Technology-based tools for literacy:
Examining factors of intervention grain size and individual differences

7th International Workshop on Advanced Learning Sciences
17-19 June, 2019, University of Jyväskylä, Finland
Struggling Readers

Computer-assisted instruction (CAI)

HOW YOU FEEL

When your struggling reader (who you’ve spent countless hours working with) suddenly jumps up multiple reading levels!

National Institute of Education, Nanyang Technological University, Singapore
Evidence of positive effects for struggling learners

Effective programs for struggling readers: A best-evidence synthesis

GraphoLearn India: The Effectiveness of a Computer-Assisted Reading Intervention in Supporting Struggling Readers of English

Computer-Assisted Reading and Spelling Intervention with Graphogame Fluent Portuguese

Technology-based tools

(Cheung & Slavin, 2013)

(Slavin, Lake, Davis & Madden, 2011)
According to a research at Cmabrigde Unievrtisy, it deosn't mttaber in waht oredr the ltteers in a wrod are, the olny iprmoetnt thng is taht the frist and lsat ltteer are in the rghit pclae. The rset can be a toatl mses and you can stll raed it wouthit porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.
Statistical Learning (SL) is the brain’s capacity to identify patterns of regularities in the world and infer from them on the structure of the environment and guide behavior.

Statistical learning is related to early literacy-related skills. 
(Spencer, Kaschak, Jones & Lonigan, 2015)

Statistical Learning Is Related to Reading Ability in Children and Adults.
(Arciuli & Simpson, 2012)
Psycholinguistics: Grainsize Theory

Rime patterns have greater consistency for English (Coltheart & Leahy, 1992; Treiman et al., 1995)

- au: laugh, gauge, caught
- aught: caught, taught, naught

Patterns in English Language

(Ziegler & Goswami, 2005)
Reading is a skill that must be learned

<table>
<thead>
<tr>
<th>m /m/</th>
<th>a /a/</th>
</tr>
</thead>
<tbody>
<tr>
<td>thumb</td>
<td>comb</td>
</tr>
<tr>
<td>hymn</td>
<td>column</td>
</tr>
<tr>
<td>solemn</td>
<td></td>
</tr>
</tbody>
</table>

(w) (qu)  
wasp quad

clasp bad
SL-Reading Link

SOOK | DOOK
SOOM | FOOM
SL-Reading Link

Growing number of studies...

- pairs of non-words such as <spange> and <spance>
- showed sensitivity to coda spelling <nge> conditions the /e/ pronunciation (words like ‘range’) whereas <nce> does not (words like ‘prance’)

- replicated adult study with children
- how often <a> was read as /e/ before <nge> as opposed to <nce>
- <oo> as /ʊ/ more often before <k> than before other coda letters.

Treiman et al. (2003)

Treiman et al. (2006)
Growing number of studies...

SL-Reading Link

- visual SL predicting later vocabulary size
- auditory SL predict real-time language processing
SL-Reading Link in children with reading disabilities

how can we use the information from statistical learning to understand how children with reading disabilities learn the English language?
What is the optimal grain size for teaching struggling learners the phoneme-grapheme correspondences of English?

Do individual characteristics of struggling learners moderate the effect of intervention?
Participants and Intervention Conditions

- 138 Primary 1 learning support program (LSP) students from up to 7 schools
- Children language background (Chinese, Malay, Tamil)

Randomly assigned to experimental conditions:

<table>
<thead>
<tr>
<th>Group 1 (Experimental)</th>
<th>Group 2 (Experimental)</th>
<th>Group 3 (Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: SeeWord Reading</td>
<td>Phase 1: SeeWord Reading</td>
<td>Phase 1 - 2: iPad app for word/sentence reading; vocabulary; comprehension</td>
</tr>
<tr>
<td>Phase 2: Graphogame Phoneme</td>
<td>Phase 2: Graphogame Rime</td>
<td></td>
</tr>
</tbody>
</table>

\( \chi^2 (4) = 2.57, p > .05 \)
### Participants and Intervention Conditions

Randomly assigned to experimental conditions:

<table>
<thead>
<tr>
<th>Group 1 (Experimental)</th>
<th>Group 2 (Experimental)</th>
<th>Group 3 (Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: SeeWord Phoneme Reading</td>
<td>Phase 2: Graphogame Phoneme</td>
<td>Phase 1 -2: iPad app for word/sentence reading; vocabulary; comprehension</td>
</tr>
<tr>
<td>Phase 2: Graphogame Rime</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(e.g., following synthetic phonics, Hulme et al., 2002)  
(e.g., following learning with analogies, Goswami & Bryant, 1990)
PHASE I
TERM 2 Weeks 2-8

Developing Accuracy for Letter-Sound Correspondence
See-Word & Words Game

- Letter-Sound Accuracy
  - 10 mins. per day
  - review and practice
  - letter, word, text level activities

- Word reading
  - word recognition
  - vocabulary building
  - reading with flash cards

(Seward et al., 2014; O’Brien & Chin, 2015)
**Intervention**

**PHASE 1**  
TERM 2 Weeks 2-8

- **Developing Accuracy** for Letter-Sound Correspondence  
  See-Word & Words Game

**Letter-Sound Accuracy**  
- 10 mins. per day  
- review and practice  
- letter, word, text level activities

**Word reading**  
- word recognition  
- vocabulary building  
- reading with flash cards

**PHASE 2**  
TERM 3 Weeks 2-8

- **Developing Fluency** for Letter-Sound Correspondence  
  Grapholearn & Words Game

**Letter-Sound Fluency**  
- 10 mins. per day  
- practice learned associations  
- activities emphasizing speed

**Rime-level Fluency**  
- 10 mins. per day  
- practice with learned associations  
- activities emphasizing speed

**Word reading**  
- word recognition  
- sentence building  
- sentence reading

(Seward et al., 2014; O’Brien & Chin, 2015)
1. Decoding accuracy (WJIII-3) and fluency (TOWRE-2)
2. Word reading accuracy (WJIII-3) and fluency (TOWRE-2)
3. Spelling (British Ability Scale-3)

- Bilingual Language Assessment Battery (BLAB; EL & MT)
- Metalinguistic awareness (phonological –CTOPP;
- Orthographic awareness – (homophone choice task)
- Cognitive (statistical learning task)
- Non-cognitive verbal (British Ability Scales)
1. Training Phase

Statistical Learning

Arciuli & Simpson, 2011; Raviv & Arnon, 2017
1. Training Phase

Statistical Learning

Archiuli & Simpson, 2011; Raviv & Arnon, 2017
2. Test Phase

Arriuli & Simpson, 2011; Raviv & Arnon, 2017
What is the optimal grain size for teaching struggling learners the phoneme-grapheme correspondences of English?

All groups made progress in word reading and decoding, with the biggest gains in word reading accuracy and fluency. The groups did not statistically differ overall. . . .
Do individual characteristics of struggling learners moderate the effect of intervention?

...but outcomes between groups differed for children with and without statistical learning difficulties.

Preliminary results indicate:
- the phoneme-level intervention may be more beneficial for those with low statistical learning ability
- the phoneme+rime intervention may be more beneficial for those with higher statistical learning ability
- the word-level intervention had similar effects for both statistical learning groups.
Do individual characteristics of struggling learners moderate the effect of intervention?

Reading improvement across intervention groups x SL groups

Post-Test Word Accuracy
Do individual characteristics of struggling learners moderate the effect of intervention?

Reading improvement across intervention groups x SL groups

Post-Test Word Fluency
Well-developed phonological systems

- Salient phonological rime units
- Sensitive to, learn, and use conditional patterns.

(Rolheart & Leahy 1992; Treiman et al., 1995)

Rime patterns greater consistency

- Sensitivity to rime unit increase as knowledge of phonemes grow
- Treatment condition 2 - children were first exposed to the phoneme condition and followed by the rime condition.

(Treiman et al., 2006)
• capacity for SL may be one of these factors
• disentangle the relative contributions of the direct versus indirect mechanisms to reading

• Mastery of each level

• children with language impairments may also have problems with selective auditory attention
  (Finneran, Francis, & Leonard, 2009)
Conclusion & Future Work

Testing probabilities
  • Taking into account statistics of language

Bilingual children
  • MT-SL-Reading link

Investigate mediating variables
  • SL – Reading link explained by attention?


References


We wish to thank all of the children, teachers, and principals who participated in this research.

AND

Thank YOU for listening to my talk!

beth.obrien@nie.edu.sg
malikka.habib@nie.edu.sg