

## ABSTRACT

The present study examined the ability to regulate attention as a possible contributor to stuttering. Four adults who stuttered (AWS) and four adults who did not stutter (AWNS) had their ECG signals recorded during three tasks: passively viewing a film clip, reading rapidly-scrolling text, and responding during a Go/NoGo task. Attention regulation was defined as the ability to release vagal influence on the heart, as indexed by increases in sympathetic-vagal balance (SVB). Results indicated that from viewing the film to reading the text, SVB increased for 25% of AWNS and 50% of AWS. On the Go/NoGo task, AWNS exhibited faster response times (455 ms) than AWS (611 ms), with RTs being negatively related to SVB. Results suggest that AWS utilize relatively more resources for attention regulation, which, during speaking, may lead to communicative performance decrements.

## INTRODUCTION

Attention is an important, though finite, resource that can be used to capture relevant information for (a) planning an utterance (Glover, 2004), (b) to maintain information in working memory (Baddeley, 2003), and (c) to monitor one's own speech (Ooman & Postma, 2002). Difficulties regulating attention may therefore contribute to stuttering, particularly during times of social or linguistic stress (e.g., Conture, 2008). Consistent with this view, Bosshardt (2002) has found evidence that the speech of AWS may be vulnerable to interference from concurrent cognitive processing.

Vagal tone, or para-sympathetic influence on heart rate variability (HRV), has been speculated to be an index of attentional or cognitive effort (Porges, 2007). As such, the balance between sympathetic and vagal (SVB) components of HRV can be used to assess attention regulation. *Increases in SVB on attention-demanding tasks would indicate appropriate release of vagal control of the heart during challenging situations.* Therefore, it was hypothesized that fewer AWS than AWNS would show an increase in SVB on attention-demanding tasks, and that lower levels of SVB would be related to poor performance.



# Sympathetic-Vagal Balance, Attention Regulation, and Adults who Stutter: Preliminary Findings



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## METHOD

**Participants:** Four AWS with no history of language, speech, or attentional problems and four AWNS participated.

**Equipment:** Ag/AgCl electrodes were placed at the superior jugular notch of the rib cage and below the lower rib on the left side of the body. The Biopac MP150 system (Biopac Systems, Inc.) was used for transduction of ECG signals, which were digitized at 500 Hz.

**Procedure:** Participants took part in three 5-min. tasks while ECG signals were acquired. Participants (a) viewed a clip from the movie "Laura", (b) read rapidly-scrolling text, and (c) took part in a Go/NoGo task (Verbruggen, et al., 2008). Participants had to press a key as quickly as possible in response to a shape, although to inhibit a response if a tone was also presented (25% of trials).

**Analysis:** Biopac Acqknowledge software was used to compute the power spectrum density (PSD) of the heart period intervals. Sympathetic (low frequency) and vagal (high frequency) components of PSD were used to compute sympathetic-vagal balance (SVB) on each of the three tasks. SVB was 1) compared between the film and the text to determine if vagal influence on HRV was released for attention-demanding tasks, and 2) correlated to response time during the Go/NoGo tasks to determine if vagal influence on the heart aided reaction times.

### Sympathetic-Vagal Balance (SVB)

AWNS	Film	Text	Direction
1	2.97	2.67	↓
2	8.99	3.31	↓
3	2.31	2.09	↓
4	1.06	1.21	↑

AWS	Film	Text	Direction
1	3.28	8.94	↑
2	2.19	1.22	↓
3	2.35	1.00	↓
4	1.28	2.16	↑

Table 1

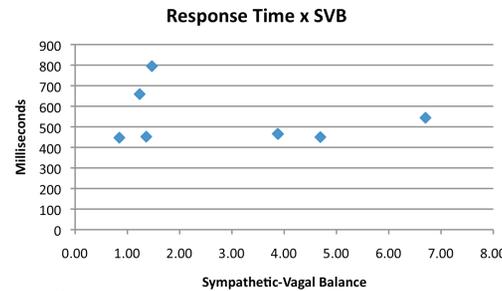


Figure 1

## RESULTS

- 1) SVB decreased, from film to reading, for 75% of AWNS and for 50% of AWS (Table 1).
- 2) Mean reaction time on Go trials was 458 ms for AWNS, while it was 611 for AWS.
- 3) Reaction time on Go trials was negatively related to SVB during Go trials for all 8 participants,  $r = -0.28$  (Figure 2).

## DISCUSSION

### Main Finding #1:

SVB increased for more AWS than AWNS from the baseline film-viewing condition to the more attention-demanding reading condition. This finding suggests that either AWS were better able to regulate attention by releasing vagal influence on the heart, or that the two conditions did not differ with respect to attention demand.

### Main Finding #2:

Consistent with other RT studies, AWS exhibited slower RTs than AWNS. AWS may have been less able to divide their attention between initiating responses on Go trials versus listening for tones during Stop trials.

### Main Finding #3:

Figure 1 shows that two of the AWS who exhibited lower levels of SVB also exhibited slower response times. These individuals may have been less able to reduce vagal influence on the task in order to respond automatically and/or efficiently during Go trials.

## Conclusion

Findings were taken to suggest that, to the extent that the release of the "vagal brake" (i.e., lower vagal, higher sympathetic) allows an individual to prepare for challenging situations, the text-reading task was not more demanding than viewing the film.

Perhaps the slower RTs of AWS may reflect that AWS are relatively more concerned about incorrectly responding to No/Go trials, and thus more vigilant overall, that is, they exhibited greater vagal tone. As a result, AWS may have been unable to respond to Go trials efficiently.

If, with other paradigms using tasks with larger sample size, more AWS than AWNS are shown to exhibit greater levels of vagal tone, this may suggest greater hyper-vigilance and/or over-monitoring for AWS, a type of self-regulation that may contribute to disruptions in their fluency.

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