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Emotional reactivity and regulation associated with fluent and stuttered utterances of preschool-age children who stutter

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Abstract

Purpose—The purpose of this study was to assess the relation between emotional reactivity and regulation associated with fluent and stuttered utterances of preschool-age children who stutter (CWS) and those who do not (CWNS).

Participants—Participants were eight 3 to 6-year old CWS and eight CWNS of comparable age and gender.

Methods—Participants were exposed to three emotion-inducing overheard conversations—neutral, angry and happy—and produced a narrative following each overheard conversation. From audio-video recordings of these narratives, coded behavioral analysis of participants' negative and positive affect and emotion regulation associated with stuttered and fluent utterances was conducted.

Results—Results indicated that CWS were significantly more likely to exhibit emotion regulation attempts prior to and during their fluent utterances following the happy as compared to the negative condition, whereas CWNS displayed the opposite pattern. Within-group assessment indicated that CWS were significantly more likely to display negative emotion prior to and during their *stuttered* than *fluent* utterances, particularly following the positive overheard conversation.

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Conclusions—After exposure to emotional-inducing overheard conversations, changes in preschool-age CWS's emotion and emotion regulatory attempts were associated with the fluency of their utterances.

Keywords

stuttering; preschool; emotion; regulation; behavior

1. Introduction

Attention has recently been paid to emotional factors in childhood stuttering, specifically focusing on characteristics such as emotional reactivity and regulation (e.g., Anderson, Pellowski, Conture & Kelly, 2003; Conture, Kelly & Walden, 2013; Choi, Conture, Walden, Lambert, & Tumanova, 2013; Eggers, De Nil, & Van den Bergh, 2010, 2012, 2013; Johnson, Walden, Conture & Karrass, 2010; Kefalianos, Onslow, Block, Menzies, & Reilly, 2012; Ntourou, Conture & Walden, 2013; Schwenk, Conture & Walden, 2007). Although results of these empirical studies as well as related speculation have not clarified all salient aspects of the association of emotion and childhood stuttering, they have provided evidence to support the continued investigation of this association.

1.1. Emotional associates of childhood stuttering: Caregiver-based report

Anderson et al. (2003) reported that children who stutter (CWS), when compared to children who do not stutter (CWNS), were more likely to exhibit temperamental profiles consistent with vigilance, nonadaptability to change, and irregular biological functions based on parental completion of the Behavioral Style Questionnaire (BSQ; McDevitt & Carey, 1978). Likewise, Eggers et al. (2010) reported that CWS, when compared to CWNS, exhibited significantly lower inhibitory control and attention shifting, as well as significantly higher anger/frustration, approach and motor activation, based on parent completion of the Dutch version of the Children's Behavior Questionnaire (CBQ-D; Van den Bergh & Ackx, 2003).

Based on three groups of items (i.e., items related to emotional reactivity, emotional regulation and attention regulation) from the BSQ, Karrass et al. (2006) reported that preschool-age CWS, when compared to their CWNS peers, were significantly more reactive, displayed greater difficulty regulating emotions, and had poorer attention regulation. Similarly, Felsenfeld, van Beijsterveldt, and Boomsma (2010) reported that probable stuttering and highly nonfluent children, when compared to typically fluent children, received more problematic scores on parent-based questionnaire ratings of attention, with attention often suggested to be a strategy to regulate emotion (e.g., Rothbart, Ahadi & Evans, 2000). Taken together, the above empirical findings suggest that certain aspects of emotionality differentiate CWS and CWNS, and these differences may be associated with the difficulties CWS have establishing normally fluent speech.

Results from the aforementioned studies are promising and provide a substantive objective component in the assessment of children's temperamental characteristics (Henderson & Wachs, 2007; Wachs & Bates, 2001); however, it should be noted that these studies address only part of the emotional picture (Campos, Frankel, & Camras, 2004). For example,

caregiver reports that are based on relatively long epochs of observation provide insights into more stable, trait-like aspects of emotion (i.e., temperament; Rothbart, Ahadi, Hershey, & Fisher, 2001), whereas behavioral observation provides information on more state-like, variable and dynamically changing aspects of emotion (Cole, Martin, & Dennis, 2004). Therefore, caregiver reports are best considered part of a comprehensive, multi-method means to study emotions in young children (see Campbell & Fisk, 1959 for further discussion of convergent lines of evidence). The use of additional methodological approaches to study emotion augment caregiver reports and address salient realities of childhood stuttering, for example, that stuttering varies considerably within and between situations, conversations, etc.

1.2. Emotional associates of childhood stuttering: Behavioral observations

As an example of a methodological alternative to caregiver reports, Schwenk et al. (2007) used coded behavioral observations to compare the ability of preschool-age CWS and CWNS to maintain attention to a task and ignore irrelevant background stimuli. They reported that CWS were significantly more likely to redirect attention away from a task, via repeatedly looking at nontask stimuli (i.e., noise associated with a motorized camera). These findings were taken to suggest CWS have difficulty habituating to irrelevant environmental stimuli.

In order to further assess CWS's emotional processes, researchers (e.g., Johnson et al., 2010; Arnold, Conture, Key, & Walden, 2011; Walden et al., 2012) assessed two aspects of emotion—positive and negative emotion. Specifically, Johnson et al. (2010) investigated the frequency of expressive behaviors displayed by preschool-age CWS and CWNS after receiving a desired (i.e., positive condition) versus a disappointing gift (i.e., negative condition). In the disappointing gift condition, CWS displayed significantly more negative emotional expressions than CWNS. Furthermore, CWS were more disfluent after receiving the desirable gift than the disappointing gift, suggesting that increased disfluency is related to the emotional tenor—*positive* in this case—of the associated communicative situation. To further address this issue, Arnold et al. (2011)– on the basis of coded behavioral observations–assessed preschool-age CWS's and CWNS's speech following positive and negative emotionally-arousing background conversations. Findings indicated that decreased duration and frequency of behavioral regulatory strategies were associated with significantly more stuttering for CWS. Using similar coded behavioral observations, Walden et al. (2012) reported that higher stuttering in CWS was significantly related to more emotional arousal/reactivity when associated with lower emotion regulation. Conversely, CWS's stuttering was lower when negative emotion was coupled with regulatory behaviors. This interaction of emotion and regulatory behaviors was taken by Walden et al. (2012) to suggest that emotion is part of the "causal nexus of developmental stuttering" (p. 641). Said another way, if emotion was purely a reaction to stuttering (Alm, 2004), then its regulation would not result in decreases in stuttering. In addition, Walden et al. (2012) also reported that when the first emotion condition (neutral/happy/angry) was emotional in nature (happy or angry), CWS stuttered significantly more during all three subsequent narrative tasks, whereas CWNS stuttered significantly less. This finding suggests that the impact of prior emotion, positive or negative, on subsequent stuttering may linger for some time.

1.3. Possible influence of emotional processes on speech fluency

Given the above review, there is growing evidence for the association between emotion and childhood stuttering. Researchers (Arnold et al., 2011; Johnson et al., 2010; Walden et al., 2012) have speculated that conditions that elicit emotion and emotion regulation may divert CWS's attentional resources away from speech-language planning and production. Evidence has shown that CWS, compared to CWNS, exhibit poorer attentional control (Eggers et al., 2010; cf. Johnson, Conture & Walden, 2012), attention regulation (Felsenfeld et al., 2010; Karrass et al., 2006; Schwenk et al., 2007), and lower efficiency of the orienting subsystem of the attentional system (Eggers et al., 2012). Therefore, emotions may interact with less adaptive attentional processes, and divert resources away from CWS's speech-language system, interfering with rapid and efficient planning for speech (e.g., Anderson & Conture, 2004; Pellowski & Conture, 2005; Weber-Fox, Spruill, Spencer, & Smith, 2008). Further, it is possible that this disruption is greatest during the period just prior to and during the overt initiation of speechlanguage, which is theoretically associated with a number of speech-language planning processes (for review, see Levelt, Roelofs, & Meyer, 1999).

1.4. The present study

The purpose of the present study was to further empirically investigate the association of emotional reactivity, emotion regulation, and childhood stuttering. Although other empirical studies have assessed differences in emotion between CWS and CWNS (e.g., Eggers et al., 2013), as well as the influence of emotion on stuttering (e.g., Choi et al., 2013), the present study employed an experimental paradigm developed to investigate emotional reactivity and regulation in a more focused and narrow timeframe. Specifically, the temporal epoch immediately prior to and during onset of children's utterances was chosen because it is a time period when (1) stuttering is apt to occur and (2) both speech-language planning and production processes exhibit considerable activity, as well as temporal overlap with one another (for review, see Levelt et al., 1999). We hypothesized that heightened emotional reactivity and/or decreased emotion regulation immediately *prior to* and *during* overt production of an utterance would be associated with instances of stuttering.

As an index of *emotional reactivity*, positive (e.g., smiles) and negative (e.g., frowns) affective behaviors were coded (Calkins, 1997; Dollar & Stifter, 2012; Graziano, Calkins, & Keane, 2011; Kidwell & Barnett, 2007; Walden et al., 2012). As an index of *emotion regulation*, fidgeting and repetitive movements were coded (e.g., tapping fingers together, tugging at the ear lobe; Calkins, 1997; Cole et al., 1992; Dollar & Stifter, 2012; Stifter & Braungart, 1995; Graziano et al., 2011; Kidwell & Barnett, 2007; Walden et al., 2012). These measures were employed for various reasons. First, these measures have been previously used to assess the association of emotion and childhood stuttering (Johnson et al., 2010; Walden et al., 2012), and thus provide continuity with emotional behaviors coded in previous empirical studies of preschool-age CWS and CWNS. Second, these behaviors have been extensively used in the field of psychology as indexes of emotional reactivity and regulation in the preschool-age population (e.g., Calkins, 1997; Cole et al., 1992; Stifter & Braungart, 1995). Third, these behaviors change relatively rapidly and were codeable during the temporal epoch of interest, a timeframe during which instances of stuttering are apt to occur.

Measures of emotional reactivity and regulation were assessed prior to and during fluent and stuttered utterances from narratives that were immediately preceded by emotionally-arousing listening conditions. These conditions were similar to those used in previous research on emotion and childhood stuttering (Arnold et al., 2011; Walden et al., 2012), and consisted of auditory recordings of three "overheard" conversations between two adults (happy, angry, and neutral). This method was adapted from empirical studies that found overheard anger increases arousal and distress in preschool-age children (Cummings, 1987; Cummings, Vogel, Cummings, & El-Sheikh, 1989). We hypothesized that exposure to emotionally-arousing conditions (happy and angry) before engaging in a speaking task would influence emotional processes and speech fluency, both within- and between-groups.

The present investigation addressed two specific issues. The first was whether preschool-age CWS and CWNS differ in terms of emotional processes associated with their fluent speech, and whether such processes were differentially influenced by the emotional tenor of the preceding emotion condition (between-group comparison). We hypothesized that preschool-age CWS, compared to their CWNS peers, would exhibit greater emotional reactivity and lower emotion regulation prior to and during their fluent utterances, particularly following the emotionally-arousing listening conditions. The second issue was whether emotions were more likely to be associated with CWS's stuttered than their fluent utterances, especially following the experimentally manipulated emotion conditions (within-group comparison). We hypothesized that CWS's stuttered, when compared to their fluent, utterances would be more likely associated with increased emotional reactivity and decreased emotion regulation, particularly following the emotionally-arousing listening conditions.

2. Method

2.1. Participants

Participants were eight preschool-age children who stutter (CWS) and eight preschool-age children who do not stutter (CWNS), all of whom were monolingual, native speakers of Standard American English[1]. Participants were between the ages of 3;1 and 5;9 (CWS: mean, $M = 50.13$ months, standard deviation, $SD = 7.92$; CWNS: $M = 50.75$ months, $SD = 10.05$) with no statistically significant between-group difference in chronological age, $t\ (14) = -.138$, $p = .892$. Each of the two talker groups consisted of six boys and two girls.

Participants' race was obtained via parental interview. CWS were 7 Caucasians, and 1 African-American. CWNS were 8 Caucasians. Parents provided socio-economic status (SES) information using the Four-Factor Index of Social Status (Hollingshead, 1975), which takes into account maternal and paternal education and occupation. There was no statistically significant difference in SES between CWS ($M = 21.38$, $SD = 3.29$) and CWNS ($M = 20.50$, $SD = 5.61$), $t\ (14) = .381$, $p = .709$.

All participants were paid volunteers naïve to the purpose and methods of the study, and were referred to the Vanderbilt Bill Wilkerson Hearing and Speech Center for participation

[1]Data used for this project were based on extant audio-video recordings, collected by Conture and colleagues (e.g., Arnold et al., 2011; Karrass et al., 2006) during the past several years and which have not previously been published using the described methodology nor purposes of the present study.

by their parents who were informed of the study via (a) free, widely read parent-oriented magazine, (b) local health care providers, or (c) self/professional referrals to the Bill Wilkerson Center.

None of the children participating in the study had received formal treatment for stuttering or other communication disorders. No participants had known or reported hearing, neurological, developmental, academic, intellectual, or emotional problems. The Institutional Review Board at Vanderbilt University approved the study protocol. For each participant, parents signed informed consent and children assented.

2.1.1. Excluded Participants—From an initial group of nine CWS and eight CWNS, one CWS was excluded because he did not provide the minimum number of eligible utterances to be included in the analysis. This resulted in eight CWS and eight CWNS for the final data analysis.

2.2. Classification and Inclusion Criteria

2.2.1. Children who stutter (CWS)—A child was considered a CWS if he or she (a) exhibited three or more stuttered disfluencies (i.e., sound/syllable repetition, sound prolongations and single-syllable word repetitions) per 100 words of conversational speech (based on a 300-word sample; Curlee, 2007; Yairi & Ambrose, 1992) and (b) received a total score of 11 or above (a severity equivalent to at least “mild”) on the *Stuttering Severity Instrument – 3* (SSI-3; Riley, 1994; CWS had a mean score of 16.38, *SD* = 3.20).

2.2.2. Children who do not stutter (CWNS)—A child was considered a CWNS if he or she (a) exhibited two or fewer stuttered disfluencies per 100 words of conversational speech based on a 300-word sample and (b) received an overall score of 10 or less (a severity of less than “mild”) on the *Stuttering Severity Instrument–3* (SSI-3; Riley, 1994; CWNS had a mean score of 6.25, *SD* = 1.28).

2.2.3. Speech, language, and hearing abilities—All 16 participants scored at the 16th percentile or higher on the (a) *Peabody Picture Vocabulary Test—Third Edition* (PPVT-III A or B; Dunn & Dunn, 1997), (b) *Expressive Vocabulary Test* (EVT; Williams, 1997), (c) *Test of Early Language Development-3* (TELD-3; Hresko, Reid, & Hamill, 1999) and (d) “Sounds in Words” subtest of the *Goldman–Fristoe Test of Articulation-2* (GFTA-2; Goldman & Fristoe, 2000). These standardized tests were administered 1–2 weeks prior to experimental testing. Furthermore, each participant passed a bilateral pure tone hearing and tympanometric screening (ASHA, 1990).

2.3. Equipment

Equipment used for experimental data acquisition consisted of a standard child’s car safety seat, a detachable steering wheel, a nineteen-inch video monitor, and audio speakers arranged within a wooden frame designed to resemble an actual, but child-size Jeep automobile. The “jeep” was positioned within a visually neutral, acoustically quiet room. Stimuli for the narratives were presented to the child on a computer monitor located in the “windshield” of the jeep and included visual images of a series of age-appropriate

storybooks. Audio and video of the child during the experimental sessions were obtained with a camcorder located next to the video monitor. From these digital recordings, occurrences of emotional reactivity and regulation, onset of emotion behavior relative to utterance onset, instances of stuttered disfluencies and length of utterance in morphemes were measured using specialized behavior-coding software (Noldus, Trienes, Hendriksen, Jansen & Jansen, 2000).

2.4. Procedure

Participants in this study were initially tested in a diagnostic session followed by a subsequent experimental session during which the data for this study were collected. The diagnostic session comprised the administration of standardized speech-language tests as well as hearing screenings described above, which were used for classification and inclusion.

2.4.1 Sequence of experimental session—The experimental session occurred approximately 1–2 weeks after the diagnostic session, and included three within-participant emotion conditions, counterbalanced across children: (a) angry, (b) happy, and (c) neutral. Prior to each emotion condition the participant was seated and buckled into the car seat positioned at the "driver's wheel" in the Jeep. First, each participant viewed pictures from the pre-narrative storybook. Second, each participant heard one of the three emotional-valenced (i.e., angry, happy, neutral) conversations between two adults, which appeared to emanate from an adjacent room. Third, the narrative task was performed approximately 1–2 minutes after the overheard conversation. The sequence of pre-narrative stimulus, presentation of emotion stimuli, and narrative task was repeated for each emotion condition.

2.4.2. Pre-narrative stimulus—Illustrations from three age-appropriate storybooks without text were shown to the participant, with one story assigned randomly to each of the three emotion conditions. All books were authored by Mercer Mayer, *A boy, a dog, and a frog* (1967), *Frog where are you?* (1969), and *Frog on his own* (1972). The child would later tell a story during the narrative tasks but during the pre-narrative task the participant was told to only look at (and not talk about or describe) the illustrations.

2.4.3. Narrative task—After the participant was exposed to each conversational manipulation, an examiner sitting beside the child then instructed the child to tell the story while viewing slides of the illustrations from the storybook (i.e., pre-narrative stimuli). An experimenter sitting beside the child then prompted the child's storytelling ("What do you see happening here?"). Throughout the narrative task the child was encouraged ("You're telling a great story."), updated on his progress ("You only have five more pages left."), and asked to elaborate ("Tell me one more thing about this page."). The participant was told when the story was complete ("The end. You told a great story.").

2.5. Description of independent variables

2.5.1. Talker group—Participants consisted of two talker groups, preschool-age CWS and their CWNS peers, as described above, who completed the three testing blocks for each of

the three emotion conditions. Presentation of conditions was randomized within and between the groups.

2.5.2. Emotion elicitation stimuli—The background conversations—angry, happy, neutral—were audio recordings of dyads of adult actresses. One dyad read an angry conversation, another dyad read a happy conversation, and another dyad read a neutral conversation. All background conversations had the same number of utterances (41 per conversation) and equivalent mean lengths of utterance, ranging from 7.22 to 7.27 grammatical morphemes. Background conversation audio recordings, created in an anechoic chamber, were made equivalent in loudness (− 25 dB root mean squared +/− .5 dB). The three background conversations were designed to be plausible conversations that the child might overhear emanating from an adjoining room. The recordings were presented to the participant through two small speakers on the left and right of the computer monitor.

As described in Arnold et al. (2011), the emotion conversations were validated using Likert scales by 29 adults and 15 preschool-age CWNS who did not participate in the main study (age: M = 4;7, range = 3;1 to 5;4). The adult ratings indicated that the emotion stimuli (i.e., angry, happy, neutral) were perceived as representing the intended emotion and arousal levels. The children rated the stimuli using scales created from pictures of emotional faces (Tottenham, Borscheid, Ellersten, Marcus, & Nelson, 2002). The happy conversation was rated by 87% of the children as “happy” whereas the angry conversation was rated by 93% of the children as “mad.” For the neutral conversation, 40% rated it as “happy” and 27% rated it as “just ok,” indicating it was perceived as mildly positive. There was a statistically significant association between the intended emotion of each conversation and child ratings (Cramér’s V = .533, $p < .0001$), suggesting that young children typically perceived the background conversations as intended.

2.6 Description of dependent variables

Four emotional and speech-language variables were measured in the one second prior to and through the completion of utterances: (1) positive and negative emotional reactivity, (2) emotion regulation, (3) whether the utterance was fluent or stuttered, and (4) length of the utterance in morphemes. A speech-language pathologist identified each utterance as fluent or stuttered (described in section 2.6.2) from the narrative task. Eligible utterances had to be preceded by at least one second during which the child was not talking.

2.6.1. Emotional reactivity—During each of the three experimental conditions, *emotional reactivity* was event coded by a speech-language pathology doctoral student in terms of presence or absence of two behaviors: (1) positive affect, and (2) negative affect. The codes of positive affect and negative affect used in the current study are well-accepted behavioral measures of emotion and have been employed in numerous other studies of preschool-age children (e.g., Calkins, 1997; Dollar & Stifter, 2012; Graziano et al., 2011; Kidwell & Barnett, 2007; Walden et al., 2012) as well as studies of toddlers (e.g., Cole et al., 1992; Grolnick, Bridges, Connell, 1996).

Behavioral indices of *positive* affect included: (a) raised/up-curled lips, (b) raised eyebrows, (c) raised cheeks, (d) happy sound/tone of voice, and (e) laughter. Behavioral indices of

negative affect included: (a) frowning, (b) furrowed/downturned eyebrows, (c) wrinkled nose, (d) unhappy sound/tone of voice, and (e) crying or screaming. Positive and negative emotional reactivity could occur concurrently during the same temporal epoch, with each coded as present/absent.

2.6.2. Emotion regulation—*Emotion regulation* was event coded by a speech-language pathology doctoral student as the presence or absence of fidgeting and other repetitive behaviors. The behaviors coded in the present study are consistent with Kopp's (1989) assertion that emotion regulation requires an action system or behavioral change and are examples of the regulatory behaviors she provides. Further, the fidgeting behaviors coded in the present study are well-accepted indices of emotion regulation and have been employed in numerous empirical studies of preschool-age children (e.g., Calkins, 1997; Cole et al., 1992; Dollar & Stifter, 2012; Stifter & Braungart, 1995; Graziano et al., 2011; Kidwell & Barnett, 2007; Walden et al., 2012), as well as studies of toddlers (e.g., Graziano, Keane, Calkins, 2010; Grolnick et al., 1996) and school-age children (Zalewski, Lengua, Wilson, Trancik, & Bazinet, 2011). In the current study, examples of *emotion regulation* included (a) playing with the car seat, (b) rubbing car seat, (c) playing with shoe, and (d) scratching/ rubbing self. Fidgeting and other repetitive self-directed movements were the present study's sole measure of emotion regulation.

2.6.3. Utterance fluency—The first author, a speech-language pathologist holding the CCC-SLP and with extensive experience measuring stuttering, evaluated each utterance to determine whether it was fluent or stuttered. Eligible fluent utterances contained neither stuttered nor nonstuttered disfluencies, as previously defined elsewhere (e.g., Arnold et al., 2011; Richels, Buhr, Conture & Ntourou, 2010). Eligible stuttered utterances contained either: (a) one stuttered disfluency, or (b) one stuttered disfluency and one nonstuttered disfluency. Utterances containing clusters of multiple stuttered disfluencies were not included because only a subset of the group of CWS participants exhibited usable stuttered utterances with clusters of stuttered disfluencies. Specifically, 5 (of the 8) CWS exhibited utterances containing stuttered disfluency clusters during the neutral, 5 during the happy, and 4 during the negative conditions. For these participants, the mean number of utterances containing clusters of stuttered dislfuencies during the neutral, happy, and negative conditions were 2.2 (*SD* = 1.64), 2.2 (1.79), and 2.0 (0.82), respectively. Utterances containing clusters of stuttered disfluencies were excluded for two reasons; 1) to facilitate generalizability to the population of preschool-age CWS, and 2) because the relatively low occurrence of such utterances precluded inferential statistical analyses.

2.6.3. Utterance length—The utterance length (LU) in morphemes was measured for both stuttered and fluent utterances.

2.7. Pre-analysis data preparation

2.7.1. Eliminated utterances—For both the fluent and stuttered utterances any instance of emotional behaviors that could not be differentiated from speech or nonspeech behaviors associated with stuttering identified by Conture and Kelly (1991) was eliminated from final

data analysis. Furthermore, participants needed to contribute at least 3 stuttered and 3 fluent utterances in each condition for their data to be considered in the respective analyses.

2.8. Data analysis

In summary, the four *dependent* variables consisted of (1) emotional reactivity, positive and negative, (2) emotion regulation, (3) utterance fluency, and (4) utterance length. The two *independent* variables included one between-group factor, talker group membership (i.e., CWS vs. CWNS), and the three (repeated measures) emotional eliciting overheard conversations (i.e., happy, angry, neutral).

All statistical models, both within-participant and between-groups models, were conditioned by LU as a covariate. Given that stuttering typically increases as length of utterance increases (Zackheim & Conture, 2003), we explicitly accounted for the variance associated with LU by using LU as a covariate.

2.8.1. Between- and within-group comparisons—Generalized Estimating Equations (GEE) (Liang & Zeger, 1986; Zeger & Liang, 1986) were used to perform binary logistic regression with multiple dependent observations nested within participants. This statistical approach was necessary because of the study's multiple observations within participants. Correlated responses included 231 fluent utterances and 153 stuttered utterances for the 8 CWS participants and 301 fluent utterances for the 8 CWNS participants in a repeated measures design.

To avoid over-fitting, we tested whether the sample complied with Harrell's (2001, p. 61) recommendation of at least 10–20 observations per parameter. With a logistic model having a binary outcome, the number of observations is the lesser number of observations of the binary outcome variable (Peduzzi et al. 1996). For the within-group comparisons (i.e., CWS had 153 stuttered and 231 fluent utterances), the 153 stuttered utterances divided by 7 parameters (including the intercept) resulted in an acceptable ratio of 21.9 observations per variable. In our Results, we report the observations per parameter ratio to avoid over-fitting.

The GEE was run using SPSS Statistics version 20, subcommand "Generalized Estimating Equations"). Explanatory variables included: *person* identifier; *within-participant effects* (emotion condition, e.g., first, second, or third); and *utterance number* (e.g., one, two, three, etc.).

Between-group (CWS/CWNS) comparisons predicted emotional reactivity and regulation. These included 3 factors—talker group, emotion condition, the interaction of talker group and emotion condition—and one covariate—length of utterance in morphemes.

Within-group comparisons predicted whether an utterance was fluent or stuttered. These included *5 factors*—emotional reactivity, emotional regulation, emotional condition, the interaction of emotion behavior (i.e., reactivity/regulation) and emotion condition—and one covariate—length of utterance in morphemes

The inferential statistics of the models for the present study are odds ratios (OR). An odds ratio expresses the probability of one outcome (Sistrom & Garvan, 2004) relative to the

probability of another outcome. An OR equal to 1 (i.e., its confidence interval includes 1) reflects equal odds that two outcomes will occur. For example, in the present study, we report the odds that stuttered utterances, compared to fluent utterances, are associated with negative affect. In this case, the significant OR of 1.8 can be interpreted as indicating that negative affect is 1.8 times more likely to be associated with stuttered than fluent utterances.

2.9 Measurement reliability

Approximately 23% of the final data corpus was used to assess inter-judge measurement reliability for the coding of (a) emotional reactivity (b) emotion regulation, (c) utterance fluency, and (d) utterance length. Reliability was based on 155 (*stuttered* = 45, *fluent* = 110) randomly selected conversational utterances: 90 from CWS (1–2 stuttered utterances per narrative, 1–2 fluent utterances per narrative) and 65 from gender-and age-matched CWNS (2–3 fluent utterances per narrative). A speech-language pathology doctoral student and post-doctoral student, both blind to talker group membership, coded each utterance independently to assess reliability.

Inter-judge agreement for the binary measures of negative affect, positive affect, and emotion regulation resulted in Cohen's Kappas = .84, .87, and .79, respectively, and for utterance fluency Kappa = .87 (Cohen, 1960). The Pearson's correlation for the continuous measure of utterance length (morphemes) was .90.

3. Results

3.1. Descriptive results: Speech, language and fluency characteristics

3.1.1 Between-group differences in total disfluencies and stutterings during conversation—Speech disfluencies were assessed during the 300-word conversational sample at the diagnostic visit. As expected, based on participant classification criteria, independent samples t-tests indicated a significant difference in *total* disfluencies between CWS ($M = 29.75$, $SD = 7.09$) and CWNS ($M = 12.13$, $SD = 5.3$), $t\ (14) = 5.6$, $p < .001$, effect size (ES) = 2.658, standard error (SE) = .686. Similarly, there was a significant difference in *stuttered* disfluencies between CWS ($M = 15.88$, $SD = 7.94$) and CWNS ($M = 2.88$, $SD = 1.55$), $t\ (14) = 4.547$, $p < .001$, $ES = 2.149$, $SE = .628$. However, there was no significant difference in *nonstuttered* disfluencies between CWS ($M = 13.88$, $SD = 6.24$) and CWNS ($M = 9.25$, $SD = 4.80$), $t\ (14) = 1.661$, $p = .119$, $ES = .786$, $SE = .519$. Also as expected, on the basis of participant classification criteria, there was a significant difference between CWS ($M = 16.38$, $SD = 3.20$) and CWNS (6.25, $SD = 1.28$) on the SSI-3, $t\ (14) = 8.298$, $p < .001$, $ES = 3.923$, $SE = .855$.

3.1.2 Between-group differences on standardized tests of speech-language abilities—Independent samples t-tests with talker group (i.e., CWS vs. CWNS) as the independent variable compared scores on standardized tests of speech-language abilities. There were no significant differences on the GFTA-2 between CWS ($M = 108.88$, $SD = 6.71$) and CWNS ($M = 104.75$, $SD = 10.95$), $t\ (14) = .909$, $p = .379$, $ES = -.430$, $SE = .506$. Similarly, there was no significant difference on the PPVT-III between CWS ($M = 107.13$, $SD = 11.62$) and CWNS ($M = 114.13$, $SD = 13.36$), $t\ (14) = 1.118$, $p = .282$, $ES = .529$, SE

= .509. There was no significant difference on the EVT between CWS (*M* = 111.38, *SD* = 14.77) and CWNS (*M* = 114.25, *SD* = 14.77), *t* (14) = .427, *p* = .676, *ES* = .201, *SE* = .501. Further, there was no significant difference on the TELD-3 receptive between CWS (*M* = 110.88, *SD* = 14.57) and CWNS (*M* = 115.00, *SD* = 10.37), *t* (14) = .653, *p* = .525, *ES* = .308, *SE* = .503. There was no significant difference on the TELD-3 expressive between CWS (*M* = 101.00, *SD* = 11.99) and CWNS (*M* = 100.75, *SD* = 5.83), *t* (14) = .053, *p* = .958, *ES* = −.025, *SE* = .500. Likewise, there was no significant difference on the TELD-3 overall score between CWS (*M* = 107.00, *SD* = 13.77) and CWNS (*M* = 109.38, *SD* = 7.80), *t* (14) = .424, *p* = .678, *ES* = .201, *SE* = .501. Lastly, there were no significant difference in MLU during the pre-experimental conversation sample between CWS (*M* = 5.72, *SD* = .57) and CWNS (*M* = 5.55, *SD* = .93), *t* (14) = .435, *p* = .670, *ES* = −.206, *SE* = .501.

3.2 Descriptive results: Narrative task performance

3.2.1 Mean length of utterance (MLU): Entire narrative task—Independent samples t-tests with talker group (i.e., CWS vs. CWNS) as the independent variable indicated no significant between-group differences in MLU during narrative performance after each of the three experimental conditions. There was no significant difference in MLU during the narrative following the *neutral* condition between CWS (*M* = 5.46, *SD* = 1.39) and CWNS (*M* = 6.16, *SD* = 1.39), *t* (14) = 1.002, *p* = .334, *ES* = .473, *SE* = .507. There was no significant difference in MLU during the narrative following the *happy* condition between CWS (*M* = 5.51, *SD* = .73) and CWNS (*M* = 6.31, *SD* = 1.12), *t* (14) = 1.675, *p* = .116, *ES* = .792, *SE* = .519. There was no significant difference in MLU during the narrative following the *angry* condition between CWS (*M* = 5.59, *SD* = .87) and CWNS (*M* = 6.46, *SD* = 1.39), *t* (14) = 1.486, *p* = .159, *ES* = .703, *SE* = .515. Table 1 provides each participant's individual MLU value across all *three* conditions.

3.3 Fluent utterances[2]

3.3.1 Between-group differences in number of fluent utterances—Independent samples t-tests compared talker group differences in number of fluent utterances in the between-group analyses. There was no significant difference in the number of *fluent* utterances produced by CWS (*N = 231; M = 9.625 and SD = 3.998 per narrative*) and their CWNS peers (*N = 301; and M = 12.542 and SD = 3.451 per narrative*), *t* (14) = 2.040, *p* = .061 (2-tailed).

3.3.2 Between-group differences in emotional reactivity and regulation prior to and during fluent utterances—The first hypothesis tested was whether CWS and CWNS's emotional processes immediately prior to and during fluent utterances differed. To avoid over-fitting of this model we divided the 231 fluent utterances of CWS (the lower number of fluent utterances in CWS and CWNS) by 7 parameters (including the intercept), resulting in an acceptable ratio of 33 observations per variable.

[2]Analyses of differences between stuttered utterances of CWS and CWNS, as well as stuttered and fluent utterances for CWNS, was precluded because CWNS contributed an insufficient number of stuttered utterances to qualify for statistical analyses.

For *fluent* utterances, there were no significant between-group main effects of negative affect (*OR* = 2.614, 95% *CI* = .845 to 8.086, *p* = .095, *ES*[3] = .531, *SE* = .318), positive affect (*OR* = 1.010, 95% *CI* = .417 to 2.445, *p* = .982, *ES* = .005, *SE* = .249), or emotion regulation (*OR* = .983, 95% *CI* = .384 to 2.516, *p* = .972, *ES* = .009, *SE* = .265). Despite not reaching significance, it is worth noting that CWS exhibited greater negative affect prior to and during their fluent utterances than did CWNS. The preceding emotion condition did not differentially predict negative affect (*p* = .760), positive affect (*p* = .556), nor emotion regulation (*p* = .876) associated with the fluent speech of CWS and CWNS.

As part of the first hypothesis, we also assessed whether the experimentally manipulated emotion inducing conditions differentially influenced the emotion processes associated with the fluent speech of CWS and CWNS. A significant between-group interaction indicated that the emotion regulation behaviors of preschool-age CWS and CWNS prior to and during their fluent utterances differed as a function of the preceding emotion condition (*p* = .001). As illustrated in Figure 1, compared to the negative condition CWS were 2.3 times more likely to exhibit emotion regulation during their fluent utterances following the happy condition (*OR* = 2.342, 95% *CI* = 1.279 to 4.288, *p* = .006, *ES* = .470, *SE* = .171) whereas CWNS were only .6 times as likely (i.e., less likely) to exhibit emotion regulation during their fluent utterances following the happy condition (*OR* = .625, 95% *CI* = .421 to .926, *p* = .019, *ES* = .260, *SE* = .111). The reciprocal is also true of the above result. Specifically, CWS were less likely to exhibit emotion regulation during their fluent utterances following the angry condition, and CWNS were more likely to exhibit emotion regulation following the angry condition.

3.4 Fluent versus stuttered utterances for children who stutter

3.4.1 Number of fluent versus stuttered utterances—A one-sample t-test compared the number of fluent to stuttered utterances in the within-group analyses for CWS. As might be expected given that on average over 80% of young CWS' speech is fluent (e.g., Yairi & Ambrose, 2005, report a mean of 11 stuttered disfluencies per 100 syllables), present findings (presented in Table 1) indicated that preschool-age CWS produced significantly more *fluent* (*N = 231, 60.2 % of total utterances; M = 9.625 and SD = 3.998 per narrative*) than *stuttered* utterances (*N = 153, 39.8 % of total utterances; and M = 6.375 and SD = 2.281* per narrative), *t* (14) = 2.548, *p* = .023 (2-tailed).

3.4.2 Within-group (CWS) differences in emotional reactivity and regulation prior to and during fluent versus *stuttered* utterances—The second hypothesis tested was whether CWS's stuttered, compared to fluent, utterances were more likely to be associated with emotion reactivity (i.e., positive affect and negative affect) and emotion regulation. To avoid over-fitting of this model we divided the 153 stuttered utterances by 7 parameters (including the intercept), which resulted in an acceptable ratio of 21.9 observations per variable. As shown in Figure 2, *negative* affect (*OR* = 1.824, 95% *CI* = 1.179 to 2.821, *p* = .007, *ES* = .332, *SE* = .123) was 1.8 times more likely to be observed

[3]Reported effect sizes (*ES*) and corresponding standard errors (*SE*) of between- and within-group results were calculated using the method described by Chinn (2000) to convert odds ratios to ES. According to Cohen's (1992) guidelines, effect size values of .2/.5/.8 may be considered small/medium/large.

prior to and during stuttered than fluent utterances. In contrast, *positive* affect (*OR* = .978, 95% *CI* = .561 to 1.704, *p* = .938, *ES* = .012, *SE* = .157) and emotion regulation (*OR* = 1.393, 95% *CI* = .976 to 1.990, *p* = .068, *ES* = .183, *SE* = .100) were not significantly associated with the fluency of an utterance. Further, there was no main effect of emotion condition (*p* = .148), which indicated that the likelihood that an utterance would be stuttered, compared to fluent, did not vary based on the preceding emotion condition.

As part of the second hypothesis, we also assessed whether there was an interaction of emotion behaviors and the preceding emotion condition in predicting the likelihood that stuttering would occur. As shown in Figure 3, there was a significant interaction of emotion condition and negative affect (*p* = .017). Specifically, CWS's utterances were 2.3 times more likely to be stuttered when associated with negative affect following the happy condition (*OR* = 2.253, 95% *CI* = 1.432 to 3.544, *p* < .001, *ES* = .449, *SE* = .128) compared to the angry (*OR* = 1.697, 95% *CI* = .905 to 3.184, *p* = .099, *ES* = .292, *SE* = .177) or neutral conditions (*OR* = 1.442, 95% *CI* = .748 to 2.777, *p* = .274, *ES* = .202, *SE* = .185). There was also a significant interaction of emotion condition and emotion regulation behaviors associated with stuttering (*p* = .018). CWS's utterances following the neutral condition were 1.8 times more likely to be stuttered when associated with emotion regulation (*OR* = 1.776, 95% CI = 1.079 to 2.922, p = .024, ES = .317, SE = .140). There was no significant interaction of emotion condition and positive affect (p = .565).

Consistent with previous research (e.g., Zackheim & Conture, 2003), length of utterance was a significant predictor of utterance fluency, with stuttered utterances more likely to be longer than fluent utterances; *OR* = 1.232, 95% *CI* = 1.134 to 1.338, *p* < .001, *ES* = .115, *SE* = .023).

4. Discussion

4.1 Overview of main findings

The present study resulted in one main *between-group* finding and three main *within-group* findings. The first main *between-group* finding indicated that the fluent utterances of preschool-age CWS were more likely to be associated with emotion regulation attempts following the happy than the angry condition, whereas CWNS were more likely to exhibit emotion regulation attempts prior to and during fluent utterances following the angry rather than happy condition. The first of three *within-group* findings indicated that negative affect was significantly more likely prior to and during CWS's *stuttered* than *fluent* utterances. Second, CWS's utterances were more likely to be stuttered when children displayed negative affect following the positive emotion condition compared to the angry or neutral conditions. Third, CWS' utterances following the neutral condition were more likely to be stuttered when associated with emotion regulation attempts. Immediately below we discuss these four main findings.

4.2.1 Between-group comparisons (CWS vs. CWNS) of emotion regulation following emotionally-arousing listening conditions: Fluent utterances—The first main *between-group* finding indicated that CWS exhibited *more* emotion regulation attempts prior to and during their fluent utterances following the happy rather than angry

condition, whereas CWNS exhibited *fewer* regulation attempts following the happy rather than the angry condition. Rather than exhibiting a general response of decreased regulation following all emotionally-arousing conditions as predicted, CWS exhibited more regulation attempts following the positive condition (compared to the angry condition). On one hand, this finding may be taken to suggest that CWS are more apt to regulate emotion associated with positive conditions. Alternatively, CWS may not have experienced increases in arousal following the angry emotion condition, thereby decreasing the need for regulatory behaviors. Either way, this result highlights that CWS and CWNS differ in terms of emotion regulation associated with fluent utterances following exposure to different emotions. It is unclear why this should be the case. For example, why do preschool-age CWS, when compared to their CWNS peers, attempt to down regulate emotion following positive to a greater degree than negative emotion? An answer must await future empirical study.

4.3.1 Within-group (CWS) comparisons of negative affect: Prior to and during stuttered versus fluent utterances—The first main *within-group* finding was that CWS exhibited significantly more negative affect associated with their stuttered than fluent utterances. This finding is consistent with previous empirical studies of the association of emotions and stuttering in preschool-age samples (e.g., Arnold et al., 2011; Johnson et al., 2010; Ntourou et al., 2013; Walden et al., 2012), as well as theoretical speculation (e.g., Conture & Walden, 2012) that negative emotions are associated with childhood stuttering. Perhaps, CWS's negative affect or emotionality, when it occurs concurrently with initiation and/or continuance of speech-language planning and production (for review of speech-language planning and production see Levelt et al., 1999), may divert their attentional resources away from, as well as disrupt, the fluency of speech and language.

An alternative explanation is that expressed emotion that is initiated *prior to* the onset of speech may reflect a form of anticipation of an upcoming instance of stuttering. To date, the present authors are not aware of any study on anticipation of stuttering in preschool-age children. In a study of *awareness*, which is different than but perhaps related to *anticipation*, Ambrose and Yairi (1994) found that 15% of preschool-age CWS indicated possible awareness of stuttering and awareness increased with age, but they acknowledged that results for children of this age were difficult to interpret (see Yairi & Ambrose, 2005 for review on awareness of stuttering in CWS, pp. 270–283). Hence, whether negative affect associated with the stutterings of preschool-aged CWS reflects anticipation and/or awareness of concurrent stuttering is an open empirical question.

A third possible explanation for preschool-age CWS's increased negative affect *during* stuttered utterances is that negative affect is "part" of the instance of stuttering itself. The behavioral measures of emotion used in the present study were not those shown to be typically associated with preschoolers' instances of stuttering (e.g., head turning to the side, eyeballs moving to side, etc; for further details see Conture & Kelly's [1991] empirical study of preschool-age CWS's associated nonspeech behavior). However, for some preschool-age CWS, the present measures of emotion may represent at least a part of the constellation of behavioral concomitants of stuttering.

4.3.2 Within-group (CWS) comparison: Negative affect prior and during stuttered utterances following positive versus neutral emotion condition—The second main *within-group* finding was that CWS's stuttered utterances were significantly more likely to be associated with negative affect following the positive rather than the angry or neutral conditions. This effect may be related to the main between-group finding that CWS exhibited more regulation attempts prior and during their fluent utterances following the positive emotion condition. This finding is consistent with the clinical observation of Adams (1992) that CWS's instances of stuttering can be associated with positive emotions. In essence, CWS may be more prone to over-arousal following positive emotion conditions, which may increase the likelihood of disruptions in fluency, thus necessitating an increased need for regulatory attempts. This finding supports Johnson et al.'s (2010) findings that CWS were more disfluent following a positive emotion-inducing condition (receiving a desirable gift) and Walden et al.'s (2012) findings that CWS stuttered more during three narratives when the first condition was emotional in nature (happy or angry). Based on current and past findings (e.g., Johnson et al., 2010; Walden et al., 2012), CWS's stuttered utterances appear to be associated with emotional arousal (positive or negative).

4.3.3 Within-group (CWS) comparison: Emotion regulation prior and during stuttering following the neutral condition—The third main *within-group* finding was that CWS's stuttered utterances were more likely associated with emotion regulation following the neutral emotion condition. Perhaps, the present measure of emotion regulation (e.g., fidgeting and other repetitive movements) during stuttered utterances may reflect CWS's attempts to cope with their ongoing instances of stuttering. Second, we had not expected regulatory responses following the neutral condition to influence stuttering. However, as Walden et al. (2012) speculated, the neutral conversation seemed to lack prosodic characteristics typical of conversation that children in this age group may be accustomed to hearing. It is possible that this neutral prosody may have made the situation novel or uncomfortable, thereby disrupting fluency by diverting attention away from speech-language processes.

4.3.4 Influence of emotion and emotion conditions on speech fluency: General discussion—Present findings are of particular interest given that the period *prior to* speech is theoretically (e.g., Levelt et al., 1999) and empirically (e.g., Anderson & Conture, 2004; Pellowski & Conture, 2005; Richels, Buhr, Conture & Ntourou, 2010) salient to the initiation and continuance of fluent speech. Therefore, CWS's poorer attentional control (Eggers et al., 2010, 2012; Felsenfeld et al., 2010; Karrass et al., 2006; Schwenk et al., 2007) may be easily disrupted by emotional processes (e.g., negative affect, emotion regulation) that impact their still-developing speech-language planning system (for review, see Ntourou, Conture, Lipsey, 2011) and may contribute to difficulties they have fluently initiating and maintaining speech. Since stuttered utterances are associated with *more* negative affect (especially following positive emotion conditions) than are fluent utterances, heightened arousal initiated *prior to* and *during* speech may contribute to disruptions in fluency for preschool-age CWS relatively near the onset of stuttering.

4.4 Caveats

The first limitation of the present study is that the selection of coded utterances was tightly controlled and may reduce our ability to generalize findings to all fluent and stuttered utterances. Selected fluent utterances contained no disfluencies and stuttered utterances contained only one stuttered disfluency but were allowed to contain one nonstuttered disfluency. These controls were used to ensure that the analysis was of utterances with single instances of stuttering and not clusters of stutterings—thought to be more severe (Lasalle & Conture, 1995)—which occurred less frequently and in only a subset of the current group of CWS participants. Given the current findings it would be interesting to study all utterances in a speech sample (e.g., utterances with multiple stuttered disfluencies, utterances with only nonstuttered disfluencies, etc.).

The second limitation is that only one coded measure of emotion regulation (e.g., movement), whereas some empirical investigations code multiple behaviors (e.g., attentional shifts and movement behaviors) was used to index emotion regulation. It is suggested that future studies of emotion regulation and childhood stuttering should attempt to obtain a wider variety of measures of regulation to more comprehensively assess how different aspects of regulation may effect stuttering.

5. Conclusions

The present study used direct, coded behavioral observations to assess whether emotional processes predict fluent and stuttered utterances in preschool-age children who do and do not stutter. Between-group findings indicate that during fluent utterances, preschool-age CWS exhibited more regulation attempts following the positive condition (compared to the negative condition), suggesting that they are more apt to regulate emotion associated with positive conditions. Within-group findings indicated that CWS exhibited significantly greater negative affect associated with stuttered than fluent utterances (especially following a positive condition), suggesting that preschool-age CWS may have less well-developed abilities to down regulate their negative emotion.

Thus, present findings from both between- and within-group analyses suggest that changes in preschoolers' emotional reactivity and regulation are associated with changes in the fluency of their utterances. Whether subsequent research determines that emotion →stuttering, emotion ←stuttering or emotion ←→stuttering, the present findings and those like it (Arnold et al., 2011; Choi et al., 2013; Eggers et al., 2010, 2013; Johnson et al., 2010; Ntourou et al., 2013; Walden et al., 2012) would appear to contribute to a more comprehensive understanding of how emotion may be associated with childhood stuttering.

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Abbreviations

CWS	Children who stutter
CWNS	Children who do not stutter
GEE	Generalized estimating equations
BSQ	Behavior Style Questionnaire
CBQ	Children's Behavior Questionnaire
LU	Length of utterance
SES	Socio-economic status

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Highlights

- Emotions of children who do (CWS) and do not (CWNS) were compared.
- During fluent utterances, regulation differed between-groups as a function of condition.
- Emotions of CWS were compared between fluent and stuttered utterances.
- For CWS, negative emotion is significantly more likely prior and during stuttered utterances, particularly following positive conditions.
- Emotion of CWS was associated with stuttered and fluent utterances.

Continuing Education

1. Temperamental characteristics of are thought to:
   a. Account for the highly variable nature of childhood stuttering
   b. **Be trait-like and stable over time**
   c. Change from task to task
   d. Be independent of emotions
2. What processes did the authors hypothesize may co-occur with emotional and regulatory responding and increase the likelihood of stuttering?
   a. **Speech-language processes**
   b. Physiological processes
   c. Temperamental processes
   d. Motor processes
3. In the present study, the authors reported results showing that children who stutter:
   a. Display more emotional reactivity initiated prior to fluent utterances than children who do not stutter.
   b. Used emotion regulation during fluent utterances less than children who do not stutter.
   c. **Exhibited significantly more negative affect prior to or during stuttered than fluent utterances.**
4. The present authors conclude that:
   a. The findings support temperamentally based models of developmental stuttering.
   b. The findings confirm that emotions cannot be included in a causal model of stuttering.
   c. The findings should not be considered relative to the temporal epoch in which emotion occurred.
   d. **The findings contribute to a better understanding of how emotions may relate to childhood stuttering.**
5. Based on the finding that stuttered utterances are more likely to be preceded by emotional reactivity compared to the fluent utterances of children who stutter:
   a. The authors concluded that attention is being disrupted from one utterance to another.
   b. The authors concluded that these children must be anticipating instances of stuttering in the period prior to speech.

c. **The authors speculated that emotions may disrupt initiation and/or continuance of fluent speech.**

d. The authors speculate that emotional reactivity must be co-occurring with regulation in order to result in stuttered speech.

Educational objectives: After reading this article, the reader will be able to: (1) describe various measures of emotional reactivity and regulation, including parent-based reports and behavioral coding, and how they may contribute to childhood stuttering; (2) explain emotional differences between the stuttered and fluent utterances of CWS and CWNS; and (3) discuss how emotions may contribute to CWS' instances of stuttering.

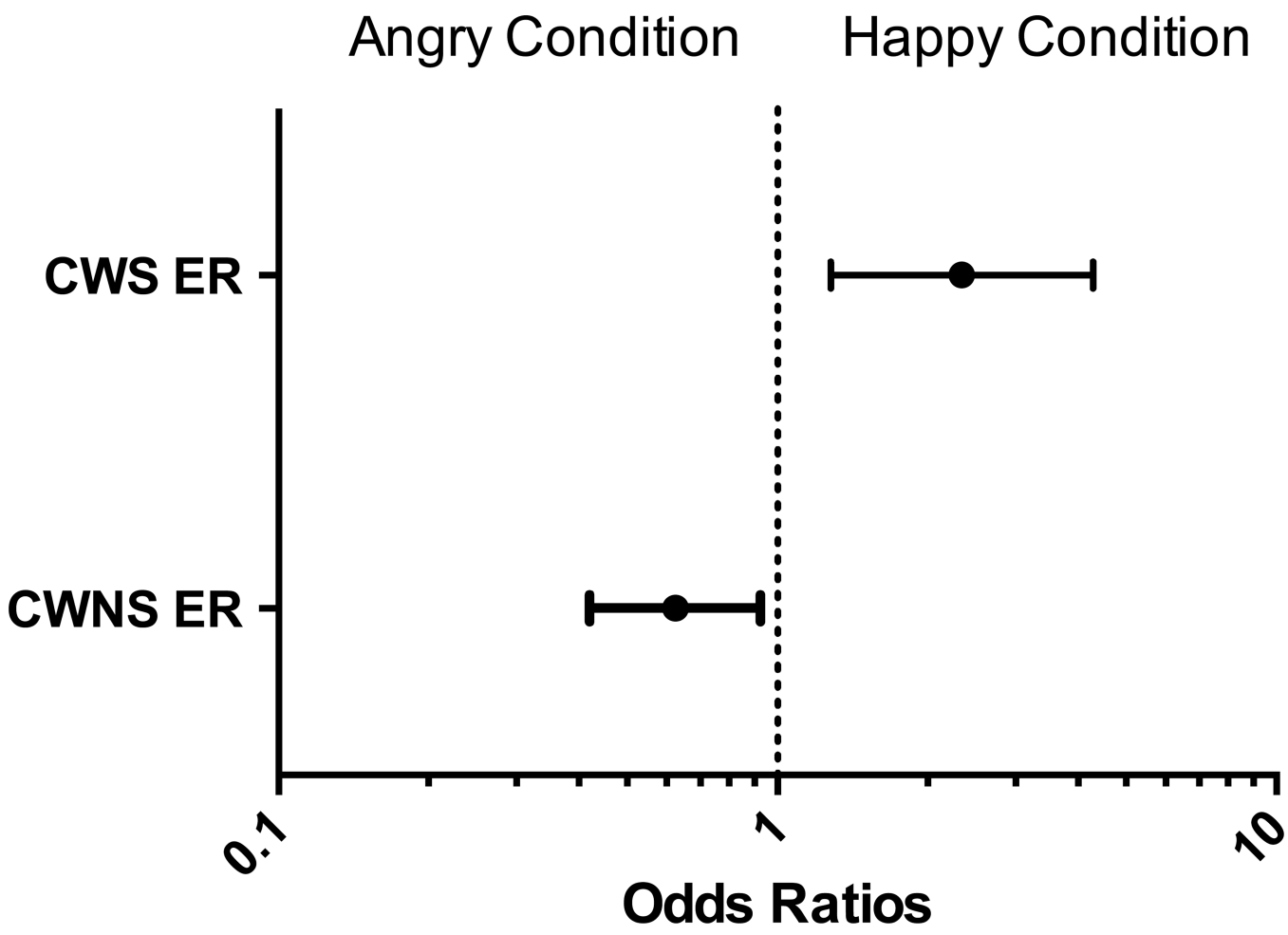

Figure 1. Emotion Regulation (ER) Prior to and During Fluent Utterances For Happy and Angry Conditions for Children Who Do (CWS) and Do Not Stutter (CWNS)

Note. Statistically significant results are those in which the 95% *Confidence Intervals (CIs*) do not overlap with a value of one.

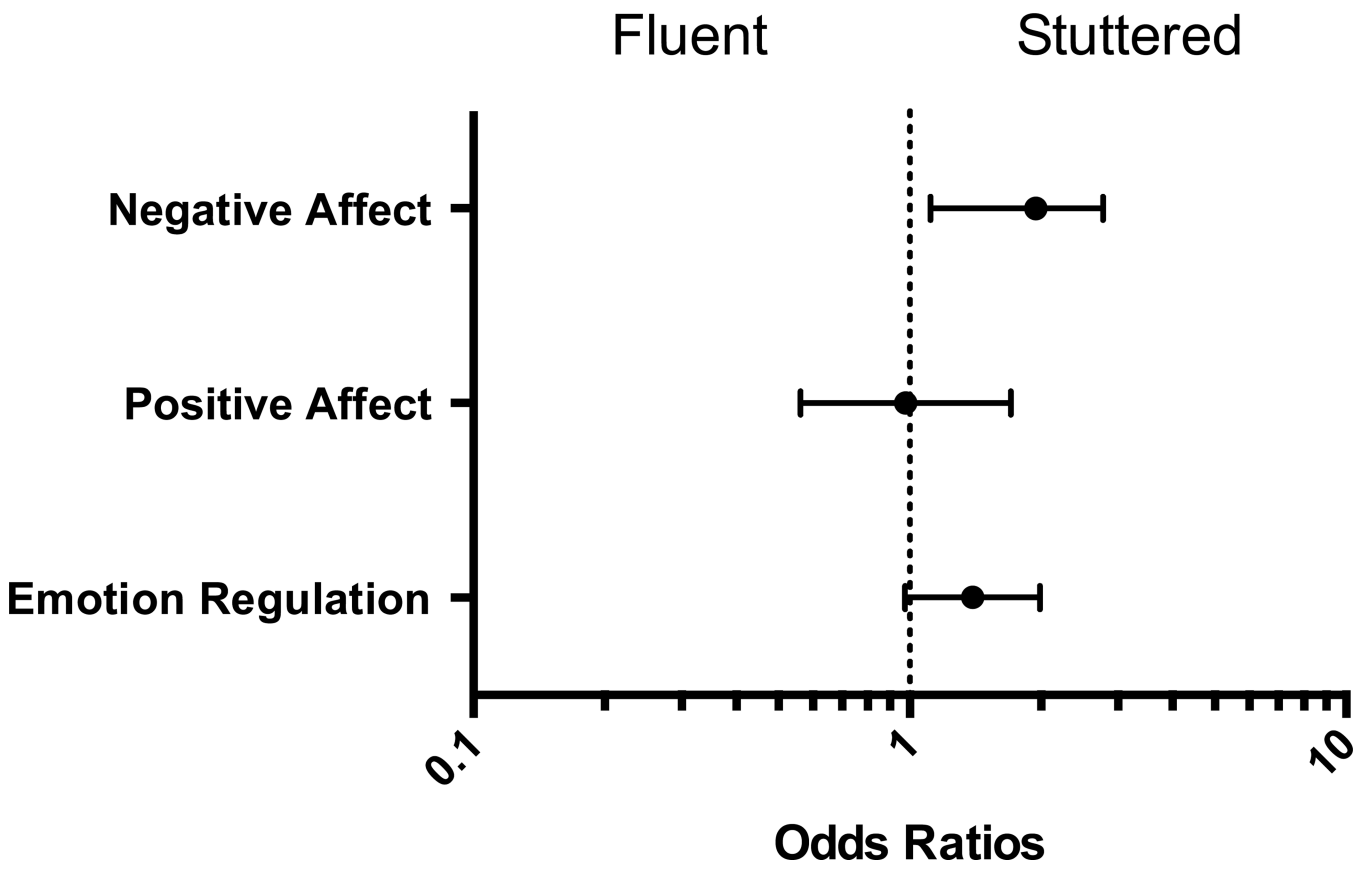

Figure 2. Comparison of Odds Ratios for Emotion and Emotion Regulation Prior to and During Stuttered Compared to Fluent Utterances for Children who Stutter

Note. Significant results are those in which the 95% confidence intervals (*CI*s) do not overlap with a value of one.

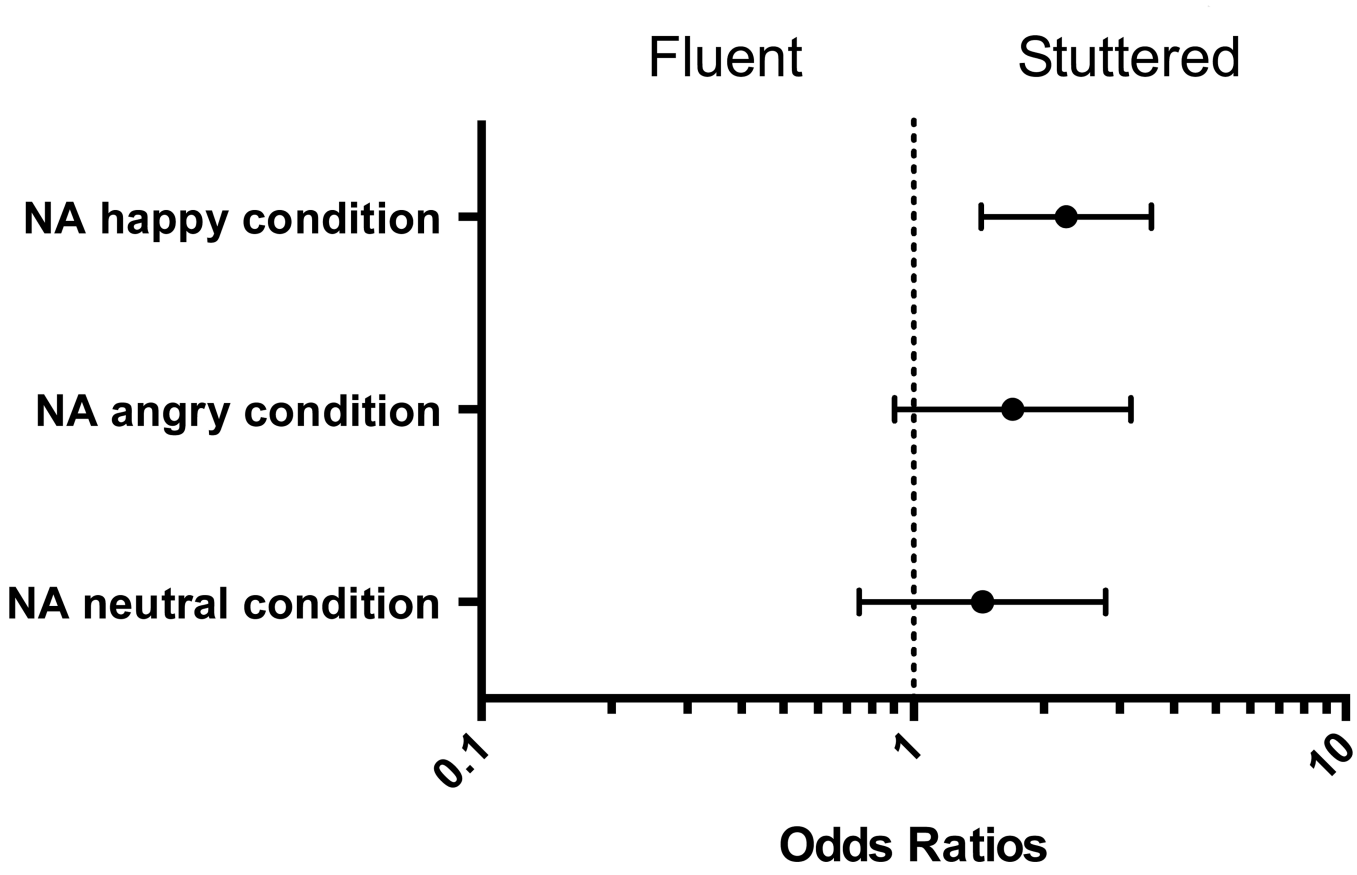

Figure 3. Negative Affect (NA) Prior To and During Stuttered and Fluent Utterances Following Each Emotion Condition for Children Who Stutter

Note. Significant results are those when the 95% *CI*s do not overlap with a value of one.

Table 1

Length and Fluency of Utterances During Narrative Tasks.

	Children who stutter					Children who do not stutter			
Participant	**Age**	**Gender**	**MLU**	**Stuttered Utterances**	**Fluent Utterances**	**Age**	**Gender**	**MLU**	**Fluent Utterances**
1	46	F	4.83	3.00	13.00	47	F	6.26	11.67
2	55	M	6.53	5.33	5.33	52	M	6.31	10.00
3	60	M	6.17	8.33	11.33	46	M	5.11	17.33
4	52	M	6.38	6.67	11.00	37	M	4.54	12.00
5	38	M	5.40	6.33	6.33	58	F	6.94	10.00
6	60	M	5.69	8.00	8.00	55	M	7.49	13.00
7	45	F	4.59	5.67	14.00	69	M	7.95	11.33
8	45	M	4.58	7.67	8.00	42	M	5.85	15.00
M	50.13		5.52	6.38	9.63	50.75		6.31	12.54
SD	7.92		0.80	1.74	3.16	10.05		1.15	2.53

Note. Age is expressed in months, F = female; M = male; MLU = mean length of utterance (in morphemes) during all three narrative tasks combined; Stuttered Utterances = mean number of stuttered utterances per narrative used in data analysis; Fluent Utterances = mean number of fluent utterances per narrative used in data analysis.

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