



## Autonomic nervous system activity of preschool-age children who stutter



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### ABSTRACT

**Purpose:** The purpose of this study was to investigate potential differences in autonomic nervous system (ANS) activity to emotional stimuli between preschool-age children who do (CWS) and do not stutter (CWNS).

**Methods:** Participants were 20 preschool-age CWS (15 male) and 21 preschool-age CWNS (11 male). Participants were exposed to two emotion-inducing video clips (negative and positive) with neutral clips used to establish pre- and post-arousal baselines, and followed by age-appropriate speaking tasks. Respiratory sinus arrhythmia (RSA)—often used as an index of parasympathetic activity—and skin conductance level (SCL)—often used as an index of sympathetic activity—were measured while participants listened to/watched the audio–video clip presentation and performed a speaking task.

**Results:** CWS, compared to CWNS, displayed lower amplitude RSA at baseline and higher SCL during a speaking task following the positive, compared to the negative, condition. During speaking, only CWS had a significant positive relation between RSA and SCL.

**Conclusion:** Present findings suggest that preschool-age CWS, when compared to their normally fluent peers, have a physiological state that is characterized by a greater vulnerability to emotional reactivity (i.e., lower RSA indexing less parasympathetic tone) and a greater mobilization of resources in support of emotional reactivity (i.e., higher SCL indexing more sympathetic activity) during positive conditions. Thus, while reducing stuttering to a pure physiological process is unwarranted, the present findings suggest that the autonomic nervous system is involved.

**Educational Objectives:** The reader will be able to: (a) summarize current empirical evidence on the role of emotion in childhood stuttering; (b) describe physiological indexes of sympathetic and parasympathetic activity; (c) summarize how preschool-age children who

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stutter differ from preschool-age children who do not stutter in autonomic activity; (d) discuss possible implications of current findings in relation to the development of childhood stuttering.

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## 1. Introduction

The association between emotional processes and developmental stuttering has attracted increasing interest over the past decade (e.g., Anderson, Pellowski, Conture, & Kelly, 2003; Arnold, Conture, Key, & Walden, 2011; Choi, Conture, Walden, Lambert, & Tumanova, 2013; Eggers, De Nil, & Van den Bergh, 2009, 2010, 2012; Felsenfeld, van Beijsterveldt, & Boomsma, 2010; Johnson, Walden, Conture, & Karrass, 2010; Karrass et al., 2006; Ntourou, Conture, & Walden, 2013; Schwenk, Conture, & Walden, 2007; Walden et al., 2012). Recent reviews of the literature have concluded that there may be a relation between the two (for review, see Jones, Choi, Conture, & Walden, 2014; Kefalianos, Onslow, Block, Menzies, & Reilly, 2012). Despite inconsistencies in the literature, there are also consistencies. For example, reviews noted that preschool-age children, who stutter (CWS) compared to children who do not stutter (CWNS), exhibit (1) less adaptability, (2) poorer attention span/persistence and attention regulation, and (3) more negative mood. Although these findings do not indicate whether emotions are causes or the consequences of stuttering, they provide replicated support for an association between emotional state regulation and childhood stuttering.

### 1.1. Emotion and stuttering

#### 1.1.1. Emotions and childhood stuttering

Studies using caregiver report questionnaires documented that CWS, compared to CWNS, displayed: (a) less temperamental adaptability, distractibility, and rhythmicity (Anderson et al., 2003), (b) increased reactivity and greater difficulty regulating emotions (Karrass et al., 2006), (c) poorer attention regulation skills (Felsenfeld et al., 2010; Karrass et al., 2006), skill implicated in emotion regulation (Rothbart, Ahadi, & Evans, 2000), and (d) less inhibitory control and attention shifting, as well as greater anger/frustration (Eggers et al., 2010). In contrast, Lewis and Golberg (1997) found that CWS were less negative in their emotions and more adaptable than CWNS. Despite some incongruence, taken as a whole these findings provide building evidence that CWS versus CWNS display consistent differences in a variety of emotion-related processes.

Using direct observation of behavior or experimental testing, researchers report that preschool-age CWS, compared to CWNS, exhibited: (a) difficulty habituating to irrelevant background stimuli (Schwenk et al., 2007), (b) more negative emotional expressions in a disappointing gift procedure (Johnson et al., 2010) and during neutral and frustrating conditions (Ntourou et al., 2013), (c) less efficiency of the orienting subsystem of the attentional system (Eggers et al., 2012; cf. Johnson, Conture, & Walden, 2012), and (d) poorer inhibitory control during a Go/NoGo task (Eggers, De Nil, & Van den Bergh, 2013).

Within-group behavioral observations have indicated that increases in CWS's stuttering are related to: (a) decreased duration and frequency of behavioral regulatory strategies (Arnold et al., 2011), (b) increased emotional reactivity concurrent with decreased regulation (Walden et al., 2012), (c) negative emotion prior to and during utterances (Jones, Conture, & Walden, 2014), particularly following positive conditions (Johnson et al., 2010; Jones, Conture, et al., 2014). In contrast, CWS's stuttering frequency was lower during narratives that followed diverting attention away from preceding non-speech tasks (Ntourou et al., 2013). Further, more behaviorally inhibited CWS (i.e., children exhibiting strong reactions to novelty or change), when compared to less behaviorally inhibited CWS, exhibited more stuttering during a conversation with an unfamiliar experimenter (Choi et al., 2013). These behavioral observations provide insights into CWS' emotional responding to specific challenging situations, as well as concomitant changes in speech fluency.

The above findings have resulted in a partial picture of the association between emotion and childhood stuttering. Including psychophysiological methods to assess the two branches (i.e., parasympathetic and sympathetic) of the autonomic nervous system (ANS) may increase our understanding of this association in preschool-age CWS. Measures of autonomic activity would provide an important feature of emotional reactivity and regulation and possibly identify covert indicators that may precede, follow, or act concurrently with more overt expressions of emotion. Since much of the empirical evidence regarding emotion and childhood stuttering comes from parent-report and behavioral observations, a psychophysiological perspective is largely lacking (cf. Arnold et al., 2011). This dearth in knowledge, in part, motivated the present study.

#### 1.1.2. Autonomic nervous system activity of adults who stutter

Despite the lack of knowledge about ANS activity of preschool-age CWS, psychophysiological concomitants of stuttering in adults have been empirically studied for several decades (e.g., Alm & Risberg, 2007; Fletcher, 1914; Gray & Karmen, 1967; Reed & Lingwall, 1980). Methods have varied considerably as technology and theories have advanced, which may, in part, contribute to a lack of consistent evidence that psychophysiological factors are associated with stuttering. For example, although adults who stutter often report anxiety about stuttering (e.g., Craig, 1990; Craig, Hancock, Tran, & Craig, 2003), this is not always associated with increases in autonomic arousal (e.g., Dietrich & Roaman, 2001). This is particularly evident in recent investigations, which have reported heart rate increases either prior to or during speech for both adults who stutter

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