Phonological Processing Abilities of Adults who Stutter

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Disclosure Statements

Kristin M. Pelczarski, Ph.D., CCC-SLP
No financial or nonfinancial interests to disclose relating to this research.

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Psycholinguistic Theories

- Fault Line Theory (Wingate, 1988)
- Neuropsycholinguistic Theory (Perkins, Kent & Curlee, 1991)
- Covert Repair Hypothesis (Postma & Kolk, 1993)
- EXPLAN (Howell & Au Yeung, 2002)
- Suprasegmental Sentence Plan Alignment (Karniol, 1995)
Phonological Encoding

- Phonological encoding may play a role in stuttering
- Not a directly observable process
- Observation of phonological processing skills can provide another way to access phonological encoding
Phonological Processing

- Phonological Awareness
- Phonological Memory
- Rapid Naming
Phonological Processing

- **Phonological Awareness**: Ability to identify, isolate, and manipulate various sized segments of language (e.g., words, syllables, phonemes)
- **Phonological Memory**: Ability to maintain phonological and auditory information for short-term retrieval
- **Rapid Automatic Naming**: Ability to rapidly retrieve coded phonetic information by converting orthographic symbols into meaningful strings of phonemes
Phonological Awareness - Adults

- **No differences reported**
  - Burger and Wijnen (1999)
  - Hennessey, Nang and Beilby (2008)

- **No differences in accuracy, but significant differences in speed of performance**
  - Bosshardt and Franssen (1996)
  - Sasisekaran and De Nil (2006)
  - Sasisekaran, de Nil, Smyth and Johnson (2006)
  - Weber-Fox, Spencer, Spruill and Smith (2004)
  - Wijnen and Boers (1994)
Phonological Memory- Adults

- Significant differences in accuracy and ability to improve repetition with practice
  - Bosshardt (1993)
  - Ludlow, Siren, & Zikira (1997)

- Significant differences in identifying and repeating nonwords
  - Hennessey et al. (2008)
  - Smith, Sadagopan, Walsh, & Weber Fox (2010)
  - Byrd et al. (2012)
Summary

- Reason to look at PE/PA due **inclusion in theoretical models**
- **Task implemented** in a number of studies
- **Differences were present**
- Further investigation warranted to determine extent of differences
- **Subtle nature**
General Hypothesis

Overall

- The majority of adults who stutter were predicted to perform within normal limits

- Between-group differences are expected to be significant despite this fact

- This is due to the subtle nature of linguistic differences in adults who stutter
Research Question #1

Question:

Do adults who stutter perform differently than nonstuttering adults on phonological awareness tasks?

Comprehensive Test of Phonological Processing (CTOPP) Phonological Awareness Composite tasks:

- Elision
- Blending
- Phoneme Reversal
- Segmenting Words
Research Question #2

Question:

Does the lexical status of the stimuli (i.e., real word or nonword) influence the performance of adults who stutter on phonological awareness tasks as compared to typically fluent adults?

CTOPP Alternate Phonological Awareness tasks:

- Segmenting nonwords
- Blending nonwords
Research Question #3

Question:
Are adults who stutter less accurate in the completion of phonological memory tasks compared to nonstuttering adults?

CTOPP Phonological Memory Composite tasks:
Memory for Digits
Nonword Repetition
Research Question #4

Question:
Do adults who stutter perform differently than nonstuttering adults on complex nonword repetition tasks?

Tasks:
- Nonword Repetition Task (NRT; Dollaghan & Campbell, 1998)
- Late-8 Nonword Repetition Task (L8NRT; Dollaghan & Campbell, 2003)
Participants

19 adults who stutter & 19 adults who do not stutter

Monolingual, Standard American English
No known hearing, language or neurological difficulties (except for stuttering)
Both male and females
Reflects 3:1 ratio of stuttering in the adult population
Age range: 21-50

Matched according to age, sex, and education levels
Phonological Processing Tasks

Phonological Awareness
- Lexical Stimuli - CTOPP
  - Elision
  - Blending words
  - Segmentation
  - Phoneme reversal

- Non-Lexical Stimuli - CTOPP
  - Blending
  - Segmentation

Phonological Memory
- CTOPP
  - Nonword repetition
  - Digit naming

- Nonword Repetition Task (NRT)
- Late-8 Nonword Repetition (L8NRT)

Rapid Automatic Naming
- CTOPP
  - Rapid color naming
  - Rapid object naming
  - Rapid letter naming
  - Rapid digit naming

Silent phoneme blending
  - Lexical decision task

Reaction-time lexical decision
Additional Tasks

- Hearing Screening
  - Pure-tone
- Speech Sample
  - Stuttering Severity Instrument (SSI-4)

- Vocabulary
  - Expressive (EVT)
  - Receptive (PPVT)

- Reading History/Exposure
  - Adult Reading History Questionnaire (ARHQ)
Results – Phonological Awareness

Research Question #1

- Do adults who stutter perform differently than nonstuttering adults on phonological awareness tasks?

Findings:

- Phonological Awareness tasks – LEXICAL (i.e., real word)
  - No significant between-group differences
Real Word Phonological Awareness

$t(17) = -1.639$

$p = .119$

$d = -.42$

No Significant Difference

- **Adults Who Stutter**
- **Adults Who Do Not Stutter**

Phonological Awareness Real Words
Research Question #2

Does the lexical status of the stimuli (i.e., real word or nonword) influence the performance of adults who stutter on phonological awareness tasks as compared to typically fluent adults?

Findings:

Alternate Phonological Awareness tasks—NONWORDS

Both groups scored lower on nonword tasks
Significant between-group differences
Lexicon was not able to assist in task completion
NonWord Phonological Awareness

$t (18) = -2.164$
$p = .022$
$d = -.42$

Significant Difference

- Adults Who Stutter
- Adults Who Do Not Stutter
Results – Phonological Memory

Research Question #3

Are adults who stutter less accurate in the completion of phonological memory tasks compared to nonstuttering adults?

Findings:

CTOPP Phonological Memory

Adults who stutter performed significantly lower than nonstuttering adults. Differences were only present on Nonword Repetition task, not digit naming.

Lexicon was not able to assist in task completion.
Phonological Memory Composite

$t(17) = -1.034$
$p = .158$
$d = -.36$
No Significant Difference

- Adults Who Stutter
- Adults Who Do Not Stutter

Phonological Memory Composite
Memory for Digits
$t(18) = 0.734$
$p = .472$
$d < 0.01$
No Significant Difference

NonWord Repetition
$t(17) = 3.157$
$p = .006$
$d = -.63$
Significant Difference

Phonological Memory Subtests

Adults Who Stutter

Adults Who Do Not Stutter
Results – Phonological Memory

Research Question #4

- Do adults who stutter perform differently than nonstuttering adults on complex nonword repetition tasks?

Findings:

- **Nonword Repetition Tasks**
  - Significant within group differences
    - L8NRT more difficult than NRT for each group
  - Significant between-group differences
    - Adults who stutter scored lower on:
      - NRT: Total Score, 2- & 3-syllables
      - L8NRT: Total Score, 2-, 3- & 4-syllables
Nonword Repetition Task

<table>
<thead>
<tr>
<th></th>
<th>Adults Who Stutter</th>
<th>Adults Who Do Not Stutter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>91.4</td>
<td>94.1</td>
</tr>
<tr>
<td>1 Syllable</td>
<td>98.2</td>
<td>96.5</td>
</tr>
<tr>
<td>2 Syllables</td>
<td>96.1</td>
<td>99.1</td>
</tr>
<tr>
<td>3 Syllables</td>
<td>96.8</td>
<td>98.8</td>
</tr>
<tr>
<td>4 Syllables</td>
<td>82</td>
<td>85.5</td>
</tr>
</tbody>
</table>

- **Total**
  - Adults Who Stutter: 91.4
  - Adults Who Do Not Stutter: 94.1
  - *t*(17) = -2.766
  - *p* = .013
  - *d* = -.73
  - Significant

- **1 Syllable**
  - Adults Who Stutter: 98.2
  - Adults Who Do Not Stutter: 96.5
  - *t*(17) = 1.567
  - *p* = .135
  - *d* = .45
  - NonSignificant

- **2 Syllables**
  - Adults Who Stutter: 96.1
  - Adults Who Do Not Stutter: 99.1
  - *t*(16) = -2.641
  - *p* = .017
  - *d* = -1.02
  - Significant

- **3 Syllables**
  - Adults Who Stutter: 96.8
  - Adults Who Do Not Stutter: 98.8
  - *t*(17) = -2.808
  - *p* = .012
  - *d* = -.76
  - Significant

- **4 Syllables**
  - Adults Who Stutter: 82
  - Adults Who Do Not Stutter: 85.5
  - *t*(18) = -1.717
  - *p* = .104
  - *d* = -.37
  - NonSignificant
Late-8 NonWord Repetition Task

<table>
<thead>
<tr>
<th>Syllables</th>
<th>Adults Who Stutter</th>
<th>Adults Who Do Not Stutter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>82.5 (87.3)</td>
<td>93.9 (94.3)</td>
</tr>
<tr>
<td>1 Syllable</td>
<td>88.7 (91.6)</td>
<td>86.5 (91.3)</td>
</tr>
<tr>
<td>2 Syllables</td>
<td>72.4 (79.2)</td>
<td></td>
</tr>
</tbody>
</table>

$t(18) = -2.871$
$p = .010$
$d = -.92$
Significant

$t(18) = -2.432$
$p = .026$
$d = -.70$
Significant

$t(18) = -2.293$
$p = .035$
$d = -.69$
Significant

$t(18) = -2.386$
$p = .029$
$d = -.77$
Significant
Adults who stutter scored lower than nonstuttering adults on tasks that used NONWORD stimuli, but not REAL WORD stimuli.

Suggests that adults who stutter rely heavily on top-down lexical knowledge to bolster potentially weak or delayed mechanisms.
Children who stutter (Pelczarski & Yaruss, 2008; Weber-Fox et al., 2008) score lower on phonological awareness tasks than nonstuttering peers.

Adults who stutter did not demonstrate this pattern with real word stimuli, but had reduced performance when nonword stimuli was used.

Indicates that phonological awareness abilities improve to some extent in adults who stutter, or that increases in vocabulary size (lexicon) facilitates the maintenance of the phonological code, masking differences present in adults.
Children and adults who stutter both perform differently from nonstuttering peers on nonword repetition tasks, but not digit span tasks. This difference persists across the lifespan.

Suggests that other mechanisms besides phonological memory may be different in people who stutter as compared to nonstuttering peers.

- Quality of the phonological representation
- Construction of the phonological representation
- Maintenance of the phonological representation
- Redintegration is the process by which pre-existing lexical semantic knowledge is used to supplement decaying or delayed phonological code.
Theoretical Implications

Provides strong empirical support for the current psycholinguistic theories of stuttering’s assertions that different or delayed phonological encoding skills contribute to stuttering.
Clinical Implications

- Subtle deficits in phonological awareness or phonological memory can be improved.

- Unpublished case studies report that children who stutter demonstrated reduced stuttering frequency after training in phonological awareness tasks (Byrd).

- More research is needed.
References


