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Reaction to Background Stimulation of Preschool Children Who Do and Do Not Stutter

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Abstract

This study investigated the maintenance of attention and adaptation to background stimuli of preschool children who do (CWS) and do not stutter (CWNS). Participants were 13 monolingual, Standard American English speaking, 3- to 5-year-old CWS and 14 CWNS. Results indicated that CWS were significantly more apt than CWNS to attend to or look at changes in background stimuli, although there were no significant differences between groups in duration and latency of these looks. Findings suggest that preschool CWS are more reactive to, distracted by, and slower to adapt and habituate to environmental stimuli than their CWNS counterparts.

Keywords

Stutter; background stimulation; reactive; emotion; emotion regulation; preschool; children

Empirical findings indicate that young children who stutter (CWS) are less successful in maintaining attention and adapting to their environment (Embrechts, M., Ebben, H., Franke, P., & van de Poel, C., 2000), as well as more reactive to environmental stimuli, than children who do not stutter (CWNS; Wakaba, 1998). Theorists have recently suggested that CWS, when compared to CWNS, may have temperamental characteristics that make them vulnerable or sensitive (e.g., Conture, 1991, 2001; Guitar, 1998; Zebrowski & Conture, 1998). Anderson, Pellowski, Conture, and Kelly (2003) assessed temperamental characteristics of preschool CWS and CWNS on the basis of parent responses to a standardized test of childhood temperament (i.e., the Behavioral Style Questionnaire (BSQ)). Of the nine dimensions assessed by the BSQ (activity level, rhythmicity, approach or withdrawal, adaptability, threshold of responsiveness, intensity of reaction, quality of mood, distractability, and attention span/persistence), Anderson and colleagues reported that 3- to 5-year-old CWS differed from CWNS on the adaptability dimension, suggesting that CWS may be slower to adapt to new situations, novelty, change, and differences. This finding is intriguing, for it indicates that emotional parameters may impact stuttering.

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However, it should be kept in mind that temperament is by definition an inherent characteristic that is *stable over time*. It is, however, a bit problematic whether one can easily relate a relatively stable characteristic like temperament to a relatively non-stable behavior such as stuttering. When considering emotional processes relative to stuttering, it may be necessary to expand observations to include variables that appear to be more sensitive to changes in state or situations, namely, emotional reactivity and regulation.

Reactivity refers to the arousability of motor, affective, and sensory response systems (Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P., 2001). Regulation in emotionally reactive situations may act to initiate, maintain, modulate, or change the occurrence, intensity, or duration of internal feeling states and emotion-related physiological process to accomplish one's goals. Emotion regulation, which often includes the regulation of attention (attention shifting and focusing) and cognition (e.g., positive cognitive restructuring), involves the regulation of emotion-relevant internal states and processes (Eisenberg et al., 2000). Karrass et al. (submitted) found that preschool CWS are significantly more emotionally reactive to situational demands, less able to regulate their emotions when they experience them, and less able to flexibly control their attention than their CWNS peers. These findings imply that the emotional reactivity and regulation of CWS may contribute to their susceptibility to begin, continue, or recover from stuttering (e.g., Conture, 1991, 2001; Guitar, 1998; Zebrowski & Conture, 1998).

Many studies of temperamental characteristics have relied on parent report. Although some have questioned the validity of parent report questionnaires of temperament (Kagan, 1994), others (e.g., Rothbart & Bates, 1998) have argued that these instruments are useful because they are relatively inexpensive, convenient to administer, and provide input from parents, who are likely to have considerable insight into, as well as exposure to, their children's temperamental characteristics. Furthermore, even though some of these tests have established reasonable objective validity (Rothbart & Bates, 1998; Thompson, 1999; Wachs, 1999), they have also been criticized on the basis that parents may be biased informants, for example, modest levels of interparent agreement are typically reported (Strelau, 1998). Thus, although useful, parent-report questionnaires may not be a definitive means to measure temperament in young children.

An alternative approach to measuring individual differences in temperament-relevant characteristics is to observe temperament-related behaviors, such as reactions to environmental stimuli and/or environmentally-induced change (Guitar, 2003). The present study investigated differences between CWS and CWNS in attention maintenance and speed of reaction to background stimuli in a laboratory setting. In the lab, a wall-mounted, remotely controlled, motorized video camera made a relatively low intensity but clearly audible, distinct noise when moved during a child's videotaped conversation with his or her caregiver. Attention reactivity and regulation were operationalized by measuring the frequency of each child's shifts of attention (looks at the camera) and the duration and latency of each shift of attention when the camera moved. We hypothesized that CWS would be more likely than CWNS to look at the camera when it moved (i.e., CWS would be more sensitive to the audible stimulation associated with the camera movement). Our second hypothesis proposed that CWS would look at the camera for a longer period of time than

CWNS. In addition, we hypothesized that CWS would have a shorter reaction time to the movement of the camera (shorter latency of looking at the camera) than CWNS.

Habituation to the occurrence of background stimuli is a simple form of learning; a decrease in responding to repeated or continued stimulation (Siegler, Deloache, & Eisenberg, 2003). If a child learns that the noise is associated with the camera movement and refrains from looking at the camera each subsequent time that it is moved, then the child would have habituated to the exposure of the stimulation, the noise of the camera. However, if a child continues to look at the camera each additional time that it is moved, then the child would have failed to habituate to the repeated exposure to the stimulus. There are currently no data that link stuttering to habituation of background stimulation. Previous reports showing high reactivity and poor adaptability of CWS (Anderson et al., 2003; Embrechts et al., 2000; Fowlie & Cooper, 1978; Wakaba, 1998) lead us to hypothesize that CWS would be more reactive to the noise of the camera movement and take longer to resume their previous activity than CWNS.

METHOD

Participants

Participants were 18 monolingual, Standard American English speaking, 3- to 5-year-old (3;0-5;11) children who stutter (CWS; $n = 10$ boys and $n = 8$ girls) and 18 of their non-stuttering (CWNS; $n = 10$ boys and $n = 8$ girls) counterparts. The mean age of the CWS was 47.1 months ($SD = 8.7$, range = 36 to 64 months). The mean age of the CWNS was 51.1 ($SD = 9.9$, range = 38 to 69 months). Of the 36 available participants, five CWS and four CWNS were excluded because they had not been exposed to at least three camera moves during their videotaped conversation with their caregiver. The remaining CWS who participated in this study had not received any prescribed speech-language treatment prior to their participation.

Participants were paid volunteers, naïve to the purposes and methods of the study, and referred to the investigators by their parents, who were informed about it through (a) an advertisement in a free, widely-read, monthly parent-oriented magazine circulated throughout Middle Tennessee; (b) Middle Tennessee area speech-language pathologists, health care providers, and daycare centers; or (c) self or professional referral to the Vanderbilt Bill Wilkerson Hearing and Speech Center for an initial assessment of childhood stuttering. The participants had no known or reported hearing, neurological, developmental, academic, intellectual, or emotional problems. No participant, either CWS or CWNS, exhibited any other known or reported speech and/or language problems, with criteria for each behavior described below.

Classification and Inclusion Criteria

Talker Group Membership: CWS vs. CWNS—Participants were assigned to one of two talker groups based on the following criteria.

Children Who Stutter (CWS)—Participants were assigned to the CWS group if they (a) exhibited three or more stuttering-like disfluencies (part-word repetitions, single-syllable

word repetitions, sound prolongations, blocks, and tense pauses) per 100 words of conversational speech (Yairi & Ambrose, 1992) and (b) received a total overall score of 11 or above (a severity equivalent of at least “mild”) on the Stuttering Severity Instrument-3 (SSI-3; Riley, 1994; CWS had a mean SSI-3 score of 20.5, $SD = 5.3$). Similar indices of stuttering have been used in other studies (e.g., Yairi, 1981; Yairi & Ambrose, 1992; Yairi & Lewis, 1984), with specific definition of “constituent members” or different disfluency types representative of stuttering-like disfluencies also described elsewhere (Johnson, 1961; Williams, Silverman, & Kools, 1968).

Children Who Do Not Stutter (CWNS)—CWNS (a) exhibited two or fewer stuttering-like disfluencies per 100 words of conversational speech (Yairi & Ambrose, 1992) and (b) received a total overall score of 10 or below (a severity equivalent of less than “mild” for preschool children) on the SSI-3 (CWNS had a mean SSI-3 score of 4.4, $SD = 3.3$).

Speech, Language, and Hearing Abilities—During a visit to the child’s home, prior to experimental testing, all participants were administered, the *Goldman-Fristoe Test of Articulation - 2* (GFTA-2; Goldman & Fristoe, 1986), *The Peabody Picture Vocabulary Test - III* (PPVT-III; Dunn & Dunn, 1997), the *Expressive Vocabulary Test* (EVT; Williams, 1997) and the *Test of Early Language Development - 3* (TELD-3; Hresko, Reid & Hamill, 1991) to assess articulation abilities, receptive vocabulary, expressive vocabulary, and receptive and expressive language skills, respectively. Requirements for inclusion in the present study were that children scored at or above the 16th percentile (approximately one standard-deviation below the mean) or above for their age group. In addition, all participants passed a hearing screening (bilateral pure tone testing at 20 dB HL for .5, 1, 2, and 4 kHz) and exhibited normal tympanograms.

Exclusion of Participants—Each participant had to have been exposed to three or more camera moves in which the position of a motorized video camera that made a low intensity but clearly audible, distinct noise was moved during the child’s videotaped conversation with their caregiver. If there were two or fewer camera moves during the participant’s conversation with the caregiver, that child was not included in the present study (of 36 participants, five CWS and four CWNS were excluded for this reason).

Definition/Description of Dependent Measures

The three dependent measures were based on reiterative, frame-by-frame videotape analysis of the participant’s nonspeech behaviors during a 300-word conversational sample between the participant and the participant’s caregiver.

Frequency of Looking or Shifts in Attention—*Attention* was defined as occurring when the child’s eyes were judged to be oriented toward any object in the room (i.e., a toy, his or her caregiver, etc.) other than the camera before the camera began to move. A shift in attention was defined as any occasion in which the child’s eyes stopped looking at the object and/or person on which they had been focusing and instead fixed their eyes on the camera. During the participant’s videotaped conversation with his or her caregiver, the frequency of the participant’s changes in gaze or shifts in attention following an audible, distinct (non-

systematically occurring) camera movement was measured. On the basis of reiterative, frame-by-frame videotape analysis, the first author recorded the number of times (frequency) that the participant re-directed his or her gaze to (i.e., looked at) the video camera as it moved and made a distinct noise.

Duration of Shifts of Attention—During the participant’s videotaped conversation with his or her caregiver, the *duration* of each shift of attention following each camera movement was measured. Using frame-by-frame video analysis, the duration of the change in gaze was recorded.

Reaction Time—If the participant looked at the video camera when it moved, then *reaction time* to look was computed by subtracting the time (in sec) between the audible indication of initial camera movement (i.e., the videoframe when it began to make an audible, distinct noise) and the beginning of (i.e., associated video frames) when the participant looked toward the camera.

Pre-Analysis Data Preparation: Definition of Lost Trials and Errors

Video camera movements where a distinct noise was made and the participant’s face could not be seen were considered to be “lost trials” and were not included in the data analysis. There were 155 total camera moves and 4 lost trials.

Intrajudge and Interjudge Measurement Reliability

Using the formula—number of agreements/number of agreements plus number of disagreements—point-by-point intrajudge and interjudge reliability was obtained for frequency of camera movements, frequency of participant looks, duration of looking per duration of camera movement (percent), and latency of looking relative to onset of camera movement (in sec). Six children (three CWS and three CWNS) were coded by the first author and a second coder (interjudge) trained in the coding and systematic observation of speech, language, and related non-speech behavior during conversational samples.

RESULTS

Descriptive Data

Stuttering/Speech Disfluencies—As would be expected, based on participant selection criteria, there was a statistically significant difference ($t(25) = 4.88, p < .001$, Cohen’s $d = 1.85$) in average total disfluencies between CWS ($M = 10.26, SD = 5.74$) and CWNS ($M = 2.57, SD = 1.36$). Likewise, there was a significant difference ($t(25) = 4.61, p < .001$, Cohen’s $d = 1.74$) in stuttering-like disfluencies between CWS ($M = 7.62, SD = 5.38$) and CWNS ($M = .93, SD = .74$).

Speech and Language Abilities—All participants achieved scores above the 16th percentile (less than 1 SD below the mean) on a series of standardized speech-language tests (PPVT-III, EVT, TELD-3, and GFTA-2). A multivariate analysis of variance (MANOVA) revealed no significant between-group differences on any of these four measures: PPVT-III $F(1,23) = 1.77, p = n.s.$, EVT $F(1,23) = .19, p = n.s.$, TELD-3-Receptive Language $F(1,23)$

= 2.58, $p = \text{n.s.}$, TELD-3-Expressive Language $F(1,23) = .74$, $p = \text{n.s.}$, and GFTA-2 $F(1,23) = .17$, $p = \text{n.s.}$

Number of Camera Moves Per Child—Results of an independent samples t-test of the number of camera moves per child for the two talker groups, CWS ($M = 5.38$, $SD = 2.84$) and CWNS ($M = 6.07$, $SD = 2.34$), did not differ ($t(25) = -.69$, $p = .50$, Cohen's $d = -0.26$).

Frequency of Looking, or Shifts in Attention, Per Number of Camera Movements (percent)

CWS exhibited a significantly greater mean percentage of looks per camera movements ($M = .35$, $SD = .36$, $t(25) = 2.09$, $p = .025$, Cohen's $d = .79$) than CWNS ($M = .13$, $SD = .16$).

Duration of Looking Per Duration of Camera Movement (percent)

As shown in Figure 2, there was no statistically significant difference between CWS ($M = .30$, $SD = .32$, $t(25) = -.62$, $p = \text{n.s.}$, Cohen's $d = .24$) and CWNS ($M = .48$, $SD = .98$) in terms of their time spent looking at the camera following its movement.

Latency to Look Relative to Onset of Camera Movement

Figure 3 reveals that there was a marginally significant difference between CWS ($M = 1.38$, $SD = .76$, $t(13) = -1.60$, $p = .065$, Cohen's $d = .82$) and CWNS ($M = 2.01$, $SD = 0.76$) in terms of their reaction time (i.e., time in seconds from onset of camera movement to onset of looking) in response to environmental change. Although the difference between the two talker groups was only marginally significant, the effect size was large (Cohen, 1988), meaning that there was nonoverlap of 47.4% between the two groups. The nonsignificance but large effect size of this finding is most likely due to the small sample size (8 CWS and 7 CWNS).

Likelihood of Looking

A Chi-Square Test of the effect of talker group (CWS and CWNS) on likelihood of never looking versus looking at least once was performed and the groups did not differ ($\chi^2(1) = 1.85$, $p = .17$). Thus, there was no difference in orienting to the camera the first time it moved, even though there was a difference in the total number of looks for CWS and CWNS.

Relation of Looking Behavior to Stuttering

Bivariate correlations were computed to determine the relation between the frequency of looks to camera moves and each participant's percent total disfluencies, percent stuttering-like disfluencies, and percent stuttering-like to total disfluencies during their conversation with their caregiver. Each of the three correlations (.42, .50, and .50, respectively) were marginally significant for CWS. However, none of the correlations (.26, .32, and -.06, respectively) were significant for CWNS. Some of the low correlations with percent stuttering and percent stuttering per total disfluencies were probably truncated, as might be expected, by a low frequency of occurrence of stuttering-like disfluencies for the CWNS.

Reliability

Intrajudge and interjudge measurement reliability for judgments of frequency of camera moves, the frequency of participant looks, and the percent duration of the participant looks to camera moves were all 100%. The result of an independent samples t-test of intrajudge and interjudge measurement reliability of reaction time was nonsignificant ($p = .37$).

Correlations between intrajudge and interjudge measurements of reaction time showed that the mean differences between the two raters varied by only a tenth of a second for one measurement and the rest were identical.

DISCUSSION

This study found that CWS shifted their attention and reacted to one specific environmental change more than CWNS; however their duration and latency to react to environmental change was not significantly different from that of CWNS. In addition, for CWS, the greater the frequency of looks to camera moves, the more disfluent his or her speech (although this relation was only marginally significant). The present study, therefore, indicates that environmental change is more often noticed and reacted to by CWS than CWNS, but is less well regulated by CWS than by CWNS. This finding may suggest that CWS are relatively more vigilant and reactive to environmental changes than their CWNS peers.

Frequency of Looking, or Shifts in Attention, Per Number of Camera Movements (percent)

CWS displayed a significantly greater mean percentage of looks per camera movement than CWNS. Not only was the difference between the two talker groups significant, but the effect size was large. There was nonoverlap of 47.4% between the groups (Cohen, 1988). This finding indicates that CWS are more often reactive and less able to regulate to environmental change than their CWNS counterparts, even though there was no significant difference in environmental change (i.e., camera moves) between the two talker groups. This finding is consistent with findings reported by Anderson et al. (2003) and Karrass et al. (submitted), that CWS react more often to environmental change, are less able to regulate their emotions, and are less able to focus their attention than CWNS. However, this finding of the present study is inconsistent with Anderson et al. (2003), who reported that CWS are less distractable than CWNS. This finding also differs from Lewis and Goldberg (1997), who reported that children at-risk for stuttering exhibited temperamental profiles consistent with high adaptability to change and a positive approach to new stimuli. The findings of the present study and the two previously mentioned studies may have differed because both Anderson et al. (2003) and Lewis and Goldberg (1997) were based on parental responses to a standardized questionnaire on childhood temperament, whereas the present study observed temperament-related behaviors. The observations in the present study suggest that CWS are less adaptable, less able to maintain their attention, and more distractable than CWNS.

If CWS appear to exhibit differences and/or slowness in their adaptation to changes in the environment, these difficulties may contribute to the difficulties that they have in establishing reasonably normal speech fluency. Furthermore, such findings may suggest that some of the unease, nervousness, or lack of comfort that CWS experience when they are in

new situations has as much to do with their slowness to adapt to novelty, and other sources of stimulation, as it does the fluency of their speech (Anderson et al., 2003).

Duration of Looking Per Duration of Camera Movement (percent)

There was no statistically significant difference between CWS and CWNS in terms of duration of looking per duration of camera movement. However, the direction of the means and the small size of the effect (Cohen, 1988) suggest that CWNS may look at each camera move for a longer period of time than CWS. If the combination of a longer duration of looking per duration of camera movement and a lower frequency of looks per camera moves for CWNS when compared to CWS is replicated in future research, it would support the hypothesis that CWNS are able to adapt to the movement of the camera, realize that the camera is making the noise, and habituate to the exposure to the environmental stimulus. Therefore, conversation with the caregiver can continue without the distraction of the movement of the camera.

Latency to Look Relative to Onset of Camera Movement (in seconds)

Although the difference between CWS and CWNS in latency to react to environmental change was not statistically significant, the effect size was large (Cohen, 1988), indicating that there was nonoverlap of 47.4% between the two groups, and the means were in the direction such that CWNS took longer to react to each camera move than CWS. The nonsignificance but large effect size of this finding is most likely due to the small sample size (8 CWS and 7 CWNS). If replicated by future research, this behavior would support the conclusion that CWS are more reactive and distractable to environmental change than CWNS. This finding suggests that CWNS may habituate more readily to exposure to irrelevant background stimuli, such as the noise of a camera when it moves while they are conversing with their caregiver.

Relation of Looking Behavior to Stuttering

Although the correlations between the frequency of looks to camera moves and each CWS participant's percent total disfluencies, percent stuttering-like disfluencies, and percent stuttering-like to total disfluencies during their conversation with their caregiver were only marginally significant, the effect sizes are considerable, suggesting that those whose frequency of stuttering was greater also had a higher frequency of looks. Therefore, the correlations for CWS participants indicate that CWS are distractable to changes in their environment and have poor attention control.

Additional Considerations

Even though CWS displayed a significantly greater mean percentage of looks per camera moves than CWNS, there was only a marginal difference between CWS and CWNS in terms of duration and latency of reactivity to environmental change. The present study included relatively few participants ($n = 13$ CWS and $n = 14$ CWNS), therefore, power to detect a difference was low. Although the size of some of our effects was substantial, the power of the statistical tests in the present study was such that only very large effects would be detected by the statistical tests. In future studies, obtaining a larger number of participants

should increase the generalizability of the findings and the power of the design to detect differences in the duration and latency of looking between CWS and CWNS.

Even though the number of camera movements per child for the two talker groups did not differ, the number of camera movements ranged from 3 to 12 per conversational sample. An improvement for future research would expose each participant to the same number of camera movements (or other exogenous environmental changes) at predetermined intervals during the participant's conversation with his or her caregiver.

It is tempting to speculate that the present findings may be an analog to what might occur when a CWS hesitates, repeats, and prolongs his or her speech. That is, they may more often react to changes in the forward flow of their speaking. Perhaps their tendency to more readily notice changes in the environment, including changes in their own speech, may encourage CWS to compensate for their disfluencies by exerting more physical tension and speeding up their speech production. Although these conjectures are based on preliminary findings, results to date are promising and suggest that emotional reactivity and regulation may play an important role in the difficulties CWS have establishing reasonably fluent speech.

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SELF-STUDY QUESTIONS

1. Empirical evidence has revealed that:
 - a. CWS are less successful in maintaining attention than CWNS.
 - b. CWS are less successful in adapting to their environment than CWNS.
 - c. CWS are more reactive to environmental stimuli than CWNS.
 - d. A and B only.
 - e. All of the above
2. *Reactivity* refers to:
 - a. A decrease in responding to repeated or continued stimulation.
 - b. The arousability of motor, affective, and sensory response systems.
 - c. Initiating, maintaining, modulating, or changing the occurrence, intensity, or duration of internal feeling states and emotion-related physiological process to accomplish one's goals.
3. *Regulation* refers to:
 - a. A decrease in responding to repeated or continued stimulation.

- b. The arousability of motor, affective, and sensory response systems.
 - c. Initiating, maintaining, modulating, or changing the occurrence, intensity, or duration of internal feeling states and emotion-related physiological process to accomplish one's goals.
4. *Habituation* refers to:
- a. A decrease in responding to repeated or continued stimulation.
 - b. The arousability of motor, affective, and sensory response systems.
 - c. Initiating, maintaining, modulating, or changing the occurrence, intensity, or duration of internal feeling states and emotion-related physiological process to accomplish one's goals.
5. The findings of the present study include:
- a. CWS shifted their attention and reacted to environmental change more than CWNS.
 - b. The duration and latency to react to environmental change of the CWS was significantly different from the CWNS.
 - c. The greater a CWS's frequency of looks to camera moves, the more disfluent his or her speech.
 - d. A and B only.
 - e. A and C only.

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LEARNING OUTCOMES

The reader should be able to (1) recognize the temperamental differences between CWS and CWNS, (2) define attention reactivity and regulation, (3) explain how attention reactivity and regulation are associated with preschool stuttering, and (4) understand recent empirical evidence relating reactivity and regulation to preschool stuttering.

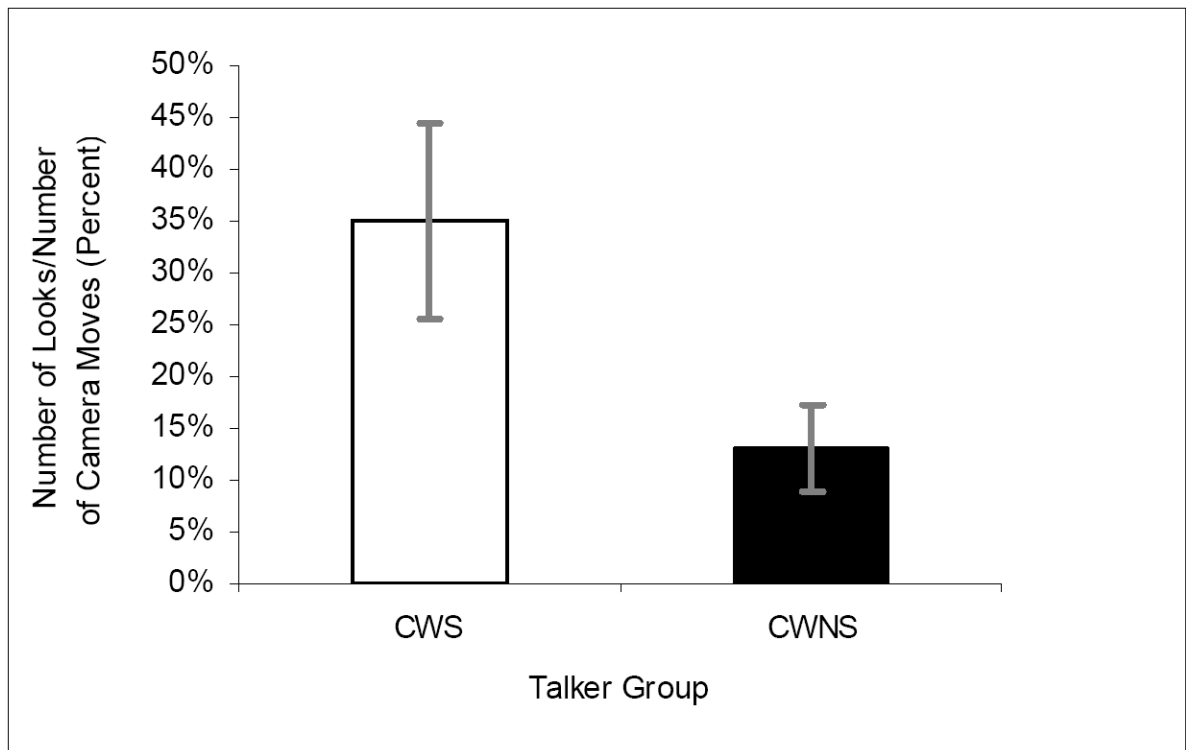


Figure One. Number of looks per number of camera movements for preschool children who do (CWS, N = 13) and do not stutter (CWNS, N = 14) during 300-word conversational samples with their caregivers.

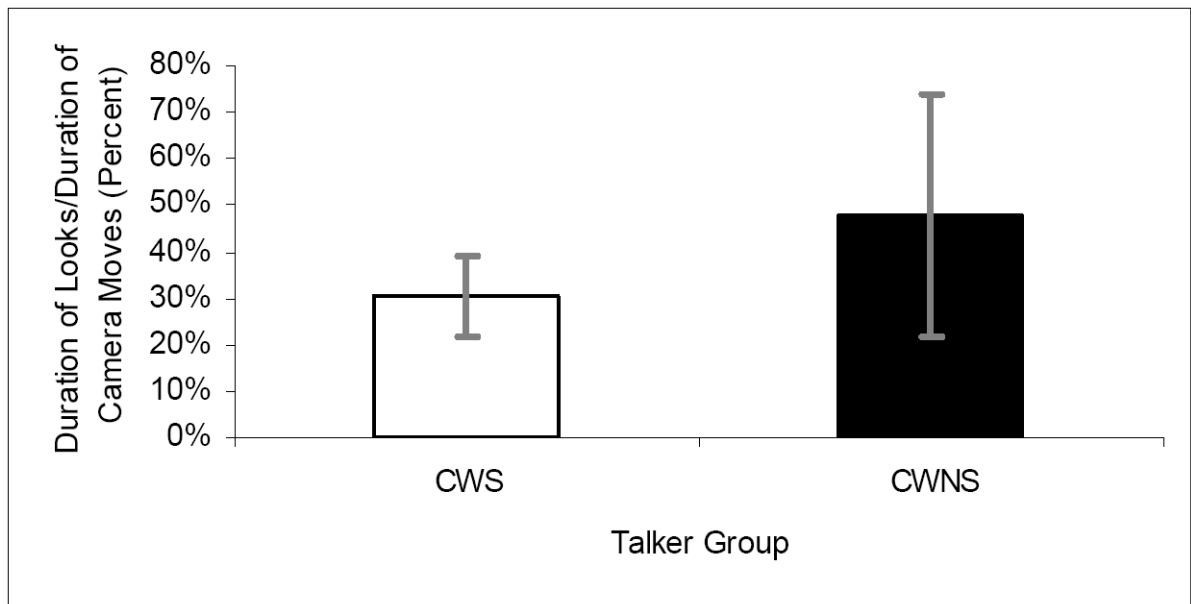


Figure Two. Duration of looks per duration of camera movements for preschool children who do (CWS, N = 13) and do not stutter (CWNS, N = 14) during 300-word conversational samples with their caregivers.

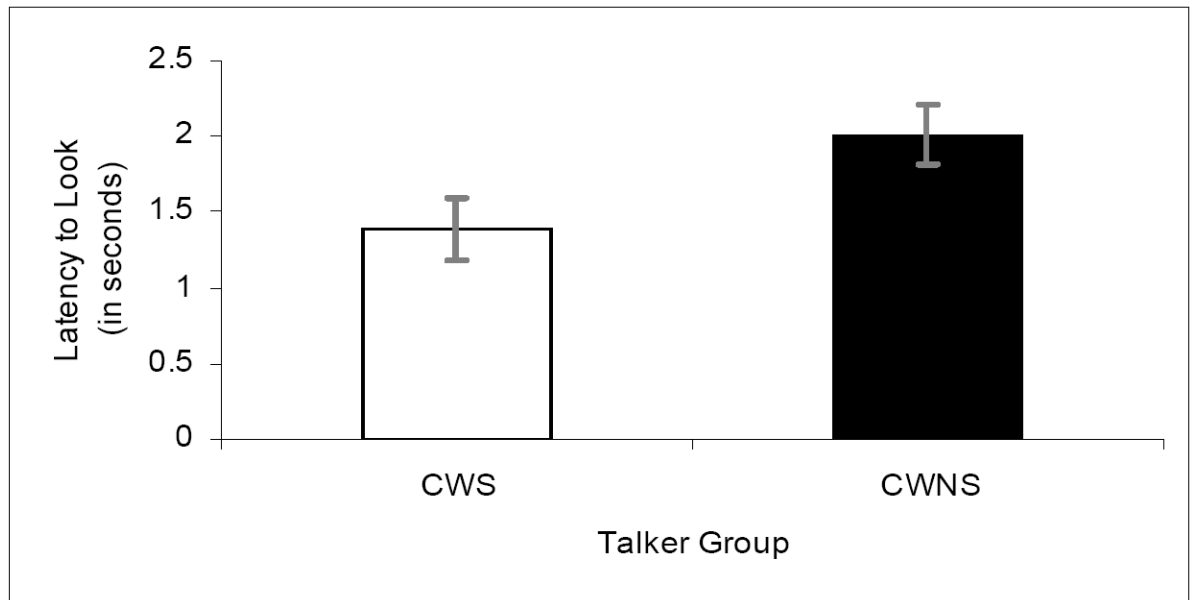


Figure Three.

Latency to look following onset of camera movements (i.e., from onset of camera movement to onset of looking) for preschool children who do (CWS, N = 13) and do not stutter (CWNS, N = 14) during 300-word conversational samples with their caregivers.