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Relationship Between Behavioral Inhibition and Secondary Behaviors in Children Who Stutter

Alana Frost

THE RELATIONSHIP BETWEEN BEHAVIORAL INHIBITION AND SECONDARY BEHAVIORS IN CHILDREN WHO STUTTER

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

BI	=	behavioral inhibition
CWS	=	children who stutter
CWNS	=	children who do not stutter
TOCS	=	Test of Childhood Stuttering
SBIS	=	Short Behavioral Inhibition Scale
SSI	=	Stuttering Severity Instrument
MLU	=	Mean length of utterance
SLD	=	Stuttering-like disfluency
SD	=	standard deviation
n	=	number
p	=	*power* or probability level
β	=	standardized beta

t	=	t test statistic
R	=	correlation coefficient
R square	=	coefficient of determination

ABSTRACT

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The present study investigated the relationship between behavioral inhibition (BI) and secondary behaviors in children who stutter (CWS). Participants were 38 CWS aged 3 to 7 years. Children engaged in a play-based conversation with an unfamiliar examiner and their interactions were video-recorded for subsequent analysis. Children's BI and physical concomitant behaviors were determined based on clinician observation and parent report measures. Communication attitudes were assessed based on self-reports (i.e., KiddyCAT), which provided information about children's perception of their communication abilities. Results suggested that there was a significant relationship between lower BI and more physical concomitants according to parent report measures, meanwhile based on clinician observation measures there was a slight trend of higher BI CWS showing more physical concomitants. Overall, findings indicated that the relationship between BI and secondary behaviors in CWS remains unclear. The present study excluded measurement of avoidance behaviors, which may have affected the direction of some trends. Further research is warranted to explore the relationship between BI and avoidance behaviors in CWS.

CHAPTER I: INTRODUCTION

Stuttering occurs in approximately 1% of the population, but the etiology is still unclear (Manning & DiLollo, 2017). Nonetheless, most researchers have agreed that stuttering may result from an interaction between underlying constitutional factors and other developmental, environmental, and learning factors (Guitar, 2019). As one of the constitutional factors, temperament has been extensively studied in relation to stuttering over the last decade (Choi, Conture, Walden, Lambert & Tumanova, 2013; Ntourou, DeFranco, Conture, Walden, & Mushtaq, 2020; Tumanova, Woods & Razza, 2020). Temperament, described as "constitutionally-based individual differences in emotional, motor and attentional reactivity and self-regulation" (Rothbart & Bates, 1998, p.109), may play a role in predisposing some individuals to stutter or protecting some from worsening stuttering (Choi, Conture, Walden & Jones, 2014). For example, the Communication-Emotional Model of Stuttering (C-E model) posits that heightened emotional reactivity and low emotional regulation may exacerbate and maintain instances of stuttering (Conture, Walden, Arnold, Graham, Hartfield & Karrass, 2014). In the same vein, the Dual Diathesis-Stress Model of Stuttering (DD-S model; Conture & Walden, 2012) suggests that the impact of external emotional stress on children differs depending on their emotional diathesis (i.e., vulnerability/temperament). In other words, the same level of emotional stress is more likely to affect some children with more vulnerable

temperament (e.g., high emotional reactivity or low emotional regulation) and increase their stuttering than those with less vulnerable temperament (e.g., low emotional reactivity or high emotional regulation).

Among various types of temperament, behavioral inhibition has received growing attention from researchers in recent years (Zentner, Shiner, & Kagan 2012). Behavioral inhibition (BI) is a temperamental style distinguished by heightened sensitivity to novel stimuli, situations, or people. Individuals with high BI exhibit hyper-vigilance as they navigate their social/physical environments and their personalities are often characterized as shy, apprehensive, or fearful (Kagan, Snidman, & Arcus 1998). Research findings regarding the effects of BI on stuttering are varied. Choi et al., (2013) suggested higher BI is associated with greater frequencies of stuttered disfluencies in children who stutter (CWS). Similarly, Ntourou et al. observed that CWS with high BI produced more frequent stuttered disfluencies. Conversely, research by Tumanova et al. showed that CWS with high BI exhibited fewer stuttered disfluencies than CWS with low BI (Tumanova et al., 2020). Regarding such equivocal findings, Tumanova and Choi (2021) suggested that the relationship between BI and stuttering frequency may vary depending on the linguistic complexity of children's utterances.

On the other hand, the relationships between BI and other markers of greater stuttering severity, such as disfluency-related consequences and negative attitudes towards speech and communication, appear less ambiguous. For example, Ntourou et al. (2020) found that young children with high BI held more negative communication attitudes and that their parents reported greater disfluency-related consequences. Likewise, Tumanova et al. (2020) found that high BI CWS exhibited shorter MLU, less

complex language, and fewer words spoken in conversation (Tumanova et al., 2020), perhaps reflecting attempts to minimize stuttering by reducing verbal output, which can be thought of as an avoidance behavior. Rodgers and Jackson's (2021) comprehensive survey of persons who stutter (PWS) across the lifespan also indicated that older CWS ages 9 to 17 years reporting greater shyness and sensitivity to their environment were more likely to engage in avoidance behaviors when they expected to stutter. Similarly, preliminary findings from Tumanova and Choi's (2021) unpublished study suggested that children's BI was associated with greater disfluency-related consequences as measured by parent reports. Specifically, they found children's BI significantly predicted the amount of physical behaviors associated with stuttering reported by parents.

The observed relationship between BI and physical behaviors associated with stuttering is not surprising given how secondary behaviors are known to develop. Secondary behaviors are often referred to as "concomitant," or "accessory" behaviors and include escape behaviors and avoidance behaviors (Guitar, 2019). Escape behaviors are physical concomitants that occur when a speaker attempts to terminate the stutter and finish the word. Common examples of physical concomitants include eye blinking, facial grimacing, noisy breathing, foot-tapping, and head jerking. On the other hand, avoidance behaviors occur when a speaker anticipates stuttering and attempts to keep from stuttering before it happens. Such physical concomitants can become avoidance behaviors if the behaviors are consistently used to avoid stuttering. Common examples of avoidance behaviors include word substitutions, postponements (e.g., "you know"), insertion of extra sounds such as "uh", pitch rises, changes in the way speech is produced, and timing devices (e.g., hand movements timed to saying the word).

According to Guitar (2019), these secondary behaviors provide initial relief from potential or realized stuttering. For example, CWS blink rapidly to escape a block or use filler phrases to avoid stuttering on a word that has been difficult for them in the past. However, such relief is short-lived, and as the CWS reverts to secondary behaviors more often during stressful speaking situations, the behaviors are reinforced.

Behaviors associated with stuttering typically do not become noticeable until CWS are aware of their stuttering and have experienced negative reactions to their speech (Conture & Kelly, 1991; Guitar 2019). These negative social interactions surrounding stuttering contribute to feelings of embarrassment and fears of certain speaking situations, which may trigger secondary behaviors in some children. Unsurprisingly, older CWS who may have more experiences with negative interactions demonstrate more frequent and severe nonspeech accessory behaviors per stuttering event (Conture & Kelly, 1991). Moreover, given Ntourou et al.'s finding that BI is associated with more negative communication attitudes in young children, it seems reasonable to hypothesize higher BI correlates with negative communication attitudes in CWS which in turn, leads to the development of secondary behaviors (i.e., BI, negative communication attitudes, physical concomitants). Therefore, it stands to reason that CWS who have high BI may be more likely to exhibit secondary behaviors than CWS with lower BI traits.

CHAPTER II: REVIEW OF LITERATURE

2.1 Behavioral Inhibition

2.1.1 Definition

BI refers to a temperamental profile typically established before a child's 1st birthday, distinguished by shyness, timidity, and avoidance in response to unfamiliar objects, people, or events (Coll, Kagan, & Reznick, 1984). Perceptions of behavioral inhibition and presentation of related traits often differ based on an individual's circumstances and culture, but it is a universal phenomenon (Zentner et al., 2012). A longitudinal study following a group of 16 infants through their 18th birthday found that 15-20 % of infants exhibited behaviorally inhibited characteristics by four months of age. These infants reacted to unexpected events with increased motor activity and visible distress, although the events posed no tangible threat (Zentner et al., 2012).

There is disagreement in previous works concerning whether BI should be defined as categorical or continuous. Some research quantifies it as an approach-withdrawal continuum based on direct behavioral observations, parental reports, or a combination of both (Clauss & Blackford, 2012). However, most works apply a categorical framework to BI, utilizing various behavioral measures and parental reports to label children as either

high or low BI. For instance, in Tumanova, Woods, and Razza's (2020) study, children were assigned BI values categorically rather than on a continuum. Participants with latency to the 6th spontaneous comment in the top and bottom 15th percentile were rated high and low BI, respectively. A categorical understanding of BI may be helpful considering that the degree and stability of BI in children, rather than the presence of BI, most strongly predicts later-life anxiety problems (Fox, Henderson, Marshall, Nichols & Ghera, 2005; Fox & Pine, 2012; Schwartz, Snidman & Kagan, 1999). Additionally, BI emerges under a wide array of conditions and may manifest in different observable behaviors depending on circumstances. Although some children have inherited biological features that predispose them to exhibit more BI, others acquire BI due to early life experiences, and in either group, BI traits can change over time. Therefore, BI does not describe a singular characteristic but rather a family of behaviors and moods that arise in response to unfamiliar events rooted in early childhood (Zentner et al., 2012)

2.1.2 Measurements of behavioral inhibition

The two primary methodologies for assessing BI are parental reports and direct behavioral observation. Caregiver reports of childhood temperament such as the *Children's Behavioral Questionnaire* and *Behavior Style Questionnaire* contain subcategories related to BI traits, such as measures of shyness (CBQ) and approach/withdrawal (BSQ). However, these parental reports represent indirect measures since they were not devised to specifically assess BI. Ntourou et al. (2020) developed a new behavioral inhibition scale to better quantify differences in BI between CWS and children who do not stutter (CWNS). Their rationale for creating the Short Behavioral Inhibition Scale (SBIS) was that preexisting parent-report questionnaires comprised

global assessments of temperament and thus had limited clinical utility for examining the specific role of BI in childhood stuttering (Ntourou et al., 2020). SBIS items assessed behaviors such as withdrawal from unfamiliar situations and were scored on a 5-point Likert-type scale.

Another important measure of BI in children is direct behavioral observation in the laboratory, where children are exposed to unfamiliar adults, peers, or objects in a structured environment. Behavioral observation may consist of verbal or nonverbal measures. Choi and her colleagues (Choi et al., 2013) used verbal measures of BI during behavioral observation. They measured children's latency (delay) to their 6th spontaneous comment during play-based conversation samples following Kagan et al.'s (1989) methodology. "Spontaneous comments" were defined as unprovoked utterances, questions, or elaborations of answers. Tumanova et al. also used latency to the 6th spontaneous comment from the child during conversation as a verbal measure of BI, in addition to measuring the total number of spontaneous comments. Alternatively, nonverbal techniques for evaluating BI involve measuring the child's latency to approaching a stranger, proximity to caregivers during the social interaction, latency in touching a toy during play, duration/frequency of play, avoidant behavior, and the number of smiles exhibited during conversation (Kagan et al., 1989; Rothbart & Bates, 1998; 2006). However, such nonverbal measures of BI have not yet been used in studies addressing the relationship between BI and stuttering.

Furthermore, most previous research analyzing associations between BI and secondary behaviors in childhood stuttering employed indirect measures of BI, such as parental reports (Tumanova & Choi, 2021) (Ntourou et al., 2020). The present study is unique because it utilized direct behavioral measures of BI; participants' degree of BI was

assessed by combining observations of their verbal and nonverbal behaviors to compute a total BI score. Additionally, while Choi et al. (2013) used one direct verbal measure of BI (e.g., latency to the 6th spontaneous comment) to investigate associations between stuttering and BI, the present study adopted Kagan et al. (1998)'s methodology and applied a direct verbal measure of BI (latency to the 6th spontaneous comment) as well as nonverbal measures of BI (total duration of spontaneous smiles and latency to touch a toy for the first time) to evaluate the relationship between BI and childhood stuttering.

2.1.3 Stability of behavioral inhibition

Previous research on BI (Kagan & Snidman, 1992) indicated highly reactive four-month-old infants who exhibited increased motor activity and distress in response to novel stimuli were biased towards withdrawal from unfamiliar situations during early childhood. Their behavioral profile was described as inhibited. Infants who exhibited lower levels of motor activity and distress were inclined towards becoming more sociable and impulsive in early childhood. Thus, measures of reactivity in infancy represent underlying temperamental tendencies that predict variations in BI at two years of age. Further longitudinal studies examining the stability of BI suggest that high and low reactive infants retain their temperaments through adolescence, particularly for individuals on the extremes of behavioral inhibition, for example highly reactive children who had demonstrated the most excessive crying or the highest degree of arousal as infants. (Kagan & Snidman, 2009; Schwartz, Wright, Shin, Kagan, Whalen, McMullin & Rauch, 2003; Fox et al., 2005).

Furthermore, 45 % of 7-year-olds who were highly reactive infants showed signs of anxiety in response to unfamiliar events, while only 15 % of children who had been low-reactive did. Highly reactive infants were also more likely to be described as "shy" during

childhood by their parents, teachers, or peers. Highly reactive children reported feelings of anxiety upon meeting strangers, visiting new places, and coping with unexpected challenges. Two-thirds of this group of children also admitted to unrealistic sources of worry compared to one-fourth of children who had been low-reactive. By age 15, highly reactive children were observed to frequently look away from their interviewer. In addition, these teenagers described feelings of distress in response to potential future difficulties (e.g., "I wanted to be a doctor, but I decided against it due to the strain") even when they were not characterized as shy or avoidant based on outward behaviors (Zentner et al., 2012). Overall, research addressing the consequences of BI suggests moderate stability of this temperament throughout the lifespan.

2.1.4. Behavioral inhibition and psychopathology

Extensive research supports a relationship between BI and certain forms of psychopathology. For instance, Biederman, Hirshfield-Becker, and Rosenbaum (2001) analyzed a mixed sample of children and concluded that there was an increased risk of social anxiety disorders among high BI preschool children. This risk became higher when the children had one or more parents with a history of panic disorders. Their team also found that children classified as high BI had an increased risk for simultaneous multiple anxiety disorders and phobias compared to children with low BI. When 76 children from both the high and low BI groups were reevaluated after three years, high BI children had a higher incidence of multiple psychiatric diagnoses, anxiety disorders, avoidant disorders, separation anxiety, and agoraphobia (Biederman et al., 2001). Mick and Telch's (1998) work also established a strong relationship between childhood BI and social anxiety among adult undergraduate college students. Their findings indicated individuals with higher

reported childhood BI were more likely to experience symptoms of social anxiety, including social phobias. However, the link between generalized anxiety disorder (GAD) and BI wasn't as clear (Mick & Telch, 1998). Similarly, a comprehensive study of 117 European and American adults using the anxiety sensitivity scale revealed individuals who reported uncomfortable sensations following arousal of the autonomic nervous system were more likely to experience panic attacks, GAD, post-traumatic stress disorder (PTSD), and social phobias (Naragon-Gainey, 2010).

2.2 Behavioral Inhibition and Stuttering

2.2.1 Differences in behavioral inhibition between CWS and CWNS

Choi et. al. (2013) analyzed relationships between BI, childhood stuttering, and speech-language output in preschool-age CWS and CWNS. Among the hypotheses of their investigation was that CWS would exhibit higher BI traits than CWNS. Research participants were 3-5 years old, divided into groups of CWS and CWNS. BI was assessed by measuring the children's latency (delay) to their 6th spontaneous comment during conversation samples. Data indicated no significant differences between CWS and CWNS regarding average BI. However, when children with extremely high and low BI (top and bottom 15th percentiles, respectively) were compared, some distinctions emerged. More CWS had very high BI, and fewer CWS had low BI, relative to CWNS (Choi et al., 2013). These findings imply that extremes of BI may be associated with the development or worsening of childhood stuttering.

Likewise, Ntourou and her colleagues (Ntourou et al., 2020) explored differences in BI between preschool-age CWS and CWNS. Findings from Ntourou et al. corroborated their hypothesis about differences in BI between CWS and CWNS. CWS had significantly higher SBIS scores than CWNS. More CWS were in the high BI group (top 15 % of SBIS scores), and fewer were in the low BI group (bottom 15 % of SBIS scores). However, despite these differences at the extremes, there was still considerable overlap in BI among CWS and CWNS, suggesting this complex trait may be more of an exacerbating rather than causal factor in stuttering (Ntourou et al., 2020).

Conversely, Tumanova et al. assessed BI by measuring delay to the 6th spontaneous comment from preschool-aged children during a conversation with an unfamiliar examiner and measuring children's total number of spontaneous comments. Parental reports of shyness from the Children's Behavior Questionnaire (CBQ) served as a supplemental measure of BI (Tumanova et al., 2020). Researchers found that although CWS were rated as shyer in parental reports compared to CWNS, there were no significant differences in BI as indexed by the number of spontaneous comments between CWS and CWNS. Furthermore, parental ratings of shyness aligned more with examiner's behavioral observations of BI for CWS than for CWNS.

2.2.2 Behavioral inhibition and stuttering frequency

Choi et al.'s (2013) findings indicated that behaviorally inhibited CWS exhibited more stuttered and non-stuttered disfluencies than less behaviorally inhibited CWS. However, BI did not appear to influence the frequency of stuttered or non-stuttered disfluencies for CWNS. The notion that high-BI CWS and CWNS would exhibit shorter mean MLU was unsupported. (Choi et al., 2013). Choi et al.'s (2013) research also

yielded compelling ancillary findings. For example, preschool-age CWS produced substantially fewer spontaneous comments and marginally fewer stuttered disfluencies during the first five minutes of conversation compared to the second five minutes. The implication is that CWS may require time to "warm up" during conversational interactions with novel partners. Therefore, measures of BI and stuttering, such as latency to the 6th spontaneous comment or frequency of stuttered disfluencies, may be more representative of the CWS's typical performance after the warm-up period (Choi et al., 2013).

Ntourou et al. (2020) proposed a positive correlation between high BI and greater frequency of stuttering. To assess stuttering frequency among high and low BI groups, trained examiners elicited conversational samples of at least 300 words from CWS and CWNS during 15-30 minutes of play-based interactions. Similarly, researchers hypothesized a correlation between SBIS scores and stuttering frequency/severity. Results supported both speculations. High BI in CWS was associated with greater frequency and severity of stuttering during child-examiner conversations. Similarly, SBIS scores were reliable predictors of stuttering frequency/severity in CWS (Ntourou et al., 2020). Supporting research referenced throughout the study suggested children with high BI have enhanced error monitoring and accordingly display increased physical tension (particularly in laryngeal muscles) during conversation with unknown adults (Ntourou et al., 2020).

Overall, findings from Ntourou et al. align with the "vicious cycle" hypothesis, which suggests that stuttering results from hypervigilant monitoring of the speech production process. According to the vicious cycle hypothesis, parameters of focus, effort, and threshold within the inner speech plan are inappropriately set in PWS. As a result, PWS

exert disproportionate energy monitoring their speech output because they want to prevent or eliminate disfluencies. PWS also maintain a more conservative threshold for judging "normal" speech output and are less accepting of low levels of disfluencies than PWNS (Vasic & Wijnen, 2001).

2.2.3 Behavioral inhibition and communication attitudes

One hypothesis from Ntourou et al. (2020) was that high BI in CWS would result in more negative communication attitudes. Therefore, researchers assessed communication attitudes using the KiddyCAT (KiddyCAT; Vanryckeghem & Brutten, 2007), a self-report binary 12-item scale given to the child participants. They used SBIS scores as an index of the degree of BI in CWS.

Initial findings did not appear to support their assumption. There was no definitive correlation between SBIS and KiddyCAT scores. However, researchers speculated that the age of the younger participants in the study might be influencing the results, considering children under four often demonstrate less awareness of their stuttering compared to older children (Ntourou et al., 2020). Therefore, Ntourou et al. separated participants into two groups based on age to determine if there was a relationship between BI and KiddyCAT scores in CWS older than age 4.

Their post-hoc hypothesis was supported by findings indicating a relationship between SBIS scores and KiddyCAT scores for children between 4;0 and 6;3, but not for three-year-olds. For the older group, CWS with high BI reported more negative attitudes towards their speech and communication abilities than CWS with low BI (Ntourou et al., 2020). Furthermore, high SBIS scores correlated with higher scores on the Test of Childhood Stuttering (TOCS; Gillam, Logan, & Pearson, 2009) disfluency-related

consequences scale, which includes statements related to both physical behaviors and negative emotional reactions associated with stuttering. Based on the findings, it is unclear whether the higher TOCS scores are indicative of greater incidences of negative communication attitudes, greater severity of physical behaviors associated with stuttering, or both. Children with higher TOCS scores were also observed to exhibit shorter MLU in conversation, perhaps reflecting self-conscious attempts to mask stuttering by reducing verbal output (Ntourou et al., 2020). Additional studies have suggested that this connection between behavioral inhibition and poor self-perception of speech in PWS may persist into adulthood; higher levels of introversion correspond with more negative communication attitudes in adults who stutter (Stipdonk, Lieftink, Bouwen, & Wijnen, 2014).

Tumanova et al. also predicted that high BI would contribute to greater stuttering-related consequences and more negative communication attitudes among CWS. Like Ntourou et al, they found that CWS with high BI demonstrated reduced MLU and produced fewer total words during conversation. Correspondingly, CWS with high BI displayed stronger reactions to their disfluencies, as evidenced by elevated TOCS disfluency-related consequences scores (Tumanova et al., 2020).

Many aspects of Tumanova et al.'s research supports the idea that BI plays a dynamic role in fluency disorders. CWS are more likely to have high BI, and high BI is a predictor of other speech-language characteristics. CWS with high BI appear to have more issues coping with difficult social interactions caused by stuttering (Tumanova et al., 2020). High BI traits may augment negative consequences of stuttering, impacting language and social/emotional development. Ntourou et al. suggested children experience social-communicative environments differently depending on their unique temperamental

characteristics. Children with high BI generally approach novel situations with avoidance, caution, and heightened physiological arousal. Therefore, neutral social interactions involving stuttering may be assessed more negatively in CWS with high BI than CWS with low BI. Negative social interactions related to stuttering, such as teasing, are similarly interpreted with greater levels of distress by CWS with high BI. Vivid recall of these interactions may contribute to the development of negative communication attitudes (Ntourou et al., 2020).

2.2.4 Behavioral inhibition and secondary behaviors

Nonspeech behaviors that co-occur with stuttering, usually described as secondary behaviors or physical concomitants, have long been considered clinically significant factors in fluency disorders. One of the most widespread tests of stuttering severity, the Stuttering Severity Instrument 4th Ed. (SSI-4, Riley, 2009), measures these behaviors along with the frequency and duration of disfluencies to render an overall judgment of stuttering severity. In addition, there is a history of clinicians applying therapy strategies to modify nonspeech accessory behaviors linked to stuttering, such as increasing PWS's eye contact with their listeners during speech (Conture & Kelly, 1991).

Secondary behaviors typically manifest as PWS become more aware of their stuttering, and their frustrations consequently increase (Guitar, 2019). The PWS starts to respond to stuttering disfluencies like blocks, prolongation, or repetitions by trying to terminate or avoid them. Such impulsive struggles eventually transform into habits. Secondary behaviors are generally divided into two classes: escape and avoidance behaviors. Escape behaviors occur during the stutter; the speaker notices their stutter and may grimace, wring their hands, blink their eyes, or jerk their head to finish their words.

Feelings of relief ensue as the stutter is terminated, and thus these behaviors are reinforced over time. Avoidance behaviors occur when the speaker anticipates stuttering and fears listener reactions or remembers past negative experiences while stuttering. To avoid negative feelings, the PWS engages in behaviors previously used to escape stuttering, for example, inserting filler words like "huh" or moving their hands before attempting to say the word containing the expected stutter. PWS may become increasingly dependent on both types of secondary behaviors to help assuage their fears of stuttering (Guitar, 2019).

Research on secondary behaviors indicates the problem increases in frequency and severity with age. Preschool CWS produce an average of 1.1 nonspeech behaviors per stuttering event near the onset of their fluency disorder (Schwartz, Zebrowski, & Conture, 1990), while older CWS have been found to exhibit an average of 1.73 nonspeech behaviors per stutter (Schwartz & Conture, 1988). Remarkably, adult PWS produce an average of 2.33 nonspeech behaviors per stuttering event (Prins & Lohr, 1972). Studies of physical concomitants are relevant considering research findings from various fields suggesting that typical adults' facial expressions affect their autonomic nervous and vascular systems (Ekman, Levenson, & Friesen, 1983; Zajonc, Murphy, & Inglehart, 1989). Such changes in biological activity may influence subjective feelings. Therefore, investigating the causes and consequences of secondary behaviors has important implications regarding psychosocial well-being in PWS.

One notable study on secondary behaviors conducted by Conture and Kelly (1991) assessed nonspeech behaviors associated with CWS's disfluencies compared to nonspeech behaviors exhibited during CWNS's fluent utterances. Subjects were 28 boys and 2 girls who stuttered and 28 boys and 2 girls who did not stutter, with a mean age of approximately

4.5 years. 300-word conversation samples were collected during the middle portion of a play-based conversation with their mother. The rationale for the delay came from Zebrowski's (1988) finding that it takes young CWS about 5-10 min to adjust to a novel conversational setting e.g., being videotaped. Sixty-six different nonspeech behaviors in CWS were evaluated using frame-by-frame analysis of ten randomly selected stuttered disfluencies. Ten fluent utterances per CWNS were assessed using the same technique. Researchers applied a conservative strategy in delineating nonspeech behaviors; behaviors like talking or playing with toys were not classified as nonspeech behaviors (Conture & Kelly, 1991).

Results indicated that CWS produced 133 % more nonspeech behaviors during stuttered words than CWNS made during fluent utterances. Two nonspeech behaviors that differed significantly between CWS and CWNS, eye turns to the left and eye blinking, may indicate CWS's efforts to reduce listener feedback and the possibility of adverse reactions to stuttering. Other nonspeech behaviors produced more often in CWS included upper lip raising and nostril flaring, potentially related to inappropriate inhalation or unconscious feelings of disgust. In addition, neutral facial expressions were observed more frequently in CWNS's fluent utterances than during CWS's stuttered utterances. Thus, a child's membership in either the CWS or CWNS group could generally be determined based on nonspeech behaviors despite some overlap in frequency and type of nonspeech behaviors observed between the two groups. Based on the results, Conture and Kelly (1991) suggested that childhood stuttering can, in part, be defined based on nonspeech behaviors and that these nonspeech behaviors represent physical manifestations of underlying emotional, linguistic, and biological phenomena associated with childhood stuttering.

Ntourou et al. (2020) also evaluated the relationship between secondary behaviors and BI by asking 45 parents of CWS to complete the disfluency-related consequences section of the TOCS. Eight of the scale's nine questions probe the extent to which the CWS exhibits secondary behaviors and other adverse reactions to stuttering. (Ntourou et al., 2020). SBIS scores were used to classify children as high or low BI. Results corroborated Ntourou et al.'s hypothesis that higher BI would correspond with greater stuttering-related consequences. They found that CWS with high SBIS scores also had higher scores on the TOCS Disfluency-Related Consequence scale. Therefore, BI was associated with greater disfluency-related consequences in preschool-age CWS, such as appearing physically tense when called on to speak, avoiding difficult words, or becoming embarrassed by their speech (Ntourou et al., 2020).

Previous works have investigated the effects of BI on various aspects of stuttering, such as communication attitudes and stuttering frequency in CWS (Choi et al., 2013; Ntourou et al., 2020; Tumanova et al., 2020). However, to date, no published study has specifically addressed the relationship between BI and the development of secondary behaviors in CWS. The present study is also unique in that there is relatively little prior research on stuttering that attempts to measure secondary behaviors based on direct clinician observation.

The present study focused on physical concomitant behaviors to evaluate the relationship between BI and secondary behaviors. Avoidance behaviors were not included in the measurement of participants' total occurrences of secondary behaviors. There were several reasons for this decision. Physical concomitants typically develop earlier than avoidance behaviors in CWS, and all participants in our study were

preschool-age children. Direct measurement of avoidance behaviors can be subjective compared to coding for physical concomitants, which align with the descriptive categories found in the physical concomitant section of the valid, norm-referenced, and reliable SSI-4. While some avoidance behaviors such as pitch changes or use of timing devices can be directly observable, many avoidance behaviors such as word substitutions and postponements are less overt and thus difficult to judge (Eichstädt, Girson, & Watt, 1998).

2.3 Summary of Literature Review

Specific mechanisms underlying the possible relationship between BI and secondary behaviors are not yet well understood. Based on previous literature, BI traits appear to be linked to a higher risk of childhood stuttering, more severe stuttering, and increased psychosocial consequences for CWS, such as higher anxiety, negative communication attitudes, and lower self-esteem. Secondary behaviors are a clinically significant component of stuttering, yet there have been relatively few attempts in previous works to directly measure observable incidences of physical behaviors associated with stuttering to determine the role they play in childhood fluency disorders. Prior research analyzing the links between BI and secondary behaviors relied on indirect parent report to assess secondary behaviors. The present study applied a variety of quantitative and qualitative measures of preschool children's occurrences of secondary behaviors, fluency, nonverbal/verbal BI, and communication attitudes to attempt to clarify the relationship between BI and secondary behaviors. Determining the nature of

the relationship between BI and secondary behaviors may have considerable implications regarding evaluation and treatment of CWS.

2.4 Purpose of the Present Investigation

The purpose of the present study is to investigate the relationship between BI, communication attitudes, and secondary behaviors in young children who stutter.

2.5 Research Question and Hypotheses

Specific research questions and hypotheses are as follows:

1. Is there an association between BI and the occurrences of physical concomitant behaviors in CWS?

   Hypothesis 1: There will be a positive relationship between BI and the occurrences of physical concomitants in CWS.

2. Is there an association between BI and communication attitudes in CWS?

   Hypothesis 2: There will be a positive relationship between BI and KiddyCAT scores in CWS.

3. Is there an association between communication attitudes and the occurrences of physical concomitant behaviors in CWS?

   Hypothesis 3: There will be a positive relationship between KiddyCAT scores and the occurrences of physical concomitants in CWS.

CHAPTER III: METHODS

3.1 Participants

Thirty-eight children who stutter aged 3 to 7 years, with an average age of 4 years 4 months, participated in this study. Participants included ten girls and twenty-eight boys. Of the children whose ethnic/racial demographics were known, fifteen participants were African-American and twenty participants were white. All participants were native speakers of General American English. Participants were recruited from preschools, speech clinics, and elementary schools throughout Mobile, AL, and Syracuse, NY, areas. All caregivers provided informed consent for their children to take part in this research.

To qualify for inclusion in the study, participants had to be classified as children who stutter (CWS), as indicated by a score of 11 or higher on the SSI-4 and reports of caregiver concerns about their children's fluency. Participants were excluded if they had clinically significant hearing, speech, language, neurological, intellectual, visual, or social-emotional impairments. Inclusion criteria was corroborated via a case history form completed by a caregiver and speech-language evaluation performed by a graduate student majoring in Speech Language Pathology. Participants were required to meet a standard score of 85 (-1SD) or higher on the Test of Early Language Development- Third Edition (TELD-3, Hresko et al., 1999), indicative of language abilities within normal limits for their chronological age.

3.2 Procedures

Approval for this study was granted by the Institutional Review Board at the University of South Alabama and Syracuse University. At the two locations, participants were observed in a loosely structured, play-based interaction with an unfamiliar female examiner (either a graduate student clinician or a licensed speech-language pathologist) in a laboratory room. Age-appropriate toys (e.g., a barn with animals) were arranged on the table between the examiner and participant, within arm's reach of the child. The examiner-participant interactions were not scripted, and the examiner was instructed to follow the child's lead as often as possible. If participants were reluctant to speak or engage in play, the examiner initiated conversation about topics such as hobbies, friends, family, or the available toys. All conversations were video recorded for further analyses. Subsequently, a norm-referenced language assessment using the TELD-3 (Hresko et al., 1999) and a hearing screening were administered. Participants' communication attitudes were determined based on scores from the KiddyCAT. The SBIS and TOCS disfluency-related consequences scale were also administered to parents of participants to serve as qualitative measures of BI and occurrences of physical concomitant behaviors, respectively. All data for this study had already been collected.

With the pre-existing data collected as above, the present author used the recordings to assess participants' fluency, duration of each physical concomitant behavior, and degree of BI. The Systematic Analysis of Language Transcripts, version 16 (SALT16; Miller & Iglesias, 2016) was used to transcribe participants' utterances and to code the four types of stuttered disfluencies (i.e., sound/syllable repetitions, monosyllabic-whole word repetitions, sound prolongations, & silent blocks) and

spontaneous comments. In addition, participants' BI was evaluated by quantifying verbal (i.e., latency to the 6th spontaneous comment) and nonverbal (i.e., total duration of smiles & latency to touching a toy) behaviors associated with BI traits exhibited during the interaction with the examiner using the SALT and the Procoder (Tapp, 2003) programs. Similarly, the duration of physical concomitants (i.e., eye blinking, foot tapping, lip pursing) exhibited during participants' stuttering moments was measured using Procoder during the first 10 min. of conversation. Further details regarding experimental procedures are discussed below.

3.3 Measurements

3.3.1 Measurement of behavioral inhibition

Children's degree of BI was assessed via parent reports as well as clinician observation of verbal and nonverbal behaviors exhibited during the interaction with an unfamiliar examiner. These measurements were combined into an overall index of BI for each participant.

Nonverbal behaviors associated with BI included the duration of smiles during the first 10 min. of conversation (Kagan et al., 1998) and the latency to touch the first toy from the beginning of the conversation (Kagan, Reznick, & Gibbons, 1989). Verbal behaviors associated with BI included the latency to the 6th spontaneous comment (Kagan et al., 1989). The latency to touching the toy for the first time and the duration of smiles were measured to one-hundredths of a second using the Procoder (Tapp, 2003)

and the latency to the 6th spontaneous comment was measured using the version 2.2.2 of Audacity (R) recording and editing software.

3.3.1.1 Parent report measures of behavioral inhibition. Following methods established by Ntourou et al. (2020), the present study used Short Behavioral Inhibition Scale (SBIS) scores as qualitative measures of the degree of BI among participants. The SBIS consists of a brief 5-item parent questionnaire developed to specifically evaluate BI traits in CWS, such as withdrawal from unfamiliar situations. The SBIS has been found to have good internal consistency and reliability (Ntourou et al., 2020).

3.3.1.2. Verbal measure of behavioral inhibition. In accordance with methods developed by Kagan et al. (1998), latency to the 6th spontaneous comment during conversation with the examiner served as a direct, verbal measure of BI among the present study's participants. Following Choi et al. 's (2013) methodology, latency was measured from initiation of the child's first utterance to initiation of their 6th spontaneous comment. Additionally, following Kagan et al. (1998, p. 1487) a spontaneous comment was defined as "any remark that is not a direct answer to the examiner's question." Therefore, unprovoked utterances, questions, and elaborations of answers were coded as spontaneous comments. Direct responses to the examiner's questions were not included. The Systematic Analysis of Language Transcripts (SALT16; Miller & Iglesias, 2016) was used to code the experimenter's observation of the presence/absence of spontaneous comments. To control for potential confounding variables, the total time duration of the children's stuttering moments as well as unintelligible utterances were subtracted from the latency to the 6th spontaneous comment. Time consisting of the examiner's utterances

was still included in the measure of latency because the examiner followed the child's lead and made comments only to elicit conversational speech from the child.

3.3.1.3. Nonverbal measures of behavioral inhibition. First, the duration of spontaneous smiles exhibited by participants throughout the first ten minutes of the child-examiner interaction was used as a nonverbal measure of BI. Smiles are facial expressions typically denoting feelings of pleasure or amusement. In accordance with Kagan et al. 's (1998) methodology, each instance that the participant produced an "upward turning of the lips combined with partial mouth opening and a relaxed face" was coded as a spontaneous smile (Kagan et al., 1998, p 1488-1489). Kagan et al.'s work found that highly reactive infants smiled significantly less than low-reactive infants at 14 and 21 months. They concluded that spontaneous smiles reflect an individual's level of comfort within their surrounding social-communicative environment.

Secondly, as an additional non-verbal measure of BI, the participant's latency to touch the first toy during the play-based interaction with the examiner was coded from the videotape and measured in seconds. According to the methodologies established by Kagan et al. (1989), Rothbart & Bates (1998), and Putnam & Sifter (2005), latency to touch the first toy during a novel social interaction serves as a reliable and valid indicator of a child's approach or withdrawal tendencies.

3.3.1.4 Index of combined behavioral inhibition scores. Following Kagan et al.'s (1989) methodology, the combined scores for verbal measures of BI (e.g., latency to the 6th spontaneous comment) and nonverbal measures of BI (e.g., latency to touching the toy for the first time & duration of smiles) were standardized (e.g., subtracting the mean from

each score and dividing the result by its standard deviation; reversing the score for smiles) and averaged. A mean standard score was treated as the composite index of BI.

3.3.2 Frequency of stuttered and non-stuttered disfluencies

Children's stuttering-like disfluencies (SLD) were assessed during the first 300 words of the conversational sample. As mentioned above, stuttered disfluencies include sound-syllable repetitions (SSR), silent blocks (B), sound prolongations (SP), and monosyllabic whole-word repetitions (WWR) (Conture, 2001).

3.3.3 Measurement of physical concomitant behaviors

For the present study, physical concomitants (sometimes known as escape behaviors) were the type of secondary behavior measured. On the other hand, avoidance behaviors, a different type of secondary behavior, were not measured due to low reliability and accuracy of measurement, as they were often unobservable (Eichstädt et al., 1998). Physical concomitants are behaviors that a speaker produces when attempting to terminate their stutter and finish the word. Occurrences of physical concomitants were measured via both parent reports and clinician observation.

3.3.3.1 Clinician observation measures of physical concomitant behaviors. Physical concomitants were coded according to the physical concomitant section of the Stuttering Severity Instrument-Fourth Edition (SSI-4) (SSI-4, Riley, 2009). Physical concomitants measured on the SSI-4 include distracting sounds (whistling, noisy breathing, sniffing, blowing, clicking), facial grimaces (jaw jerking, tongue protrusion, lip pressing, jaw tension), head movements (turning away, looking around, head jerking, poor eye contact) and movements of the extremities (hands near face, torso movement, arm and hand movement, leg movement, foot tapping. swaying).

Children's total duration of physical behaviors associated with stuttered disfluencies (i.e., escape behaviors) were measured during the first 10 minutes of the conversational sample using Procoder. Prior to coding, the author watched the video of each participant's conversational sample and performed a qualitative assessment of physical concomitants using the SSI-4. Then, the onset and offset of the 4 categories (i.e., distracting sounds, facial grimaces, head movements, & movements of the extremities) was marked in seconds using the Procoder.

3.3.3.2 Parent report measures of physical concomitant behaviors. The present study used scores from a subcategory of the TOCS disfluency-related consequences scale as a parent-report measure of children's occurrences of physical behaviors associated with stuttering. Scores from the disfluency-related consequences scale of the TOCS were previously used in Ntourou et al. (2020) and Tumanova et al. 's (2020) works investigating the possible impact of BI on childhood stuttering. The TOCS manual (p. 62) indicates that the nine questions on the TOCS disfluency-related consequences scale can be divided into the following categories: (1) physical behaviors that occur during stuttering moments, (2) strategies to avoid stuttering moments, (3) negative feelings/emotions associated with stuttering, and (4) adverse social consequences of stuttering (TOCS; Gillam et al., 2009). The first three questions on the scale fall into category 1 since they describe physical behaviors associated with stuttering. Thus, the present study used scores specifically from category 1 of the disfluency-related consequences scale to qualitatively assess occurrences of children's physical concomitant behaviors.

3.3.4 Measurement of communication attitudes

The KiddyCAT was used to assess participant communication attitudes. Young CWS were asked by clinicians to report their feelings and attitudes about their speech. The KiddyCAT is a standardized, norm-referenced 12 item binary (yes/no) questionnaire developed to measure preschool children's communication attitudes (KiddyCAT; Vanryckeghem & Brutten, 2007). Children may receive a maximum score of 12; higher scores indicate more negative communication attitudes (Vanryckeghem & Brutten, 2007). Research from Clark, Conture, Frankel, and Walden (2012) supports the use of the KiddyCAT as a reliable and valid measure of communication attitudes and emotions among preschool-aged CWS. According to their findings, CWS produced significantly higher KiddyCAT scores than CWNS, even when controlling for potential confounding factors such as age and gender. Their work also established "speech difficulty" as the primary construct underlying the KiddyCAT's design.

3.4 Data Analyses

A multiple linear regression was performed to address each of the research questions. Specifically, for research question 1, "Is there an association between BI and the occurrences of physical concomitant behaviors in CWS?" children's BI scores served as an independent variable, and occurrences of physical concomitants served as a dependent variable. For research question 2, "Is there an association between BI and communication attitudes in CWS?" children's BI scores served as an independent variable, and their KiddyCAT scores served as a dependent variable. Finally, for research question 3, "Is there an association between communication attitudes and the occurrences

of physical concomitant behaviors in CWS?" children's KiddyCAT scores served as an independent variable, and occurrences of physical concomitants served as a dependent variable. Participants' age and frequency of stuttered disfluencies served as covariates to control for their potential influence on the dependent variables in each model.

3.5 Reliability

3.5.1. Intra-rater reliability

Participants' video-taped responses were used to judge intra-rater reliability. Agreement between the examiner's initial coding and re-coding of the participants' composite scores of BI and duration of physical concomitant behaviors was determined using intraclass correlation coefficients (ICC; McGraw & Wong, 1996). 12.5 percent of the data (n = 3) for duration of smiles within 10 minutes, latency to touching the toy, and the duration of physical concomitants was randomly selected. In addition, the examiner's SSI-4 physical concomitant scores and the duration of physical concomitant behaviors were analyzed for intra-rater reliability.

There was good reliability between the experimenter's initial and re-coding of the children's duration of smiles, *intraclass correlation =.983, Cronbach's alpha= .991, p=.009*. Reliability was very high between the experimenter's initial and re-coding of latency to touching the toy, *intraclass correlation =1.000, Cronbach's alpha= 1.000, p=<.001.* Intra-rater reliability for the total duration of physical concomitants was similarly high, *intraclass correlation =1.000, Cronbach's alpha= 1.000, p=<.001*. The

direction of the relationship between the examiner's SSI-4 physical concomitants rating and the total duration of physical concomitant behaviors was consistent (*Spearman's rho*= -.495, *p*=.014), indicative of moderate intra-rater reliability across different clinician observation measures of physical concomitants.

3.5.2. Inter-rater reliability

Approximately 29% of the total final data corpus for participants (*n=7*) was selected at random to assess inter-rater reliability for the duration of smiles and duration of physical concomitant behaviors. 21% of the data for participants (*n*=5) was selected at random to assess inter-rater reliability for latency to touching the toy. An analysis of the relationship between the present author and reliability coder's SSI-4 physical concomitant scores was used as an additional measure of inter-rater reliability. A speech-language pathology graduate student served as a blind reliability coder.

There was good agreement between the examiner and the reliability coder's measures of physical concomitant behaviors within 10 minutes, *intraclass correlation =.984, Cronbach's alpha= .991, p=<.001*. There was very high agreement between the examiner and reliability coder's measure of the latency to touching a toy, perhaps reflecting that touch is a fairly objective behavior, *intraclass correlation =1.000, Cronbach's alpha= 1.000, p=<.001.* There was poorer agreement between the examiner and reliability coder's measure of smiles within 10 minutes, *intraclass correlation =.359, Cronbach's alpha= .569, p=<.165.* This may suggest clinicians' differing levels of sensitivity in interpreting spontaneous smiles in young children. Comparisons of the examiner and reliability coder's SSI-4 physical concomitant scores also revealed

differing levels of sensitivity in judging the degree of physical concomitants among participants, *intraclass correlation =.470, Cronbach's alpha= .783, p=<.001*. However, the direction of the trend was consistent, implying agreement between raters in identifying which participants displayed more or fewer physical concomitants *(Spearman's rho=.572, p=.005).*

CHAPTER IV: RESULTS

4.1 Descriptive Information

4.1.1 Participants' language ability

All 38 participants earned a standard score of 85 or higher on the Test of Early Language Development-3 (TELD-3, Hresko et al., 1999).

4.1.2 Participants' behavioral inhibition characteristics as measured by parent reports

As shown in Table 2, the mean SBIS score of participants was 16.54 with a minimum of 9 and maximum of 25. The standard deviation was 4.46. SBIS data was collected from 37 participants.

4.1.3 Participants' behavioral inhibition characteristics as measured by clinician observation

As shown in Table 1, the mean total duration of nonverbal behavioral inhibition as measured by clinician observation of spontaneous smiles using Procoder was 85.18s, with a minimum of 8.33s, maximum of 273.4s, and a standard deviation of 74.40s. Additionally, the mean duration of participants' latency to touch the toy during the interaction with the examiner was 39.07s, with a minimum of 0.01s, maximum of

555.47s, and standard deviation of 112.80s. Data for duration of smiles and latency to touching the toy was collected from 24 participants. Clinician observation of verbal BI through the mean duration of participants' latency to the 6th spontaneous comment was 180.80s, with a minimum of 7.89s, maximum of 757.04s, and standard deviation of 163.14s. Data for latency to the comment was collected from 36 participants.

4.1.4 Participants' disfluency characteristics

Each participant's 300-word conversational speech sample was analyzed for disfluencies. The mean percentage of stuttering-like disfluencies (SLD) was 8.37% with a minimum of 0, maximum of 35.24%, and standard deviation of 7.36%. Data was collected from 34 participants.

4.1.5 Participants' physical concomitant behavior characteristics as measured by parent reports

As shown in Table 2, the mean score of 38 participants from the physical behaviors subcategory of the TOCS disfluency-related consequences scale was 3.48, with a standard deviation of 2.52 (range: 0 to 9).

4.1.6 Participants' physical concomitant behavior characteristics as measured by clinician observation

As shown in Table 3, the mean of participants' total duration of physical concomitant behaviors observed within 10 minutes was 23.63s, with a standard deviation of 25.32s (range: 1.66s to 115.23s). The average duration of each individual physical concomitant behavior observed per participant was 1.36s (SD: 70s). The mean total durations of different types of physical concomitants were as follows: 6.82s for head movements, 6.36s for grimaces, 0.72s for distracting sounds, and 9.73s for movements of

the extremities. Data for all these measures was collected from 24 participants. In addition, children's mean score on the SSI-4 physical concomitants section was 3.37 with a standard deviation of 2.67 (range: 0 to 11).

4.1.7. Participants' communication attitudes

As shown in Table 2, the mean KiddyCAT score collected from 26 participants was 3.85 with a standard deviation of 2.99 (range: 0 to 10).

4.2 Findings Related A Priori Hypotheses

Prior to testing, assumptions of multiple regressions were checked. There was no multicollinearity issue on any of the variables. In addition, the results of Shapiro-Wilk tests indicated that the residuals were normally distributed. Therefore, no adjustment was made for variables in each multiple regression model and the multiple regressions were conducted to address research questions as planned.

4.2.1 Relation between behavioral inhibition and secondary behaviors

***Hypothesis 1*:** There will be a positive relationship between BI and the occurrences of physical concomitant behaviors in CWS.

In general, findings did not support Hypothesis 1 yet nonetheless revealed some interesting correlations. Specifically, the results of multiple regression analysis indicated that there was a significant relationship between parent report measures of children's behavioral inhibition (as indexed by SBIS scores) and physical concomitant behaviors (as indexed by scores from the physical behaviors category of the TOCS disfluency-related consequences scale), $\beta = .300$, $t = 2.058$, $p = .047$. The overall model fit was Adjusted R^2

= .234. This finding contradicts our hypothesis since it suggests that children with lower BI are considered by their parents to exhibit more physical concomitant behaviors than children with higher BI.

In contrast, results of the multiple regression analysis indicated no significant relationship between children's composite BI scores and the clinician's observations of the total duration of children's physical concomitants, $\beta = .150$, $t = 0.676$, $p = .507$. The overall model fit was Adjusted $R^2 = -.024$. Although no significant relationship existed, there was a slight positive trend with children rated as having higher BI being observed to exhibit more physical concomitants during stuttering.

Due to the inconsistent findings above, an ancillary analysis was conducted to determine the relation between parent reports of physical behaviors associated with stuttering and the clinician's observations. The result showed that although not significant (*Spearman's rho*= -.404, p=.050), there was a trend of negative correlation between the two variables, indicating that clinicians and parents may perceive physical concomitants differently in CWS.

4.2.2 Relation between BI and communication attitudes

Hypothesis 2: There will be a positive relationship between BI and KiddyCAT scores in CWS.

In general, findings did not support Hypothesis 2. Specifically, the results of multiple regression analysis indicated that there was no significant positive relation between parent reports of children's BI (as indexed by SBIS scores) and their communication attitudes (as indexed by KiddyCAT scores), $\beta = .005$, $t = 0.025$, $p = .980$. The overall model fit was Adjusted $R^2 = .055$. Likewise, there was no significant relation

between combined nonverbal/verbal clinician observations of BI and communication attitudes (as indexed by KiddyCAT scores), β = -.372, t = -2.004, p = .059. The overall model fit was Adjusted R^2= .528. However, results of the analysis revealed a significant positive relationship between children's percentage of words stuttered (% SLD) in conversation and their communication attitudes (as indexed by KiddyCAT scores), β = -.925, t = 4.987, p = <.001. The overall model fit was Adjusted R^2= .528. This finding suggests that CWS with more frequent SLD may hold more negative communication attitudes than those with less frequent SLD.

Ancillary analysis of the correlation between parent reports of BI and the clinician's observations yielded no significant correlation (*Spearman's rho*= -.318, p=.062). However, the direction of the relationship was consistent with our hypothesis since it suggested both parents and clinicians tended to judge whether children were high or low BI similarly.

4.2.3 Relation between communication attitudes on secondary behaviors

Hypothesis 3: There will be a positive relationship between KiddyCAT scores and the occurrences of physical concomitant behaviors in CWS.

In general, findings did not support Hypothesis 3. Specifically, the results of multiple regression analysis indicated no significant relationship between children's communication attitudes (as indexed by KiddyCAT scores) and parent reports of occurrences of physical concomitant behaviors (as indexed by scores from the physical behaviors subcategory of the TOCS disfluency-related consequences scale), β = .213, t = 1.083, p = .290, R^2 *change* = .083. Likewise, results revealed no significant correlation between children's communication attitudes (as indexed by KiddyCAT scores) and

clinician observations of occurrences of physical concomitants, β = -.002, t = -.005, p = .996, R^2 change = -.089.

CHAPTER V: DISCUSSION

In summary, there were two main findings that needed further discussion. First, according to parent reports there was a significant negative relationship between BI and physical concomitant behaviors in CWS, yet no corresponding relationship was established based on clinician observation measures. Second, there was no evidence of a significant relationship between BI and communication attitudes, or between physical concomitant behaviors and communication attitudes. However, there was a significant relationship between stuttering frequency and communication attitudes.

5.1 Relation between Behavioral Inhibition and Secondary Behaviors

First, our findings indicated a significant negative relationship between children's BI and the occurrences of physical concomitant behaviors according to parent report measures. Parents generally perceived children with lower BI as exhibiting more physical concomitants than children with higher BI. This direction of this finding was inconsistent with our hypothesis. Our results were also inconsistent previous findings from Ntourou et al. (2020) suggesting that children with higher BI scores (as indexed by the SBIS) also tended to have higher scores on physical behaviors category of the TOCS disfluency-related consequences scale.

On the other hand, findings from the present study suggested no significant relationship between clinician observations of BI and physical concomitant behaviors in CWS during a 10-minute child-examiner play-based interaction. In fact, there was a slight trend of children with higher BI being rated by the clinician as exhibiting more physical concomitant behaviors. These seemingly contradictory results from parent report measures vs. clinician observation indicate that presentation of physical concomitants in CWS may differ depending on the child's environment and communication partners. Alternatively, these findings may be suggestive of differences in how parents and clinicians identify secondary behaviors. Indeed, our data showed that there was a marginally significantly negative relationship between parents' reports of physical concomitants and clinicians' observations of physical concomitants. Then, why is there a difference between the parents and clinicians in their perception of physical behaviors associated with stuttering?

A major advantage of parent report measures is that parents are with their child more often than clinicians, and thus can provide valuable knowledge about a child's stuttering and related behaviors across a wide variety of communicative situations. Information about how parents perceive the impact of stuttering on their child is crucial because parents play an important role in helping young children manage and understand their stuttering (Rocha, Yaruss, & Rato, 2019). However, prior research suggests that parents of CWS report a general lack of knowledge about stuttering (Rocha et al., 2019; Carey, Onslow, & O'Brian, 2020).

According to a study of preschool CWS by Carey et al. (2020), some parents had difficulty identifying stuttering moments in their children and did not realize sound

prolongations and silent blocks were considered stuttering-like disfluencies. This same study revealed that experienced SLPs identified stuttered disfluencies from conversational samples of CWS whose parents reported they had naturally recovered from stuttering (Carey et al., 2020). Similarly, research into parent perceptions of stuttering by Guttormsen, Yaruss, and Naess (2021) indicated that while parents generally perceived themselves to be confident in assessing the impact of stuttering on their child's communication in daily situations, they expressed more uncertainty regarding their children's cognitive and behavioral reactions to stuttering (Guttormsen et al., 2021) Given these findings, it can be speculated that many parents may have trouble identifying secondary behaviors in preschool CWS and distinguishing physical concomitants from other behaviors not necessarily associated with stuttering, such as fidgeting. Thus, it is recommended that clinicians be careful when interpreting parent reports of secondary behaviors in CWS and provide parents with specific examples of physical concomitants and avoidance behaviors before asking questions about the child's secondary behaviors.

The present study's findings may also be partially explained by the potential relationship between BI and verbal output. Tumanova et al. (2021) found that higher BI was associated with fewer total words in conversation (Tumanova et al., 2021). It stands to reason that reduced verbal output may lead to fewer opportunities for stuttering and behaviors associated with stuttering while increased verbal output may result in more opportunities for stuttering and behaviors associated with stuttering. The present study analyzed parental and clinician measures of physical concomitants, which occur in conjunction with stuttering-like disfluencies. Thus, it can be speculated that children with

increased verbal output associated with lower BI may stutter more and consequently exhibit more physical concomitant behaviors than those with higher BI. Further research is needed to support or refute this speculation.

On the other hand, it should be noted that the present study excluded measurement of avoidance behaviors, and this may have affected the direction of the relationship between secondary behaviors and BI. According to prior research, high BI is strongly associated with avoidance as a temperamental trait (Ntourou et al., 2020). Thus, it is possible that some participants with higher BI exhibited significant avoidance behaviors during the interaction between the child and unfamiliar examiner, but these behaviors were not captured by our study. Future research about relationships between BI and secondary behaviors in stuttering should explore the role of avoidance behaviors more thoroughly to establish more valid conclusions.

5.2 Relation between Behavioral Inhibition and Communication Attitudes

The second finding indicated there was no significant relation between BI and communication attitudes in CWS. Contrary to our predictions, higher BI was not associated with more negative communication attitudes. Additionally, our analysis indicated that the direction of the relationship between parent report measures and clinician observations of BI among participants was consistent. This suggests that our measures were fairly reliable since clinicians and parents tended to evaluate the degree of BI in CWS similarly.

Our findings about BI and communication attitudes are generally aligned with prior research from Ntourou et al. (2020) showing no relationship between BI and

KiddyCAT scores in preschool CWS. One important difference from Ntourou et al.'s work is that they conducted a post-hoc analysis to examine the relationship between BI and KiddyCAT scores in 4- to 6-year-old children (excluding 3-year-olds) which resulted in a significant relationship between BI and KiddyCAT scores. We did not conduct the same analysis due to the limited number of older children among participants. Thus, the relationship between BI and communication attitudes warrants further investigation in older CWS.

Correspondingly, our findings indicated that there was no significant relation between physical concomitants and communication attitudes in CWS. Both parent reports and clinician observations of more occurrences of physical concomitants were not associated with negative communication attitudes. This finding was inconsistent with our original predictions based on models from Conture & Kelly (1991) and Ntourou et al. (2020) suggestive of links between stuttering awareness, BI, negative communication experiences, and more occurrences of physical behaviors associated with stuttering. However, the present study's findings align with recent work by Winters and Byrd (2021) indicating that more severe physical concomitants were not necessarily predictive of more negative communication attitudes (Winters & Byrd, 2021).

On the other hand, the present study showed a significant correlation between stuttering frequency and communication attitudes in CWS. Specifically, children who stuttered on more words had more negative communication attitudes. This finding regarding stuttering frequency is interesting considering prior research examining possible links between %SLD and KiddyCAT scores indicated children with greater stuttering frequency were no more likely to report negative communication attitudes

(Winters & Byrd, 2021) (Groner, Walden, and Jones, 2016). Establishing possible causes of negative communication attitudes in CWS is important since these children tend to experience negative peer reactions, higher anxiety, and lower self-esteem, the consequences of which increase with age (Carey et al., 2020).

5.3 Limitations and Future Research Suggestions

The present study has several limitations and future research suggestions. First, half of the data collected to assess secondary behaviors was from questionnaires given to caregivers. As discussed previously, it is possible that parents may have inadequate knowledge of secondary behaviors, rendering some responses unreliable. Therefore, it is recommended that future research in this area include parent education about specific examples of physical concomitant behaviors prior to them completing parent reports. Second, children's avoidance behaviors were not included in our data. The authors focused on measuring physical concomitant behaviors because they were more overt and observable, with concrete, descriptive categories that corresponded to the behaviors listed on the physical concomitants section of the SSI-4. Excluding measures of avoidance behaviors may have affected some trends considering the possibility that some participants who exhibited avoidance behaviors may not have exhibited many physical concomitant behaviors. It is suggested that future research on the relation between BI and secondary behaviors include direct observations of avoidance behaviors, even though they may be more challenging for clinicians to accurately judge or measure. Finally, the present study may be limited by its retrospective design using previously collected videos of play-based interactions with participants. The clinician analyzing conversational

samples for measures of behavioral inhibition and physical concomitant behaviors was not the same clinician that participated in the interactions. This design allowed for a greater sample size, but it may have made it difficult for the observing clinician to account for factors that could have potentially influenced measurements, such as participant fatigue, general level of activity, personality, and mood. It is therefore recommended that future researchers investigating the relationship between BI and secondary behaviors consider an alternative design with a single clinician both engaging in the play-based interaction with the participant and analyzing data from the videos.

5.4 Clinical Implications

Although the present study's findings were generally not consistent with the author's hypotheses, this work represents an important step towards investigation of the relationships between BI, secondary behaviors, and communication attitudes among CWS. Secondary behaviors may provide clues about the potential trajectory of a young child's stuttering. For example, prior research suggests that children who naturally recover from stuttering demonstrate a decrease in physical behaviors associated with stuttering over time. Meanwhile, children with persistent stuttering exhibit more physical concomitants that remain stable with time (Yairi, 2004). Additionally, more physical concomitant behaviors at a younger age may indicate more advanced stuttering (Guitar, 2019).

Findings of a possible discrepancy in perceptions of physical concomitant behaviors between clinicians and parents suggest the need for further education during the evaluation and treatment of CWS. Some parents may have difficulty identifying

secondary behaviors in CWS, considering these behaviors are variable and can be mistaken for behaviors unrelated to stuttering, particularly in more hyperactive children. Clinicians may want to outline specific types of physical concomitants and avoidance behaviors, explain why they occur in stuttering, and provide examples of these behaviors observed in their child during the evaluation. Appropriate education and counseling about secondary behaviors can help empower parents to become more active participants in their child's treatment.

Although the present study did not establish a causal relationship between BI and negative communication attitudes, prior works indicate BI traits may influence the development of fluency disorders (Ntourou et al., 2020; Guitar 2019). Assessments of BI such as the SBIS (Short Behavioral Inhibition Scale; Ntourou et al. 2020) should thus be incorporated into fluency diagnostics for young children (Guitar, 2019). Additionally, since high BI children may be reluctant to engage with clinicians in the unfamiliar environment of a therapy room, clinicians may want to ask parents to videotape their child in a more typical communication environment (e.g., home, playing with friends) to gain a more accurate understanding of the child's stuttering severity. BI traits may manifest differently depending on environmental factors, but BI is a biologically-based aspect of temperament and appears to remain stable from childhood through adulthood (Rothbart & Bates, 1998; 2006; Zentner et al., 2012) Unsurprisingly, high BI is a known risk factor for persistent stuttering. Children with higher BI may require a longer duration of treatment and may be less responsive to therapy than same-age peers. Consequently, thorough counseling and education are essential for the families of high BI CWS. Negative listener reactions such as impatience from a parent may compound difficulties

experienced by high BI CWS, such as fear of certain speaking situations (Guitar, 2019). Both higher BI and stuttering have been found to increase the risk of children developing social anxiety disorders in childhood and adolescence (Fox et al., 2005; Smith, Iverach, O'Brian, Kefalianos, & Reilly, 2014).

Indirect treatment approaches may be most beneficial for high BI CWS (particularly those who also hold negative communication attitudes). For example, clinicians may encourage parents to set aside 10-15 minutes per day for a one-on-one conversation with their child as they engage in their preferred activities. In addition, clinicians can teach parents to reduce stress on the CWS by using a slower speaking rate with frequent pauses. Conversely, direct treatment strategies such as the Lidcombe program, which emphasizes reinforcement of fluent utterances, may prove frustrating and counterproductive for high BI CWS; such approaches could cause the child to focus even more on their speech and fluency (Guitar, 2019).

CHAPTER VI: CONCLUSION

In summary, the relationship between BI and occurrences of physical concomitant behaviors in CWS was unclear. Based on parent report measures, there was an association between lower BI and more physical concomitant behaviors. Meanwhile, according to clinician observation measures there was no significant relationship, although there was a slight trend of children with higher BI exhibiting more physical concomitants. Given the conflicting findings, it is possible that parents and clinicians interpret secondary behaviors differently, but further research is warranted to support this speculation. Additionally, there was no significant relationship between BI and negative communication attitudes, and likewise negative communication attitudes were not associated with more occurrences of physical concomitant behaviors. Ancillary analyses indicated the only variable that appeared to correlate with negative communication attitudes was stuttering frequency. Nonetheless, it should be noted that the present study excluded measurement of avoidance behaviors, and this may have affected the direction of the relationship between secondary behaviors and BI. Further research is warranted to explore the relationship between BI and avoidance behaviors in CWS.

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APPENDIX: TABLES

Table 1. Clinician Observation Measures of Behavioral Inhibition

	Minimum	Maximum	Mean	SD	Number of Participants
Duration of smiles within 10 minutes	8.33s	273.94s	85.18s	74.40s	24
Latency to 6th spontaneous comment	7.89s	757.04s	180.80s	163.14s	36
Latency to touching toy	0.01s	555.47s	39.07s	112.80s	24
BI index	-1.17	3.53	0.09	0.96	36

Note: data for time measured in seconds

Table 2. Parent and Self Report Measures of Behavioral Inhibition, Communication Attitudes, and Physical Concomitants

	Minimum	Maximum	Mean	SD	Number of Participants
SBIS	9.00	25.00	16.54	4.46	37
KiddyCAT	0.00	10.00	3.85	2.99	26
TOCS physical behaviors subcategory of Disfluency-Related Consequences Scale	0.00	9.00	3.42	2.52	38

Table 3. Clinician Observation Measures of Behaviors Associated with Stuttering

	Minimum	Maximum	Mean	SD	Number of Participants
Duration of physical concomitants within 10 minutes	1.66s	115.28s	23.63s	25.32s	24
Head Movements	0.00s	20.41s	6.82s	5.22ss	24
Grimaces	0.00s	71.35s	6.36s	14.38s	24
Distracting Sounds	0.00s	4.94s	0.72s	1.45s	24
Movement of Extremities	0.00s	92.48s	9.73s	19.28s	24
% SLD	0.00%	35.24%	8.37%	7.36%	34
SSI-4 Physical Concomitants Rating	0.00	11.00	3.37	2.67	35
Average Duration of Physical Concomitants	0.41s	3.49s	1.36s	0.70s	24

Note: data for time measured in seconds

BIOGRAPHICAL SKETCH

Alana Frost was born in Mobile, Alabama. She graduated from Daphne High School in 2008 and then graduated from The University of Alabama with her Bachelor of Arts in 2012. Alana obtained her Master's in Secondary Education from The University of Alabama in 2014 and worked as a middle and high school Social Sciences teacher and track/soccer coach for the next five years. She was serving as the Curator of Education at GulfQuest National Maritime Museum when she accepted placement at the University of South Alabama to pursue a Master's degree in Speech-Language Pathology in 2020. Alana will receive her Master of Science in Speech-Language Pathology in August 2022.