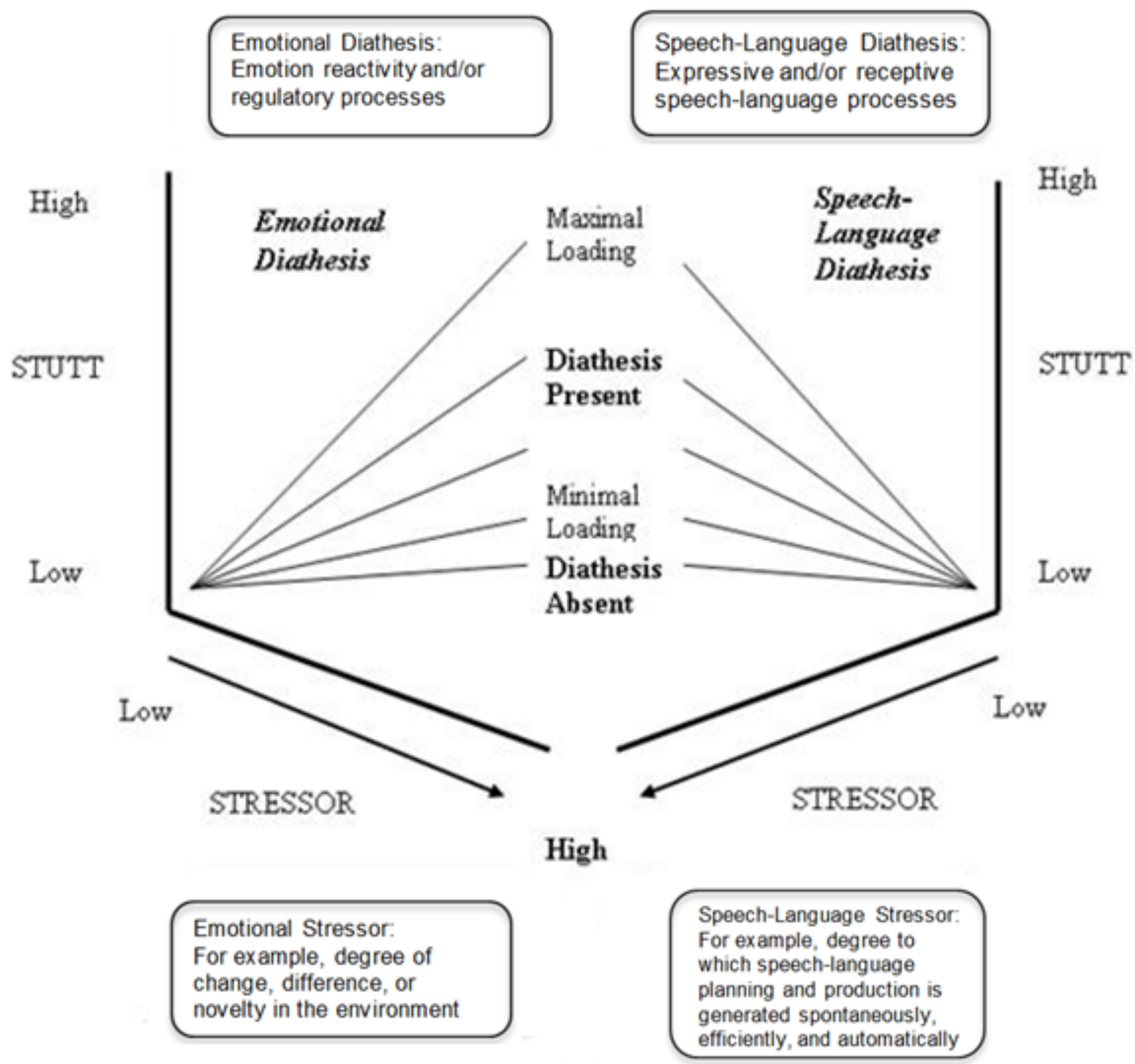

Figure 1. The Dual Diathesis-Stressor (DD-S) Model of Developmental Stuttering. The figure portrays the hypothesized relation between diatheses and stressors and the impact this relation is thought to have on stuttering. The two stressors are portrayed as continuous and the two diatheses as quasi-continuous variables (Conture & Walden, in press).

As suggested by the DD-S model, the emotion diathesis consists of relatively stable proclivities for emotional reactivity and regulation, whereas language diathesis refers to speech-language planning and production abilities, with the “loading” or degree of diathesis/vulnerability thought to reflect individual differences. The emotional stressors can be internal or environmental stimuli/variables that elicit emotional responding, with language stressors thought to involve various situational requirements for communicative exchanges. For example, the fluency of a highly emotionally reactive child with poor regulatory skills might be compromised in highly emotionally-arousing communicative/social situations.

Overview of Existing Empirical Evidence

Intriguing lines of empirical evidence regarding the contribution of emotions to developmental stuttering have emerged from studies using different methodological designs such as behavioral observations, parent-report questionnaires, and psychophysiology (e.g., Anderson et al., 2003; Arnold et al., 2011; Buhr, Frankel, Walden, Conture, & Porges, 2011; Karrass et al., 2006; Embrechts, Ebben, Franke, & van de Poel, 1998; Johnson et al., 2010; Jones, Conture, Frankel, & Walden, 2011; Wakaba, Iizawa, Gondo, Inoue, & Fuino, 1998; Walden et al., 2011).

Among these empirical studies of emotions and stuttering, some (e.g., Anderson et al., 2003; Lewis & Goldberg, 1997) have focused on relatively stable/trait-like/dispositional (temperament) variables of emotional development. The trait-like construct of *temperament* is believed to encompass a group of related characteristics (e.g., Zentner & Bates, 2008) which, according to Rothbart and Bates (1998), can be described as constitutionally, biologically-based individual differences in reactivity and regulation that demonstrate consistency across various situations and relative stability over time. Thus, temperament is one attribute of children that mediates the environmental influences (Goldsmith et al., 1987). Several researchers have proposed that temperament consists of different dimensions such as adaptability to new situations or people, activity level, attention span/persistence, inhibitory control, rhythmicity, quality of mood and so forth (e.g., Rothbart, Ahahdi, Hershey, & Fisher, 2001; Thomas & Chess, 1977).

In contrast to studies of temperament in children who stutter, others have accessed more variable/state-like/situational components of emotional functioning, such as emotional reactivity and emotion regulation (e.g., Johnson et al., 2010; Jones et al., 2011; Karrass et al., 2006; Walden et al., 2011). *Emotional reactivity* refers to the threshold, intensity, and ease with which individuals become emotionally aroused to changes in the environment. *Emotion regulation*, a construct closely related to emotional reactivity, has been described as consisting of extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals" (Thompson, 1994; p. 27).

This shift in emphasis to emotional reactivity and emotion regulation is seemingly related to the fact that, unlike temperamental characteristics which are considered to be generally stable over time, emotional reactivity and emotion regulation are believed to vary across situations and can be measured on a moment-to-moment basis, similar to the measurement of speech disfluencies (e.g., Spinrad et al., 2004). Below, is presented a brief overview of findings regarding CWS and CWNS' temperament (dispositional) and emotion reactivity/emotion regulation (situational). These findings result from empirical studies involving parent-report questionnaires, psychophysiological measures, and behavioral observation in laboratory settings. In addition, findings regarding the relation between emotional processes (emotional reactivity, emotional regulation) and disfluencies are briefly discussed.

Parent-report Questionnaire Studies of Emotions and Childhood Stuttering

Results of studies of emotional processes of CWS and CWNS based on parent-report questionnaires (e.g., *Behavioral Style Questionnaire [BSQ]*; McDevitt & Carey, 1978; *Dutch version of Child Behavior Questionnaire [CBQ-D]*; Van den Bergh & Ackx, 2003) indicate that young CWS, when compared to CWNS, are rated (a) significantly higher on activity level (e.g., Anderson et al., 2003; Embrechts et al., 1998; Eggers et al., 2010), (b) more sensitive, anxious, fearful, introverted, withdrawn (e.g., Fowlie & Cooper, 1978; cf. Embrechts et al., 1998), (c) less adaptable to change (Anderson et al., 2003; Howell et al., 2004; Wakaba, 1998; cf. Lewis & Goldberg, 1997; cf. Williams, 2004), (d) more impulsive and less adept at attentional focusing, attentional shifting, inhibitory control, and perceptual sensitivity (e.g., Eggers et al., 2010; Embrechts et al., 1998; Felsenfeld, van Beijsterveldt, & Boomsma, 2010), (e) more emotionally reactive and less able to flexibly control their attention and shift attention away from emotionally arousing stimuli (e.g., Karrass et al., 2006), (f) less rhythmic in their daily life activities (Anderson et al., 2033; Wakaba, 1998; cf. Lewis & Goldberg, 1997), and (g) more negative in quality of mood (Eggers et al., 2010; Wakaba, 1998; cf. Lewis & Goldberg, 1997).

In general, results from these caregiver-rating studies suggest that CWS differ from CWNS across some, but not all, emotion-related dimensions.

Psychophysiological Studies of Emotions and Childhood Stuttering

Arnold et al. (2011) assessed psychophysiological (i.e., electroencephalographic, EEG) indices of emotional reactivity and regulation in young CWS and CWNS during emotionally arousing background conversations and found no significant between-group differences in psychophysiological/EEG indices. Similarly, Kazenski, Guitar, McCauley, and Falls (2007) examined physiological measures of reactivity (jitter, shimmer, fundamental frequency, acoustic startle eye-blink response) in young CWS and CWNS in low and high stress situations and did not find significant between-group differences. However, Kazenski et al. did report that within the CWS group physiological measures differentiated severe from mild-moderate stutterers.

In contrast, Jones (2011) measured respiratory sinus arrhythmia (RSA), a physiological index of emotional regulation, during a baseline and two emotion-inducing child video clips as well as narrative tasks and found that young CWS exhibited significantly lower overall RSA than their fluent peers. Furthermore, CWS, unlike their fluent peers, displayed a significant decrease of RSA change from the baseline to the narrative tasks. This finding might indicate that during talking, CWS are less apt to engage the “social communication system” (e.g., Porges, 2007) than their normally fluent peers, perhaps because they perceive communication as a challenge. In contrast, Buhr and his colleagues (2011) reported that preschool-age CWS exhibited statistically significant higher RSA than their normally fluent peers.

At last, Ortega and Ambrose (in press) assessed school-age CWS’ emotional reactivity to daily stressors by measuring the stress biomarkers cortisol and alpha-amylase. Their results indicated that CWS’ levels of cortisol and alpha-amylase were significantly lower than published norms. However, due to the relatively small sample size ($N = 9$) and the absence of a CWNS control group these results challenge straightforward interpretation. In contrast, van der Merwe, Robb, Lewis, and Ormond (2011) compared cortisol levels in seven preschool-age CWS and seven gender- and age-matched CWNS and found no statistically significant between-talker-group difference.

Behavioral Observational Studies of Emotions and Childhood Stuttering

Schwenk, Conture, and Walden (2007) experimentally investigated differences between CWS and CWNS in attention focusing and speed of reaction to irrelevant background stimuli in a laboratory setting. These researchers found that CWS were significantly more reactive to these environmental stimuli and less able to quickly habituate to them.

Frankel et al. (2011) coded overt emotional reactivity and emotion regulation behaviors while preschool-age CWS and CWNS listened to one neutral and two emotionally arousing overheard conversations as well as while they produced narratives. They reported that CWS exhibited less positive emotion and less emotion regulation than CWNS, whereas there was no statistically significant between-talker group difference in overall negative emotional response. However, while CWNS exhibited more negative emotion while listening to the emotionally arousing conversations than while listening to the neutral one, CWS exhibited no such differentiation.

In a related study, Johnson and colleagues (2010) used the *disappointing gift* procedure (e.g., Cole, Zahn-Waxler, & Smith, 1994) during which young CWS and CWNS received a desirable gift prior to a free-play conversation and a disappointing gift before a similar conversation. The nonverbal expressive behaviors (positive, negative) during receipt of each gift as well as speech disfluencies following each gift were coded. Johnson et al. reported that while receiving the undesirable gift CWS exhibited more negative emotional expressions than CWNS but during the receipt of the desirable gift there was no statistically significant between-talker group difference in display of positive emotion. These findings were discrepant to those reported by Frankel et al (2011), but given the real possibility that emotions are contextually or situationally bound, differences in findings might be attributed, at least in part, to the difference in experimental paradigms.

Relation of Emotions to Speech

Although between talker-group differences in overall emotional development appear to support the notion that emotional processes contribute to childhood stuttering, they do not specifically link these differences in emotions to changes in actual instances of stuttering. To the present writer's knowledge, only four studies (Arnold et al., 2011; Johnson et al., 2010; Jones et al., 2011; Walden et al., 2011) have experimentally examined the relation between emotional processes (emotional reactivity, emotional regulation) and instances of stuttering-like (SLD) and nonstuttering-like disfluencies (nonSLD) in preschool-age children. Specifically, in two of them (Arnold et al., 2011; Walden et al., 2011) emotion and emotion regulatory behaviors as well as SLDs and nonSLDs were coded while preschool-age CWS and CWNS produced narratives after being exposed to three different emotion-eliciting overheard conversations (happy, angry, neutral). Findings of both studies indicated that CWS who used regulatory strategies less frequently and for shorter durations were more apt to exhibit increased disfluencies. No such relation was found for CWNS. Also, Walden et al. reported that only for CWS was co-occurrence of greater negative emotionality and more frequent regulatory behaviors associated with less stuttering. However, results from parent-reported emotional reactivity and emotion regulation support this finding for both CWS and CWNS.

Furthermore, Jones et al. (2011) conducted a coded behavioral analysis of the emotional reactivity in preschool-age CWS and CWNS prior to and during their stuttered and fluent utterances. Findings indicated that negative affect was significantly more likely *prior to* CWS' stuttered than fluent utterances, and that emotionally reactive behaviors were significantly more likely to occur *during* stuttered compared to fluent utterances. Also, Johnson and colleagues reported that CWS were more disfluent after receiving the desirable than the disappointing gift. In essence, changes in emotional processes appear to be related to changes in CWS' stuttering.

Purpose

Given the above literature review, it seems quite possible that emotions play a role in childhood stuttering. However, given the relatively few published empirical studies regarding preschool-age children who stutter, replication is needed. Furthermore, it is also salient that emotions are influenced by surrounding events and thus their manifestation might differ across everyday and/or experimental situations.

Therefore, the present study was designed to experimentally investigate emotional reactivity in terms of positive and negative affect, and emotion regulation as indexed by self-speech and off-task behaviors in preschool-age CWS and CWNS as well as the relation of these emotional processes to speech (dis)fluency. Specifically, this investigation addressed four issues. First, the study addressed whether there would be a difference in emotional reactivity and emotion regulation between CWS and CWNS during a neutral (control) and a frustrating (experimental) task. The present writer hypothesized that, overall, CWS would exhibit more negative affect, less positive affect, and less emotional regulation than CWNS. Second, the study addressed whether both talk groups would respond differentially to the emotional tenor of the context. The present writer hypothesized that CWNS compared to CWS, would exhibit greater increase in negative affect and emotion regulation behaviors, and greater decrease in positive affect during the frustrating than the neutral task. Third, the study examined the relation between emotional processes (emotional reactivity and emotion regulation) exhibited during the tasks and the frequency of stuttering-like (i.e., stuttering-like disfluencies per total words; SLD/TW) and non-stuttering-like, or other disfluencies (i.e., other disfluencies per total words; OD/TW) produced in subsequent narratives. It was hypothesized that higher emotional reactivity and lower emotion regulation exhibited during the neutral and the frustrating tasks would be related to higher frequency of stuttering-like disfluencies and other disfluencies produced during the subsequent narrative tasks. Last, the study investigated whether CWS, when compared to CWNS, would exhibit greater increase in the frequency of stuttering-like and other disfluencies during the narrative following the frustrating task than during the narrative following the neutral task.

CHAPTER II

METHOD

Participants

Participants were 18 preschool-age CWS (14 boys) and 18 preschool-age CWNS (14 boys), all of whom were monolingual, native speakers of American English with no known or reported history of neurological, hearing, developmental, attentional, emotional, academic, and/or intellectual problems. Besides CWS's stuttering, none of the 36 participants presented with speech and/or language problems and none of the CWS had received formal treatment for stuttering. Participants were between 3;0 [years;months] and 5;11 years of age (CWS: $M = 51.67$, $SD = 9.71$; CWNS, $M = 53.61$, $SD = 9.49$) and there was no statistically significant between-group difference in chronological age, $t(34) = .61$, $p = .55$.

All participants were paid volunteers naïve to the purposes and methods of the study and were recruited as part of a longitudinal study investigating the relation between stuttering and emotions conducted by Vanderbilt University's Developmental Stuttering Project (DSP). The present study's protocol was approved by the Institutional Review Board at Vanderbilt University, Nashville, Tennessee and for each of the 36 participants, parents signed an informed consent, and their children assented.

Classification and Inclusion Criteria

Conversational Sampling

To obtain speech disfluency data for purposes of talker-group classification, a conversational sample of 300 words was elicited during an approximately 15-30 minutes loosely structured play-based interaction between each participant and a researcher trained in elicitation of conversational samples. The researcher and child were seated next to each other at a small table with toys situated directly in front of them as they interacted verbally with each other while playing with the toys.

Children Who Stutter (CWS)

Participants were assigned to the CWS group if they (a) exhibited three or more stuttering-like disfluencies (SLDs; sound/syllable repetitions, monosyllabic word repetitions, audible and inaudible sound prolongations, and within-word pauses) per 100 words of conversational speech (Yairi & Ambrose, 1992) and (b) received a total overall score of 11 or above (a severity equivalent of at least "mild" for preschool children) on the *Stuttering Severity Instrument – 4* (SSI-4; Riley, 2009). The mean percent of stuttering frequency (%SLDs) and the mean SSI-4 score for the CWS group was 10.33 (*SD* = 5.44) and 19.83 (*SD* = 5.94) respectively.

Children Who Do Not Stutter (CWNS)

A child was considered a CWNS, if he/she (a) exhibited two or fewer stuttering-like disfluencies per 100 words of conversational speech (Yairi & Ambrose, 1992) and

(b) received a total overall score of 8 or below (a severity equivalent of less than "mild" for preschool children) on the SSI-4. The mean percent of stuttering frequency (%SLDs) and the mean SSI-4 score for the CWNS group was 0.96 (*SD* = 0.63) and 6.44 (*SD* = 2.53) respectively.

Speech, Language, and Hearing Criteria

Prior to experimental testing, all participants were administered the *Peabody Picture Vocabulary Test - Fourth Edition* (PPVT-IVA or B; Dunn & Dunn, 2007), the *Expressive Vocabulary Test - Second Edition* (EVT-2A or B; Williams, 2007), the *Test of Early Language Development - Third Edition* (TELD-3A or B; Hresko, Reid, & Hamill, 1999) and the "Sounds in Words" subtest of the *Goldman–Fristoe Test of Articulation – Second Edition* (GFTA-2; Goldman & Fristoe, 2000) to assess receptive and expressive vocabulary, receptive and expressive language skills, and articulation abilities respectively. Requirements for inclusion in the present study were that children score at or above the 16th percentile rank on all of the standardized tests for their age group. In addition, all participants passed a bilateral pure tone screening at 20dB HL at 1000, 2000, and 4000 Hz.

Socioeconomic Status

Socioeconomic status (SES) was determined based on parent-report of occupation and education on the Four Factor Index of Social Position (Hollingshead, 1975), which takes into account both maternal and paternal occupation and educational level. There was no significant difference in SES between CWS (*M* = 43.67, *SD* = 12.08) and CWNS (*M* = 48.69, *SD* = 10.67), $t(34) = 1.31$, $p = .20$.

Excluded Participants

To achieve the sample size of 36 (i.e., 18 CWS, and 18 CWNS) a larger pool (*N* = 67) was initially considered. From an initial group of 25 CWS, 8 participants were excluded for the following reasons: noncompliant behavior during the experimental procedure (*N* = 4), scored lower than the 16th percentile rank on one or more of the speech and language norm-referenced tests (*N* = 2), incomplete data due to technical difficulties during the experimental procedure (*N* = 1), and parent- reported social-emotional problem (*N* = 1). From an initial group of 36 CWNS, 7 participants were excluded for the following reasons: noncompliant behavior during the experimental procedure (*N* = 4), scored lower than the 16th percentile rank on one of the speech and language norm-referenced tests (*N* = 1), incomplete data due to technical difficulties during the experimental procedure (*N* = 1), and parent-reported attentional problem (*N* = 1). Furthermore, 10 other CWNS were not included in the final data analysis because there was no match with an available CWS peer. Finally, 6 participants were excluded due to failure to meet the previously discussed talker group criteria.

General Overview of Study

Participants were tested on two separate occasions: a diagnostic and a subsequent experimental session. The initial or diagnostic session included administration of standardized speech-language tests, hearing screening, and elicitation of speech sample through play-based interaction as described above, for participant classification and inclusion purposes. During the second or experimental session participants completed a *control* and an *experimental* condition in an counterbalanced order.

Experimental Session

Gift Selection

At the beginning of the experimental session, participants were presented with six gifts (i.e., whistle, bubbles, plastic "winner medal" for children, ponytail holder/scrunchy, plastic bracelets, car) and were asked to select the most desirable one ("the really, really cool one"). Then, the experimenter put the selected toy in an 20.3 cm x 20.3 cm x 20.3 cm clear, acrylic, transparent box (see Figure 2), locked the box and put it outside of the participants' eyesight. Participants were told that if they did a good job with the different tasks they would be given the desired toy at the end of the session (i.e., "Today you are going to play some games and tell a couple of stories. If you do a good job with the games and the stories, you will get this prize to take home with you").

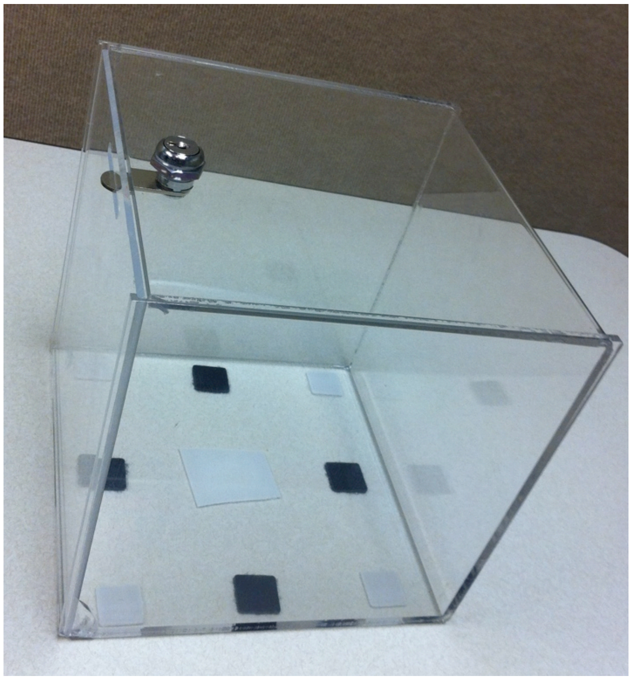

Figure 2. Clear, acrylic, transparent box used during the *experimental* condition to contain each participant's most desired gift.

Control and Experimental Conditions

Subsequent to gift selection, each of the 36 children completed a *control* and an *experimental* condition. For both conditions participants were comfortably seated in a small rolled armchair. Affixed to the chair was a seat belt that was buckled around the child to reduce the likelihood the child would move outside of the area captured by the video-recording cameras. As shown in Figure 3, each emotion-manipulation task ("apples and leaves in transparent box," ALTB; "attractive toy in a transparent box," ATTB) was followed by a story preview and a narrative task.

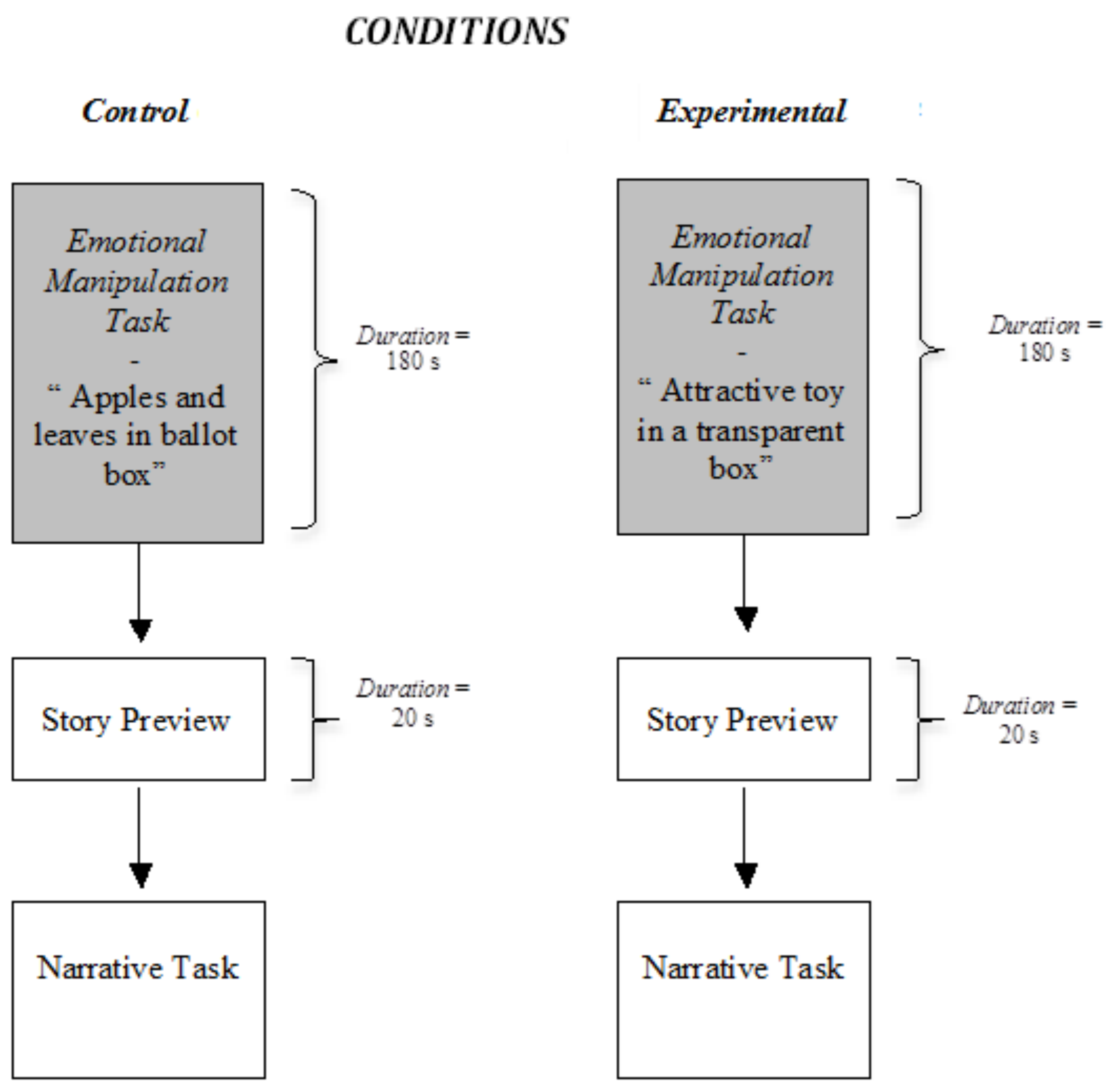

Figure 3. Sequence of activities (i.e., emotional manipulation, preview of the story pictures, and narrative) during the control and the experimental conditions.

Emotion Manipulation Tasks

Apples and Leaves in Transparent Box (ATLB) Task (Control Condition)

At the beginning of the *control* condition participants engaged in an approximately 3-minute "apples and leaves in transparent box" (ALTB) task involving a clear, acrylic ballot box and small pieces of construction paper (see Figure 4). For this task, participants were asked to remove 98 small construction paper apple- and leaf-cut outs, which were attached by hook and loop fasteners ("Velcro") to a 46.2-cm wide and 40.6-cm tall tree cut-out and put them in the acrylic locked ballot box through a 2.5-cm wide and 10.2-cm length slit. Specifically, participants were told, "I need to do something in the next room but I will be back very soon. While I am gone please put the apples and the leaves, one at a time just like that (experimenter demonstrates the task for the participant) in the box." The box and the tree were attached by hook and loop fasteners on a low chair in front of the child and on a plastic box next to the child respectively. There was no significant between-group difference in the duration of the control task (in sec) between CWS (M = 182.63, SD = 16.70) and CWNS (M = 184.69, SD = 14.22), $t(34) = .40$, $p = .69$.

Figure 4. Clear, acrylic, transparent ballot box used during the *control* condition and paper apple- and leaf-cut outs attached by hook and loop fasteners ("Velcro") to a tree cut-out that participants were asked to insert through a slit into the box.

This ALTB ("control") task was designed to share similarities with the experimental condition's "attractive toy in a transparent box" (ATTB) procedure, which will be described immediately below. Specifically, both tasks (ALTB and ATTB) involved a transparent box and also required participants to use their hands to manipulate age-appropriate objects. However, the ALTB task, contrary to the experimental ATTB procedure, was not expected to elicit intense and/or frequent frustration-related emotions.

Attractive Toy in a Transparent Box (ATTB) (Experimental Condition)

For the *experimental* condition, participants completed the "attractive toy in a transparent box" (ATTB) procedure from the laboratory temperament assessment battery (LabTab; Goldsmith et al., 1999). Specifically, the experimenter gave the participants a set of 10 keys, none of which opened the transparent box that contained the desired gift. Participants were instructed that to open the transparent box and get the gift, they would have to use this set of keys to open the box (i.e., "I need to do something in the other room. I will let you work on opening the box. I don't know which key opens the box so make sure you try each one of them. When you open the box you can take the prize and take it home with you."). After directions were given to the participants, the experimenter left the room and participants were left by themselves to try to open the locked box with the wrong keys for approximately 3 minutes (see Figure 5). While participants were by themselves in the testing room they were audio-visually monitored by the experimenter and their parent(s) through a one-way mirror.

Figure 5. Participant trying to open the locked box with the wrong set of keys during the *attractive toy in a transparent box* (ATTB) task.

At the end of the 3-min period, the experimenter returned to the room, acknowledged that she must have given the child the wrong keys, and told the participant that they would open the box and get the prize at the end of the session when he/she would be done with all the games (i.e., "I am sorry. I think I gave you the wrong keys. We can open the box and take this prize at the end when you will be done with all your games.").

The transparent box was attached by hook and loop fasteners on a low chair in front of the child. There was no significant between-group difference in the duration of the ATTB task (in sec) between CWS (M = 190.21, SD = 9.27) and CWNS (M = 184.70, SD = 7.87), $t(34) = 1.92$, $p = .06$

Story Preview and Narrative Task

Immediately following each of the emotion manipulation tasks (i.e., ALTB and ATTB), the experimenter returned to the room and previewed with the participant a story about a dog and a little girl by using 20 pictures/photos from two of Alexandra Day's series of textless picture books (i.e., *Carl's Sleepy Afternoon,* and *Carl's Snowy Afternoon*). Pictures were presented at a constant rate of two pictures (side-by-side) per 2 seconds with PowerPoint slide show on a 23-inch Apple LED cinema display attached to a MacBook. At the beginning of the "story preview" condition, participants were instructed to quietly look at the pictures and think about the story in preparation for the narrative task. That is, children were told, "Now it's time for you to tell the story (*name of the story*)". This story is about a dog named Carl. But first let's look at the pictures and think about the story you are going to tell."

After participants previewed the story, they were encouraged to tell it by looking at the pictures on the screen ["Now it's time for you to tell the story (*name of the story)*].

To elicit the narrative, the experimenter provided up to three standard prompts (e.g., "Tell me more," "What is happening on this page," "What else?"), if needed, until the child produced at least two utterances per picture (see, Arnold et al., 2011; Jones et al., 2011; Walden et al., 2011).

Throughout the narrative task, participants were updated on their progress regarding completion of the task (e.g., "You only have three more pages left") but were not encouraged or given specific feedback about their performance (e.g., the participants were not told: "You're telling a great story"). Rather the experimenter responded to participants' picture descriptions / narrative with general comments such as "mhm", and "ok."

Narrative Stimuli

As mentioned above, illustrations from two textless age-appropriate storybooks (Day, 2005, 2009) were used to elicit narrative samples, with one story assigned randomly to each of the two conditions (i.e., control and experimental). Pilot data from three preschool-age children indicated that both stories elicited comparable number of spoken words (Carl's Sleepy Afternoon: $M = 313.67$, $SD = 95.48$; Carl's Snowy Afternoon: $M = 319.67$, $SD = 118.63$; $t(2) = 2.78$, $p = .95$), a finding consistent with the present study's final data corpus (Carl's Sleepy Afternoon: $M = 329.11$, $SD = 97.99$; Carl's Snowy Afternoon: $M = 329.83$, $SD = 98.78$; $t(34) = .06$, $p = .95$).

Audiovisual Recording

During the experimental sessions, audiovisual recordings were made by two video cameras, one mounted on a 40.64-cm tall tripod directed toward the child's face (Canon HD Camcorder VIXIA HF S10) and one directed diagonally towards the child's body (Canon VCC50i). In order to combine those two recordings into a single audiovisual record, Pinnacle Studio HD editing software was used. Specifically, for each participant the audiovisual recordings from the Canon HD and the Canon CVV50i cameras were processed by the editing software and temporally synchronized. This resulted in a new mpeg2 file with the two video images (i.e., face and body shot) and the audio from the HD recording multiplexed into a split screen. Based on these split-screen audiovisual files, all dependent variables (e.g., stuttering-like disfluencies, negative affect) were measured.

Description / Definition of Independent (IV) and Dependent (DV) Variables

Independent Variables

As shown in Table 1, talker group (i.e., CWS and CWNS) and emotion manipulation condition (i.e., control and experimental) were the independent variables (IVs) of the present study. Participants were assigned to the two talker groups (i.e., CWS and CWNS) based on the classification and inclusion criteria described above. Also, as previously mentioned, presentation of control and experimental conditions were counterbalanced within and between talker groups.

Table 1
Independent Variables (IVs) and Dependent Variables (DVs) used in this study during the emotion manipulation tasks (i.e., ALTB, ATTB) and the subsequent narrative tasks.

Emotion Manipulation Task	**Narrative**
IV: **Talker Group:** • CWS • CWNS	*IV:* **Talker Group:** • CWS • CWNS
IV: **Condition:** • *Control*: "Apples and Leaves in Transparent Box" (ALTB) • *Experimental*: "Attractive Toy in a Transparent Box" (ATTB)	
DV: **Emotional Reactivity** • Positive affect • Negative affect *DV*: **Emotion Regulation** • Self Speech • Off Task	*DV:* **Speech Disfluency:** • *Speech Disfluency Ratios*: – Ratio of other disfluencies per total words (OD/TW) – Ratio of stuttering-like disfluencies per total words (SLD/TW)

Dependent Variables

As shown in Table 1, three dependent variables were measured: (1) emotional reactivity, (2) emotion regulation, and (3) speech (dis)fluency, each of which is defined and described immediately below.

Emotional reactivity. During the offline review of the digital video recordings of the control and experimental emotion manipulation tasks (i.e., ALTB and ATTB) emotional reactivity was coded as: (1) positive affect, and (2) negative affect. Behavioral measures of *positive* affect included: (a) lip corners pulled up / smile (broad or closed lip), (b) raised cheeks, (c) positive in content and/or tone verbalizations (e.g., "that is fun"), and (d) non-verbal positive vocalizations (e.g., laughing, giggling). Behavioral measures of *negative* affect included: (a) lip corners pulled down and out, (b) furrowed/downturned eyebrows, (c) eyes narrowed/squinted, (d) wrinkled nose, (e) negative in content and/or tone verbalizations (e.g., "that is so hard"), (f) non-verbal negative vocalizations (e.g., sharp breath exhalation, sighing), and (g) aggressive behaviors (e.g., banging, kicking, throwing) directed towards objects (e.g., transparent box, keys). The above coding scheme was based on a review of several coding schemes for emotional reactivity employed in other empirical studies (i.e., Calkins, 1997; Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; Cole, Barret, & Zahn-Waxler, 1992; Goldsmith et al., 1999; Jahromi, Gulsrud, & Kasari, 2008; Jahromi & Stifter, 2008; Walden et al., 2011).

An event-based continuous strategy for recording observational data was employed (e.g., Bakeman & Gottman, 1997). That is, onset and offset times of every expressive behavior observed during the control and the experimental manipulation tasks were coded for each participant by using PROCODER, a specialized behavior-coding software (Tapp & Walden, 1993). Given that the two emotional reactivity categories described above (i.e., positive and negative affect) are not mutually exclusive but rather can co-occur at the same time, participants' negative and positive emotional behaviors were coded separately. Thus, "time-budget" information (i.e., proportion of time coded in a particular way) regarding each of the two emotional reactivity categories described above was recorded.

Time periods during which the participant's face was not visible on the camera were deemed uncodable and thus were excluded from analyses. There was no significant between-talker group difference in the mean number of uncodable seconds for neither the ALTB (CWS: $M = 4.19$, $SD = 4.97$; CWNS: $M = 1.6$, $SD = 3.59$; $t(34) = 1.78$, $p = .08$) nor the ATTB tasks (CWS: $M = 3.6$, $SD = 4.48$; CWNS: $M = 2.18$, $SD = 4.07$; $t(34) = .99$, $p = .33$.

For inter-judge measurement reliability a trained secondary rater coded 22% of the total data corpus, that is eight randomly selected ALTB segments (4 from CWS, 4 from CWNS) and eight randomly selected ATTB segments (4 from CWS, 4 from CWNS). Cohen's (1960) Kappa statistic for negative and positive affect was 0.77 and 0.75 respectively.

Emotion regulation. Emotional regulation was coded as: (1) self speech, and (2) off-task behaviors. *Self speech* refers to verbalizations produced by the child (e.g., "I don't know which key it is," "This is the most boring things I have ever done," "I need help") in the absence of the experimenter. *Off-task behaviors* refers to the diversion of attention to something other than the ALTB and the ATTB tasks and includes but is not constrained to behaviors such as: (i) looking at the keys but not attempting to open the box, (ii) looking at different objects in the room while not attempting to open the locked box or put the apples and leaves in the transparent box during the ATTB and the ALTB tasks, (iii) looking at the prize in the box but not attempting to open the box.

As described above for the coding of emotional reactivity behaviors, the onset and offset of occurrence of *self speech* and *off-task* behaviors observed during the ATTB and the ALTB tasks was coded and the duration of their use was recorded for each participant.

For inter-judge measurement reliability the same trained secondary rater coded 22% of the total data corpus, that is eight randomly selected ALTB segments (4 from CWS, 4 from CWNS) and eight randomly selected ATTB segments (4 from CWS, 4 from CWNS). Cohen's (1960) Kappa statistic for self-speech and off-task behaviors affect was 0.9 and 0.95 respectively.

Speech disfluency. Computer-based transcriptions of the narratives (SALT, Systematic Analysis of Language Transcripts; Miller & Iglesias, 2008) were produced based on participants' audiovisual recordings. Abandoned and interrupted utterances as well as utterances containing singing and recitation were excluded from analyses. The final analysis data set for CWS and CWNS consisted of 12,153 and 11,569 words respectively.

Stuttering-like disfluencies (SLDs; sound/syllable repetitions, monosyllabic word repetitions, audible and inaudible sound prolongations, and within-word pauses) and other disfluencies (ODs; multisyllabic word repetitions, phrase repetitions, interjections, and revisions) were coded within each transcribed narrative.

Interjudge measurement reliability for speech disfluency coding was calculated based on the narrative speech samples of 4 randomly selected CWS and 4 randomly selected CWNS (representing 22% of the total data corpus). The first and second coders were certified speech-language pathologists trained in coding speech disfluencies. Coefficient alpha (Cronbach, 1951) assessed reliability of the two coders on the percentage of SLDs (i.e., total number of SLDs per total number of words produced *100), and the percentage of ODs (i.e., total number of ODs per total number of words produced *100) Coefficient alphas for those four variables ranged were .94 and .98 respectively.

Data Analysis Plan

A series of separate generalized linear mixed models (GLMM) were constructed to examine the study's following four research questions:

1) Do CWNS and CWS significantly differ in the amount of exhibited emotional reactivity (i.e., positive and negative affect) and emotion regulation (i.e., self-speech and off-task) behaviors in response to emotion-eliciting tasks (i.e., ALTB, ATTB)?

2) Do CWNS and CWS respond significantly different to the experimental manipulation? That is, do CWNS when compared to CWS, exhibit greater increase in

negative affect and emotion regulation behaviors (self-speech, off-task), and greater decrease in positive affect during the frustrating (ATTB) than the neutral (ATLB) task?

3) Is there a relation between emotional processes (emotional reactivity and emotion regulation) exhibited during the tasks and the frequency of stuttering-like (i.e., stuttering-like disfluencies per total words; SLD/TW) and other disfluencies (i.e., other disfluencies per total words; OD/TW) produced in subsequent narratives for CWS and CWNS?

4) Do CWS, when compared to CWNS, exhibit greater increase in the frequency of stuttering-like and other disfluencies during the narrative following the frustrating task (ATTB) than during the narrative following the neutral task (ALTB)?

Prior to data analyses, Spearman rho correlations were conducted to assess the relation between percentage of self-speech and percentage of off-task and thus determine whether they should be treated as separate entities in the analyses or not. Results indicated a non-significant correlation between self-speech and off-task during the frustrating (ATTB) task (r = .284, p = .093), and a marginally significant positive correlation in the neutral (ALTB) task (r =.327, p = .052). Thus, given the relatively small amount of shared variance between self-speech and off-task in both the control (r^2 = 10.69) and the experimental (r^2 = 8.06) tasks these two emotion regulatory behaviors were treated as distinct entities in the analyses. The matrix for the bivariate correlations for all emotional reactivity and emotion regulation variables (i.e., negative affect, positive affect, self-speech, off-task) for each talker group (CWS, CWNS) within each emotion manipulation task (i.e., ALTB, ATTB) is provided in the appendix.

To address the first two questions, four separate models were constructed to examine the four dependent measures (i.e., percentage of negative affect, percentage of positive affect, percentage of self-speech, percentage of off-task). Given the non-normality of all four outcomes (*positive emotion*: skewness = 1.8, kurtosis = 2.52; *negative emotion*: skewness = 1.67, kurtosis = 2.18; *self-speech*, skewness = 2.61, kurtosis = 7.5; and *off-task*, skewness = 2.01, kurtosis = 3.74), the GLMM analyses used a log link function to fit them to a gamma distribution. All four models included talker group (CWS, CWNS) and condition (control, experimental) as fixed factors, and age and gender as covariates. Also, the interaction of talker group and condition as well as a random effect intercept were included in all the models. Furthermore, the Satterthwaite approximation, which does not assume equal variances, was used to calculate degrees of freedom for both main effects and talker group x condition interactions (Satterthwaite, 1946).

To address the third research question, for each talker group two separate models were constructed to examine percentage of stuttering-like disfluencies (%SLDs), and percentage of normal disfluencies (%NDs) respectively. Both models included percentage of negative affect, percentage of positive affect, percentage of self-speech, and percentage of off-task as fixed factors and condition (control, experimental), and age as covariates. The GLMM analyses used a log link function to fit "percentage of SLDs" and "percentage of ODs" to a gamma and a normal distribution respectively.

To answer the fourth and last question, two separate GLMM analyses were conducted to examine percentage of stuttering-like disfluencies (%SLDs), and percentage of other disfluencies (%ODs) respectively. Both models included talker group (CWS, CWNS), condition (control, experimental), and interaction of talker group and condition as fixed factors, and age as a covariate. The Satterthwaite approximation was used to calculate degrees of freedom.

CHAPTER III

RESULTS

Between-group Differences in Emotional Processes

Prior to presentation of the findings regarding the dependent variables, emotional reactivity (i.e., positive affect, negative affect) and emotion regulation (i.e., self-speech, off-task behavior) described in the research questions/hypotheses, results pertaining to the effect of the experimental manipulation for each of these four dependent variables will be also presented.

Negative Affect

Effect of experimental manipulation. As shown in Figure 6, significantly more negative affect was observed during the ATTB (*estimated marginal mean* = 12, *standard error* = 1.37) than the ALTB (*estimated marginal mean* = 4.33, *standard error* = 0.57) task, $F(1,20) = 38.56$, $p < .01$. The experimental manipulation was effective for both talker groups given that both CWS and CWNS exhibited significantly more negative affect during the experimental/frustrating than the control/neutral condition [*CWS*: $F(1,66) = 26.68$; $p < 0.01$; *CWNS*: $F(1,23) = 9.53$; $p < 0.01$]. The estimated marginal means and standard errors for CWS and CWNS for the control and the experimental conditions are presented on Table 2.

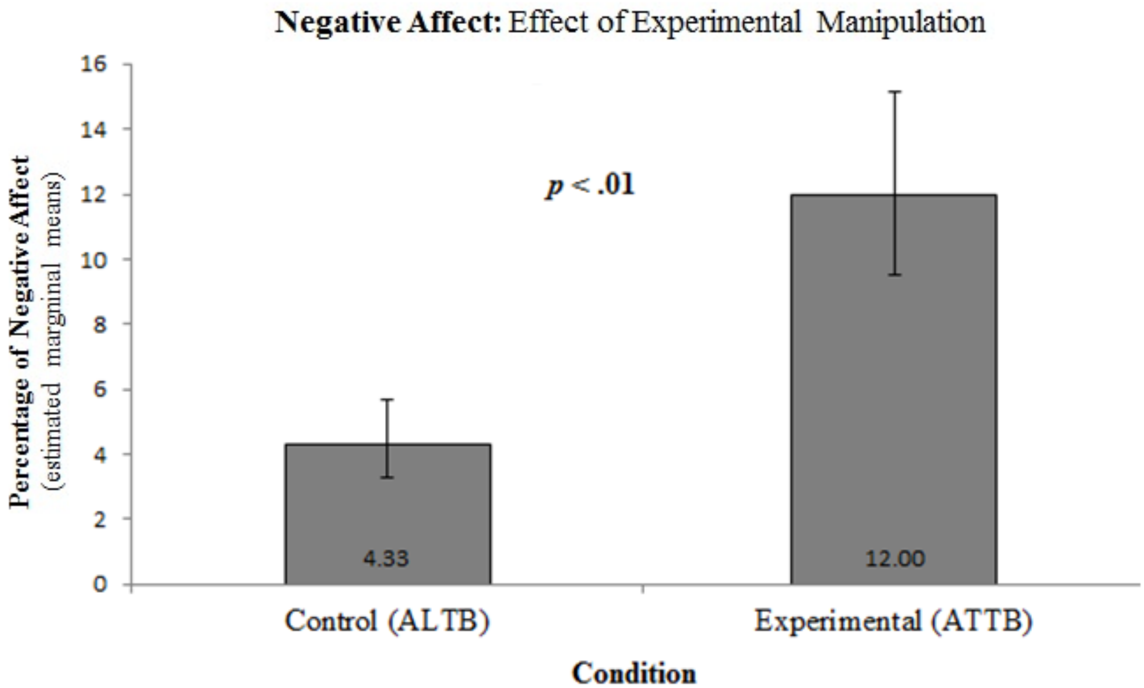

Figure 6. Main effect of condition (control vs. experimental) for negative affect. The estimated marginal means are displayed in the graph and the error bars represent their 95% confidence interval.

Table 2

Estimated marginal means and standard errors for emotional reactivity, emotion regulation, and disfluency measures for children who stutter (CWS) and children who do not stutter (CWNS) during the control and the experimental conditions.

Dependent Measures	Control Condition		Experimental Condition	
	CWS	CWNS	CWS	CWNS
	Mean (Std.Error)	Mean (Std.Error)	Mean (Std.Error)	Mean (Std.Error)
Emotional Reactivity				
Negative Affect	6.12 (1.14)	3.06 (0.59)	18.26 (3.41)	7.89 (1.53)
Positive Affect	2.76 (0.57)	2.7 (0.58)	2.16 (0.45)	2.5 (0.54)
Emotion Regulation				
Self-Speech	3.64 (0.9)	1.25 (0.32)	6.94 (1.7)	5.85 (1.49)
Off-task	7.72 (2.67)	6.22 (2.21)	15.7 (5.36)	9.18 (3.25)
Disfluencies				
Stuttering-like disfluencies	10.82 (1.73)	1.65 (0.26)	11.16 (1.79)	1.79 (0.27)
Other disfluencies	6.1 (0.92)	7.44 (0.94)	7.05 (0.93)	6.78 (0.94)

Talker-group differences. As initially hypothesized, as shown in Figure 7, CWS (*estimated marginal mean* = 10.57, *standard error* = 1.33) displayed significantly more negative affect than CWNS (*estimated marginal mean* = 4.92, *standard error* = 0.65), $F(1,23) = 18.14$, $p < 0.01$.

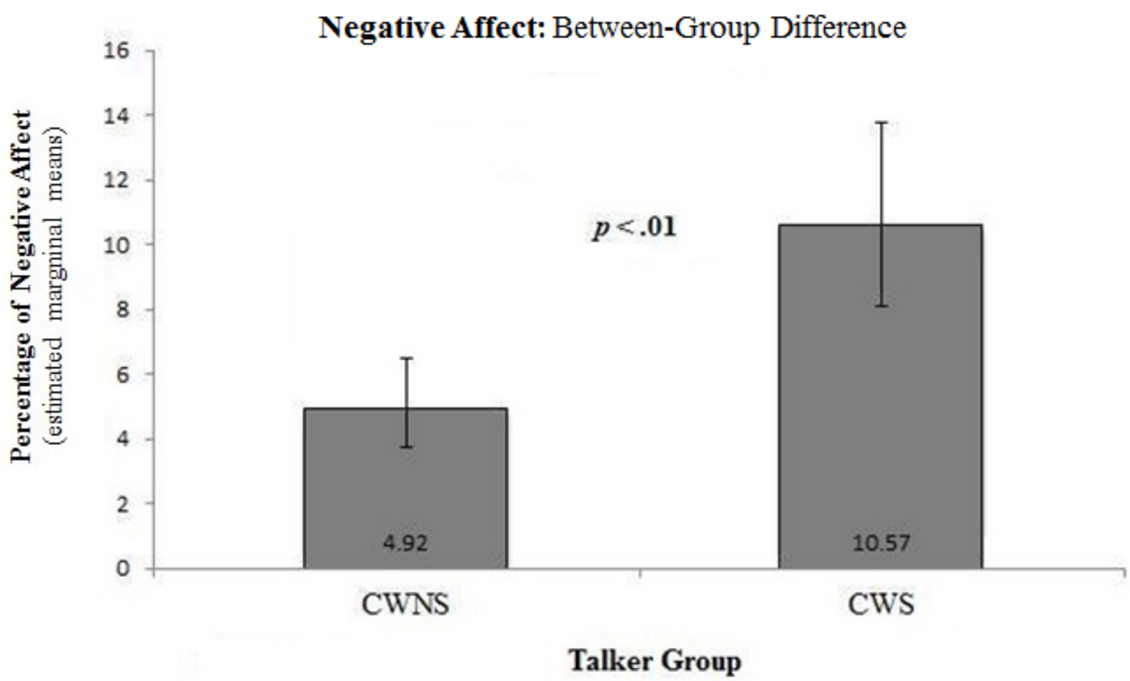

Figure 7. Main effect of talker group (children who stutter, CWS, vs. children who do not stutter, CWNS) for negative affect. The estimated marginal means are displayed in the graph and the error bars represent their 95% confidence interval.

Furthermore, as shown in Figure 8, this between-group difference in negative affect was significant for both the control, $F(1,57) = 6.72$, $p < 0.05$, and the experimental conditions, $F(1,38) = 13.22$, $p < 0.01$.

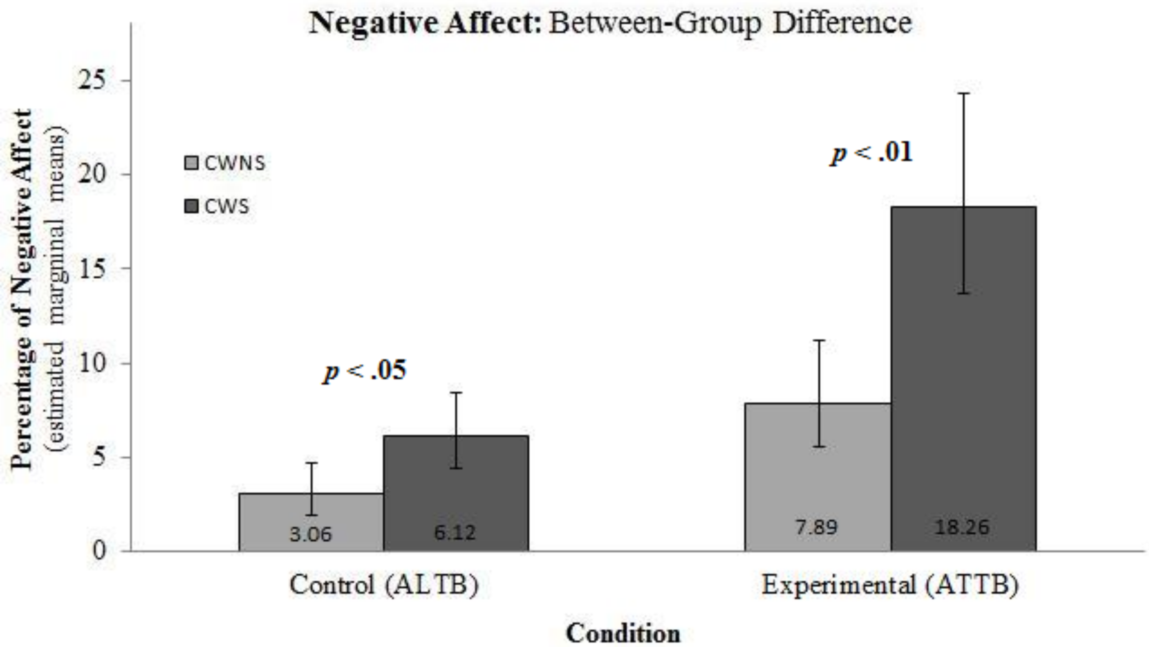

Figure 8. Between-group difference (children who stutter, CWS, vs. children who do not stutter, CWNS) for negative affect in the control and experimental condition. The estimated marginal means are displayed in the graph and the error bars represent their 95% confidence interval.

However, as shown in Figure 9, contrary to predictions there was no statistically significant talker group x condition interaction, $F(1,16) = 0.2$, $p = .66$. In other words, even though both CWS and CWNS exhibited significantly more negative affect during the experimental/frustrating than the control/neutral condition this difference was not differential for the groups. That is, CWS and CWNS responded similarly to the experimental manipulation.

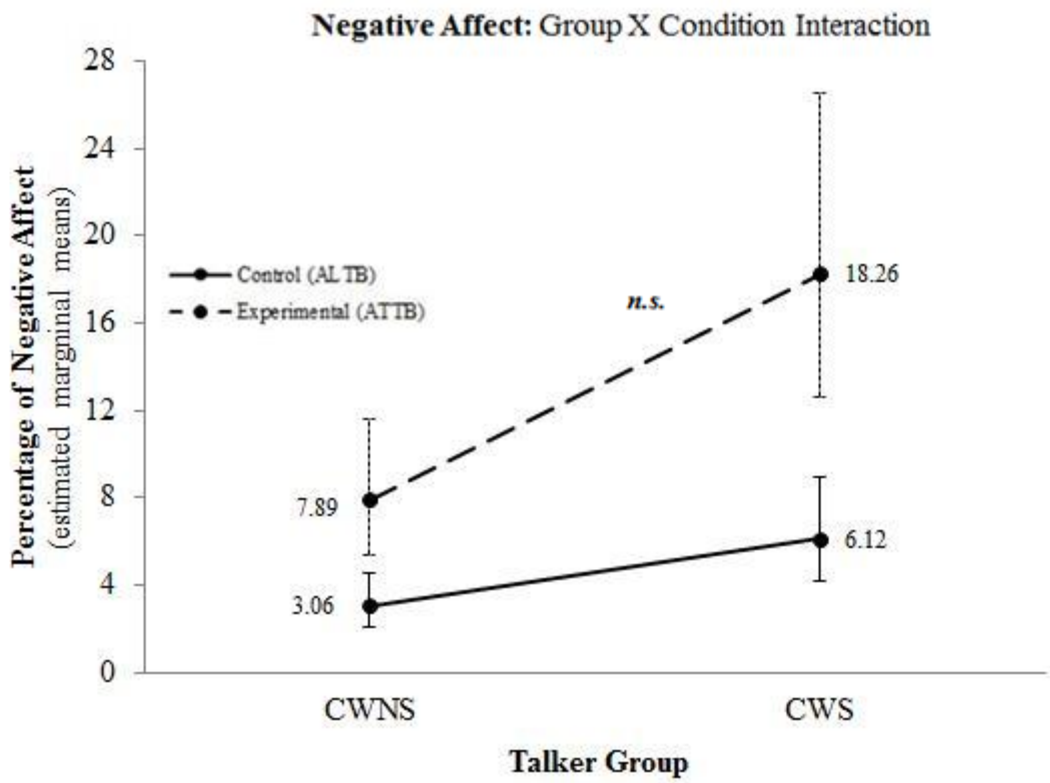

Figure 9. Estimated marginal means (displayed in the graph) for negative affect exhibited during the control/neutral (ALTB) and the experimental/frustrating (ATTB) tasks for children who stutter (CWS) and children who do not stutter (CWNS). The talker group x condition interaction was not significant. Error bars represent the 95% confidence interval of the estimated marginal means.

Positive Affect

Effect of experimental manipulation. There was no significant difference in the amount of positive affect displayed during the control (*estimated marginal mean* = 2.73, *standard error* = 0.49) and the experimental condition (*estimated marginal mean* = 2.33, *standard error* = 0.35), $F(1,24) = 0.87$, $p = .36$.

Talker-group differences. Contrary to initial hypothesis, as shown in Figure 10, there was no between-group difference in the amount of positive emotion, $F(1,26) = 0.08$, $p = .78$ (CWS: *estimated marginal mean* = 2.45, *standard error* = 0.42, CWNS: *estimated marginal mean* = 2.6, *standard error* = 0.48).

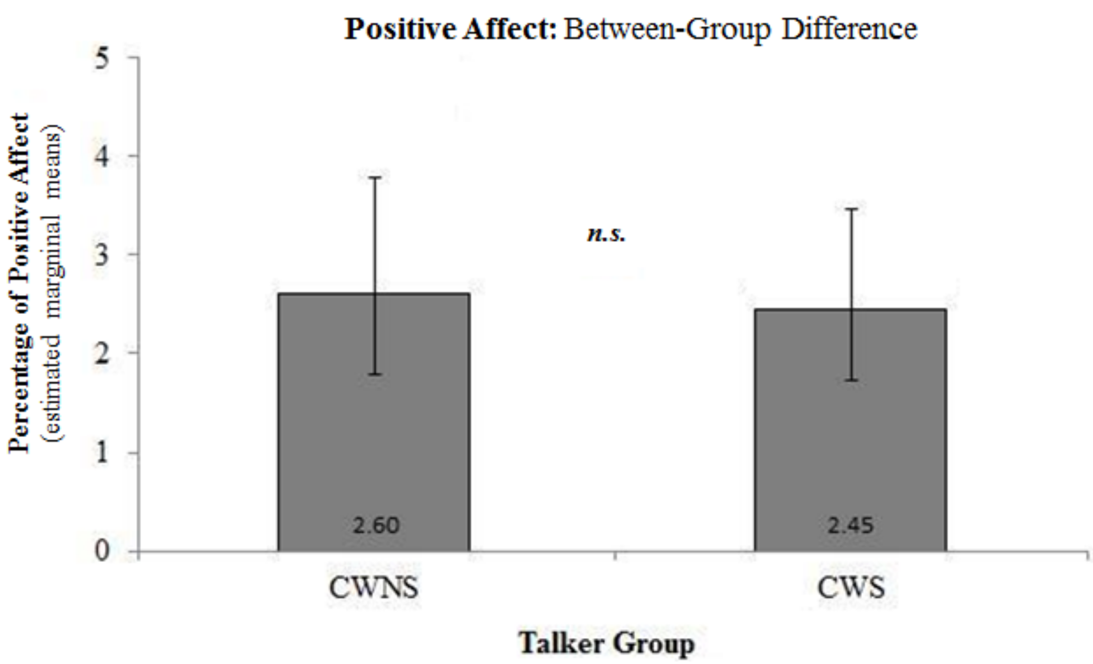

Figure 10. Estimated marginal means (displayed in the graph) for positive affect exhibited by children who stutter (CWS) and children who do not stutter (CWNS). Error bars represent the 95% confidence interval of the estimated marginal means.

Similarly, as shown in Figure 11, there was no significant talker group x condition interaction, $F(1,21) = 0.25$, $p = .62$. Neither CWS nor CWNS exhibited significantly less positive affect during the experimental than the control condition [*CWS*: $F(1,43) = 1.21$; $p = .28$; *CWNS*: $F(1,15) = 0.07$; $p = .79$]. The estimated marginal means and standard errors for CWS and CWNS for the control and the experimental conditions are depicted on Table 2.

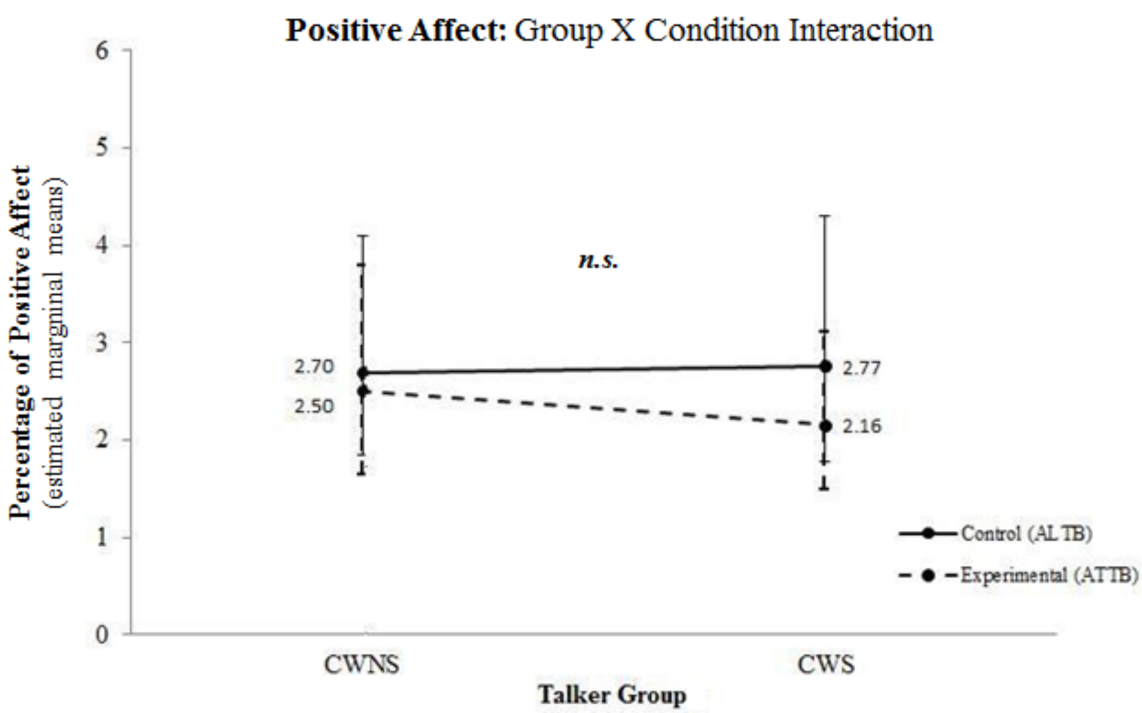

Figure 11. Estimated marginal means (displayed in the graph) for positive affect exhibited during the control/neutral (ALTB) and the experimental/frustrating (ATTB) tasks for children who stutter (CWS) and children who do not stutter (CWNS). The talker group x condition interaction was not significant. Error bars represent the 95% confidence interval of the estimated marginal means.

Ancillary Findings regarding Emotional Reactivity

As mentioned above, the experimental manipulation was effective for both talker groups given that both CWS and CWNS exhibited significantly more negative affect during the experimental/frustrating than the control/neutral condition. However, it is unknown whether the control condition was emotionally "neutral" for both talker groups. To answer this question, the amount of positive affect exhibited during the ALTB/control task was compared to that of negative affect exhibited during the same task, for both CWS and CWNS. Given that these two measures of emotional reactivity are not normally distributed, data were assessed with nonparametric tests.

Results from the nonparametric Wilcoxon signed-ranks test indicated that for CWNS during the control (ALTB) condition there was no statistically significant difference between positive and negative affect, $z = -1.16$, $p = .25$. Thus, for CWNS the ALTB task seemed to be an emotionally neutral task. However, during the control condition, CWS exhibited significantly more negative than positive emotional behaviors, $z = -3.00$, $p < .01$, suggesting that unlike their fluent peers, CWS perceived the "control" task to be negative in valence. These findings together with the significant talker-group difference in negative affect in both the control and the experimental conditions were taken to suggest that CWS are more negatively emotionally reactive than CWNS.

Self-Speech

Effect of experimental manipulation. As shown in Figure 12, there was a statistically significant difference in the amount of self-speech produced during the experimental (*estimated marginal mean* = 6.37, *standard error* = 1.14) than the control (*estimated marginal mean* = 2.13, *standard error* = 0.34) task, $F(1,20) = 28.58$, $p < 0.01$.

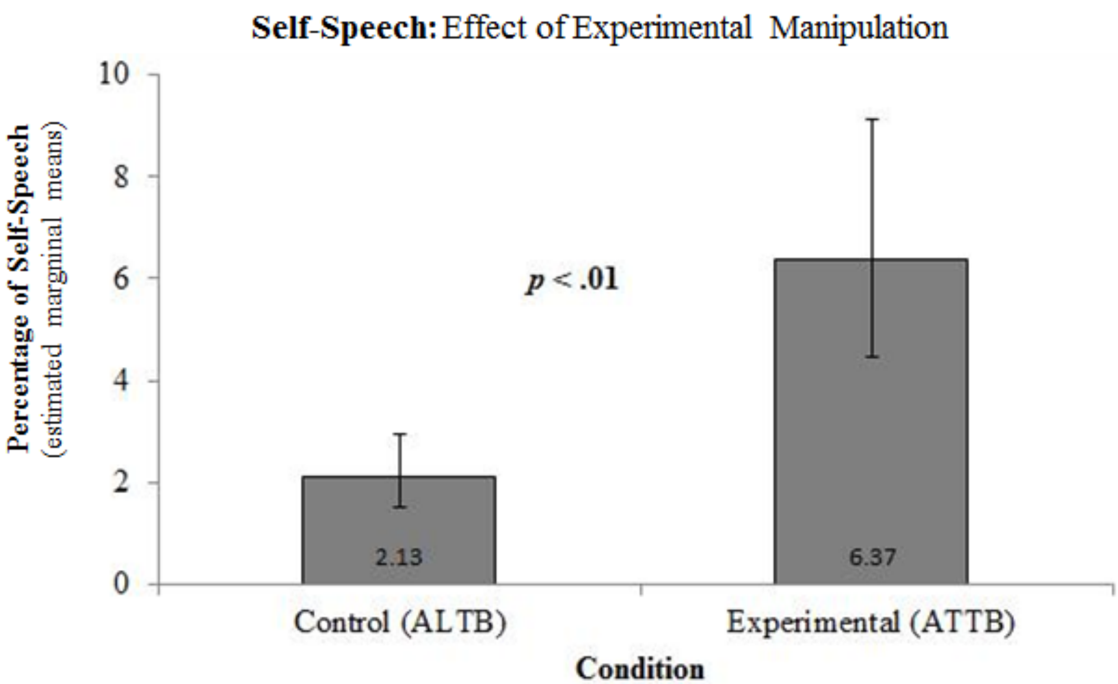

Figure 12. Main effect of condition (control vs. experimental) for self-speech. The estimated marginal means are displayed in the graph and the error bars represent their 95% confidence interval.

Talker-group differences. Contrary to initial hypothesis, as shown in Figure 13, CWS (*estimated marginal mean* = 5.03, *standard error* = 1.01) exhibited significantly greater amount of self-speech than CWNS (*estimated marginal mean* = 2.7, *standard error* = 0.43), $F(1,22) = 6.56$, $p = .02$. This between-group difference in self-speech was significant for the control, $F(1,50) = 7.64$, $p < 0.01$, but not for the experimental condition, $F(1,40) = .21$, $p = .65$.

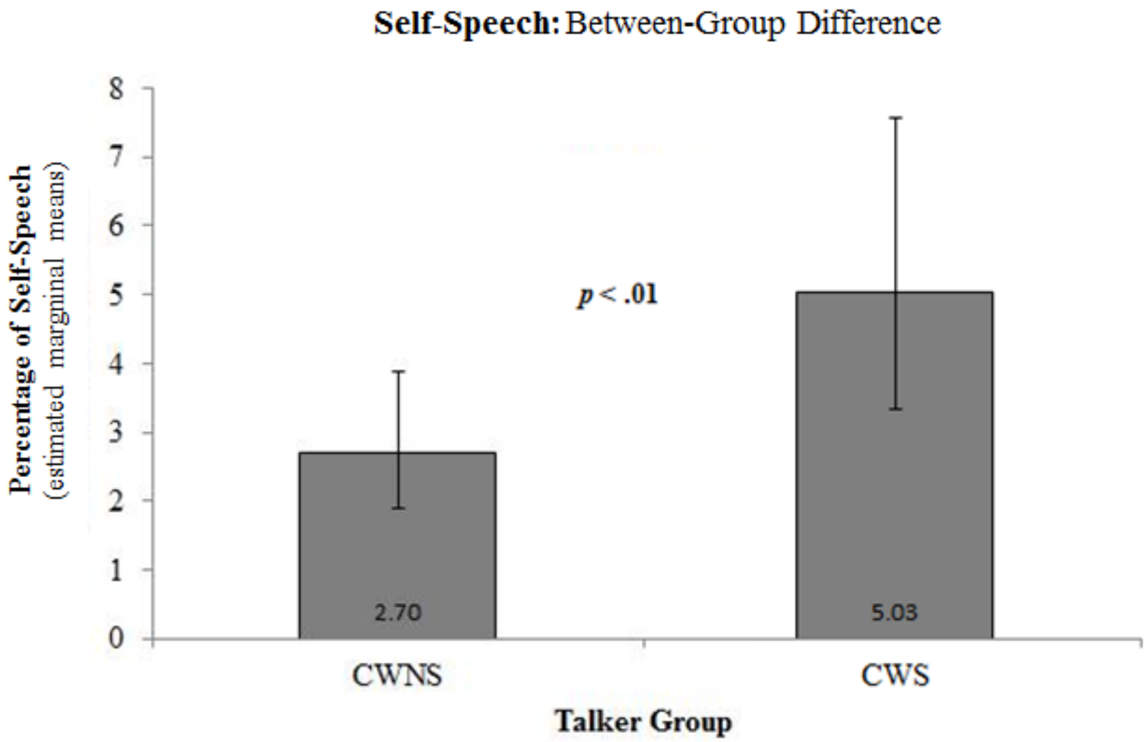

Figure 13. Main effect of talker group (children who stutter, CWS, vs. children who do not stutter, CWNS) for self-speech. The estimated marginal means are displayed in the graph and the error bars represent their 95% confidence interval.

Furthermore, as shown in Figure 14, there was a significant talker group x condition interaction, $F(1,24) = 4.82$; $p = .04$. Further assessment of this interaction provided support for the initial hypothesis in that only CWNS exhibited a significant increase in the amount of self-speech exhibited from the control to the experimental condition, $F(1,42) = 10.08$; $p < 0.01$. However, the increase in self-speech for the CWS group from the control to the experimental condition was not statistically significant, $F(1,25) = 3.44$; $p = .08$. The estimated marginal means and standard errors for CWS and CWNS for the control and the experimental conditions are depicted on Table 2.

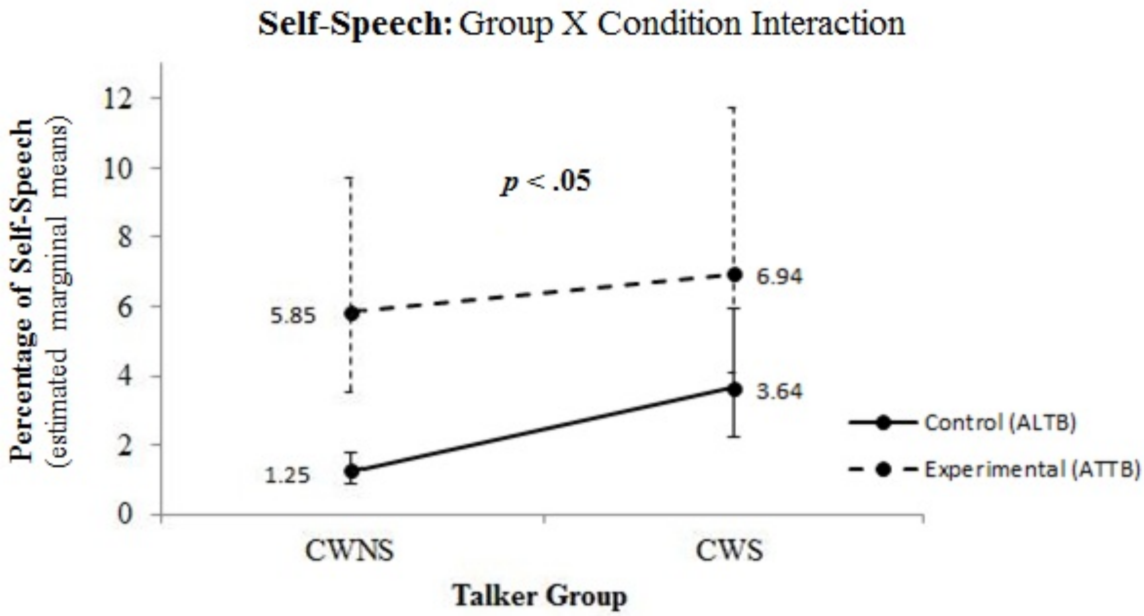

Figure 14. Talker group x condition interaction for self-speech. Estimated marginal means (displayed in the graph) for self-speech exhibited during the control/neutral (ALTB) and the experimental/frustrating (ATTB) tasks for children who stutter (CWS) and children who do not stutter (CWNS). Error bars represent the 95% confidence interval of the estimated marginal means.

Off-Task

Effect of experimental manipulation. There was no significant difference in the amount of off-task behaviors exhibited during the control (*estimated marginal mean* = 6.93, *standard error* = 1.3) and the experimental condition (*estimated marginal mean* = 12.01, *standard error* = 2.99), $F(1,21) = 3.28$, $p = .08$.

Talker-group differences. Contrary to initial hypothesis, as shown in Figure 15, there was no between-group difference in the amount of off-task behaviors, $F(1,19)$ =

1.5, $p = .24$ (CWS: *estimated marginal mean* = 11.01, *standard error* = 2.17, CWNS: *estimated marginal mean* = 7.56, *standard error* = 1.85).

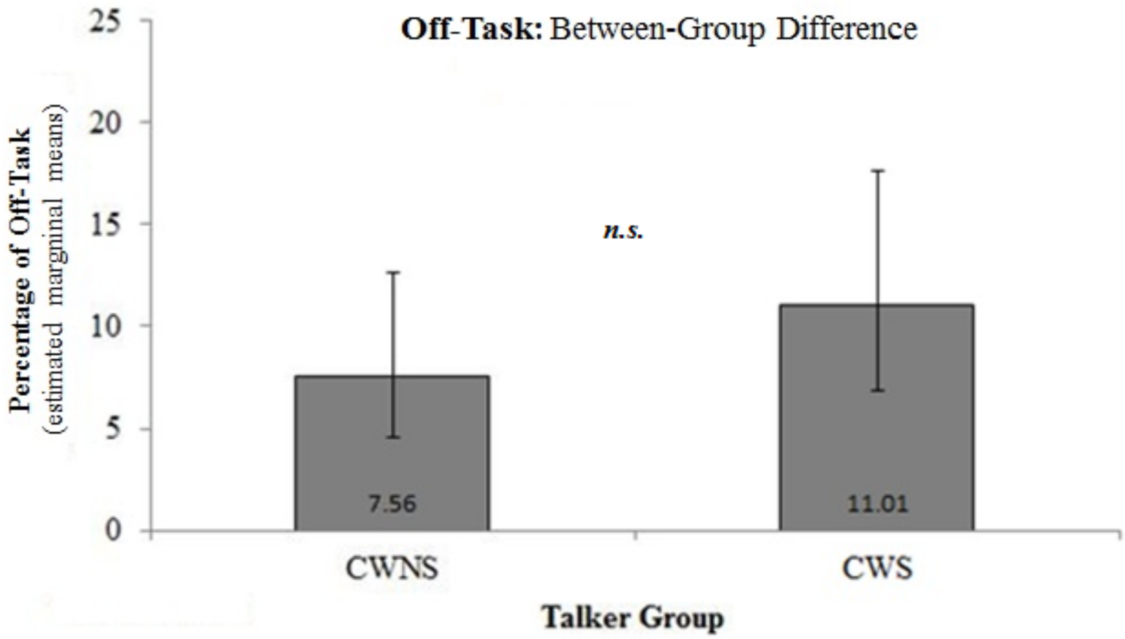

Figure 15. Estimated marginal means (displayed in the graph) for off-task for children who stutter (CWS) and children who do not stutter (CWNS). Error bars represent the 95% confidence interval of the estimated marginal means.

Similarly, as shown in Figure 16, for off-task behavior there was no significant talker group x condition interaction, $F(1,22) = 0.27$, $p = .60$. Neither CWS nor CWNS exhibited significantly more off-task behaviors during the experimental than the control condition [*CWS*: $F(1,59) = 2.37$; $p = .28$; *CWNS*: $F(1,10) = 0.57$; $p = .47$]. The estimated marginal means and standard errors for CWS and CWNS for the control and the experimental conditions are depicted on Table 2.

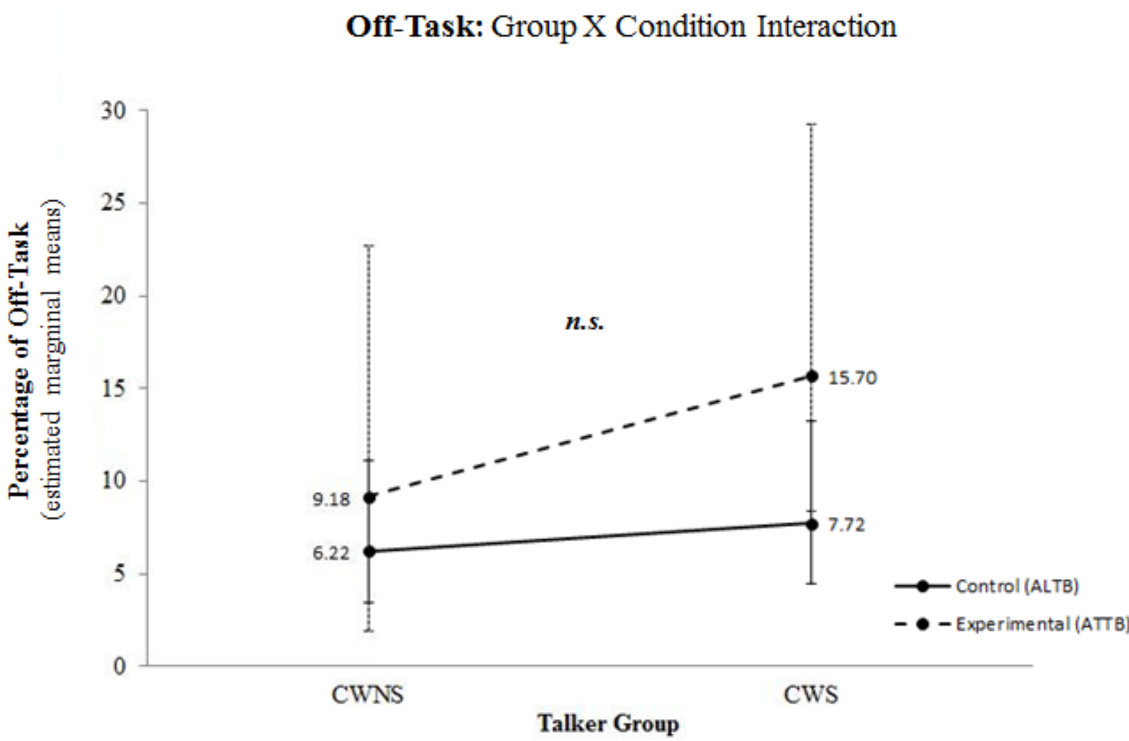

Figure 16. Estimated marginal means (displayed in the graph) for off-task exhibited during the control/neutral (ALTB) and the experimental/frustrating (ATTB) tasks for children who stutter (CWS) and children who do not stutter (CWNS). The talker group x condition interaction was not significant. Error bars represent the 95% confidence interval of the estimated marginal means.

Relation between Emotional Processes and Disfluencies

Children Who Stutter

Contrary to initial hypotheses, for CWS proclivity to *self-speech* while engaged in the control and the experimental tasks was associated with greater percentage of stuttering-like disfluencies during the narrative tasks, est. $\beta = .04$, $p = .05$. Furthermore, as initially predicted, greater duration of off-task behaviors during the tasks was negatively related to the percentage of stuttering-like disfluencies produced during the subsequent narratives, est. β = -.04, *p* = .03. That is, the less CWS participants diverted their attention from the tasks, the more they stuttered during the narratives. Also, contrary to predictions, neither positive (est. β = -.03, *p* = .09) nor negative affect (est. β = -.01, *p* = .82) were associated with stuttering.

Finally, for CWS, neither emotional reactivity (i.e., positive affect, negative affect) nor emotion regulation behaviors (i.e., self-speech, off-task) were associated with percentage of other disfluencies (*negative affect*, est. β = -.004, *p* = .91; *positive affect*, est. β = .02, *p* = .38; *self-speech*, est. β = -.01, *p* = .75; *off-task*, est. β = -.04, *p* = .20).

Children Who Do Not Stutter

For CWNS, only negative affect was associated with percentage of other (i.e., non-stuttered) disfluencies (est. β = .06, *p* = .006) produced during the subsequent narratives. That is, CWNS's proclivity to negative emotional reaction during the tasks was associated with greater percentage of other disfluencies exhibited during the narrative tasks. However, negative affect was not associated with percentage of stuttering-like disfluencies (est. β = .17, *p* = .09).

CWNS's other emotional reactivity and emotion regulation behaviors were not associated with either the percentage of stuttering-like (*positive affect*, est. β = -.07, *p* = .46; *self-speech*, est. β = -.13, *p* = .31; *off-task*, est. β = .16, *p* = .17) or the percentage of other disfluencies (*positive affect*, est. β = .001, *p* = .95; *self-speech*, est. β = -.01, *p* = .81; *off-task*, est. β = -.02, *p* = .50).

Conditions and Disfluencies

Contrary to predictions, as shown in Figure 17 and depicted on Table 2, neither CWS [$F(1,67) = .02$; $p = .89$] nor CWNS [$F(1,67) = .12$; $p = .73$] exhibited greater percentage of stuttering-like disfluencies in the experimental compared to the control condition.

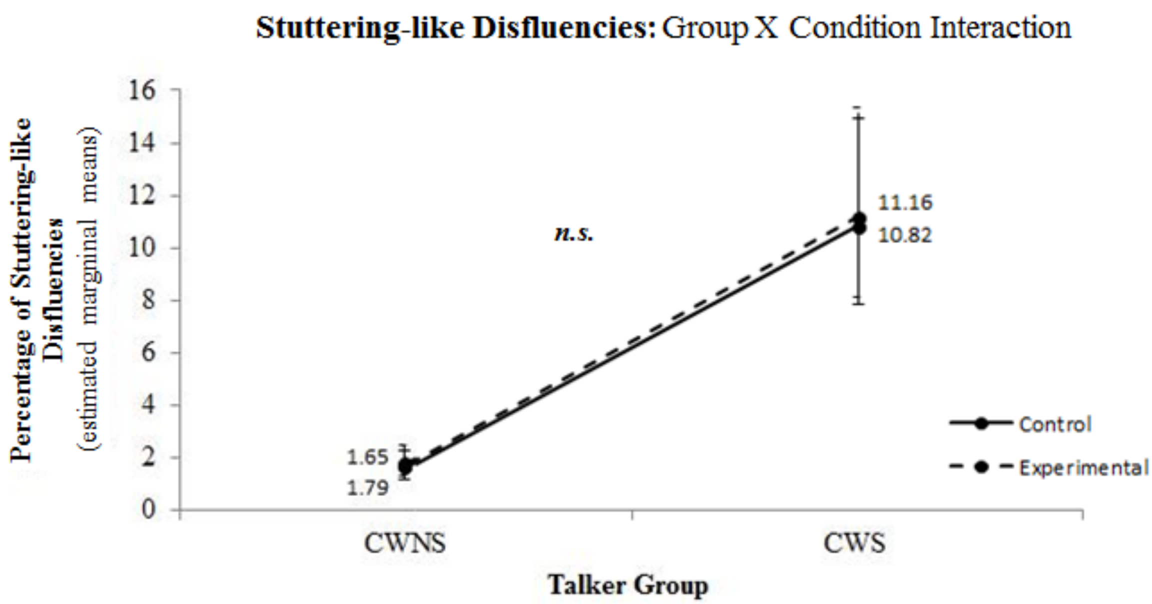

Figure 17. Estimated marginal means (displayed in the graph) for stuttering-like disfluencies exhibited during the control and the experimental narratives for children who stutter (CWS) and children who do not stutter (CWNS). The talker group x condition interaction was not significant. Error bars represent the 95% confidence interval of the estimated marginal means.

Similarly, as shown in Figure 18, neither a main effect of condition [$F(1,61) = .04$, $p = .85$], nor an interaction effect of condition by talker group [$F(1,61) = .75$, $p = .39$] was found for the percentage of other disfluencies. The estimated marginal means and standard errors for CWS and CWNS for the control and the experimental conditions are depicted on Table 2.

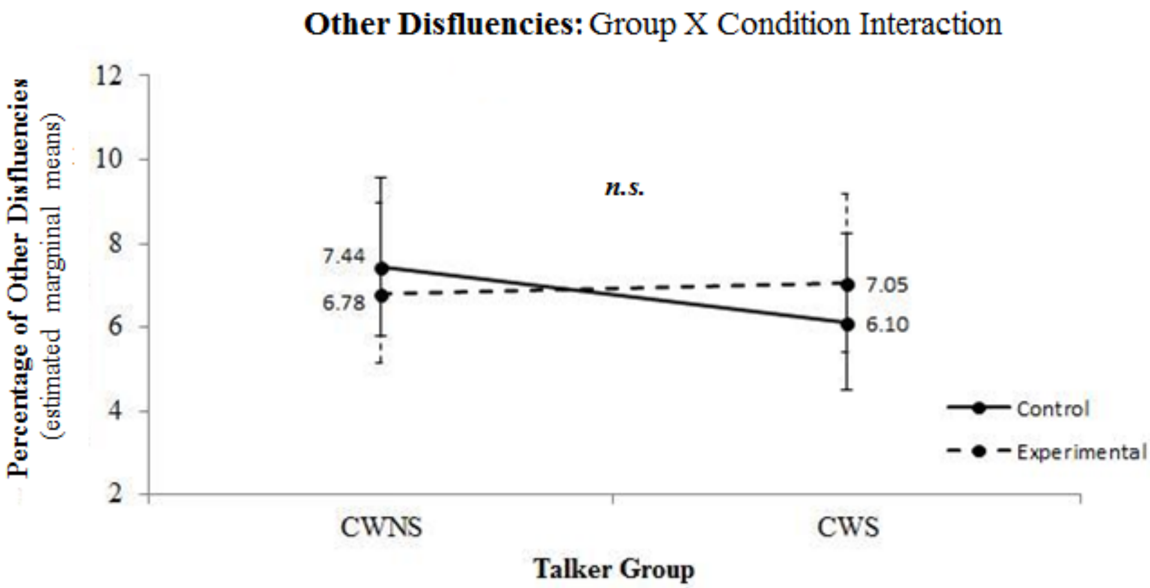

Figure 18. Estimated marginal means (displayed in the graph) for other disfluencies exhibited during the control and the experimental narratives for children who stutter (CWS) and children who do not stutter (CWNS). The talker group x condition interaction was not significant. Error bars represent the 95% confidence interval of the estimated marginal means.

The main findings of this study will be presented in the initial section of Discussion to appear immediately below.

CHAPTER IV

DISCUSSION

Overview of Main Findings

The present study resulted in five main findings. The first main finding indicated that, as initially predicted, CWS exhibited more negative emotion than CWNS during both the neutral and the frustrating tasks. However, no such between-group difference was observed for positive affect. The second main finding indicated that, contrary to predictions, CWS produced more self-speech than CWNS, with only CWNS displaying a significant increase in self-speech from the neutral to the frustrating task. The third main finding indicated that, for CWS, greater amount of self-speech during the tasks was associated with higher percentage of stuttering-like disfluencies produced during the subsequent narrative tasks. The fourth main finding indicated that, for CWS, greater duration of off-task behaviors during the tasks was associated with lower percentage of stuttering-like disfluencies during the subsequent narrative tasks. The fifth, and final finding indicated that for CWS there was no relation between emotional processes (i.e., emotional reactivity, emotion regulation) and non-stuttered or other disfluencies, whereas for CWNS negative affect was related to other disfluencies. Implications of each of these five findings are discussed in the sections to follow.

Emotional Reactivity: Between-group Differences

The first main finding confirmed initial hypothesis of increased negative affect in CWS. This result is consistent with previous research that CWS, when compared to CWNS, are more reactive (e.g., Karrass et al., 2006; Schwenk et al., 2007), negative in quality of mood (e.g., Eggers et al., 2010; Wakaba, 1998), and exhibit more negative emotional expressions when receiving a disappointing gift (Johnson et al., 2010). Furthermore, this finding is consistent with the suggestion that a temperament that is sensitive, reactive, easily aroused, and relatively intolerant of frustration contributes to the onset and development of stuttering (e.g., Guitar, 2006; Hill, 1999; Starkweather, 2002).

However, the present finding that CWS exhibited greater negative emotional reactions compared to CWNS is inconsistent with Frankel et al.'s (2011) report that the two talker groups did not appreciably differ in the display of negative affect. This discrepancy could be explained by methodological differences between the two studies. That is, Frankel and colleagues created conditions of emotional arousal by "passively" exposing participants to audiotaped conversations, of different emotional valence, between two adult female actresses as opposed to the present study for which participants were "actively" engaged in emotion-eliciting tasks. Perhaps young children are more likely to exhibit a wider range of emotional reactions when "actively" engaged to situations and stimuli that are of greater valence and importance to them (i.e., trying to open the box to get a desired gift, or receiving an undesirable gift).

Lastly, contrary to predictions, CWS and CWNS did not appreciably differ in terms of displayed positive emotion, a finding possibly attributed to the nature of the tasks. That is, it is likely that neither the control nor the experimental task were conducive to elicitation of positive emotion.

Emotion Regulation: Between-group Differences

The second main finding regarding between-group difference in self-speech did not support the initial hypothesis that CWS would produce less self-speech than their normally fluent peers. This prediction was based on previous research findings describing CWS as less able to regulate their emotions than CWNS (Karrass et al., 2006), and exhibiting less emotion regulatory behaviors than CWNS (Frankel et al., 2011). However, it should be noted that, unlike the present study, Karrass et al (2006) investigated parental reports of CWS's emotion regulatory *effectiveness* (e.g., high regulation leading to lower reactivity), rather than the *occurrence of regulatory attempts*.

Nevertheless, closer scrutiny of the present study's findings, as well as consideration of the dynamic interplay between emotional reactivity and emotion regulation seems to confirm rather than oppose Karrass et al.'s finding that CWS are poorer emotion regulators than CWNS. In other words, CWS might have engaged in more self-speech behaviors than their fluent peers but, contrary to expectations, decreased levels of emotional reactivity did not accompany these regulatory attempts. This may suggest that even though CWS used more regulatory behaviors, their regulatory efforts might not have been very effective in modulating their emotions.

Similarly, although Frankel et al. reported that CWS exhibited less self-regulatory behaviors than CWNS, they also found no significant between-group difference in displayed negative emotion. Thus, one could speculate that in the present study CWS exhibited more emotion regulation, indexed by self-speech, than their fluent peers because of their increased negative affect. Alternatively, the difference in the types of emotion regulatory behaviors examined in these two studies could partially explain the inconsistency in findings. Specifically, the role of the regulatory behaviors coded by Frankel and colleagues (i.e., fidgeting, self-soothing, and looking away) in emotion regulation might be different to that of self-speech.

Self-speech, or private speech (i.e., overt, audible speech that is not addressed to a listener), has been extensively studied as a tool for behavioral self-regulation in the preschool years (e.g., Winsler, de León, Carlton, Wallace, & Willson- Quayle, 2003; Winsler, Manfra, & Diaz, 2007). Specifically, self-speech has been shown to play an important role in planning, monitoring, guiding, and self-motivating oneself during different activities. Thus, it is not surprising that an increase in task complexity and difficulty yields an increase in the frequency of self-talk (e.g., Duncan & Pratt, 1997; Patrick & Abravanel, 2000). However, in the present study, only CWNS adjusted the use of self-speech to task demands by exhibiting significantly more self-speech during the experimental than the control task. The finding that CWS demonstrated high levels of self-speech during both control and experimental tasks could be taken to suggest that, unlike their fluent peers, CWS perceived both tasks to be challenging, an interpretation which could be indirectly supported by CWS's concurrent increased negative affect.

With regard to the role of self-speech in behavioral self-regulation, fewer studies have considered the use of language, in the form of self-speech, in emotion regulation. Specifically, Broderick (2001) found that preschool-age children who were rated as well-regulated by their parents and teachers used more private speech during three different kinds of activities (i.e., free play, art activity, puzzle construction) than their peers who were characterized as poor emotion regulators. In the context of this study, this finding could be taken to suggest that CWS are better-regulated than their fluent peers. However, as aforementioned, one needs to consider emotion regulation in the context of emotional reactivity. That is, if CWS were indeed better emotion regulators than CWNS one would expect, contrary to the present study's findings, those regulatory behaviors to be accompanied by decreased levels of emotional reactivity compared to those of their fluent peers. So, the possibility exists, that mere increases in self-speech were less than effective at regulating their emotion.

Apropos to the above possibility, Day and Smith (2011) examined the usage of different types of self-speech during the "attractive toy in the transparent box paradigm," and found that only facilitative task-relevant utterances (i.e., utterances that were related to the task but did not stop efforts to open the box) were correlated with decreased negative emotion, whereas high levels of nonfacilitative task-relevant utterances (i.e., utterances that were related to the task but inhibited or stopped efforts to open the box) were related to high levels of negative emotion. Thus, one could posit that even though CWS exhibited a greater quantity of self-speech behaviors than CWNS, these behaviors might have been qualitatively different. However, given that this study did not distinguish between different types of self-speech this speculation must await further empirical assessment.

Relation of Self-Speech and Stuttering-Like Disfluencies for Children Who Stutter

The third main finding did not confirm initial hypothesis of self-speech being negatively related to the frequency of stuttering-like disfluencies. That is, according to this study's results, the more CWS engaged in self-speech during the neutral and the frustrating tasks, the more they stuttered during the narrative tasks. This finding suggests the possibility that the relation of self-speech and speech-language planning and production processes is mediated by emotional reactivity in one of the following alternative ways. First, it could be speculated that CWS who use self-speech effectively to regulate their emotions during non-communicative tasks, have difficulty modulating their emotional reactions during communication given the perceived or real limited opportunities for self-speech. Alternatively, for other CWS, heightened emotional arousal might be due to the fact, as suggested by Day and Smith (2011), that some types of self-speech are associated with increased rather than decreased negative emotions. Perhaps, therefore, for some CWS self-speech heightens rather than lowers their emotionality. Regardless of whether heightened emotional arousal is attributed to the presence rather the absence of self-speech it is possible that in both scenarios, such arousal may divert limited attentional resources from an already, for some CWS, vulnerable speech-language planning and production system (e.g., Ntourou, Conture, & Lipsey, 2011) and in turn contribute to disruptions in fluency.

The second possibility for the relation between self-speech and stuttering-like disfluencies is that, CWS who use self-speech to regulate their emotions while they are talking create for themselves concurrent communicative activities. This may mean that during communication, CWS's tendency to self-speech becomes internal speech and thus competes and interferes with the formulation of their communicative intent or “preverbal message” (see, Levelt, 1989, p. 9), resulting in a greater likelihood of fluency disruptions.

Relation of Off-Task and Stuttering-Like Disfluencies for Children Who Stutter

The fourth main finding confirmed initial hypothesis of off-task behaviors being associated with frequency of stuttering-like disfluencies. That is, CWS who tended to shift their attention away from the neutral and the frustrating tasks were less likely to be disfluent during the subsequent narratives. This finding could be interpreted in the following two ways. First, even though neither emotional reactivity nor emotion regulation behaviors were assessed during story-telling, it could be suggested that during speech, attention shifting has fluency-inducing effects by modulating heightened emotional responses. This interpretation is consistent with results from other studies that measured emotional processes during narrative tasks and reported that CWS who use regulatory strategies less frequently and for shorter durations are more apt to exhibit increased disfluencies (Arnold et al., 2011; Walden et al, 2011). Second, it is possible that attention shifting facilitates speech fluency not only by modulating emotional reactions but also by diverting undue attention to or monitoring of the ongoing speech act. The latter possibility has been shown to be fluency inducing for some adults who stutter (e.g., Arend, Povel, & Kolk, 1988), maybe for those whose stuttering is partially attributed to a hyperfunctioning internal speech-planning and production monitoring system (e.g., Vasić & Wijnen, 2005).

Relation of Emotional Processes and Other Disfluencies

The fifth main finding was that for CWS, neither emotional reactivity nor emotion regulation behaviors were predictive of other disfluencies. To the present writer's knowledge this was the first attempt to assess young CWS's emotional processes in relation to their non-stuttered or other disfluencies. This finding could be taken to suggest that for CWS non-stuttered, when compared to stuttering-like disfluencies, are less susceptible to environmental stressors. Interestingly though, for CWNS increased negative affect was associated with increased percentage of other disfluencies. Thus, one could hypothesize that even though non-stuttered, unlike stuttering-like disfluencies, are produced with similar frequency by both CWS and CWNS their underlying production mechanism might be different.

Implication of Findings for the DD-S Model

The finding that CWS exhibited greater negative emotion than CWNS confirms the DD-S notion that CWS and CWNS differ in terms of emotional diathesis. Likewise, the finding that CWS made more self-speech regulatory attempts than CWNS is probably related to the aforementioned difference in emotional reactivity. That is, increased negative affect on the part of CWS lead to greater self-speech regulatory attempts. Furthermore, the finding that both CWS and CWNS exhibited more negative affect in the frustrating (ATTB) than the neutral (ATTB) task talks to the basic tenet of the DD-S model that emotional stress leads to activation of emotional diathesis. A third finding, although not explicitly specified on the DD-S model, was that greater self-speech regulatory attempts were associated with more stuttering, in contrast to greater off-task behaviors, which were associated with decreases in stuttering. Although, the DD-S model is at present silent regarding the relation of regulatory attempts versus regulatory effectiveness relative to changes in stuttering, this relation appears in need of further consideration as well as empirical exploration.

Caveats

Sequence of Tasks

As stated earlier in the methods section, for all participants the "story preview" task separated the emotion manipulation tasks (i.e., ATTB, ALTB) and the narrative tasks. Even though this experimental sequence might have facilitated the story-telling task given that participants previewed the story immediately prior to telling it, it is not unlikely that the temporal gap between emotion manipulation tasks and narrative tasks dissipated the effect of emotions elicited during the tasks to the speech (dis)fluency.

Behavioral Measures of Negative Affect and Emotion-Eliciting Tasks

As described in the methods section, some of the nonverbal expressive behaviors coded during the control (i.e., ALTB) and the experimental (i.e., ATTB) tasks included "eyes squinted," "furrowed eyebrows," and "wrinkled nose." Even though, these facial expressions are suggestive of negative affect, they can also accompany physical effort in the form of motoric overflow. Thus, one cannot categorically refute the possibility for the higher demands for physical effort during the ATTB task to have attributed to the finding that participants exhibited more negative affect during the experimental than the control task. However, it is unlikely that this caveat had an effect on the significant between-group difference.

Behavioral Coding of Self-Speech

Due to the somewhat restricted sample size ($N = 36$) and the relatively infrequent use of self-speech it was not feasible to code different types of self-speech (e.g., facilitative task-relevant utterances, nonfacilitative task-relevant utterances, inaudible muttering) in order to elucidate the between-group differences in self-speech and better understand the role of self-speech in speech (dis)fluency.

CHAPTER V

CONCLUSION

Results from this study, using direct observation of behavioral correlates of emotional reactivity and emotion regulation, provide support for the notion that preschool-age CWS are more reactive than CWNS, a notion and finding made curious by the fact that CWS exhibit more self-speech regulatory behaviors than CWNS. Bringing together these two findings leads one to the possibility that CWS's regulatory attempts may not be very effective in modulating their emotions. Furthermore, for preschool-age CWS, there appears to be a link between emotion regulation strategies and stuttering-like disfluencies, with self-speech seemingly inhibiting fluency whereas attention shifting, or off-task behaviors, seemingly facilitating fluent speech-language production. These latter findings suggest that the relation between emotion regulation and fluency disruptions could be influenced by attentional processes, unregulated emotional arousal, and/or competing communicative intentions. However, further research is needed to experimentally investigate these propositions and by so doing elucidate the impact of emotional processes on speech-language planning and production in young children. Overall, findings from this study support the notion that emotional processes are associated with childhood stuttering and likely contribute to the difficulties that at least some CWS have establishing normally fluent speech.

APPENDIX

Bivariate correlations (Spearman rho) for the emotional reactivity (i.e., negative affect, positive affect) and emotion regulation variables (i.e., self-speech, off-task) within each condition (i.e., control, experimental), for all participants and separately for children who do (CWS) and do not (CWNS) stutter.

		Negative Affect	Positive Affect	Self-Speech	Off-Task
All Participants, Control Condition	Negative Affect	1.00			
	Positive Affect	0.23	1.00		
	Self-Speech	0.38*	0.28	1.00	
	Off-Task	0.27	0.05	0.33	1.00
All Participants, Experimental Condition	Negative Affect	1.00			
	Positive Affect	0.09	1.00		
	Self-Speech	0.29	0.30	1.00	
	Off-Task	0.25	0.11	0.28	1.00
CWS, Control Condition	Negative Affect	1.00			
	Positive Affect	0.17	1.00		
	Self-Speech	0.40	0.47*	1.00	
	Off-Task	-0.13	0.05	0.41	1.00
CWS, Experimental Condition	Negative Affect	1.00			
	Positive Affect	0.21	1.00		
	Self-Speech	0.33	0.18	1.00	
	Off-Task	0.26	0.07	0.05	1.00
CWNS, Control Condition	Negative Affect	1.00			
	Positive Affect	0.26	1.00		
	Self-Speech	0.01	0.02	1.00	
	Off-Task	0.64**	0.15	0.31	1.00
CWNS, Experimental Condition	Negative Affect	1.00			
	Positive Affect	0.21	1.00		
	Self-Speech	0.33	0.18	1.00	
	Off-Task	0.26	0.07	0.05	1.00

Note: ** Correlation is significant at the .01 level (2- tailed), * Correlation is significant at the .05 level (2-tailed).

REFERENCES

Anderson, J., Pellowski, M., Conture, E., & Kelly, M. (2003). Temperamental characteristics of young children who stutter. *Journal of Speech, Language and Hearing Research, 46*, 1221-1233.

Arends, N., Povel, D. J., & Kolk, H. (1988). Stuttering as an attentional phenomenon. *Journal of Fluency Disorders, 13*, 141–151.

Arnold, H. S., Conture, E. G., Key, A. P. F., & Walden, T. (2011). *Emotional reactivity, regulation, and childhood stuttering: A behavioral and electrophysiological study. Journal of Communication Disorders, 44*, 276-293.

Bakeman,R., & Gottman, J. M. (1997). *Observing interaction: An introduction to sequential analysis* (2nd ed.). New York: Cambridge University Press.

Baumgartner, J. M., & Brutten, E. J. (1983). Expectancy and heart rate as predictors of the speech performance of stutterers. *Journal of Speech and Hearing Research, 26*, 383-385.

Broderick, N. Y. (2001, June). An investigation of the relationship between private speech and emotion regulation in preschool- age children. *Dissertation Abstracts International: Section B: The Sciences & Engineering, 61*(11-B), 6125.

Buhr, A. P., Frankel, C. B., Walden, T. A., & Conture, E. G. (2011). *Respiratory sinus arrhythmia and childhood stuttering*. Manuscript submitted for publication.

Calkins, S. D. (1997). Cardiac vagal tone indices of temperamental reactivity and behavioral regulation in young children. *Developmental Psychobiology, 31*, 125–135.

Caruso, A. J., Chodzko-Zajko, W. J., Bidinger, D. A., & Sommers, R. K. (1994). Adults who stutter: responses to cognitive stress. *Journal of Speech and Hearing Research, 37*, 746-754.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational & Psychological Measurement, 20*, 37-46.

Cole, P., Barret, K., & Zahn-Waxler, C. (1992). Emotion displays in two-year-olds during mishaps. *Child Development, 63*, 314–324.

Cole, P. M., Zahn-Waxler, C., Fox, N. A., Usher, B. A., & Welsh, J. D. (1996). Individual differences in emotion regulation and behavior problems in preschool children. *Journal of Abnormal Psychology, 105*, 518 – 529.

Cole, P. M., Zahn-Waxler, C., & Smith, K. D. (1994). Expressive control during a disappointment: Variations related to preschoolers' behavior problems. *Developmental Psychology, 30*, 835–846.

Conture, E. & Walden, T. (in press). Dual Diathesis-Stressor Model of Stuttering. A chapter to appear in Beliakova, L., & Filatova, Y. (Eds.) *Theoretical Issues of Fluency Disorders*. Moscow: Vlados.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297–334.

Day, A. (2005). *Carl's Sleepy Afternoon*. New York, NY: Farrar Straus Giroux.

Day, A. (2009). *Carl's Snowy Afternoon*. New York, NY: Farrar Straus Giroux.

Day, K. L., & Smith, C. L. (2011, May). *Understanding children's emotion regulation: Examining the role of private speech*. Poster presented at the Annual Convention of the Association for Psychological Science, Washington, D.C

Dietrich, S., & Roaman, M. H. (2001). Physiologic arousal and predictions of anxiety by people who stutter. *Journal of Fluency Disorders, 26*, 207 – 225.

Duncan, R. M., & Pratt, M. W. (1997). Microgenetic change in the quantity and quality of preschoolers' private speech. *International Journal of Behavioral Development, 20*, 367–383.

Dunn, L. M. & Dunn, L. M. (2007). *Peabody Picture Vocabulary Test* (4th ed., PPVT-IV). Circle Pines, MN. American Guidance Services, Inc.

Eggers, K., de Nil, L. F., van den Bergh, B. R. (2010). Temperament dimensions in stuttering and typically developing children. *Journal of Fluency Disorders, 35*(4), 355-372.

Embrechts, M., Ebben, H., Franke, P., & van de Poel, C. (1998). Temperament: A comparison between children who stutter and children who do not stutter. In E. C. Healey & H. F. M. Peters (Eds.), *Stuttering: Proceedings of the second world congress on fluency disorders* (Volume 2). Nijmegen, The Netherlands: University Press Nijmegen.

Felsenfeld, S., van Beijsterveldt, C. E. M., & Boomsma, D. I. (2010). Attentional regulation in young twins with probable stuttering, high nonfluency, and typical fluency. *Journal of Speech Language and Hearing Research, 53*, 1147-1166.

Fowlie, G. M., & Cooper, E. B. (1978). Traits attributed to stuttering and nonstuttering children by their mothers. *Journal of Fluency Disorders, 3*, 233–246.

Frankel, C. B., Walden, T. A., & Conture, E. G. (2011). *Differences in emotional processes between preschool-age children who do and do not stutter.* Manuscript in preparation.

Glauber, I (1958). The psychoanalysis of stuttering. In J. Eisenson (Ed). *Stuttering: A Symposium* (pp. 71-120). New York: Harper & Row.

Goldman, R., & Fristoe, M. (2000). *Goldman-Fristoe Test of Articulation* (GFTA). Circle Pines, MN. American Guidance Services, Inc.

Goldsmith, H. H., Buss, A. H., Plomin, R., Rothbart, M. K., Thomas, A., Chess, S., Hinde, R. A., & McCall, R. B. (1987). Roundtable: What is temperament? Four approaches. *Child Development*, 58, 505-529.

Goldsmith, H. H., Reilly, J., Lemery, K. S., Longley, S., & Prescott, A. (1999). *The Laboratory Temperament Assessment Battery: Preschool Version.* University of Wisconsin.

Hill, D. (1999). Evaluation of child factors related to early stuttering: A descriptive study. In N. Bernstein Ratner, & E. C. Healey (Eds.), *Stuttering research and practice: Bridging the gap* (pp. 145–174). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Hollingshead, A. A. (1975). *Four-factor index of social status*. Unpublished manuscript, Yale University, New Haven, CT.

Howell, P., Davis, S., Patel, H., Cuniffe, P., Downing-Wilson, D., Au-Yeung, J., & Williams, R. (2004). Fluency development and temperament in fluent children and children who stutter. In Packman, A., Meltzer, A. Peters H. F. M. (Eds.). *Theory, research and therapy in fluency disorders*. *Proceedings of the fourth world congress on fluency disorders* (pp. 250-256). Nijmegen, The Netherlands: University Press Nijmegen.

Hresko, W., Reid, D., & Hamill, D. (1999). *Test of Early Language Development-3* (TELD-3). Austin, TX: Pro-Ed.

Jahromi, L. B., Gulsrud, A., & Kasari, C. (2008). Emotional competence in children with Down Syndrome: Negativity and regulation. *American Journal of Mental Retardation, 113*, 32-43.

Jahromi, L. B., & Stifter, C. A. (2008). Individual differences in preschoolers' self-regulation and theory of mind. *Merrill-Palmer Quarterly, 54*(1), 125-150.

Johnson, K., Walden, T., Conture, E., & Karrass, J. (2010). Spontaneous regulation of emotions in preschool children who stutter: Preliminary findings. *Journal of Speech, Language, Hearing Research*, *53*, 1-18.

Johnson, W. (1955). A study of the onset and development of stuttering. In W. Johnson & R. R. Leutenegger (Eds.), *Stuttering in children and adults* (pp. 37-73). Minneapolis, MS: University of Minnesota Press.

Johnson, W., & Associates (*1959*). *The onset of stuttering*. Minneapolis: University of Minnesota Press.

Jones, R. M. (2011). *Respiratory sinus arrhythmia prior and during narratives of preschool-age children who stutter*. Unpublished manuscript.

Jones, R. M., Conture, E. G., Frankel, C. B., & Walden, T. A. (2011). *Emotional reactivity prior to and during (dis)fluent utterances of children who do and do not stutter.* Manuscript submitted for publication.

Karrass, J., Walden, T., Conture, E., Graham, C., Arnold, H., Hartfield, K., & Schwenk, K. (2006). Relation of emotional reactivity and regulation to childhood stuttering. *Journal of Communication Disorders, 39*, 402-423.

Kazenski, D. M., Guitar, B., McCauley, R. J., & Falls, W. (2007, November). *Physiological responses to stress in preschool children who stutter*. Poster session presented at the annual meeting of the American Speech-Language-Hearing Association, Boston, MA.

Levelt, W. (1989). *Speaking: From intention to articulation*. Cambridge, MA: Bradford Books/The MIT Press.

Lewis, K. E., & Goldberg, L. L. (1997). Measurements of temperament in the identification of children who stutter. *European Journal of Disorders of Communication, 32,* 441-448.

McDevitt, S. C., & Carey, W. B. (1978). A measure of temperament in 3 – 7 year old children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 19*, 245-253.

Miller, J. F., & Iglesias, A. (2008). *Systematic Analysis of Language Transcripts (SALT)*. Middleton, WI: SALT Software LLC.

Monroe, S. M., & Simons, A. D. (1991). Diathesis-stress theories in the context of life-stress research: Implications for the depressive disorders. *Psychological Bulletin, 110*, 406–425.

Ntourou, K., Conture, E. G., & Lipsey, M. W. (2011). Language abilities of children who stutter: A meta-analytical review. *American Journal of Speech-Language Pathology, 20*, 163-179.

Ortega, A. Y., & Ambrose, N. G. (in press). Developing physiologic stress profiles for school-age children who stutter. *Journal of Fluency Disorders*.

Patrick, E., & Abravanel, E. (2000). The self-regulatory nature of preschool children's private speech in a naturalistic setting. *Applied Psycholinguistics, 21*, 45-61.

Porges, S W. (2007). The polyvagal perspective. *Biological Psychology, 74,* 116-143.

Riley, G. (2009). *Stuttering Severity Instrument for Young Children* (4th ed.). Austin, TX: Pro-Ed.

Rothbart, M. K., Ahahdi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development, 72*, 1394-1408.

Rothbart, M. K., & Bates, J. E. (1998). Temperament. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (pp. 105–176). New York: Wiley.

Satterthwaite, F. E. (1946). An approximate distribution of estimates of variance components. *Biometrics Bulletin, 2*, 110–114.

Schwenk, K., Conture, E., & Walden, T. (2007). Reaction to background stimulation of preschool children who do and do not stutter. *Journal of Communication Disorders, 40*, 129-141.

Sheehan, J. G. (1953). Theory and treatment of stuttering as an approach-avoidance conflict. *Journal of Psychology, 36*, 27-49.

Spinrad, T. L., Eisenberg, N., Harris, E., Hanish, L., Fabes, R. A., Kupanoff, K., et al. (2004). The relation of children's everyday nonsocial peer play behavior to their emotionality, regulation, and social functioning. *Developmental Psychology, 40*, 67-80.

Starkweather, C. W. (2002). The epigenesis of stuttering. *Journal of Fluency Disorders, 27*, 269–28.

Tapp, J., & Walden, T. A. (1993). PROCODER: A professional tape control, coding, and analysis system for behavioral research using videotape. *Behavior Research Methods, Instruments, and Computers, 25*, 53–56.

Thomas A. & Chess, S. (1977). *Temperament and Development.* New York: Brunner Mazel.

Thompson, R. A. (1994). Emotion regulation: In search of definition. In N. A. Fox (Ed.), The development of emotion regulation: Biological and behavioral considerations. *Monographs of the Society for Research and Child Development, 59*(2-3, Serial No. 240), 25-52.

Treon, M. (2010). Revised stuttering and related TPNB-LPPD threshold syndrome hypothesis in light of recent research. *Psychology and Education*, Monograph 47 (No. 3&4).

van den Bergh, B., & Ackx, M. (2003). Een Nederlandse versie van Rothbarts 'Children's Behavior Questionnaire'. [The Dutch version of Rothbart's Children's Behavior Questionnaire]. *Kind en Adolescent, 24*, 77–78.

van der Merwe, B., Robb, M. P., Lewis, J., & Ormond, T. (2011). Anxiety measurements and salivary cortisol levels in children who stutter. *Contemporary Issues in Communication Sciences and Disorders, 38,* 1-10.

Vasić, N., & Wijnen, F. (2005). Stuttering as a monitoring deficit. In R. J. Hartsuiker, R. Bastiaanse, & A. Postma (Eds.), *Phonological encoding and monitoring in normal and pathological speech*. Hove: Psychology Press.

Wakaba, Y. (1998). Research on temperament of children who stutter with early onset. In E.C. Healey & H.F.M. Peters (Eds.), *Stuttering: Proceedings of the second world congress on fluency disorders* (Volume 2). Nijmegen, The Netherlands: University Press Nijmegen.

Wakaba, Y., Iizawa, M., Gondo, K., Inque, S., & Fujino, H. (2003). Preliminary study on effects of temperament characteristics on early development of stuttering children. *Proceedings from the 5th Annual Conference of the International Fluency Association.* Montreal, Canada.

Walden, T. A., Frankel, C. B., Buhr, A. P., Johnson, K. N., Conture, E. G., & Karrass, J. M. (2011). *Dual diathesis-stressor model of emotional and linguistic contributions to developmental stuttering*. Manuscript submitted for publication.

Weber, C. M., & Smith, A. (1990). Autonomic correlates of stuttering and speech assessed in a range of experimental tasks. *Journal of Speech and Hearing Research, 33*, 690 – 706.

Williams, K. T. (2007) *Expressive Vocabulary Test* (2nd ed., EVT). Circle Pines, MN. American Guidance Services, Inc.

Williams, M. J. (2004). *Childhood stuttering and temperament*. Unpublished doctoral dissertation, University of Nevada, Reno.

Winsler, A., de León, J. R., Wallace, B., Carlton, M. P., &Willson- Quayle, A. (2003). Private speech in preschool children: Developmental stability and change, across-task consistency, and relations with classroom behavior. *Journal of Child Language, 30*, 583–608.

Winsler, A., Manfra, L., & Diaz, R. M. (2007). “Should I let them talk?” Private speech and task performance among preschool children with and without behavior problems. *Early Childhood Research Quarterly, 22*, 215–231.

Yairi, E., & Ambrose, N. (1992). A longitudinal study of stuttering in children: a preliminary report. *Journal of Speech and Hearing Research, 35*(4), 755-760.

Zentner, M., & Bates, J. E. (2008). Child temperament: An integrative review of concepts, research programs, and measures. *European Journal of Developmental Science, 2*, 7-37.