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Efficacy of attention regulation in preschool-age children who stutter: A preliminary investigation

Kia N. Johnson^{a,*}, Edward G. Conture^b, and Tedra A. Walden^c

^aDepartment of Communication Sciences and Disorders, James Madison University, United States

^bDepartment of Hearing and Speech Sciences, Vanderbilt University, United States

^cDepartment of Psychology, Vanderbilt University, United States

Abstract

Purpose—This preliminary investigation assessed the attentional processes of preschool-age children who do (CWS) and do not stutter (CWNS) during Traditional cueing and Affect cueing tasks.

Method—Participants consisted of 12 3- to 5-year-old CWS and the same number of CWNS (all boys). Both talker groups participated in two tasks of shifting and focusing attention: (a) Traditional cueing and (b) Affect cueing. The Affect cueing task was preceded by stress-heightening instructions intended to influence participants' emotionality. In both tasks participants provided non-speech motor responses (i.e., button pressing) to computer-presented target stimuli. Targets were preceded by a visual cue (i.e., highlighted box) occurring in the same (i.e., Valid trials) or opposite (i.e., Invalid trials) location as the target stimuli. Reaction times (RT) were measured (in ms) from the onset of the target stimuli to the onset of the non-speech motor response. Errors were tallied for both experimental conditions and were categorized by type.

Results—Findings of this preliminary investigation indicated that there were no significant between-group differences in RT or frequency of erroneous responses. There were differences in error type that were correlated with RT for both CWS and CWNS when stress-heightening instructions were introduced.

Conclusion—Preliminary findings suggest that *speed* of attentional disengaging, shifting and re-engaging does not differ between preschool-age CWS and CWNS during the experimental paradigm employed in this study and that introducing stress-heightening instructions does affect components of performance for both preschool-age CWS and CWNS. Caveats for the present study include a limited sample size of young preschool-aged children as well as methodological concerns.

Learning outcomes—Readers will be able to: (1) Define attention regulation and describe findings that investigate the role of attention regulation in developmental stuttering of preschool-age children; (2) Describe the components of attention regulation employed during a Posner Cueing Task; (3) Describe the findings of the present study in relation to other studies investigating attention regulation and developmental stuttering in preschool-age children.

Keywords

Stuttering; Children; Attention; Cueing task; Regulation

1. Introduction

Recent theoretical accounts of childhood stuttering suggest that emotions contribute to its development (Conture et al., 2006; Conture & Walden, 2012). Such speculation is consistent with empirical evidence indicating that CWS display more negative affectivity (Eggers, De Nil, & Van den Bergh, 2010) and more emotion reactivity to their environment (Karrass et al., 2006; Schwenk, Conture, & Walden, 2007). Findings also suggest that CWS, when compared to CWNS, differ in their use of effortful control (Eggers et al., 2010) and seem less well-equipped to self-regulate emotional responses and adapt to novelty (Anderson, Pellowski, Conture, & Kelly, 2003; Embrechts, Ebben, Franke, & van de Poel, 2000; Johnson, Walden, Conture, & Karrass, 2010; Karrass et al., 2006; Lewis & Goldberg, 1997; Schwenk et al., 2007; Williams, 2006), emotional processes which reportedly impact preschool-age CWS' speech fluency (Walden et al., 2012). Emotion regulation, that is, mechanisms or methods that permit modulation of internal emotion and behavior reactions, has been extensively studied in the field of psychology (Cole, Martin, & Dennis, 2004; Eisenberg et al., 2000; Thompson, 1994). Regulatory mechanisms can maintain or enhance emotional arousal, as well as inhibit or suppress arousal (Thompson, 1994). The development of emotion regulation is thought to progress with age, beginning in infancy, and changing from external sources of emotion regulation (e.g., caregivers) to more internal sources of self-regulation (for further discussion of the development of emotion regulation, see Calkins, 1994; Cole, Michel, & Teti, 1994; Diener & Manglesdorf, 1999; Stifter & Wiggins, 2004).

In early stages of development, the young child begins by using less sophisticated self-regulatory strategies that provide soothing and comfort to the child (Diener & Manglesdorf, 1999; Grolnick, Bridges, & Connell, 1996). As children continue to develop, so do their attentional, memory, and cognitive processes, making them better able to internally regulate their own emotions by shifting or diverting attention, particularly during instances of negative emotion in distressing situations (Eisenberg & Spinrad, 2004; Grolnick et al., 1996; Perez-Edgar & Fox, 2005). Children's use of strategies also becomes more deliberate and controlled (for more discussion, see Eisenberg & Spinrad, 2004), suggesting more efficient emotion regulation. Therefore, in a preschool-age child with typically developing emotion regulation, more mature self-regulatory strategies (e.g., distractibility or shifting attention) are related to more psychosocially competent outcomes (Diener & Manglesdorf, 1999; Grolnick et al., 1996). In other words, more mature self-regulation of emotions helps the child better cope with socially and emotionally arousing experiences.

One important aspect of emotion regulation—attention regulation (AR)—includes directing or allocating attention in response to a challenging situation. Attention regulation involves the ability to maintain and engage attention (attention focusing) as well as the ability to appropriately disengage and shift attention from one object/event to another (attention shifting) (Belsky, Friedman, & Hsieh, 2001; Grolnick et al., 1996; Karrass et al., 2006). In contrast, the inability to maintain focused attention on a particular object/event may be associated with various childhood concerns, such as specific language impairment (e.g., Finneran, Francis, & Leonard, 2009). Attention regulation is regarded as an effortful, voluntary strategy seen in children as young as 2½ years of age (Eisenberg & Spinrad, 2004; Kochanska, Coy, & Murray, 2001; Thompson, 1994), though with age it becomes more sophisticated and complex.

Differences in AR have been reported between adults who do and do not stutter (Arends, Povel, & Kolk, 1988; Bosshardt, 1999, 2006; Bosshardt, Ballmer, & de Nil, 2002; Heitmann, Asbjornsen, & Helland, 2004; Smits Bandstra, De Nil, & Rochon, 2006). Findings based on parent-report have suggested that CWS, when compared to CWNS, exhibit lower or maladaptive AR (Eggers et al., 2010; Felsenfeld, van Beijsterveldt, & Boomsma, 2010; Karrass et al., 2006) and specific difficulty with maintaining (Embrechts et al., 2000) and shifting attention from one task to another (Anderson et al., 2003). Bush (2006), employing direct observations of preschool-age CWS and CWNS attentional behavior, reported that CWS took significantly longer than CWNS to look away from a focal point (the computer monitor) to begin a narrative task after listening to an audio-taped emotionally arousing conversation. Her finding suggests that CWS are less distracted than CWNS, a finding consistent with Anderson et al. (2003). However, Schwenk et al. (2007) reported that CWS were significantly more apt than CWNS to shift their attention from an ongoing task (play) to an irrelevant environmental stimulus, and demonstrated failure to habituate to a repeated stimulus, suggesting that CWS are more distracted than CWNS. A more recent study by Eggers, De Nil, and Van den Bergh (2012) examined the efficiency of underlying attentional networks in CWS and CWNS using the Attention Network Test which measures use of attention-related abilities (e.g., alerting, orienting, and executive control). Although findings indicated no between group differences in alerting and executive control, CWS were reported to have less efficient orienting network. Collectively, these studies share a common thread: AR, a necessary component of emotional development for this age group, is less developed in CWS; however, reported findings do not make clear exactly how AR differs.

Issues of differing sample sizes and/or methodological differences among these studies make between-study comparisons difficult. For example, questionnaire-based studies (Anderson et al., 2003; Craig, Hancock, Tran, & Craig, 2003; Eggers et al., 2010; Embrechts et al., 2000; Felsenfeld et al., 2010; Karrass et al., 2006; Vanryckeghem, Hylebos, Brutten, & Peleman, 2001; Wakaba, Iizawa, Gondo, Inoue, & Fujino, 1998) ask parents specific or limited scenario questions, whereas behavioral studies (e.g., Bush, 2006; Johnson et al., 2010; Karrass et al., 2006; Schwenk et al., 2007) compare CWS and CWNS during a specific experimental task.

Theoretical explanation of the role emotional development plays in the instances of stuttering in young children is captured in the Communication Emotional (CE) Model of Stuttering (Conture et al., 2006). This model attempts to account for childhood stuttering as it relates to both speech-language planning/production and emotional variables (including emotion regulation). If CWS are less mature in their development of emotion regulation they may lack or have less well-developed strategies needed to regulate their emotions, for example, the use of self-direction of their attention during moments where there is a need to achieve or maintain fluent speech during an attention-taxing situation. Therefore, AR difficulties for some CWS may negatively impact their speech-language planning and production, contributing to disruptions in fluent initiation and continuation of communication. Given the limited findings regarding emotional and attentional differences between CWS and CWNS, further empirical assessment of these differences (based on observational data), and their possible contributions to the onset and development of childhood stuttering is warranted.

It was the present authors' hypothesis that preschool-age CWS, when compared to preschool-age CWNS, are less able to regulate their attention. This may challenge their ability to initiate and/or maintain normally fluent speech by diverting attentional, linguistic and/or cognitive resources away from speaking and toward emotionally arousing stimuli. If this is the case, individuals must allocate limited attentional resources to meet the challenges

of a particular task or tasks (for a brief review of the limited-capacity hypothesis, see Spaulding, Plante, & Vance, 2008). With limited attentional resources, distributing attention to one task leaves fewer resources to devote to another task (e.g., speaking task; Spaulding et al., 2008).

To empirically assess attentional processes, the Posner *Traditional* cueing task (Posner & Cohen, 1984; Posner, Inhoff, Friedrich, & Cohen, 1987; Posner, Petersen, Fox, & Raichle, 1988) has been used with children as young as 5 years of age (e.g., Perchet & Garcia Larrea, 2000; Perchet, Revol, Fournieret, Mauguier, & Garcia Larrea, 2001; Perez-Edgar & Fox, 2005), as well as adults (Thomsen, Specht, Ersland, & Hugdahl, 2005) who stutter and clutter (Heitmann et al., 2004). To the author's knowledge, this task has not been used with young preschool-age children (3- and 4-year olds) and has not been used with CWS.

The *Traditional* cueing task assesses orientation of covert attention—the act of focusing attention on a defined location—while responding to stimuli presented in the periphery (for further review, see Ward & Brown, 1996; McDonald, Bennett, Chambers, & Castiello, 1999). It has been reported that when attention is oriented or cued to a specific location, stimuli appearing at or near that visually attended location (e.g., the right or left side on a computer monitor screen) are processed faster and more efficiently than target stimuli appearing in an uncued location (Posner & Cohen, 1984; Posner et al., 1987) (see Fig. 1).

However, if attention is oriented to one location and the target appears in another, uncued location (opposite the cue), the participant's response requires disengaging attention from the cued location, shifting attention, and then reengaging attention to the new uncued location (Perchet & Garcia Larrea, 2000; Perchet et al., 2001; Perez-Edgar & Fox, 2005; Posner & Cohen, 1984; Posner et al., 1987).

Responding to stimuli preceded by a cue in the same location (Valid cues) has been shown to result in faster reaction times (RT; or the time it takes for the participant to respond to the stimulus). This is thought to be the case because fewer “steps” are needed to respond (i.e., disengaging attention from focal point, shifting attention to cued location, and engaging attention to stimulus). In contrast, reaction times from responding to stimuli preceded by a cue in a different or opposing location (Invalid cues) result in slower RTs since more steps are needed to respond. Heitmann et al. (2004) reported that adults who stutter, responding to a Posner Cueing Task, exhibited longer reaction times, in comparison to a control group and a group of adults who clutter; findings were interpreted to suggest that adults who stutter have difficulties with attention focusing. In contrast, Perchet et al. (2001) reported that children with ADHD demonstrate faster RTs, but an increase in errors.

It has been suggested that the smaller the RT difference between Invalid and Valid trials, the more efficient attentional resources are allocated, whereas larger RT differences indicate difficulty regulating attentional resources (e.g., Perez-Edgar & Fox, 2005; Perez-Edgar, Fox, Cohn, & Kovacs, 2006). Previous research has defined this difference (Invalid RT–Valid RT) as the *validity effect* (Perchet & Garcia Larrea, 2000; Perchet et al., 2001; Posner et al., 1987), or for the purposes of the present study, the “validity difference.”

More recently, the manipulation of affect has been paired with the Posner Cueing Task to further examine the impact of emotional variables on attentional processes (Perez-Edgar & Fox, 2005; Perez-Edgar et al., 2006), a procedure similar to the *Traditional* cueing task except for instructions to participants. Specifically, the instructions for the *Affect* cueing task are designed to influence affect immediately prior to performing the task. It has been reported that when young children are presented with affect-influencing instructions prior to the task, they produce faster (shorter) RTs, an increase in validity difference, and an increase in errors (Perez-Edgar & Fox, 2005; Perez-Edgar et al., 2006). These findings suggest that

the inclusion of an affect component may cause faster disengagement and shifting of some attentional resources from one location to another. Thus, based on previous questionnaire-based and behavioral studies with CWS, it was speculated that these differences would be larger in CWS, particularly during an emotionally arousing situation.

Therefore, it was the purpose of this preliminary study to assess the attentional processes of preschool-age CWS and CWNS during a Traditional and Affect cueing task. The authors anticipated that empirical use of a Traditional and Affect cueing task would expand methodological options for investigating attention regulation in young preschool-age CWS and CWNS.

With regard to speed of responding, it was anticipated that both CWS and CWNS Valid RTs would be faster than Invalid RTs. However, it was our first hypothesis that regardless of condition (Traditional or Affect), CWS would exhibit significantly slower Valid and Invalid cue RTs than CWNS (Heitmann et al., 2004; also, see Bloodstein & Bernstein Ratner, 2008, Table 5–3, for detailed review of [non]speech RT studies of children, teens and adults who stutter). Thus, we predicted a main effect of talker group (CWS and CWNS). Second, it was hypothesized that CWS would demonstrate a significantly larger validity difference than CWNS, suggesting that shifting attention from one location to another delays their responses. Thus, we also predicted a talker group $\times$ cue (Valid and Invalid) effect. Third, it was hypothesized that validity differences would be larger when affect was manipulated (*Affect* cueing task) in comparison to the cueing task without affect manipulation (*Traditional* cueing task). Thus, we predicted a significant interaction of talker group (CWS and CWNS) $\times$ cue (Valid and Invalid) $\times$ condition (Traditional and Affect).

With regard to response accuracy, our first hypothesis was that CWS when compared to CWNS, would demonstrate significantly more errors across both conditions. Thus, we predicted a main effect of talker group. We also hypothesized that this increase in errors among CWS would be larger when affect was manipulated. Thus, we predicted a talker group condition effect for errors.

2. Methods

2.1. Participants

Participants consisted of 12 preschool-age boys who stutter (CWS) and 12 preschool-age boys who do not stutter (CWNS), all native speakers of American English. Participants were involved in a series of studies conducted by Vanderbilt University's Developmental Stuttering Project.

Participants were between the ages of 3;0 (years; months) to 5;11 (CWS: $M = 58.00$, $SD = 6.78$; CWNS: $M = 58.83$, $SD = 9.20$) with no significant between-group difference in age, $t(22) = -.25$, $p = .80$. There were 10 Caucasian and 2 African American participants in the CWS group; there were 9 Caucasian, 1 African-American and 2 bi-racial participants in the CWNS group. All participants were paid volunteers naïve to the purposes and methods of the study and were referred to the Vanderbilt Bill Wilkerson Center by their parents, speech-language pathologists, daycare, preschool, or school personnel. No participant had previously received formal/structured intervention for stuttering or any other communication disorder. Participants had no known or reported hearing, neurological, developmental, academic, intellectual, or emotional problems as reported by the parent/guardian. The study protocol was approved by the Institutional Review Board of Vanderbilt University. For each participant, parents signed informed consent and children assented.

2.2. Classification

2.2.1. Children who stutter (CWS)—A child was considered a CWS if he (a) exhibited three or more stutterings (i.e., sound/syllable repetitions, monosyllabic whole-word repetitions, sound prolongations, and broken words) per 100 words of conversational speech (based on a 300-word sample; Conture, 2001) and (b) received a total 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 score of 18.25, $SD = 4.52$; stuttering frequency: $M = 8.14$, $SD = 4.58$).

2.2.2. Children who do not stutter (CWNS)—A child was considered a CWNS if he (a) exhibited two or fewer stutterings per 100 words of conversational speech (based on a 300-word sample) and (b) received a total score of 8 or less (a severity equivalent of less than “mild”) on the SSI-3 (CWNS had a mean score of 7.67, $SD = .78$; stuttering frequency: $M = 1.28$, $SD = .61$).

2.2.3. Standardized speech-language tests and hearing screening—To participate in this study, all participants scored at or above the 16th percentile or higher (approximately 1 standard deviation below the mean) on the (a) Peabody Picture Vocabulary Test-Third or Fourth Edition (PPVT-III or IV A or B; Dunn & Dunn, 1997, 2007), (b) *Expressive Vocabulary Test First or Second Edition* (EVT or EVT-2; Williams, 1997, 2007), (c) *Test of Early Language Development-3* (TELD-3; Hresko, Reid, & Hamill, 1999) and (d) the “Sounds in Words” subtest of the *Goldman-Fristoe Test of Articulation-2* (GFTA-2; Goldman & Fristoe, 2000), standardized tests used to assess receptive and expressive vocabulary, receptive and expressive language skills, and articulation abilities, respectively. One standard deviation below the mean is commonly used as a criterion to identify children with clinically significant language impairment (e.g., Fujiki, Spackman, Brinton, & Hall, 2004). Furthermore, each participant passed a bilateral pure tone hearing and tympanometric screening (American Speech-Language-Hearing Association, 1990).

2.2.4. Socioeconomic status (SES)—Each participant's SES was determined through parent report of occupation on the Four Factor Index of Social Position (Hollingshead, 1975), which involves the assessment of maternal and paternal occupation and educational levels. Scores range from 8 to 66; higher scores indicate higher SES. There was no significant difference between CWS ($M = 41.79$, $SD = 9.98$) and CWNS ($M = 46.62$, $SD = 10.23$), $t(22) = 1.17$, $p = .25$.

2.3. Procedures

Participants and their parents visited the university laboratory twice; 1–2 weeks apart. The first visit, approximately 2.5 h, involved speech, language and temperament assessments, as well as a hearing screening. During this visit, the experimenter also gathered demographic information about the participant's developmental, medical, and speech-language history from the parent. Each child also participated in a conversation with the experimenter to assess speech disfluency. During the second visit, each participant completed the Traditional and Affect cueing tasks. This visit was approximately 1 h, which included a meeting with the parent and a speech-language pathologist to address questions the parent had about the child's speech-language performance.

2.3.1. Traditional cueing task—The Traditional cueing task is based on methodology by Perez-Edgar and Fox (2005), Perez-Edgar et al. (2006), Perchet and Garcia Larrea (2000) and Perchet et al. (2001), for 6- to 10-year old children. For this reason, the present task was modified to make it more age-appropriate for preschool-age children as described below (see Rueda, Posner, Rothbart, & Davis-Stober, 2004 for a brief discussion on age-

appropriate modification of a task). Both cueing tasks were presented on a 17-in. monitor placed 1 m in front of the participant. Stimuli were presented using *E-Prime* (“E-Prime”, 2002), which has been used in other empirical studies to present peripheral cueing stimuli (e.g., Thomsen et al., 2005; Zhang & Zhang, 2007).

Before beginning the experimental tasks, each participant was trained on the cueing task, first, using identical pictures and targets presented in a book. Second, each child participated in a short practice period involving 6 computer trials lasting approximately 1 min and included verbal feedback indicating that the participant completed the practice task (i.e., “You finished the game”). During both training periods, with and without the computer, the child was instructed to respond as quickly as possible and to keep his eye gaze on the fixation point (a cartoon face). Prior to the Traditional cueing task, each participant identified a ‘really cool prize’ that was later used during the Affect cueing task. Each child was given general instructions explaining the Traditional cueing task, which consisted of 56 trials. As shown in Fig. 2, each trial consisted of the following, listed in the order in which they appeared: (1) a preparatory visual stimulus (i.e., a “green stoplight”; positioned at the center of the computer monitor in the same location as the later appearing fixation point) with a 1000 ms duration, (2) a 200 ms peripheral cue—a yellow rectangle appearing on the left or the right of a centralized fixation point (i.e., cartoon face similar to clip art) with equal probability and (3) a visual target stimulus (a “cookie”), presented to the left or the right of the centralized fixation point with up to a 3000 ms duration (cue-to-target interval = 150 ms). After the button-pressing response, the preparatory visual stimulus (“green light”) appeared immediately to begin the next trial cycle. The intertrial interval from cue to cue ranged from a minimum of 1200 ms (in the case of very rapid responses) to a maximum of 4200 ms (in the case of no response during the 3000 ms period following presentation of the target). The Traditional cueing task was approximately 5 min in duration.

During each trial, the participant was asked to detect and respond to the visual target stimulus by pressing a button response box (Response Pad 200; Electrical Geodesic, Inc. Oregon). The button response box had four buttons. However, the rightmost button and leftmost button were clearly identified as the response buttons and each was marked with a sticker resembling a cookie. Reaction time or latency in button pressing was measured (in ms) from the onset of the target stimulus to the button-press response. Verbal feedback was provided during the practice block and both experimental conditions (Traditional cueing condition and the Affect cueing condition) regarding completion of the task (e.g., “keep going”, “finish the game”). This feedback was intended to provide a response to the participant if he asked a question during the task. Feedback was intended to encourage the participant to complete the task. No feedback was given regarding correct or incorrect responses. The experimenter stood behind the participant as to not distract the participant from the task and to avoid giving any nonverbal feedback.

The 56 Traditional cueing trials consisted of three cue-target combinations (“Valid cue” trials, “Invalid cue” trials and “No-cue” trials) randomly presented. The “No-cue” trials were randomly interspersed throughout the 56 trials as filler trials. Unlike Valid and Invalid cue trials, No-cue trials do not provide an opportunity to measure RT following a cued signal. Thus, in the present study, No-cue trials were included to make it difficult for participants to discern the purpose of the experiment and/or develop a response set (Anderson & Conture, 2004).

Neither RT nor error data during the No-cue trials was included in the final data analysis. Participants were instructed to provide key press responses on the right or the left of the button response box to correspond to the side of the monitor on which the target appeared (right or left).

During the cueing task it was necessary to present a substantial number of Valid trials to build the participant's attention toward an expected cued location while interspersing a smaller number of unanticipated Invalid and No-cue trials.

2.3.2. Valid cue trials—During Valid cues trials (32 of 56 trials, 57.14%), the peripheral cue (i.e., yellow square) correctly indicated the location of the upcoming visual target (i.e., “cookie”), with equal number on the right and left location on the monitor.

2.3.3. Invalid cue trials—During Invalid trials (16 of 56 trials, 28.57%), the peripheral cue appeared opposite the location of the upcoming target, with equal number on the right and left location on the monitor.

2.3.4. No cue trials—During the No-cue or control trials (8 of 56 trials, 14.29%), the target appeared on either the right or left side of the screen with no cue presented prior to the target.

2.3.5. Affect cueing task—The Affect cueing task was identical to the Traditional cueing task; except for the instructions. Similar to methodology used by Perez-Edgar and Fox (2005) and Perez-Edgar et al. (2006), after completing the Traditional cueing condition, each participant was reminded of the ‘really cool prize’ they selected at the beginning of the experimental session. Children were given affect-influencing instructions specifying that they must do well on the next game to receive the prize. After the instructions each child participated in 56 additional trials in the same format as the Traditional cueing task. According to Perez-Edgar and Fox (2005) and Perez-Edgar et al. (2006), this type of instruction prior to the task influences children's affect by increasing their stress prior to the task.

Similar to Perez-Edgar and Fox (2005), the Traditional cueing task always preceded the Affect cueing task. Although this eliminated the possibility of randomizing the order of the two tasks, it permits a relatively uncontaminated assessment of participants' AR before introducing emotion-inducing instructions (see Perez-Edgar & Fox, 2005 for further discussion). In previous studies with older children, eliminating randomization of the two tasks was not found to affect findings (Perez-Edgar & Fox, 2005).

2.4. Pre-analysis data preparation

Similar to other studies using the Posner Cueing Task (e.g., Perez-Edgar & Fox, 2005) or studies eliciting RT data (e.g., Hartfield & Conture, 2006), the following format was used for pre-analysis data preparation which included Valid and Invalid cue trials only.

2.4.1. Outliers—First, errored or non-errored RT responses greater than three standard deviations above the mean of all participant responses for that particular condition were excluded. Also excluded were any RTs less than 200 ms so that omission errors (no response provided after the onset of the target which would result in 0 ms RT) could be accurately accounted for. The criterion of 200 ms was selected based on adult piloting data for the present study in which adults presented an overall minimum RT of 200 ms. Typically, adults exhibit faster RTs than children (Bloodstein & Bernstein Ratner, 2008). Therefore, for the present study, any RT less than 200 ms (faster than adult pilot RTs) or greater than three *SD* above the group mean were more than likely the result of processes other than those under investigation (a criterion recommended by Fidell and Tabachnick (2002) and Osborne and Overbay (2004)). According to Ratcliff (1993), RT outliers are typically either short—due to fast guesses of an uncooperative or uninterested participant—or long, due to loss of attention, daydreaming or distraction. Thus, it is advantageous to

judiciously exclude outliers (Ratcliff, 1993). Both talker groups exhibited a comparable number of outliers (CWNS: $n = 141$; CWS: $n = 123$).

2.4.2. Button-pressing errors—For the RT analysis, button-pressing errors were removed and analyzed separately. As mentioned above, button-press errors were of two forms: (1) Orientation errors and (2) Omission errors. In addition, if more than 35% (greater than 19 errors) of a participant's key press responses contained errors in either of the 2 experimental tasks (i.e., Traditional or Affect), the participant's data were excluded. This criterion is based on methodology used in other RT paradigms with preschool-age CWS (e.g., Byrd, Conture, & Ohde, 2007; Hartfield & Conture, 2006; Melnick, Conture, & Ohde, 2003) and ensures that each participant's data is fairly represented in the data corpus with nearly comparable numbers of accurate responses. Both talker groups produced a comparable number of errors (CWS: $n = 63$; CWNS: $n = 84$).

2.5. Pre-analysis data processing

2.5.1. Children who do not stutter (CWNS)—From an initial group of 31 CWNS, four participants were excluded because of technical difficulties, three participants because of noncompliant behavior (e.g., failure to remain seated and/or in the room during data collection, refusal to begin task, crying) and one because of a parent-reported behavioral problem on the child research intake form (i.e., Attention Deficit-Hyperactivity Disorder). Of the remaining 23 CWNS participants, two were excluded because more than 35% of their naming responses were errors in at least one of the two experimental conditions. Additionally, nine CWNS were unable to be age- and gender-matched to CWS and were also excluded from the present study. Thus, 12 CWNS participants were included in the present study.

The remaining 12 CWNS participants provided button-pressing responses for 1344 Valid and Invalid target trials (672 Valid and Invalid trials per condition). Of the 1344 target trials, 141 target trials (*Traditional condition*: $n = 75$ or 5.58%; *Affect condition*: $n = 66$ or 4.91%) were excluded because the RT was either <200 ms or $>$ three *SD* above the mean for all CWNS (i.e., outliers). Based on the criterion for error identification, 84 (*Traditional condition*: $n = 46$ + *Affect condition*: $n = 38$) of the remaining 1203 (*Traditional condition*: $n = 597$ + *Affect condition*: $n = 606$) button-pressing responses were excluded because: (a) 4.82% (58/1203) were Orientation errors and (b) 2.16% (26/1203) were Omission errors.

Thus, the final corpus of RT data for the 12 CWNS participants consisted of 1119 (*Traditional condition*: $n = 551$ + *Affect condition*: $n = 568$) accurate button-pressing responses.

2.5.2. Children who do stutter (CWS)—From an initial group of 20 CWS, one participant was excluded because of incomplete data due to technical difficulties, five because of noncompliant behavior (e.g., failure to remain seated and/or in the room during data collection, refusal to begin the task, crying), and one because of parent-reported behavioral problems on the child research intake form. Of the remaining 13 CWS participants, one participant was excluded for having more than 35% of his naming responses in error in at least one of the two experimental conditions. Thus, 12 CWS participants were included in the present study.

The remaining 12 CWS participants provided button-pressing responses for 1344 Valid and Invalid target trials (672 Valid and Invalid trials per condition). Of the 1344 target trials, 123 target trials (*Traditional condition*: $n = 54$ or 4.02% + *Affect condition*: $n = 69$ or 5.13%) were excluded because the RT was an outlier. Based on criteria for error identification, 63 (*Traditional condition*: $n = 31$ + *Affect condition*: $n = 32$) of the remaining 1221 (*Traditional*

condition: n = 618; *Affect condition: n* = 603) pressing responses were excluded because: (a) 3.93% (48/1221) were Orientation errors and (b) 1.23% (15/1221) were Omission errors.

Thus, the final corpus of RT data for the 12 CWS participants consisted of 1158 (*Traditional condition: n* = 587 + *Affect condition: n* = 571) accurate button-pressing responses.

2.6. Design

Talker Group classification was based on speech disfluency data from the conversational sample, as previously discussed. Two dependent variables were employed for the present study: (a) RT and (b) accuracy/errors, defined below.

2.7. Data analysis

2.7.1. Descriptive data—To assess possible between-group differences in SES and chronological age, *t*-tests were employed. *t*-Tests were also used to verify that both talker groups differed in the frequency of stuttering-like disfluencies and mean SSI-3 scores. Additional descriptive data (i.e., scores on all standardized speech and language) were analyzed using a multivariate analysis of variance (MANOVA) to ensure that talker groups did not differ in their speech-language performance.

2.7.2. Reaction time data—The primary dependent measure for this study was the RT for each type of trial (i.e., Valid and Invalid) for the two experimental conditions (i.e., Traditional and Affect cueing tasks). Reaction time or response latency was measured (in ms) from the onset of the presentation of the target to the onset of the participant's button-pressing response, which was automatically tabulated by *E-Prime*.

Histogrammic assessment of RT responses indicated that they were normally distributed. Reaction time data was submitted to a series of group (CWS vs. CWNS) $\times$ condition (Traditional vs. Affect) $\times$ validity (Valid vs. Invalid) repeated measures analyses of variance (RM-ANOVAs).

2.7.3. Accuracy data—Button-pressing errors were categorized as two types (Perchet & Garcia Larrea, 2000; Perchet et al., 2001): (a) Omission errors – no response provided after the onset of the target; (b) Orientation errors – response did not correspond with the correct target side. These errors were automatically recorded by *E-Prime*. Cueing trials (Valid, Invalid and No-cue) were presented in a randomized order.

Histogrammic assessment of overall error responses indicated that the data were normally distributed. Thus, accuracy/error responses were assessed using a repeated measures analysis of variance (RM-ANOVA) with group (CWS vs. CWNS), error type (Omission/Orientation errors), and condition (Traditional/Affect) as independent variables.

2.8. Intra- and inter-judge measurement reliability

Kappa coefficients measured intra-judge and inter-judge reliability for total disfluencies (stuttered disfluencies plus non-stuttered disfluencies, e.g., revisions) and stuttering-like disfluencies. Four participants were randomly selected from each talker group. The 300-word conversational sample elicited from each participant resulted in 1200 words (approximately 33% of the total data corpus for each group). Intrajudge reliability was assessed by having the experimenter judge each speech sample for the presence of all disfluencies as well as stuttering-like disfluencies on two separate occasions. Interjudge reliability was assessed by having the experimenter and a doctoral student, both certified speech-language pathologists with experience in assessing stuttering, judge each speech sample for the number of all disfluencies and stuttering-like disfluencies.

For CWS, intrajudge reliability for the mean frequency of total speech disfluencies and stuttered disfluencies was .98 and .94, respectively, whereas interjudge reliability was .90 and .88, respectively. For CWNS, intrajudge reliability for the mean frequency of total speech disfluencies and stuttered disfluencies for was .93 and .82, respectively, whereas interjudge reliability was .99 and .96, respectively.

2.9. Additional analytical considerations

2.9.1. Statistical power—The N of cases in the present study ($N = 12 + 12 = 24$), results in an inability to detect small, clinically trivial differences. To see what the study can detect, we performed power analyses using PASS 2008 software (Hintze, 2008). (a) For a Pearson correlation, (b) a between-group t -test, and (c) a repeated measures experiment. As Kraemer, Mintz, Noda, Tinklenberg, and Yesavage (2006) suggests, we understand power by estimating the minimum detectable effect size to see how sensitive the study is to differences when they occur. Each time, we used traditional (Cohen, 1988) criteria ($p < .05$ two-tailed, power = 80%, Cohen's effect size guidelines, e.g., $d = .2/.5/.8$ - small/med/large).

A Pearson correlation with $N = 24$ would be able to detect r as low as $r = .585$ with 80% power. This correlation is “large” given Cohen's suggestion that $r = .8$ is “large.” A two-group t -test (with $N = 12 + 12$) could detect differences as small as $d = 1.19$. Again, per Cohen, this is “large.” A repeated measures analysis, with 4 measurements per participant and an autocorrelation observed to be $r = .95$ in this sample, could detect differences in group means as low as $d = 1.12$, another “large” effect.

These power estimates suggest that the study is adequately powered to detect large effects, but not “medium” ($d = .5$ SDs) or “small” effects ($d = .2$ SDs). This sensitivity is adequate for learning clinically important connections large enough to be observed in a single case, but not subtle distinctions that can be seen only in large groups.

2.9.2. Effectiveness of cue—To ensure that the cue (a yellow frame)—presented prior to the target (“cookie”)—effectively cued attention to the right or left of the computer monitor, Valid RTs from the Traditional condition were compared to no-cue RTs from the same condition. For both talker groups, all accurate (with outliers excluded) no-cue trials from the Traditional condition (CWS: $n = 84$; CWNS: $n = 82$) were compared to an equal number of randomly selected accurate (with outliers excluded) Valid cue trials using a talker group (CWS–CWNS) $\times$ cue type (Cued [Valid]–Uncued [no cue]) RM-ANOVA.

Findings indicated a significant main effect of cue type, $F(1, 22) = 91.23$, $p < .001$, with both talker groups exhibiting faster cued RTs (CWS: $M = 650.89$, $SD = 277.49$; CWNS: $M = 652.10$, $SD = 196.34$) than uncued RTs (CWS: $M = 942.26$, $SD = 279.31$; CWNS: $M = 916.35$, $SD = 263.08$). There was no significant between-group difference, $F(1, 22) = .02$, $p = .89$ nor cue type $\times$ talker group interaction, $F(1, 22) = .22$, $p = .65$. These findings indicate that the cue prior to the target did facilitate faster responses than responding without a cue.

3. Results

3.1. Descriptive measures

3.1.1. Stuttering/speech disfluencies—As expected based on group assignment criteria, there was a significant difference, $t(1, 22) = 4.78$, $p < .001$, in average total disfluencies between CWS ($M = 12.17$, $SD = 5.12$) and CWNS ($M = 4.85$, $SD = 1.38$) and a significant difference, $t(1, 22) = 5.14$, $p < .001$, in *stuttered* disfluencies between CWS ($M = 8.14$, $SD = 4.58$) and CWNS ($M = 1.28$, $SD = .61$). There was also a significant difference, t

(1, 22) = 8.00, $p < .001$, in SSI-3 scores between CWS ($M = 18.25$, $SD = 4.52$) and CWNS ($M = 7.67$, $SD = .78$).

3.1.2. Speech and language abilities—A MANOVA revealed no significant between-group differences on any standardized measures of speech and language: GFTA $F(1, 22) = 1.91$, $p = .18$, PPVT $F(1, 22) = .31$, $p = .59$, EVT $F(1, 22) = .29$, $p = .59$, TELD-Receptive Language $F(1, 22) = .08$, $p = .77$, TELD-Expressive Language $F(1, 22) = .11$, $p = .74$.

3.2. Between-group differences in reaction time (RT)

3.2.1. Differences in RT between two cueing conditions—To assess hypotheses related to RT, a talker group (CWS and CWNS) $\times$ condition (Traditional and Affect) $\times$ cue type (Valid and Invalid) RM-ANOVA was used. Results, illustrated in Fig. 3, indicated no main effect of talker group, $F(1, 22) = .38$, $p = .54$, or condition, $F(1, 22) = 1.65$, $p = .21$. As expected, there was a main effect for cue type (Valid vs. Invalid), $F(1, 22) = 87.23$, $p < .001$, with both CWS and CWNS exhibiting faster (lower) RTs for Valid trials than Invalid trials. There was no significant interaction of condition $\times$ cue type, $F(1, 22) = 1.30$, $p = .27$, or talker group $\times$ condition $\times$ cue type, $F(1, 22) = 1.15$, $p = .30$.

To examine the hypothesis related to validity difference, a MANOVA was conducted with talker group as the independent variable and validity difference from the Traditional vs. Affect conditions as the dependent variable. Results, as illustrated in Fig. 4, indicate, no significant main effect for group, $F(1, 22) = .06$, $p = .80$, or validity difference, $F(1, 22) = 1.30$, $p = .27$. There was also no significant group $\times$ validity difference interaction, $F(1, 22) = 1.15$, $p = .30$.

3.3. Between-group differences in mean errors

3.3.1. Differences in overall mean number of errors from two cueing conditions—To assess hypotheses related to errors/accuracy, a talker group (CWS and CWNS) $\times$ condition (Traditional and Affect) $\times$ error type (Omission and Orientation) RM-ANOVA was used. Results, illustrated in Fig. 5, indicated no main effect of talker group, $F(1, 22) = .76$, $p = .39$ or condition, $F(1, 22) = .32$, $p = .58$. There was, however, a significant main effect of error type, $F(1, 22) = 14.30$, $p < .01$, since both CWS and CWNS produced more Orientation than Omission errors, regardless of condition. There was no significant talker group $\times$ error type interaction, $F(1, 22) = .00$, $p = .95$, or condition $\times$ error type interaction, $F(1, 22) = .19$, $p = .67$. Lastly, based on the commonly used $p < .05$ significance level, there was no statistically significant 3-way interaction of talker group $\times$ condition $\times$ error type, $F(1, 22) = 3.27$, $p = .08$.

4. Ancillary considerations

4.1. Reaction time correlated with errors

To assess whether there was a relation between errors and RT for either talker group in either condition, correlations were conducted within each talker group to determine if there was a relation between Valid and Invalid RTs and overall errors from both conditions. Correlations were also computed between Valid and Invalid RTs and errors by type for both conditions.

For CWS, Valid and Invalid RTs did not significantly correlate with overall errors (i.e., omission plus orientation errors) in either the Traditional (Valid: $r = .05$, $p = .88$; Invalid: $r = -.04$, $p = .91$) or the Affect condition (Valid: $r = .30$, $p = .35$; Invalid: $r = .22$, $p = .48$). Furthermore, in the Traditional condition, Valid and Invalid RTs did not significantly correlate with Omission or Orientation errors (significance range of $p = .36$ to $.91$).

For the Affect condition, however, CWS's Valid and Invalid RTs significantly correlated with Omission errors (Valid: $r = .70, p < .01$; Invalid: $r = .69, p < .05$), but not Orientation errors (Valid: $r = -.11, p = .74$; Invalid: $r = -.21, p = .51$) (see Fig. 6). In other words, for CWS, there was no relation between overall errors and RT in either the Traditional or Affect condition, but for the Affect condition as CWS's Omission errors increased so did both Valid and Invalid RTs.

For CWNS, Valid and Invalid RTs did not significantly correlate with overall errors in either the Traditional (Valid: $r = .34, p = .28$; Invalid: $r = .10, p = .76$) or Affect condition (Valid: $r = .17, p = .59$; Invalid: $r = .38, p = .22$). Furthermore, in the Traditional condition, Valid and Invalid RTs did not correlate with Omission errors nor Orientation errors (significance range of $p = .06$ to $.56$).

For the Affect condition, CWNS's Valid and Invalid RTs significantly correlated with Omission errors (Valid: $r = .79, p < .01$; Invalid: $r = .71, p < .01$), but not Orientation errors (Valid: $r = -.12, p = .72$; Invalid: $r = .15, p = .64$). In other words, as with CWS, there was no relation between overall error production and RT in either condition for CWNS, but increased Omission errors was related to increased RT when affect was manipulated.

In summary, present preliminary findings indicated that RT for both preschool-age talker groups was faster for Valid than Invalid cues in both conditions. Furthermore, affect-stimulating instructions had no appreciable influence on RTs for children in either talker group. Affect-stimulating instructions did, however, influence Omission errors for both talker groups, in that an increase in Omission errors correlated with increased RT for both CWS and CWNS.

5. Discussion

The present preliminary study resulted in four main findings. The first finding indicated that, as expected, both preschool-age CWS and preschool-age CWNS demonstrated significantly faster (shorter) RTs in response to Valid than Invalid cues and slower (longer) RTs in response to Invalid cues. The second main finding indicated that, contrary to hypotheses, there was no overall difference in RTs between CWS and CWNS when affect was manipulated. The third main finding indicated that there were no differences in overall frequency of errors produced by CWS and CWNS, regardless of condition. The final main finding was that for both CWS and CWNS there was a significant positive correlation between increased Omission errors and increased Valid and Invalid cue RTs in the Affect condition only.

5.1. Faster RTs for CWS and CWNS in response to Valid cues

Both preschool-age CWS and their CWNS peers exhibited faster responses in Valid than Invalid cue trials, a finding consistent with previous research (Eckstein, Shimozaki, & Abbey, 2002; Fox, Russo, & Dutton, 2002; Perchet & Garcia Larrea, 2000; Posner, 1980; Posner & Petersen, 1990). For both CWS and CWNS the Valid cues facilitated faster responding regardless of whether affect was manipulated. This preliminary finding supports the feasibility of using this task with preschool-age children who do and do not stutter.

This finding is consistent with a limited capacities model of attention (Kahneman, 1973; Spaulding et al., 2008), which proposes that attentional resources are divided between activities based on task demands. It appears that for both talker groups, Valid cue trials place less stress on attentional processes since all attention is oriented toward one location. However, Invalid cues appear to place demand on attentional processes, since attention must be distributed between two locations—the location of the cue and the location of the target.

Thus on Invalid cue trials one must inhibit an initial response to disengage and shift attention to the opposing location (Posner & Cohen, 1984). One would think that for a child with less efficient ability to regulate attentional processes this process would prove to be challenging. However, from the present RT finding, regulating attention does not appear to be significantly more challenging for preschool-age CWS than CWNS. This finding is inconsistent with results of previous studies, based on parent reports on standardized tests, that there are differences in attention processing skills between CWS and CWNS (e.g., Anderson et al., 2003; Eggers et al., 2010; Karrass et al., 2006). Present findings of no differences between CWS and CWNS in orienting attention is also inconsistent with Eggers et al. (2012) who did report between group differences in orienting attention. The contradiction between the two studies could be explained by differences in methodology in that efficiency in orienting attention were measured in different ways—the present study using a Posner Cueing Task (based on cueing RT) and the other using the Attention Network Test (based on cueing RT and a flanker task; for further discussion, see Fan, McCandliss, Sommer, Raz, & Posner, 2002). Contradictory findings could also be explained by a much larger (CWS: $n = 41$, CWNS: $n = 41$) and older (4;0–9;0) sample of participants. Perhaps, if the present study included a sample similar to that used in the Eggers et al. (2012) study findings may have been more consistent.

5.2. No RT between-group differences when affect was manipulated

Contrary to hypotheses, there was no between-group difference in RT when affect was manipulated. Basing our speculation on previous findings (Perez-Edgar & Fox, 2005; Perez-Edgar et al., 2006) with other disordered populations (i.e., Attention Deficit-Hyperactive Disorder, Depression, respectively), it was hypothesized that manipulating affect prior to the cueing task would have a greater influence on the performance of preschool-age CWS, than their CWNS peers, resulting in slower Invalid RTs and, as a result, an increased validity effect. Based on previous studies with similar methodology—albeit with much older children (i.e., Perez-Edgar & Fox, 2005; Perez-Edgar et al., 2006)—for populations shown to have less efficient regulation of attentional processes (i.e., CWS; Karrass et al., 2006), manipulating affect prior to the cueing task was predicted to pose difficulty in efficiently allocating attentional resources as needed.

It could be that preschool-age CWS may not have less developed regulation of attentional processes, at least for the tasks used in the present study. However, findings based on parent-reports (Anderson et al., 2003; Craig et al., 2003; Eggers et al., 2010; Embrechts et al., 2000; Felsenfeld et al., 2010; Karrass et al., 2006; Vanryckeghem et al., 2001; Wakaba et al., 1998), behavioral observations of young (Bush, 2006; Johnson et al., 2010; Karrass et al., 2006; Schwenk et al., 2007) and older preschool-age children (Eggers et al., 2012) as well as attention regulatory abilities of adults (Bosshardt, 1999, 2006; Bosshardt et al., 2002; Heitmann et al., 2004; Smits Bandstra et al., 2006) contradict this conclusion. It is more than likely the case that the affect manipulation associated with the cueing task, as used in the present study, did not provide a substantial amount of arousal to influence affect-related reaction times. This reasoning is based on previous findings in affect-manipulated Posner tasks (Perez-Edgar & Fox, 2005; Perez-Edgar et al., 2006), which report dramatic decreases in RTs and increased validity effects, which were not reduplicated in our current control group. For the present study, this explanation would mean that for the actual task, both conditions (Traditional and Affect cueing tasks) would have been perceived by the participants as being the same. As a result, the data for the present study would also appear very similar. In other words, data would suggest no between-group differences or between condition differences when affect was manipulated. This is also apparent with visual inspection of the RT data (see Fig. 3).

5.3. No between group differences in errors when affect was manipulated

The third main finding, contrary to hypotheses, indicated no difference in the frequency of errors produced by either CWS or CWNS in either condition. No between-group differences in the present study could simply be interpreted to mean that perhaps there are no differences in AR abilities of preschool-age CWS and CWNS, at least using the present task. Alternately, finding no between-group differences in errors could be contributed to methodological concerns with adapting this task to preschool-age participants, when compared to other studies using similar tasks with school-age children (e.g., Perez-Edgar and Fox, 2005; Perez-Edgar et al., 2006).

5.4. Correlation between increased errors and increased RTs

The fourth and final main finding was that for both CWS and CWNS positive correlations only existed between increased Omission errors and increased Valid and Invalid cue RTs in the Affect condition, but not the Traditional condition. Thus, this preliminary finding appears to suggest that manipulation of affect influences or motivates preschool-age children to monitor the speed (RT) and accuracy (errors) of their non-speech (button-pushing) motoric responses.

A child's ability to self-regulate has been linked to the ability to monitor error production, considered to be a precursor to the development of inhibitory control (i.e., Jones, Rothbart, & Posner, 2003; Posner & Rothbart, 1998). Specifically, as an individual detects an error, he or she may slow down to reduce future errors. This adjustment is thought to provide a balance between accuracy and speed of responding (Fernandez-Duque, Baird, & Posner, 2000). Based on the present experimental methodology, CWS and CWNS appear roughly comparable in their ability to make Omission errors and adjust their speed of responding when affect is induced, in this case by the experimental instructions. So, although preliminary, present findings do seem to suggest that regardless of talker group, affect, stress or motivation influence some aspects of preschool-age children's performance during an attention task, when compared to less affective-laden situations.

5.5. Caveats

5.5.1. Sample size—The participant sample size is relatively small for both talker groups (CWS: $n = 12$ and CWNS: $n = 12$). Power analysis data previously reported in the present study, based on data from Perez-Edgar and Fox (2005) suggested a need for a rather larger sample size per group ($n = 8-56$), which posed a significant challenge to the current study, particularly for CWS. Indeed, Perez-Edgar and Fox (2005) did not use sample sizes of 56 per talker group (Group A: 29 children/Group B: 31 children), but did find significant differences in cueing conditions. Failure to find similar findings in the present study could be the result of this stark difference in sample size.

5.5.2. Age—The present study included participants between the ages of 3;0 (years; months) and 5;11. Methodology in the present study was modeled after Perez-Edgar et al. (2006), which found differences between a control sample and an attention-disordered sample. Participants in Perez-Edgar et al. (2006) were 6–10 years; participants in Perez-Edgar and Fox (2005) were 7 years of age. It may be the case that the preschool-age participants in the present study were too young to replicate findings that the affect-influencing directions influenced performance. It would be interesting to determine whether older, for example, school-age, CWS and CWNS might exhibit differences similar to those reported in other areas (e.g., Perez-Edgar et al., 2006).

5.5.3. Methodology—The cueing task for the present study was modified to suit preschool-age children. Previous studies have used simpler, but perhaps more abstract, less

engaging methods. For example, Perez-Edgar and Fox (2005) used a blue-outlined box as the cue and a white box as the target for 7-year-olds while Perchet and Garcia Larrea (2000) used a yellow-outlined box as the cue and a red star as the target with school-age children. Both studies used a black cross as the fixation point. The present study, however, used a fictional character face as the fixation point and a common snack as the target. It may be the case that between-group differences in RT were not observed because the task was more concrete, overly easy and/or appealing, reducing the influence of negative affect.

Present methodology also included a “green stop light” as a preparatory signal presented prior to each target to signal the child to get ready, as has been used in other RT methods with young children who stutter (Anderson & Conture, 2004; Byrd et al., 2007; Hartfield & Conture, 2006). It could be the case that the green light implied an accurate response for each response instead of merely a preparatory signal.

Although affect-influencing instructions were piloted and in line with previous studies, it could be that the experimenter's instructions to the child did not create sufficient emotional arousal. The instructions were paired with the picture of a star symbolizing the end of both tasks, which may have sent a contradictory message to the child. Presenting a star at the conclusion of each task may have suggested to the child that he performed the task well regardless of the affect-influencing instructions. In other words, although the affect-influencing instructions indicated that the child did not perform well during the Traditional cueing task, the star may have suggested otherwise.

6. Conclusion

Present preliminary findings, based on one experimental paradigm, do not support the notion that preschool-age CWS are less able to regulate their attention than preschool CWNS. This finding is not consistent with results of other empirical studies investigating the relation among attention, emotion, and childhood stuttering (e.g., Anderson et al., 2003; Eggers et al., 2012; Embrechts et al., 2000; Felsenfeld et al., 2010; Karrass et al., 2006). Of course, most of these studies were based on parent reports—with the exception of Eggers et al. (2012)—whereas the present findings were based on children's response speed and accuracy during an experimental task thought to manipulate attention. Perhaps, therefore, in the context of the present methodology preschool-age CWS experience little or no challenge in AR. However, given the novelty of the methodological approach with preschool-age CWS, it would seem prudent for future studies to replicate the present study taking into consideration the caveats noted above.

Empirical findings of others indicate that attention and its regulation are associated with stuttering, but the nature of that association is still unclear and the circumstances surrounding that association remain poorly understood. It is hoped that future experimental studies, like the present preliminary one, will shed light onto the possible role that AR plays in childhood stuttering. Until such future time, however, the role of AR, like others thought to be related to childhood stuttering, remains uncertain but nonetheless very intriguing.

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Appendix A. Continuing education questions

1. Attention regulation is a component of and is not synonymous with emotion regulation.
  - a. True.
  - b. False.
2. Which of the following is not true regarding attention regulation.
  - a. Attention regulation includes allocating attentional process in response to a challenging situation
  - b. Includes attention focusing, attention shifting and distractibility
  - c. Begins to develop in early adulthood
  - d. All of the above are true.
3. The Posner Cueing Task assesses only one aspect of attention regulation – attention shifting.
  - a. True.
  - b. False.
4. According to the present study, which of the following is true
  - a. Both CWS and CWNS exhibited faster reaction times in response to valid trials rather than invalid trials
  - b. CWS exhibited faster reaction times in the valid and invalid trials when compared to CWNS
  - c. CWS exhibited slower reaction times in the valid and invalid trials when compared to CWNS
  - d. Both CWS and CWNS exhibited slower reaction times in response to valid trials rather than invalid trials.
5. The present study reported no between group differences in reaction time when affect was manipulated.
  - a. True.
  - b. False.

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Fig. 1.
Components of visual-spatial attention assessed during the Posner Cueing Task.

Fig. 2.

Outline of experimental design for both trial types (i.e., valid and invalid trials) during both the Traditional and Affect cueing tasks. Cue: yellow square frame. Target: “cookie” (within square frame during valid trials, opposite side of cue during invalid trials). The fixation point was a cartoon face similar to clip art positioned in the middle of the computer screen. Latency of the non-speech, motor response of button-pushing (reaction time, RT) – from onset of target to onset of button response – was measured in milliseconds (ms). From onset of target, participant had 3000 ms to respond (i.e., push button); a new cue – target combination begins upon participant button-pushing response. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 3. Reaction time (ms; $\pm$ std error) for both talker groups during the *Traditional* cueing condition and the *Affect* cueing condition.

Fig. 4. Validity difference (Invalid RT-Valid RT) for both CWS and CWNS across both conditions (Traditional and Affect).

Fig. 5.
Mean overall errors for both CWS and CWNS in both conditions (Traditional and Affect).

Fig. 6.
Correlations between RT and errors by type for the Traditional condition and Affect condition.