**Introduction**

- It has been suggested that cluttering and stuttering are related fluency disorders, with different output characteristics.
- The Covert Repair Hypothesis (CRH; Postma & Kolk, 1993) may also be relevant to cluttering, and to the dissociation of the two disorders.
- In the CRH, stuttering disfluencies are suggested to be side effects of internal repairs of errors generated during phonological encoding.
- A variation of the CRH, the Vicious Circle Hypothesis (VCH; Vasic & Wijnen, 2005) hypothesizes that the disfluencies are the result of a faulty speech monitor attempting to repair errors that are not actually present.
- Speech errors in stuttering may arise because of lack of planning time, possibly related to phonological encoding (Van Zaalen et al., 2009).
- People who stutter (PWS) have been shown to be slower on a phoneme monitoring task, suggesting pre-articulatory problems at the level of phonological encoding (Sasisekaran et al., 2006).
- The purpose of this study was to determine if the phonological manipulation abilities of people who stutter (PWC) are different than that of controls and of PWS.
- We hypothesized that cluttering may be reflective of a reduction in internal speech monitoring due to deficient phonological encoding and/or pre-articulatory monitoring.
- Due to ‘hypomonitoring,’ errors in the speech plan would not be detected pre-articulatorily and therefore make their way to the final output, resulting in more errors during a phoneme monitoring task.
- This covert speech task requires completion of the phonological encoding step and invoking the internal speech monitor, as participants must silently scan the phonological code to decide if a sound is present.

**Methods**

<table>
<thead>
<tr>
<th>Participants</th>
<th>Mean Age</th>
<th>Males/Females</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWC (n=7)</td>
<td>27.6</td>
<td>1/6</td>
<td>93.9</td>
</tr>
<tr>
<td>PWS (n=14)</td>
<td>31.6</td>
<td>10/4</td>
<td>64.6</td>
</tr>
<tr>
<td>Controls (n=19)</td>
<td>28.2</td>
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</tbody>
</table>

**Pre-tests**

- Participants completed subtests from the Psycholinguistic Assessments of Language Processing in Aphasia (PALPA, 1992).
- Auditory Repetition of Words and Nonwords (9), Rhyme Judgment (15), Repeating Initial Sounds (16), Phonological Segmentation of Final Sounds (17), and Picture Naming (53).

**Phoneme Monitoring**

- Tasks were a partial replication of Sasisekaran et al. (2006).
- Participants monitored for the presence of a target phoneme (e.g./ba/) during silent picture naming.
- Participants were familiarized with the words and named them correctly prior to the experiment.
- 28 bisyllabic words were used, with the target phoneme occurring in one of four positions, CVC/CVC (e.g. /piggyp/).
- Phonemes to monitor: /p/, /t/, /k/, /b/, /d/, /g/, /m/, /n/, /s/, /l/.
- Which were balanced among position within the words.

**Auditory Monitoring**

- This task was developed to closely approximate the phoneme monitoring task.
- Participants monitored for a tone among a sequence of four tones using a similar procedure as in the phoneme detection task.
- Assessed general auditory monitoring.

**Simple Motor Task**

- Participants pressed the spacebar as soon as a tone was presented.
- Allowed us to rule out any basic motor response differences between groups.

**Results**

**PALPA Tests**

- PWC’s performance was not significantly different from that of controls.
- A main effect of Group was found for PALPA 9: Words (F(2,36) = 3.959, p = 0.028), PWS scored significantly lower (M=79.6, SD=5.0) than controls (M=79.9, SD=0.23; p = 0.046).
- A main effect of Group was found for PALPA 14: Words (F(2,36) = 9.75, p = 0.003), PWS performed significantly worse (M=32.7, SD=2.7) than controls (M=35.7, SD=1.9; p = 0.003).
- PWS also performed worse than PWC (M=35.3, SD=2.3) although this did not reach significance (p>0.05).
- A main effect of Group was found for PALPA 17 (F(2,36) = 4.882, p = 0.013), PWS (M=43.9, SD=1.5) performed significantly worse than controls (M=44.9, SD=0.3; p=0.012).

**Phoneme Monitoring**

**Reaction Time**

- Main effect of Group was not significant (F(2, 37) = 0.503, p = 0.609), indicating similar performance on this task for each group (PWC: M=729ms, SD=172; Controls: M=765ms, SD=204).

**Accuracy**

- Main effect of Group was not significant (F(2, 37) = 0.291, p = 0.749), indicating similar performance across groups on both tasks.
- Similarly, no main effect of Group was found for error rate during picture naming (F(2, 36) = 0.296, p = 0.745), or for simple motor task (F(2, 37) = 0.094, p = 0.911) again indicating similar performance across all groups on both tasks.

**Discussion and Conclusions**

- We replicated the findings of Sasisekaran et al. (2006) by demonstrating that PWS have numerically slower reaction times than controls during phoneme monitoring, but not on an auditory monitoring or a simple motor task.
- Contrary to Sasisekaran et al. (2006), PWS in this study did make significantly more errors than controls during phoneme monitoring.
- Results offer support for both CRH and VCH. As PWS exhibited delayed as well as erroneous phonological encoding/monitoring.
- PWC performed nearly identically to controls on all tasks with regard to timing and accuracy.
- Conclude that PWC do not have a deficit with regard to the phonological encoding and/or monitoring of their internal speech plan and that this is not the cause of the errors in their final output.
- Does not rule out planning deficits before/after phonological encoding, deficits in phonological encoding of longer utterances, or lexical access deficit in natural conversation.

**References**


The authors would like to thank the National Stuttering Association for permission to recruit participants from their support groups. We also thank Megan Elledge, Taylor Hanaylik, Adina Raizen, and Tori Sharpe for their assistance.

**Auditory Monitoring**

- Main effect of Group was not significant (F(2, 37) = 0.503, p = 0.609), indicating similar performance on this task for each group (PWC: M=729ms, SD=172; Controls: M=765ms, SD=204; Figure 4).

- No main effect of Group was found for naming latency of target photos (F(2, 35) = 0.740, p = 0.484), or for simple motor task (F(2, 37) = 0.180, p = 0.885), indicating similar performance across groups on both tasks.
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**Naming and Simple Motor Task**

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