The role of the *lexicon* in early identification and intervention for language and reading disabilities

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Research Goal

Elucidate causal mechanisms underpinning language and reading disabilities

Improve early identification and intervention for children at risk for language and reading disabilities
Research Goal

- Elucidate causal mechanisms underpinning language and reading disabilities

- Improve early identification and intervention for children at risk for language and reading disabilities

- The lexicon
Big Issue #1

Poor readers are not identified until they begin learning how to read
Big Issue #1

- Poor readers are not identified until they begin learning how to read
  - Reading tests don’t identify poor readers until 1st grade and beyond

Solution: Measure precursors to reading
Big Issue #2

Precursors to reading
  – Phonological awareness & vocabulary
    Good sensitivity
    Poor specificity (Heath & Hogben, 2004)

Solution:
  – Use theory and data to create better tests of precursors
Simple View of Reading

Framework for understanding components of reading
The Simple View of Reading
(Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990)

Reading Comprehension
The Simple View of Reading

(Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990)

Reading Comprehension

Word Recognition
The Simple View of Reading
(Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990)

Reading Comprehension

Word Recognition

Listening Comprehension
To improve early identification of reading impairment…

Need to examine precursors to
  – Word recognition
  – Listening Comprehension

Use theory to create better tests of these precursors
  – Good sensitivity and good specificity
Could the lexicon be the key to early identification and intervention for all poor readers?
The Simple View of Reading

Reading

Word Recognition

Listening

Comprehension

Lexicon
Lexical Entry
Lexical Entry
Lexical Entry

Form representation
Lexical Entry

Form representation

/p/ /l/ /e/ /n/
Lexical Entry

Form representation

/p/ /l/ /e/ /n/

/plen/
Lexical Entry

Form representation → Semantic representation

/plen/
Lexical Entry

Form representation

/p/ /l/ /e/ /n/

/plen/

Semantic representation

*Flying object*

*Carries people and cargo*
Lexical Entry

Form representation

/p/ /l/ /e/ /n/

/plen/

Semantic representation

Flying object

Carries people and cargo
The Simple View of Reading
& the Lexicon

Reading

Form Representation

Word Recognition

Listening

Comprehension
The Simple View of Reading & the Lexicon

Reading

Form Representation
Word Recognition

Semantic Representation
Listening
Comprehension
Advantages to the Lexicon and Early ID

The lexicon
- Maps to Simple View components
- Develops early and is easy to measure

Theories related to the lexicon and…
- Word recognition
  - Phonological awareness
- Listening comprehension
  - Vocabulary knowledge
Form representations and phonological awareness performance

Funded by the International Dyslexia Association
(General Grant; PI: Hogan)
The Simple View of Reading & the Lexicon

Form Representation

Word Recognition

Phonological awareness

Reading

Semantic Representation

Listening

Comprehension
Tests of phonological awareness have been used to identify children who will be at risk for reading impairment

- Example test: phoneme deletion

Over-identify good readers as having poor phonological awareness (Heath & Hogben, 2004)
- Poor specificity

Using data-driven, theory-based selection of phonological awareness test words is likely to improve early detection of reading impairment
Lexical Entry

Form representation

/p/ /l/ /e/ /n/  Sound-to-be-deleted

/plen/  Neighborhood density
Sound Sonority

- Sonority: resonant property that somewhat corresponds to its degree of constriction during production (Chin, 1996)

- Highly sonorous: more vowel-like
- Least sonorous: less vowel-like
Sonority Hierarchy

Least sonorous

- voiceless stops/affricates /p/
- voiced stops/affricates /d/
- voiceless fricatives /f/
- voiced fricatives /v/
- Nasal /m/
- Liquids /l/
- Glides /w/
- Vowels /a/

Most sonorous
Sonority and Phonological Awareness

- The higher the sonority of the sound, the more difficult it is to delete that sound from a word during a phonological awareness task (Yavas & Gogate, 1999)

- Example: wall vs. call

- Focus on individual sounds is in line with the phonological deficit hypothesis (Catts 1986, 1989; Elbro, 1996)
Neighborhood Density

- Neighbors differ by the subtraction, addition, or substitution of 1 phoneme

**Dense**

**Sparse**
Neighborhood Density and Phonological Awareness

Because words from dense neighborhoods have many neighbors, they contain more phonemic detail in order to differentiate one from another. Example

Deleting a sound from a word is easier when the word contains more phonemic detail
(Hogan, Bowles, Catts, Storkel, 2010; Metsala, 1999)

Focus on word as integrated whole is in line with the Lexical Restructuring Model (Metsala & Walley, 1998)
This study examined the impact of the sound-to-be-deleted and neighborhood density simultaneously.
Research Questions

1: Do phonological awareness deletion test words differing in the sonority of the sounds-to-be-deleted differ in accuracy?

Prediction:
Yes, words with low sonority sounds-to-be-deleted will be more accurate compared to words with high sonority sounds-to-be deleted.
Research Questions

2: Do phonological awareness deletion test words differing in \textit{neighborhood density} differ in accuracy?

Prediction:

Yes, words from \textit{dense neighborhoods} will be more accuracy compared to words from sparse neighborhoods.
Research Questions

3: Are their interactions between the sonority of the sound-to-be-deleted and neighborhood density?

Prediction:
Yes

words from dense neighborhoods will be most accurate regardless of the sonority of the sound-to-be-deleted

words from sparse neighborhoods with low sonority sounds-to-be-deleted will be more accurate than words from sparse neighborhoods with high sonority sounds-to-be-deleted
Methods
Participants

- Typically developing 5- & 6-year-olds ($n = 13$)
- Enrolled in kindergarten ($M = 70$ months, $SD = 5$)
- Middle to high socioeconomic status
- English only speakers
- No history of speech and/or language impairment
- Normal language skills
  - Expressive vocabulary ($M=109$, $SD=16$)
  - Receptive vocabulary ($M=110$, $SD=14$)
  - Nonverbal IQ ($M=118$, $SD=17$)
  - Phonological awareness ($M=107$, $SD=16$)
  - Literacy knowledge ($M=111$, $SD=8$)
Task

- Phoneme Awareness Deletion Task
  - CVC words initial sound deletion
    - Remaining sounds created a VC real word
  - Presented via computer
  - Picture support

- Why Phoneme Deletion Task?
  - Consistently best phonological awareness predictor of reading (e.g., Torgesen, Wagner, & Rashotte, 1994)
  - Neighborhood density is phoneme-based metric
Deletion Task

- 20 high frequency test words:
  - Varied by 1) sound sonority
    2) neighborhood density

- Most sonorous - Dense neighborhood density
- Least sonorous - Dense neighborhood density
- Most sonorous - Sparse neighborhood density
- Least sonorous - Sparse neighborhood density
## Initial Deletion Task

<table>
<thead>
<tr>
<th>High sonority – Dense</th>
<th>High sonority – Sparse</th>
</tr>
</thead>
<tbody>
<tr>
<td>wall</td>
<td>wheel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low sonority – Dense</th>
<th>Low sonority – Sparse</th>
</tr>
</thead>
<tbody>
<tr>
<td>cat</td>
<td>coat</td>
</tr>
</tbody>
</table>
Results
Results

Accuracy

- high sonority
- low sonority

Neighborhood Density

dense
sparse
Implications for Findings

- Supports both neighborhood density and sonority of sound-to-be-deleted as metrics for test word difficulty
Future Directions

- Just the beginning....
  - Big question for future work: Can these item characteristics be used to construct more sensitive tests of phoneme awareness for the detection of reading risk?
  - Can phonological and lexical knowledge be changed to result in better phoneme awareness and, in turn, reading abilities?
Future Directions

Collecting more data to confirm trends and examine other influences on performance
- Picture vs. no picture support
- Real vs. nonwords
- Initial vs. final sound deletion
- Influence of letter knowledge
- Task: Phoneme deletion vs. odd-one-out
Future Directions

Examing the impact of form representations on phonological awareness performance

– Across development

(NIH/NIDCD 9667; PI: Hogan)
Future Directions

- Determine the utility of lexicon-based processing measures for *aligning with* and *predicting* reading component dissociations in poor reader subgroups
  - Examine word learning in subgroups
    (NIH NICDC 9667; PI: Hogan)
Poor Reader Subgroups
(Catts, Hogan, & Fey, 2003)

Reading Comprehension

Word Recognition

Dyslexia

Listening Comprehension
Poor Reader Subgroups
(Catts, Hogan, & Fey, 2003)

Reading Comprehension

Word Recognition

Listening Comprehension

Poor Comprehender
The Simple View of Reading & the Lexicon

- Reading
  - Form Representation
  - Semantic Representation
  - Word Recognition
  - Listening
  - Comprehension
Overall Summary

Study of the lexicon and its representations allows data-driven, theory-based inspection of reading component precursors.

Ultimate result:

improvement of early identification and intervention for those at risk for reading disabilities.
Other projects related to the lexicon & language and reading disabilities

- Word learning differences in poor reader subgroups (Gray, Hogan, Alt, Cowan, & Green, 2010)
  - Impact of working memory and bilingualism

- Orthographic influences on phonologically-based tasks (Hogan & Suddarath, 2010; Hogan, 2008)
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stop – vowel - stop
bat

stop – vowel - stop

pat

stop – vowel - stop
stop – vowel - stop

voiced stop – vowel - stop

stop – vowel - stop
stop – vowel - stop

→

voiced stop – vowel - stop

→

stop – vowel - stop

→

unvoiced stop – vowel - stop
bat

voiced stop – vowel - stop

pat

unvoiced stop – vowel - stop