EMOTION-RELATED REGULATION STRATEGY USE IN PRESCHOOL-AGE CHILDREN WHO STUTTER

A thesis submitted to the
Kent State University Honors College
in partial fulfillment of the requirements
for University Honors

by

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May, 2019

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ACKNOWLEDGMENTS

I would like to extend my utmost appreciation to my faculty advisor, Dr. Hayley Arnold, under whose guidance I have grown exponentially. My oral defense committee members – Dr. Jennifer Roche, Dr. Karin Coifman, and Dr. Timothy Meyers – are so valued for their roles in advancing this project and my growth as a researcher. The incredible support I have received from close friends and family, especially my parents, has had a resounding influence on my progress with this project and my development as a thoughtful professional. In addition, I extend special thanks to my colleagues in the Speech-Language Physiology research lab who devoted hours of hard work to assisting me with this project.

Introduction

Theories indicate a multi-factorial approach may be most appropriate when investigating possible influences on the cause, maintenance, and aggravation of stuttering in children (Conture et al., 2006; De Nil, 1999; Smith & Weber, 2017; Walsh, Mettel, & Smith, 2015). Several contributors, such as motor control, linguistic elements, and cognitive processes, are thought to play a role in the speech-language processes that are impaired in children who stutter (CWS; Jones et al., 2014; Walden et al., 2012; Watkins, Smith, Davis, & Howell, 2008). Though investigations into these various potential factors formerly focused on stable influences attributed to trait-like individual differences, this concentration has evolved into a deeper interest in more fluid, affective frameworks for understanding stuttering (Arends, Povel, & Kolk, 1988; Arnold, Conture, Key, & Walden, 2011; Ntourou, Conture, & Walden, 2013). More specifically, a recent wave of studies has focused on the interaction between emotion processing systems as a contributor to a multi-factorial model of stuttering in children (Walden et al., 2012; Zengin-Bolatkale, Conture, Key, Walden, & Jones, 2018).

Although emotion processing correlates can be influenced by individual differences, they are often recognized as indicators of a child's interaction with the environment (Eisenberg, Champion, & Ma, 2004; Rothbart, Ziaie, & O'Boyle, 1992). The recent stuttering research has shown refined interest in the self-regulatory measures involved in emotion processing (Arnold et al., 2011; Eisenberg, Champion, et al., 2004; Ntourou et al., 2013). *Self-regulation* is a self-imposed system of emotion processing that utilizes executive functioning skills to facilitate or inhibit the modulation of behavioral reactivity. Accordingly, these emotion-related regulation skills become more effective with age as underlying cognitive functions continue to develop (Dohle, Diel, & Hofmann, 2018; Eggers, De Nil, & Bergh, 2010). *Emotion-related regulation*, a subsector of self-regulation, refers to the relatively broad concept of regulatory steps taken, either self-driven or imposed by other people (e.g., parents, teachers) to make changes on activated emotions (Eisenberg, Champion, et al., 2004; Simonds, Kieras, Rueda, & Rothbart, 2007). Behavioral indices of emotion-related regulation can be recognized as indicators of an individual's affective responses to the environment, or their *emotional reactivity*, exemplifying the interconnectedness of these two constructs.

As understanding and investigation of emotion-related regulatory processes have expanded, so has the use of these findings in stuttering research. Recent investigations focused on further developing understanding of emotion processing in relation to stuttering have shown that emotion-related regulation is associated with stuttering (Arnold et al., 2011; Jones, Conture, & Walden, 2014; Karass et al., 2006; Ntourou et al., 2013). Work in such studies reported significant differences in regulatory attempts between preschool-age children who do and do not stutter (Eggers, De Nil, & Van den Bergh, 2013; Ntourou et al., 2013). For instance, use of emotion-related regulation strategies has been shown to correlate with fewer speech disfluencies in preschool-age CWS (Arnold et al., 2011), suggesting that implementation of self-regulatory strategies may reduce stuttering in preschool-age children. In another study of preschool-age children, CWS experienced a higher frequency of subsequent stuttering when emotional arousal was high and emotion regulation was low (Walden et al., 2012), indicating a direct relationship between disfluencies and emotion regulation attempts. These emotion-related regulatory skills are necessary for positive social and psychological development, reportedly more so than whether or not a child stutters and the degree of stuttering (Hollister, 2015). The developmental confluence of cognition, language, and regulatory processes occurring around the typical age of onset for stuttering (around ages 3-4) further indicates the possibility of regulation interacting with language-process impairments to impact stuttering (Cole et al., 1994; Conture et al., 2006; Kopp, 1982; Mischel and Patterson, 1978; Vygotskiĭ, 1962).

Such investigations that focused on reactivity and regulation of emotion in young CWS gave way to discussion of other contributing factors (e.g., executive function, attentional control) that ventured outside of the confines of emotion to provide a more integrated framework for examining regulation processes in relation to stuttering (Johnson, Walden, Conture, & Karrass, 2010; Jones et al., 2014; Ntourou et al., 2013). Although not strictly considered to be terms only of emotion-related regulation, processes such as executive functioning, attentional regulation, and related concepts contribute to maintaining emotional homeostasis (Eisenberg, Smith, Sadovsky, & Spinrad, 2004; Simonds et al., 2007). Many of these highly-related concepts act unanimously with emotion processes to promote effective regulation, making way for a new realm of study into affective factors potentially related to stuttering.

Effortful Control

One of most integral components of emotion-related self-regulation is an inhibitory mechanism referred to as effortful control (Rothbart & Rueda, 2005; Rothbart, Sheese, Rosario Rueda, & Posner, 2011; Simonds et al., 2007). *Effortful control*, a self-regulatory process driven by executive functioning, refers to the ability to voluntarily suppress a dominant response in order to perform a subdominant response (e.g., focusing on a parent's speech despite environmental distractions; Eisenberg, Champion, et al., 2004; Kochanska, Murray, & Harlan, 2000; Rothbart & Bates, 1998; Rothbart & Rosario Rueda, 2005). As such, executive functioning tasks (e.g., planning, detecting errors, integrating information relevant to selecting behavior) are also contributors to successful effortful control. Eisenberg et al. (2004) considers effective use of effortful control to be essential in children who optimally regulate their emotions.

Effortful control is comprised of both *attentional regulation* (i.e., the ability to voluntarily shift or maintain focus, also aptly called *attentional control*) and *behavioral regulation* (i.e., the ability to intentionally modulate behavior as appropriate, recognized also as *inhibitory control*) (Eisenberg, Champion, et al., 2004; Eisenberg, Smith, et al., 2004; Simonds et al., 2007). These components work together to perform active, internally guided regulation of behavior and emotion (Kochanska et al., 2000). With such influential roles in regulation of the environment, effortful control has been the focus of several recent studies in the stuttering literature. One such study found parent- and clinician-reported high stuttering severity to correlate with low measures of effortful control, indicating strong support for theories suggesting effortful control as a significant influencer in stuttering severity (Kraft, Ambrose, & Chon, 2014). Furthermore, effortful control has consistently been found to be significantly reduced in CWS (Eggers et al., 2010; Hollister, 2015).

Though focus on effortful control correlates has continued to gain more interest in recent studies (Eggers, De Nil, & Van den Bergh, 2009; Eggers et al., 2013; Hollister, 2015; Kraft et al., 2014), stuttering research has largely failed to further break down the strategies employed as a means of self-regulation, a construct that research has already shown to be extremely complex (Eisenberg, Champion, et al., 2004). Simply considering the occurrence, or lack thereof, of regulatory behaviors is not sufficient, as it has been shown that children who do and do not stutter might significantly differ on a more complex level (Ntourou et al., 2013).

Although the literature has only begun to investigate relations between regulatory strategy types and stuttering, findings already indicate a relationship between strategy type and talker groups (Ntourou et al., 2013; Roche & Arnold, 2018). For instance, Ntourou et al. (2013) investigated two main emotion regulation strategy types: distraction and self-speech, which was further broken down and categorized. The study coded video data of CWS and CWNS preschool-age children in a frustrating task to assess both for regulation, as mentioned above, and for emotional reactivity, which was recognized by correlates of positive and negative affect. CWS were found to employ self-speech regulatory techniques with greater frequency than their typical peers during the control condition, and only the CWS showed higher levels of self-speech when compared to CWNS peers. Furthermore, Roche and Arnold (2018) revealed that, in typically (dis)fluent adults, the use of one type of emotion regulation, called expressive suppression, was associated with *increased* speech disfluency, indicating a relationship between regulatory strategy type and speech disfluency.

Though research on the relations between regulation processes and stuttering have revealed potential associations (Arnold et al., 2011; Jones et al., 2014; Ntourou et al., 2013; Roche & Arnold, 2018), the field has yet to provide substantial study of the relation between stuttering in preschool-age children and the specific patterns of emotion regulation strategy use. The power of resulting findings is weakened when studies neglect to acknowledge the complexity of these self-regulatory behaviors. To appropriately address this gap in knowledge, shifting the focus of this research onto a more comprehensive analysis of the different types of regulation employed by preschool-age children who stutter and preschool-age children who do not stutter (CWNS) is necessary.

Although essential to fully understanding relations between regulation and stuttering, such a shift in focus poses a challenge, as there remains no agreement on the best practices for differentiating strategies of self-regulation (Eisenberg, Champion, et al., 2004). One of the favored mechanisms of coding regulatory strategies has been to recognize behaviorally categorized subsectors of self-control strategy usage. Common behavioral correlates used to analyze different regulatory strategies include motor, verbal, and visual indicators of regulation (Arnold et al., 2011; Manfra, Davis, Ducenne, & Winsler, 2014; Rothbart et al., 1992). Visual indicators (e.g., gaze aversion, visual distraction) can be correlated to participants' attentional components of regulation (Arnold et al., 2011; Bush, 2006; Ntourou et al., 2013). Behaviors that are motoric or verbal in nature have similarly been used to identify behavioral regulation or inhibitory control attempts (Bush, 2006; Jahromi & Stifter, 2013; Jones et al., 2014; Jones et al., 2014; Nuske, Hedley, Tseng, Begeer, & Dissanayake, 2017). These behavior regulation strategies are described in detail below.

Behavioral Regulation

As one of the primary components of effortful control, behavioral regulation draws from executive functioning skills to inhibit and sustain behavior according to the environment. Although also a primary facet of emotion-related self-regulation, inhibitory control is considered by cognitive models as a mechanism of executive function, parallel to executive processes such as planning, working memory, and cognitive flexibility (Ofoe, Anderson, & Ntourou, 2018; Rothbart & Rosario Rueda, 2005). For the purposes of this study, behavioral regulation was observed in two facets: motoric and verbal regulatory attempts. Both behavioral correlates of self-regulation are explored in further detail below.

Motoric regulation. Movement has been recognized as a reliable indicator of regulatory attempts (Buss & Goldsmith, 1998; Manfra et al., 2014; Rothbart et al., 1992). Spontaneous motor movements can be broken down into two categories: gross motor movement (e.g., stepping forward, extending an arm in front of the body) and fine motor movement (e.g., fidgeting with fingers, playing with hair). Examinations of gross motor movement in the context of self-regulation often recognize two subsets of gross motor behavior: (a) approach (e.g., extending a hand toward a forbidden object) and (b) avoidance (e.g., turning away from a tempting item or situation; Manfra et al., 2014). In this case, approach and avoidance are recognized as opposing forces, where avoidance indicates effective regulation and approach reflects ineffective regulation. Fine motor movement can also be recognized through different presentations of behavior, such as repetitive behaviors (e.g., tapping a pencil against a surface repeatedly), physically restrictive behaviors (e.g., pressing hands over the mouth), and entertaining behaviors (e.g., playing with the fabric of a dress). Arnold et al. (2011) recognized similar behavioral patterns when examining regulation, categorizing the motoric patterns as self-stimulating behaviors if they were performed in a repetitive or self-soothing manner.

Verbal regulation. Recent studies that have investigated behavioral regulation as a potential factor in stuttering in preschoolers have shown specific interest in how children use speech-language productions as part of their self-regulatory toolbox (e.g., Ntourou et al., 2013). For example, in Ntourou et al. (2013), responses of CWS and CWNS to a frustration task indicated that CWS exhibited more self-speech behaviors than did CWNS. Furthermore, this self-speech appeared to exacerbate disfluency in the CWS.

Studies on the topic of verbal self-regulation often reference the literature on self-talk or self-speech, which refers to speech directed at the self during tasks that are either positive, negative, or irrelevant in nature (Ntourou et al., 2013; Zourbanos & Papaioannou, 2014). Presence and quality of self-speech are known to play a key role when used in self-regulation or self-control (Toner & Smith, 1977; Patterson & Mischel, 1976), indicating the importance of examining self-speech and its attributes during the present study's temptation task. As found in Ntourou's study (2013) that observed preschool-age CWS and CWNS in a frustration task, we expect CWS might show greater use of verbal regulatory strategies than do the CWNS.

Attentional Regulation

In combination with the behavioral components of regulation encompassed by effortful control, attention is thought to be a primary factor in effective self-regulation. Imaging data suggest that there are three neurological networks relating to aspects of attention that can be attributed to the following functions: alerting (readiness to receive and respond to stimuli), orienting (directing attention to target stimuli), and executive attention (monitoring, detecting and resolving conflict between brain regions; Fan, McCandliss, Fossella, Flombaum, & Posner, 2005; Geva, Zivan, Warsha, & Olchik, 2013; Mahoney, Verghese, Goldin, Lipton, & Holtzer, 2011; Posner & Fan, 2007; Posner & Rothbart, 2007). *Executive attention*, which is also known to be responsible for the production of appropriate behavioral responses, is considered by some as synonymous to executive control monitoring due to its role in regulating executive control processes (Geva et al., 2013; Mahoney et al., 2011). Executive attention is considered to be one of main contributing components of effective self-regulation, alongside effortful control (Rothbart & Rosario Rueda, 2005; Rothbart et al., 2011), and mature executive attention has even been considered the origin of self-regulation development (Eggers, De Nil, & Van den Bergh, 2012; Simonds et al., 2007). Furthermore, neurologically-based studies have revealed executive attention's role as a neural substrate of effortful control, with mechanisms for monitoring and resolving conflicts among feelings, thoughts, and responses (Posner & Rothbart, 2007; Simonds et al., 2007).

According to a psychological study by Berthelsen, Hayes, White, and Williams (2017), these abilities (i.e., controlling and directing attention) that develop across infancy and early childhood are “the basis of self-regulation” (p. 2). Just as self-regulation is known to develop around three or four years of age, studies suggest that the infant brain shifts to an executive network as a primary system of attention around the age of three or four years (Rothbart et al., 2011), likely contributing to the onset and development of effective attentional regulation.

Executive attention implicates executive functioning pathways to perform what is known as *attentional regulation,* or attentional control. Because of its role as one of the primary mechanisms of effortful control, attentional regulation is understood to play a key role in self-regulation (Eggers et al., 2010; Eisenberg, Champion, et al., 2004; Zengin-Bolatkale et al., 2018) and is important in studies examining self-regulatory behaviors (Berthelsen et al., 2017).

As such, stuttering literature has recently taken an increased interest in attentional control, finding it to be potentially important in further understanding disfluency (Anderson & Ntourou, 2018; Bush, 2006; Costelloe, Davis, Cavenagh, & Doneva, 2018; Eggers et al., 2010; Ofoe et al., 2018; Zengin-Bolatkale et al., 2018). For instance, Costelloe et al. (2018) found that CWS scored generally lower than CWS on all 13 clinical assessments used to measure selective attention, sustained attention, and attentional switching. Furthermore, a study by Karrass and colleagues (2006) identified that CWS had significantly more difficulty with successful attentional regulation than CWNS peers.

Gaze aversion. Due to the internal nature of attention, behavioral coding of attentional regulation is largely reliant on identifying visual patterns of study participants. *Gaze aversion*, or the amount of time spent not looking at the supposed object of attention, as a behavioral correlate of self-control reflects these attentional components of regulation (Manfra et al., 2014).

Other studies in stuttering literature have utilized visual patterns to attend to potential attentional differences between CWS and CWNS. For instance, Arnold et al. (2011) recognized participant distraction as diversion of attention to something other than the given narrative task, identifying that this could be recognized by the participant looking in the mirror rather than at the computer screen. Ntourou et al. (2013) recognized a similar definition for distraction, noting examples of participant distraction that relied on visual cues (e.g., looking at different objects around the room, looking at the prize for the task without attempting to engage in the process to achieving the prize, etc.). Other empirical studies similarly used distraction as a behavioral coding mechanism for attention (Calkins, Gill, Johnson, & Smith, 1999; Day & Smith, 2013; Jahromi & Stifter, 2013).

Expected Outcomes

We hypothesized that, as found in Ntourou et al. (2013), CWS would demonstrate signs of more regulatory attempts than CWNS, specifically in verbal and attentional categories. We further hypothesized that studying preschool-age children's behavioral reactions to the Forbidden Toy paradigm would reveal tendencies of CWS to use different self-regulatory methods than those frequently used by CWNS in the paradigm.

These findings allow us to further understand how strategy use in CWS is related to regulatory strategies by CWNS. Additionally, the goals of this study may enable investigation of whether CWS use a different quantity or quality of effortful control than CWNS. Results allow for further assessment of the relationship between self-regulatory strategy usage and stuttering in preschool-age children.

Methods

Participants

Children who stutter (CWS). Thirteen children (seven males, six females) between the ages of 3;4 (years;months) and 5;7 (*M* = 4;2, *SD* = 9 months) met classification criteria for CWS for this study (Arnold et al., 2011; Johnson et al., 2010; Jones et al., 2014; Ntourou et al., 2013). Participants were classified as CWS if they (a) exhibited three or more stuttering-like disfluencies (SLDs) per 100 syllables of conversational speech based on a 600-syllable sample and (b) attained of a score of 11 or higher (i.e., severity classified as mild or higher) on the *Stuttering Severity Instrument-4* (SSI-4; Riley, 2009). Speech disfluencies considered SLDs included: (a) sound-syllable repetition, which is either complete or incomplete repetition of a syllable within a word, (b) whole word repetition, (c) audible sound prolongation, which can be described as fixed articulatory postures with audible airflow, and (d) inaudible sound prolongation, which can be described as fixed articulatory postures with inaudible airflow, including those occurring at the beginning and middle of words (Conture, 2001, Table 1.1, pp. 5-6; Teesson, Packman, & Onslow, 2003).

Children who do not stutter (CWNS). Thirteen children between the ages of 3;2 and 5;5 were matched to the CWS based on age +/-6 months (*M* = 4;2, *SD* = 10 months) and sex (seven males, six females). Children were classified as CWNS if they (a) had two or fewer SLDs per 100 syllables and (b) attained a score of 11 or less (i.e. severity classified as less than "mild") on the SSI-4 (Riley, 1994). Chronological age was not significantly different between the two talker groups, $t(24) = -.13$, $p = .90$.

Parental reports revealed that all participants were native speakers of American English and that none of the participants reported history of neurological, hearing, developmental, attentional, emotional, academic, and/or intellectual problems. No participants had a history of formal speech-language therapy. Participants were primarily Caucasian (91.2%; 5.9% Black/African American; 2.9% Asian or Pacific Islander). Family socioeconomic levels, as estimated by Hollingshead's index of social status (1975), showed a range of socioeconomic levels present in the study's sample *(range* = 31.0-66.0, $M = 50.42$, $SD = 9.9$). The parents of the participants represented a wide range of postsecondary education levels. Mother's number of years of post-secondary education ranged from 0 to 11 ($M = 6.12$, $SD = 2.64$), and father's years of post-secondary education ranged from 0 to 12 ($M = 4.38$, $SD = 2.42$). Statistical analysis revealed no significant difference between talker groups in ethnicity, family socioeconomic level (Hollingshead, 1975), mother's years of post-secondary education, or father's years of post-secondary education ($p > .05$). Demographic information for each talker group is shown in Table 1.

Participants in this study were paid volunteers, recommended by parents, speech-language pathologists, or personnel from the day-care, preschool, or school. Participants were part of a larger study on inhibitory control and parents of each participant gave informed consent. The Kent State University Institutional Review Board approved this investigation. Additional criteria for the participants used in this study are found in the Procedures section of this study.

Table 1

Descriptive Statistics of Demographic Data

Demographic	CWS (*n* = 13)		CWNS (*n* = 13)	
	M	*SD*	*M*	*SD*
Chronological age (in months)	50.46	8.74	50.00	9.8
Family SES[a]	50.04	9.31	50.81	10.82
Maternal years of post-secondary education	5.46	2.30	6.77	2.89
Paternal years of post-secondary education	4.08	1.71	4.69	3.01
	% of CWS		% of CWNS	
Race				
American Indian/Alaskan Native	0.0		0.0	
Asian or Pacific Islander	7.7		0.0	
Black/African American	7.7		8.0	
White	84.6		92.3	
Other/Unknown	0.0		0.0	

Note. CWS = children who stutter; CWNS = children who do not stutter; SES = socioeconomic status.
[a]Family SES values were calculated using Hollingshead's index of social status (1975) as described above.

Procedure

Each participant's involvement in this study consisted of two separate lab visits, approximately one week apart. In the first visit, the participant was assessed for speech, language, and hearing to determine study eligibility and talker group classification. Assessments given included the *Stuttering Severity Instrument – 4* (Riley, 2009), the *Test for Auditory Comprehension of Language – Fourth Edition* (TACL-4; Carrow-Woolfolk, 2014), the *Goldman-Fristoe Test of Articulation: Second Edition* (G-FTA-2; Goldman & Fristoe, 2000), the *Expressive Vocabulary Test, Second Edition* (EVT-2; Williams, 2007), the *Peabody Picture Vocabulary Test, Fourth Edition* (PPVT-III; Dunn & Dunn, 2007), and the *Structured Photographic Expressive Language Test – Preschool* (SPELT-3; 2005). These measures assessed stuttering severity, receptive language, articulation, receptive and expressive vocabulary, and receptive and expressive language, respectively. To be included in the study, participants had to score at or above the 16th percentile on the standardized assessments of speech and language. Participants all passed bilateral pure tone hearing screenings at 1, 2, and 4 kHz at 20 dB HL (ASHA, 1997)[1]. All 26 participants used for this study met the aforementioned inclusion criteria. However, several participants who were involved in the inhibitory control study were not included for use in this examination of emotion regulation and stuttering[2].

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[1] One participant passed the hearing screening at 30 dB, the minimum testing level for that hearing test due to environmental noise. Analyses conducted both with and without this participant's data yielded no appreciable difference in outcome, so the participant's data were included in the study's final data analysis.

[2] A larger group of participants (*N* = 54) were considered for this study before inclusion criterion were applied. Eleven original participants were not included for reason of failing to meet study requirements; seventeen qualified children were randomly excluded for the purposes of participant matching; two qualified participant data were not considered due to inability to see the

Experimental procedures. During the second visit, participants completed several tasks to test inhibitory control, including a variation of the Forbidden Toy paradigm (modeled after Carlson & Wang, 2007). While sitting cross legged on the floor in front of a researcher, the child was presented with a *Playskool* electronic robot toy, named *Alphie*. To introduce the toy to the child, the experimenter turned on the toy, which provided an audible introductory message inviting the child to play with it. Before placing the toy on the ground approximately 10 cm in front of the child, the experimenter stated, “Okay, but before we start playing with him, I have to go out of the room and do some work. So sit here without touching the toy, okay?” Thirty seconds after the end of the toy’s initial message, the toy played a randomly selected message among five different prompting messages. One of these messages, which accompanied a flashing button on the toy, was “I have an itch. Can you push this button?” One minute later, the toy alerted the participant that the toy was shutting down with the message, “Shutting down in T minus five seconds. Five, four, three, two- Are you sure you don’t want to play anymore?” before finally shutting down with the message, “One. Alright. Bye-bye.” The toy would then remain silent for the rest of the paradigm unless a button was pushed by the participant.

In the adjacent room, researchers watched the child through two-way glass to see if or when the child touched the toy. If the participant touched *Alphie* at any point during this paradigm, the experimenter returned to the room. If the child still had not touched the toy before five minutes had elapsed, the experimenter re-entered the room. For this

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child’s upper body for at least half of the recorded task time due to child movement and camera angle.

reason, children who touched the toy spent less time in this paradigm than did those who refrained from touching the toy. The paradigm was always followed by the option of playtime with *Alphie*.

Dependent Variables/Measures

The coding procedure for this study assessed measures of emotion-related regulation. Coders, who were blind to the talker group of the participants, used a standardized coding manual and recording sheet based on the coding standards described. Coding for the Forbidden Toy paradigm was based on audiovisual recordings made during the experiment by a JVC Full HD recording device with a Konica Minolta HD lens. The recording device was mounted on a tripod so that *Alphie* and the front of the participant were both in view of the video's frame at the beginning of the paradigm.

Emotion-related regulation. The regulation variables and coding methods that are detailed by this study are based on an earlier study that studied the self-control strategies attempted by 3- and 4-year-old children during a resistance task, similar to the temptation task that was used in this study (see Appendix A; Manfra et al., 2014). Regulation correlates based on observations of the audiovisual participant data included (a) total time until touch, (b) verbalizations, (c) gross motor movement, (d) fine motor movement, and (e) gaze aversion. For three of the five measures of emotion-related regulation listed – verbalizations, gross motor movement, and fine motor movement– different sub-categories were identified to further classify the behavior, as detailed in the following corresponding sections.

Inter-judge reliability for the behavioral coding of regulatory attempts was calculated for all component and subcomponent categorization of effortful control evaluated in this study – verbalization, gross motor movement, fine motor movement, and gaze aversion. Thirty-one percent of participant data (eight randomly selected participants out of the 26 total) was coded by a secondary trained coder who was blind to the purposes of this study and blind to participant talker group classification. All reliability measurements, as reported within each variable's corresponding section of this report, were calculated according to the coding results of the primary and secondary coder using Krippendorf's alpha (Hayes & Krippendorff, 2007). Variables for which the data did not meet criterion for inter-coder reliability were discussed between the two coders until an agreement on the proper classification was reached. The data produced from these revisited discrepancies replaced old data and were then used in final data analyses.

Data collection. Coding for variables of emotion regulation – verbalization, gross motor movement, fine motor movement, gaze aversion – utilized event-based continuous recording methods (Bakeman & Gottman, 1997), with the smallest unit being 1 second. Behaviors with an observable duration of less than 1 second were excluded from analysis. For each codeable behavior observed, a time of onset, a time of offset, and a description of the behavior seen were recorded. Descriptions of the behavior included all verbalizations verbatim and utilized the pre-determined qualifiers of the respective behaviors, as described in each variable's corresponding section below. Because verbalizations, gross motor movement, fine motor movement, and gaze aversion are not mutually exclusive and behavioral measures of one of these four variables could overlap with those of the other, these four variables were coded for separately as timed-event sequences. To account for the varying lengths of the task for each participant, the data for all variables corresponding to emotion regulation used the elapsed time with the variable as a ratio of the total time of that participant's Forbidden Toy task in data analysis (Bakeman & Gottman, 1997).

Total time. The total codeable time of the participant's task was recorded as *total time* and indicated the latency of the Forbidden Toy task. The *start time* of the task was defined as when the experimenter first left the toy in front of the child and proceeded to leave the room. The *stop time* of the task was indicated either by the child touching the toy or, if the child refrained from touching, by the experimenter re-entering the room after five minutes since the start time. In the case of a couple participants ($N = 2$), the experimenter entered the room and prematurely ended the task before the five-minute mark, even though the toy had not been touched. These early extinctions of the task were due to the perceived undue stress of the child (e.g., crying, repeatedly leaving the experimentation room) and are further addressed in the Results section of this study.

Verbalizations. Coders classified *verbalizations* across one of four types of speech, including: (a) utterances about the rules or task, (b) descriptions about *Alphie*, (c) speech irrelevant to the toy, rules, or task, and (d) unintelligible vocalizations (Manfra et al., 2014). *Utterances about the rules or task* included words or phrases that the child used to remind him or herself that he or she was not to play with the toy until the experimenter returned to the room (e.g., "Don't touch *Alphie*."; "She said to wait until she comes back."). Verbalizations that were considered *descriptions about Alphie* regarded the toy in a playful manner and did not focus on resisting the temptation posed by the toy (e.g., "That toy is cool!"; "Bee-boop!"). Additionally, singing about the rules or task was considered a description about the toy. Utterances that were not focused on the stipulations of the task (e.g., "This room is small."; "Go Power Rangers!") were considered to be *speech irrelevant to the toy, rules, or task*. This category likewise recognized humming, irrelevant singing, or nonsensical noises. Verbalizations that were unclear as to topic but were clearly not nonsense noise, such as whispers, mutters, or unclear utterances, were considered to be *unintelligible vocalizations*. Unintelligible vocalizations have typically been found to be relevant to the task at hand (Winsler & Carlton, 2003; Winsler, Fernyhough, McClaren, & Way, 2005). Verbalizations were recorded both by the number of speech utterances that occurred and by the total elapsed time of the utterances. Verbalization total time was coded for with a correlation coefficient of .72, with subcategorization of utterances about the rules or task, descriptions about *Alphie,* irrelevant speech, and unintelligible vocalizations at a reliability level of .85. Coders identified the number of utterances per participant with a reliability coefficient of .79.

Movement. To analyze the child's movement as another means of regulating emotion, this study recognized two categories of movement: (a) gross motor movement and (b) fine motor movement (Manfra et al., 2014). *Gross motor movements* consisted of large-body movements where body position changed or stretched across a spatial area in the testing room (e.g., lay down, reach arm out to toy). To further differentiate between the child's movements, all behavioral measures corresponding to gross motor movements were assigned to one of two sub-categories: (a) approaching *Alphie*, or (b) avoiding *Alphie.* Any movements from a participant's limb or entire body that moved toward or circumvented Alphie were categorized as *approaching Alphie*. Behavior classified as *avoiding Alphie* was movement away from the toy that consequently increased the distance between the participant and *Alphie* (e.g., scooting backward, walking away from *Alphie*). Krippendorf's alpha for reliability was .65 for gross motor movement, with a coefficient of .62 for categorizing gross motor movements into the two sub-categories. These indicators of reliability revealed less than acceptable reliability for the given categories and were therefore revisited by the two coders who collaborated to produce the data used in analysis.

In addition to examining the child's cross-spatial motion, fine motor movements were coded as attempts to regulate. *Fine motor movements* were described as very small movements that do not span across the spatial areas in the testing room (e.g., rocking back and forth, twitching, rapid shaking of the head, playing with hair; Manfra et al., 2014). The two categories of fine motor movement that were reliably coded were (a) repetitive movements and (b) physical restraint. When participants demonstrated confined movements involving the hands or feet that were repeated at least three times consecutively (e.g., tapping hand on leg, shaking leg or arm, bouncing up and down, drumming fingers on the floor), the behaviors were classified as *repetitive movements.* Movements considered to be *physical restraint* included any behaviors that constrained the hands or other parts of the body (e.g., sitting on hands, covering mouth, putting hands underneath armpits). Movements fitting the description of fine motor movements but not within either of the above subcategories were still coded, allowing for a comprehensive measurement of fine motor movements. Fine motor movement was coded for with a correlation coefficient of .65, with subcategorization of repetitive movement, physical restraint, and other motor movements at a reliability level of .72.

Reliability measurements for coding three of the 16 variables, including total gross motor movement, fine motor movement, and categorization of gross motor movement, fell below .7, indicating lower than criterion-level reliability (Hayes & Krippendorff, 2007). Because these variables did not reach acceptable inter-rater reliability, the differences in these categories were resolved between the two coders to result in the data that were then used in analysis. Replications of this procedure would require more refined definitions between the listed coding categories for this paradigm.

Gaze aversion. The participants' use of distraction to inhibit tempting behavior was recorded through the variable of gaze aversion. *Gaze aversion* measured the amount of time that the child spent not looking at *Alphie* (Manfra et al., 2014). If less than half of the child's body was out of the camera's frame due to movement mid-task, the direction of the feet was used to indicate gaze – when the child's feet faced away from the toy, the participants were considered to be averting their gaze. Prior studies have similarly used participant visual patterns as a signifier of distraction as a means of emotion regulation or inhibitory control (e.g., Arnold et al., 2011). Krippendorf's alpha for gaze aversion was .93, indicating firm reliability between raters.

Times when more than half of the participants' bodies, including their faces, were not visible were excluded from analysis of gaze aversion. There was not a significant difference in the proportion of uncodeable seconds for CWNS *(M* = .01*, SD* = .07) and the proportion of uncodeable seconds for CWS *(M* =.05*, SD* = .14*), t*(24) = -.96, *p* = .35. Raters reached a Krippendorf's alpha coefficient of .99 for uncodeable time for gaze aversion, indicating exceptional reliability.

Results

As expected, during a 600-syllable conversational sample with a researcher, CWS demonstrated greater mean total disfluencies (M = 73.62, SD = 8.27), $t(23.26) = -3.35$, $p < .001$, in addition to stuttering-like disfluencies (M = 42.85, SD = 5.23), $t(24) = -6.66$, $p = -35.92$, when compared to CWNS (total: M = 30.38, SD = 9.90; stuttering-like: M = 6.92, SD = 1.32). A multivariate analysis of variance (MANOVA) revealed that CWS and CWNS showed no difference on standardized speech-language test performance (Wilks' $\lambda = .87$, F (5, 20) = X, $p > .05$)[3], as anticipated by prior knowledge of stuttering. Chi-square analyses and *t* tests determined that there were no significant differences between CWS and CWNS on age, gender, ethnicity, socioeconomic status (SES), and ethnicity. Consequently, these factors were left out of further analysis.

Seven (27%) of the 26 participants successfully refrained from touching *Alphie* before the experimenter returned to the room, 17 participants (65%) touched the toy, and two (8%) participants' tasks were prematurely terminated due to signs of distress. Twelve (92%) of the 13 CWNS touched the toy despite the instruction not to, whereas only five (38%) of the 13 CWS touched *Alphie* during the task.

Task Interruption

Three participants, all of whom belonged to the stuttering talker group, showed signs of distress that were sufficient to require experimenter involvement prior to the

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[3] SSI-4 standards scores (Riley, 2009) were excluded from multivariate analyses of variance for speech-language testing performance.

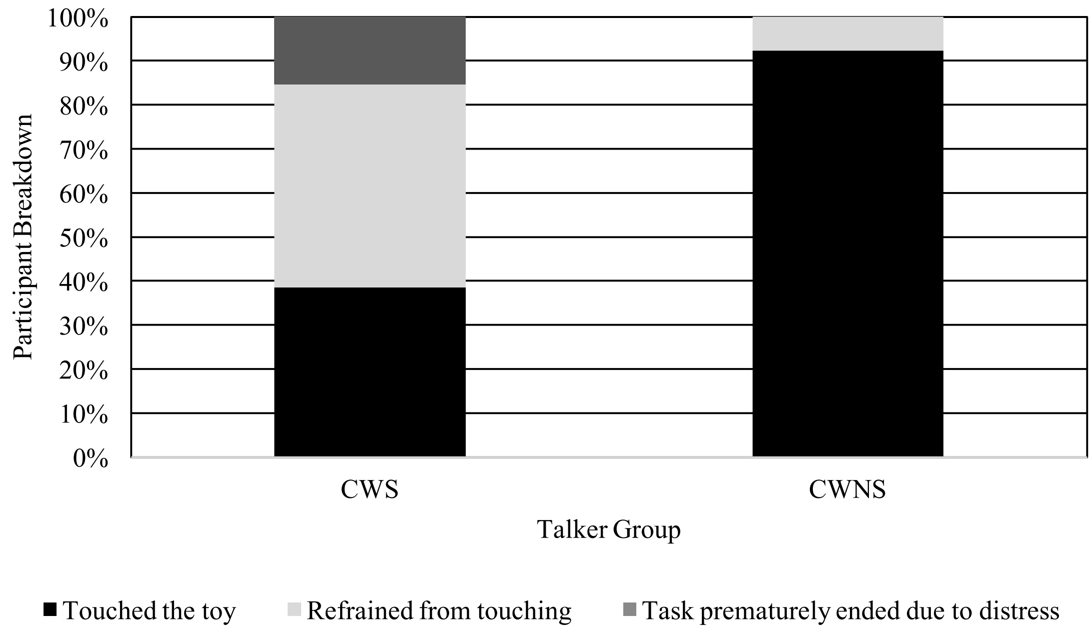

Figure 1. Task completion status for CWS and CWNS talker groups. CWS = children who stutter, CWNS = children who do not stutter.

scheduled end of the task. Recognized signs of distress included crying, whimpering sounds, repeatedly calling out for a parent, and varied combinations of these behaviors. The experimenter ended two of the respective participants' tasks prematurely due to the apparent distress. The remaining participant was briefly comforted by the experimenter mid-task, but ultimately completed the entire paradigm.

Three other participants required experimenter intervention but did not show signs of distress. These three participants who interacted with the experimenter mid-task required experimenter involvement because they were seeking response. These participants exhibited behaviors such as opening the door to talk to the experimenter or a parent, or repeatedly asking where the experimenter or parent was. In all three cases, the participant belonged to the CWNS talker group.

Differentiation of Strategy Type Usage

A series of independent sample *t* tests were employed to assess whether there were significant between-group differences in type of strategy use[4]. Arithmetic means for percentage of time the child employed gross motor approach strategies were significantly higher for CWNS than for CWS, $t(17) = 2.21$, $p = .04$, indicating that CWS spent less of their task time moving toward *Alphie* than the CWNS participants did. The independent sample *t*-test results indicated no other significant differences of individual strategy type usage between CWS and CWNS. Results are described in more detail below.

Verbal strategies. One of the goals of this study was to investigate potential differences between CWS and CWNS in their use of verbalization as a regulatory strategy. Table 2 shows a detailed breakdown of verbal strategy use in CWS as compared to CWNS, including the average proportion of the task in which the child was verbalizing. An independent samples *t* test of significance revealed no difference in the proportion of time spent verbalizing, regardless of type of utterance, between CWS and CWNS, $t(24) = .37$, $p = .72$.

Median time ratio measurements of verbalization subcategories are reported in Table 2 for both CWS and CWNS. Mann-Whitney U Tests indicated that the distributions did not differ significantly between CWS and CWNS for utterances about

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[4] Between one and three outliers were present in one or both talker groups for the variables of Utterances About the Rules or Task, Utterances About the Toy, Irrelevant Utterances, Unintelligible Vocalizations, Verbalizations, Approach, Avoid, Repetitive Movements, Physically Restrictive Movements, Other Fine Motor Movements, and Total Fine Motor Movement. Analysis done both with and without outliers revealed no difference in statistical significance between groups for each variable. Outliers were excluded from parametric testing accordingly for final data analysis to preserve normality assumptions.

the rules or task (Mann – Whitney $U = .96$, $n_1 = n_2 = 13$, $p > .05$), verbalizations regarding the train (Mann – Whitney $U = .24$, $n_1 = n_2 = 13$, $p > .05$), irrelevant verbalizations (Mann – Whitney $U = .545$, $n_1 = n_2 = 13$, $p > .05$), or unintelligible utterances (Mann – Whitney $U = .51$, $n_1 = n_2 = 13$, $p > .05$).

Motoric behavior. This study was also interested in assessing potential differences in the proportion of time that CWS and CWNS participants engaged in motoric gross and fine motor behaviors. Means for all motoric behavior time ratios are also included in Table 2.

An independent samples *t* test of significance revealed no significant difference between the proportion of the time in which CWS and CWNS participants exhibited any identified gross motor movements, including both approach and avoidance behaviors, $t(24) = 1.74$, $p = .09$). Although there was no between-group difference in the amount of avoidant behavior, $t(24) = -.90$, $p=.38$, CWNS showed significantly more movements indicative of approach than did the CWS $t(17.24) = 2.21$, $p =.04$).

However, fine motor categories presented no statistical difference between CWS and CWNS. Independent sample *t* testing confirmed that CWS and CWNS did not differ significantly in the average time ratio of fine motor movement, $t(24) = -.41$, $p = .69$. Mann-Whitney U tests additionally showed that identified categories of fine motor behavior, including repetitive movements (Mann – Whitney $U = .29$, $n_1 = n_2 = 13$, $p > .05$), physical restraint (Mann – Whitney $U = .84$, $n_1 = n_2 = 13$, $p > .05$), and other fine motor movements (Mann – Whitney $U = .72$, $n_1 = n_2 = 13$, $p > .05$), did not significantly differ between CWNS and their peers with stuttering.

Table 2

Motor, Speech, and Verbal Descriptive Statistics of CWS Versus CWNS

	Number of participants who did behavior				Percentage of total time until touch			
	CWS (n = 13)		CWNS (n = 13)		CWS (n = 13)		CWNS (n = 13)	
	n	%	*n*	%	%	SD	%	SD
Touch	5	38.5	12	92.3				
Gaze aversion	12	92.3	11	84.6	40.3	29.0	27.4	22.2
Movement	12	92.3	13	100.0	31.4	18.8	38.3	29.1
Gross motor	11	84.6	12	92.3	11.5	10.7	21.2	17.0
Moved toward	9	69.2	12	92.3	6.6	8.1	18.0	16.8
Moved away	9	69.2	7	53.8	4.9	5.3	3.2	4.6
Fine motor	10	76.9	11	84.6	19.9	17.0	17.1	18.3
Repetitive	7	53.8	6	46.2	8.7	10.8	2.9	5.9
Restraint	3	23.1	2	15.4	.7	1.7	4.3	14.2
Other	10	76.9	9	69.2	10.5	13.0	10.0	15.6
Verbalizations	6	46.2	7	53.8	6.8	11.0	8.5	13.5
About rules	4	30.8	3	23.1	.7	1.4	2.1	5.2
About train	4	30.8	7	53.8	1.0	2.1	5.3	8.8
Irrelevant	4	30.8	3	23.1	4.8	9.6	.7	1.5
Unintelligible	2	15.4	4	30.8	.3	.8	.5	.9

Gaze aversion. This study aimed to analyze whether participants from one talker group spent more time averting their gaze from *Alphie* during the task. The mean proportion of the task time spent looking away from the toy for both CWS and CWNS is presented in Table 2. An independent samples *t* test revealed no significant difference in looking between CWS and CWNS, $t(24) = -1.28$, $p = .21$. Despite not having statistical significance, the mean proportion of the task time spent looking away from *Alphie* was considerably higher for CWS (*M* = 40.3%, *SD* = 18.8) than for CWNS (*M* = 27.4%, *SD* = 22.2).

Combining strategy types. Similar to Manfra et al. (2014), this study analyzed participant use of one or a combination of motor and verbal strategies, as shown in Figure 2. All participants were recorded as having employed at least one of these strategies. Though 13 participants (50%) used only motoric strategies for regulation, only one child (4%), a member of the CWS talker group, participated in only verbal regulatory strategies. Almost as common as using solely motor regulatory strategies was use of a combination of strategy types, in which case the participant exhibited both motor and verbal regulatory behaviors.

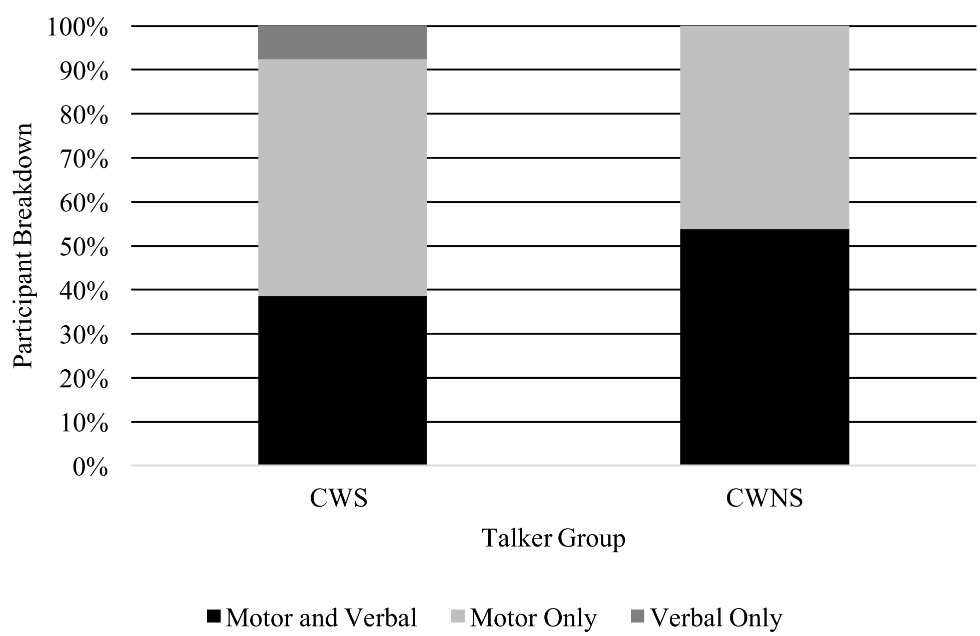

Figure 2. CWS and CWNS use of single or combined strategy types. CWS = children who stutter, CWNS = children who do not stutter.

Discussion

In this study, participants completed a temptation task that challenged the children to resist touching a tempting, interactive robot toy, called *Alphie*, for five minutes until the experimenter returned to the room. A coding procedure adapted from Manfra et al. (2014), a study utilizing a similar temptation paradigm, analyzed the participants' data based on the theorized components of effortful control, including behavioral correlates of motoric regulation, verbal regulation, and attentional regulation. Analyses investigated between-group differences in the types of regulatory strategies used, as well as successful completion of the temptation task.

The results yielded three main findings. First, in the temptation paradigm used by this study, CWNS were significantly more likely to touch the toy despite the experimenter's request not to. Similarly, these CWNS participants demonstrated more gross motor behavior indicative of movement toward the toy than did CWS. Finally, analyses showed that a significantly greater proportion of CWS presented with distress than their CWNS peers. This study extends the current literature by providing further insight into how emotion-related regulation is employed by preschool-age CWS as compared to CWNS, in addition to contributing to understanding of the effectiveness of emotion-related regulation in CWS. The following discussion will further detail these findings.

Regulatory Strategy Type Differences

The primary purpose of this study was to investigate potential differences in the types of strategies employed by the CWS and CWNS participants. Contrary to this study's primary hypotheses expecting a between-group difference for the types of strategies used, results indicated no significant differences in regulatory strategy types and frequencies attempted by CWS and CWNS. Results did not offer any support for preferential use of particular strategy types as originally hypothesized. Furthermore, the study's hypothesis that CWS would exhibit more use of verbalizations, as suggested by the findings from Ntourou et al. (2013), is not supported by the data of this study. Both CWS and CWNS exhibited a similar amount of verbalizations during the task.

The only significant difference between the behavioral measures of CWS and CWNS revealed that CWNS displayed significantly more gross motor behavior consistent with approaching the toy than CWS participants. This analysis coincides with the finding from the current study that CWNS were significantly more likely to touch *Alphie* during the task. Because moving toward the toy, instead of away, could be recognized as counterproductive, or as undermining regulation, these findings may be interpreted to indicate that CWNS in this study were not as effective at regulating behavior in a temptation task as CWS.

Attentional regulation. Although CWS ($M = 40.3$, $SD = 29.0$) demonstrate a considerably higher mean for gaze aversion than CWNS ($M = 27.4$, $SD = 22.2$), there was not a statistically significant difference in the proportion of the task that the participants averted their gaze from the toy. The CWS participants' greater mean for gaze aversion may be consistent with prior reports that CWS have difficulty maintaining attention during non-speech related tasks (e.g., Walden et al., 2012). Additionally, the higher mean for gaze aversion in CWS could be attributed to attentional weakness and difficulty resisting distractions that have been noted by prior studies (Eichorn, Marton, & Pirutinsky, 2018).

Meanwhile, the CWS participants' significantly greater success in completing the task without touching the toy does not corroborate these theories suggesting stuttering as a matter of insufficient attentional regulation and certainly complicates interpretation of the results. However, these findings suggesting weak attentional systems do not necessarily directly contradict CWS participants' seemingly more successful effortful control either. Deficits in attention for people who stutter have been thought to occur only in orienting networks (i.e., directing attention to stimuli; Eggers et al., 2012), and not the executive functioning components of attention (eg., monitoring, detecting, and resolving conflicting input), such as those necessary for successful effortful control.

Strategy Effectiveness

Data from the present study showed CWNS to be significantly more likely than CWS to touch the toy during the task, despite the experimenter's request not to. The comparative results between CWS and CWNS would suggest CWS to be the more effective regulators, contradictory to the prior studies on regulation in stuttering literature (e.g., Ntourou et al., 2013; Walden et al., 2012).

Manfra et al. (2014), a study utilizing a similar temptation task and coding construct, found differences between types of strategies used by typically developing participants who touched the toy (touchers) and participants who refrained from touching the toy (non-touchers). The present study's results are not congruent with Manfra et al. (2014), who found that participants who used a combination of both motor and verbal regulatory strategies were more likely to resist temptation than those who employed only motor or verbal strategies, respectively. Our findings suggest that CWS and CWNS were similar in how many participants used both verbal and motor strategies and how many used only motor strategies, as illustrated by Figure 2. Meanwhile, the CWNS were seemingly significantly less effective in their regulation. This finding seems to suggest that, contrary to our hypothesis, CWS do not differ from their typically developing peers in the types of strategies being used, but instead may differ in how effective the attempted regulation is.

Task Interruption

All participants requiring experimenter intervention due to signs of distress (i.e., crying, calling out for help) belonged to the CWS talker group, consistent with theories suggesting CWS children to be more emotionally reactive and display significantly more negative affect than CWNS peers (e.g., Ntourou 2013). Specifically, findings showing that CWS have higher levels of anger or frustration (e.g., Eggers et al., 2010) are congruent with the outcome of the present study, where three participants in the stuttering talker group, as compared to none of the CWNS participants, showed signs of distress that were significant enough to require experimenter involvement.

Implications for Stuttering Theory

As mentioned before, findings suggest that CWS may have heightened regulatory ability, evidenced by the significantly smaller proportion of CWS who successfully completed the temptation task when compared to the largely unsuccessful CWNS talker group. However, as reported in Hollister (2015), a study of effortful control in school-age children who stutter, the literature has previously associated stuttering with lower attention, higher negative affect, lower emotion regulation, and lower inhibitory control. One possible explanation for the contrast between the present study's results and such pre-existing findings might be that CWS do, as the current study suggests, have heightened inhibitory control skills, although those regulatory systems are more rigid, leaving them less adaptable (Van der Linden, 2013).

Bush (2006) reported lower attentional regulatory abilities in CWS, but identified this deficit as a proclivity to be more consistent in attention to an interesting stimulus, looking away less often and after a longer period of time than CWNS. Similarly, Eichorn et al. (2018) showed that CWS were less likely to shift attention from the task stimulus, additionally reporting a greater overall concern about errors during the experimental task. Furthermore, recent findings coincide with the present study's indication of a relationship between people who stutter and higher levels of behavioral inhibition (Choi, Conture, Walden, Lambert, & Tumanova, 2013). The more rigid attention-related regulatory skills, such as the more persistent attention on the stimulus, combined with increased stress surrounding personal success in the task, could be connected to the higher distress levels in the stuttering talker group. Although CWS were more successful at inhibiting temptation to touch the toy, this regulation may have come with emotional consequence, causing enough distress to result in experimenter intervention in the task for some participants.

The findings of this study, both those suggesting more effective regulation and elevated levels of negative reactivity in CWS, may alternatively suggest stuttering as a form of over-active monitoring of the environment. Theories suggesting less flexibility in attention regulation (Karass et al., 2006; Van der Linden, 2013) compliment this idea, allowing for the heightened attention to the task, as evidenced by significantly greater success in the paradigm, while also accounting for the regulatory deficits commonly accepted in stuttering literature. Furthermore, neural imaging data reporting over-activity in the right non-language hemispheric regions in people who stutter supports theories connecting disfluency and over-regulation of the environment (Rouse, 2016). These right-hemispheric processing centers are known to process paralinguistic features of speech (e.g., social cues, body language, intonation, etc.) for language integration. If language systems in CWS are receiving higher levels of nonverbal feedback, this may overwhelm the language processes and, therefore, induce higher incidence and severity of stuttering.

Heightened focus on making mistakes and greater attention to the toy may, consequently, offer too great of a cognitive load to effectively regulate the emotional implications of the task. Given these considerations, the drastically different success rates between CWS and CWNS may be related to an offset balance between emotional and behavioral regulatory systems. In other words, perhaps by being more regulated behaviorally, CWS may have been less able to regulate emotionally. Emotion-related regulatory processes, such as the ones discussed in this study, have important implications, as challenges with these processes may exacerbate difficulties for CWS in establishing fluent speech and language, particularly in the midst of mistakes, disruptions, or hesitations (Bush, 2006). Future studies should further investigate the distinction between emotion and behavioral regulatory processes and the implications of overactive processing in relation to stuttering in preschool-age children.

Caveats

Sample limitations. As is typical with stuttering literature, the present study utilized a relatively low sample size of 26 children. The lower sample size impacted data analysis methods and likely played a role in variables that violated normality assumptions. Also, the non-normal distributions of many variable measures impacted the power of analyses.

Furthermore, studying stuttering in preschool-age children offers some inherent limitations. Approximately 75% of children in the preschool-age group utilized in this and many other studies will likely recover from stuttering, and only 25% will persist (Ambrose & Yairi, 1999). Without longitudinal data, this study cannot appropriately account for potential differences between children whose stuttering will persist and whose will not.

Procedural concerns. This study revealed several methodological concerns to be considered when designing similar future studies. For instance, future iterations of the Forbidden Toy task might further consider the desirability of the toy, as *Alphie* may not have achieved the level desirability for all participants that was assumed by the temptation task. Ensuring that the toy maintains a relatively stable and high level of desirability across participants will help increase the security of future findings.

Additionally, variable camera placement excluded otherwise qualified participants from analysis and may have impacted the reliability of coding across participants. Improving the consistency of camera placement procedures for recording the task would prevent unnecessary variability in analysis of behavioral correlates of regulation and, therefore, likely increase reliability and strength of the study's findings.

The present findings indicate areas of consideration for future applications of the coding procedures used both in this study and in Manfra et al. (2014). Low reliability measurements in several categories[5] suggest that a revision of coding mechanisms is imperative. If coding constructs were effectively consistent with Manfra et al. (2014), it would be expected that CWNS data would mirror that of the original study's participants, where 10 of the 39 total participants were reported to have not attempted any strategies. In contrast, the present study reported that all participants attempted regulation during the task, indicating that the coding mechanism or coder training may have led to over-coding behaviors as types of regulation. Future renditions of this task and this coding mechanism might include increased coder training or a more detailed coding manual that further differentiates regulation from unrelated behaviors. Furthermore, in this study, only the secondary coder was blind to the purpose of the study and the primary coder was fully

[5] Coding constructs of gross motor movements, categorization of gross motor subcategories, and fine motor movements demonstrated Kalpha reliability correlates of less than .7.

aware of the intents and procedures of the research. Future studies using a similar task and variables should be coded by several trained coders, all of whom are blind to the purpose of the study. These improvements to coder involvement will further promote reliability for the data collected.

Conclusion

Results from this study, based on the coded behavioral correlates of attentional and behavioral regulation, do not show support for a relationship between stuttering talker group and the types of emotion-related regulatory strategies used by preschool-age children. Meanwhile, CWNS, on average, showed a significantly greater proportion of time spent moving closer to the toy than did their CWS counterparts. Similarly, significantly more CWNS touched the toy despite the experimenter's request not to, suggesting that CWS may be more effective in matters of behavioral inhibition. This finding is potentially contradictory to some prominent findings in stuttering literature indicating that CWS regulate less often and less effectively than their CWNS peers. Future studies should continue to investigate talker group regulatory strategy differences, pulling from this study and prior works to replicate and refine investigation procedures and synthesize conflicting results.

CWS participants' representation as the only children who showed signs of significant distress (e.g., crying, calling out for help) concurs with theories that preschool-age CWS may be more emotionally reactive than CWNS. Combined with this study's findings that suggest increased ability to resist temptation, these data point to a need for further investigation of stuttering as a matter of over-regulation of the environment in preschool-age children.

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Appendix A

Coding Manual

ERS Study - Coding "Quick Guide"

Start Time - time when Alphie is placed on floor in front of child

Touch Time - If participant does not touch toy, simply indicate so and record time that experimenter opens door to re-enter room

Verbal

How to identify an *utterance*: A complete sentence, independent clause (can stand alone), conversational turn, or any segment of speech separated from another by 3 seconds or more.

Types of Utterances:

- Utterances about the rules or the task (UART)
    - Words or phrases that reminded the child that she or he was to not play with the toy until the experimenter returned to the room
    - E.g., "Can't touch Alphie."; "He said to wait 'till he comes back."
- Descriptions about the toy (DAT)
    - Did not focus on the goal of resisting temptation
    - Focused on Alphie in a descriptive or playful manner
    - E.g., "That toy is cool!"; "Bee-boop!"
- Speech irrelevant to task, rules, or toy (SPI)

    - Irrelevant to Alphie, rules, or task
    - Could include humming, irrelevant singing, or nonsensical noises
        - Singing *about the task or the rules* counted in the appropriate category above
    - E.g., "This room is small."; "Go Power Rangers!"
- Unintelligible vocalizations (UV)
    - Whispers, muttering, or unclear utterances that were clearly not nonsense noise was considered unintelligible vocalizations

Movement

The child will not necessarily be moving for every second of the video- it is okay if not every second is accounted for in this portion of coding.

- *Gross motor* = large-body movements where the child changed or stretched across (e.g., lay down) a spatial area in the testing room
    - Approach/moving toward Alphie (APPROACH)
        - Any movement either from the entire body or from a limb that moved toward Alphie or circumvented Alphie
        - EX: Pointing to Alphie, walking toward Alphie, walking around Alphie while remaining the same distance away
    - Avoid/moving away from Alphie (AVOID)
        - Avoid gross motor was considered movement away from Alphie, thus increasing the distance between the participant and Alphie

        - E.g., walking away from Alphie

- *Fine motor* = very small movements that did not span across spatial areas in the testing room, such as rocking back and forth, twitching, rapid shaking of the head, playing with hair
    - Repetitive movements (REPM)
        - Fine motor movements that involved the hands or feet and were repeated at least 3 times consecutively
        - E.g., tapping hand on lap, shaking leg or arm, bouncing up and down, drumming fingers on floor
    - Physical restraint (PRES)
        - Any behavior that constrained hands or other parts of the body
        - E.g., sitting on hands, covering mouth, putting hands underneath armpits
    - Other (OTH)
        - All other non-repetitive fine motor movements
        - Including those used for entertainment
        - E.g., playing with a handkerchief, hair, shoelace

Not Looking

- Looking (LOOK)
    - Amount of time in seconds spent looking at Alphie or, if off camera, with feet toward toy

- Not looking (NOLO)
    - Amount of time in seconds spent not looking at Alphie or, if off camera, feet not facing toward toy
- Uncodeable Gaze
    - Time where participant is completely off screen with feet not visible