# Braille Oral Reading Fluency – The Role of Phonological Processing

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# Outline

1. Overview of the larger study and goals

2. Overview of Reading Development/Reading Disability

3. Results

4. Discussion

5. Instructional Implications

# Overview of Larger Study

- Data from 18 high-school students

  - Academically achieving: expect diploma by age 21

  - No additional disabilities

  - Used braille as primary literacy medium

  - Located in CA or BC

  - 9 female

  - Average age 15.6 years (min 13, max 21)

  - Average onset 1.6 years (15 congenital, 1, 2, 5)

# Overview of Larger Study

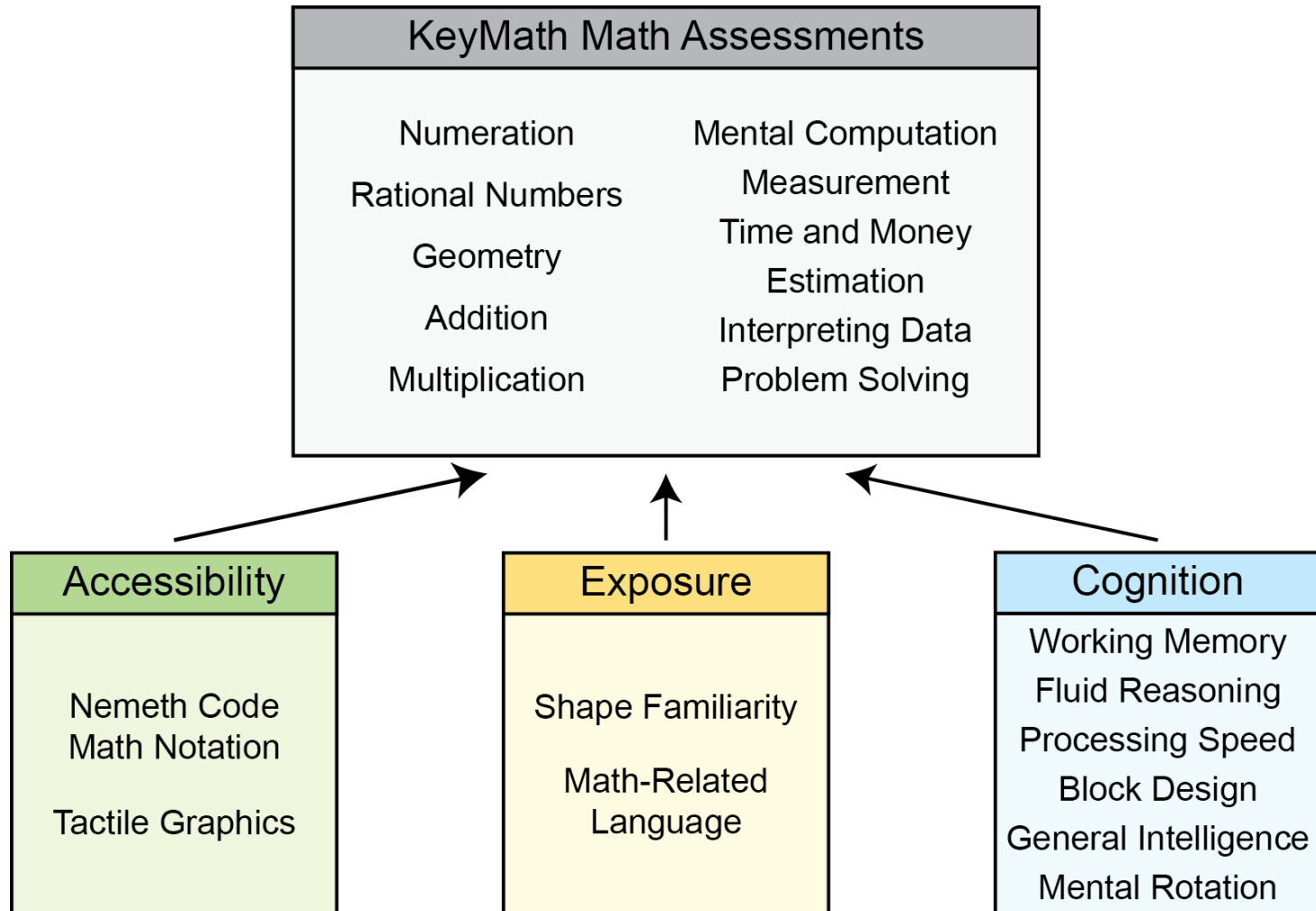| Participants | Condition |
|---|---|
| 5 | Retinopathy of prematurity (ROP) |
| 3 | Anophthalmia or microphthalmia |
| 2 | Glaucoma |
| 2 | Retinal detachment |
| 2 | Unknown |
| 2 | Leber congenital amaurosis (LCA) |
| 1 | Norrie disease |
| 1 | Optic nerve hypoplasia (ONH) |
| 1 | Familial exudative vitreoretinopathy (FEVR) |

# Overview of Larger Study

- Tested on 26 measures

  - 11 math achievement (KeyMath braille)

  - 15 accessibility, exposure, and cognitive measures

    - Including: DIBELS ORF, Complete CTOPP

# Overview of Larger Study

## KeyMath Math Assessments

| | |
|---|---|
| Numeration | Mental Computation |
| Rational Numbers | Measurement |
| Geometry | Time and Money |
| Addition | Estimation |
| Multiplication | Interpreting Data |
| | Problem Solving |

### Accessibility

Nemeth Code
Math Notation

Tactile Graphics

### Exposure

Shape Familiarity

Math-Related
Language

### Cognition

Working Memory
Fluid Reasoning
Processing Speed
Block Design
General Intelligence
Mental Rotation

# Current Study

- Goals
  1. Is phonological processing (3 subcomponents) a good predictor of Oral Reading Fluency for contracted braille?
  2. If not, what are the important subskills necessary to becoming a fluent reader of contracted braille?

# Reading Achievement
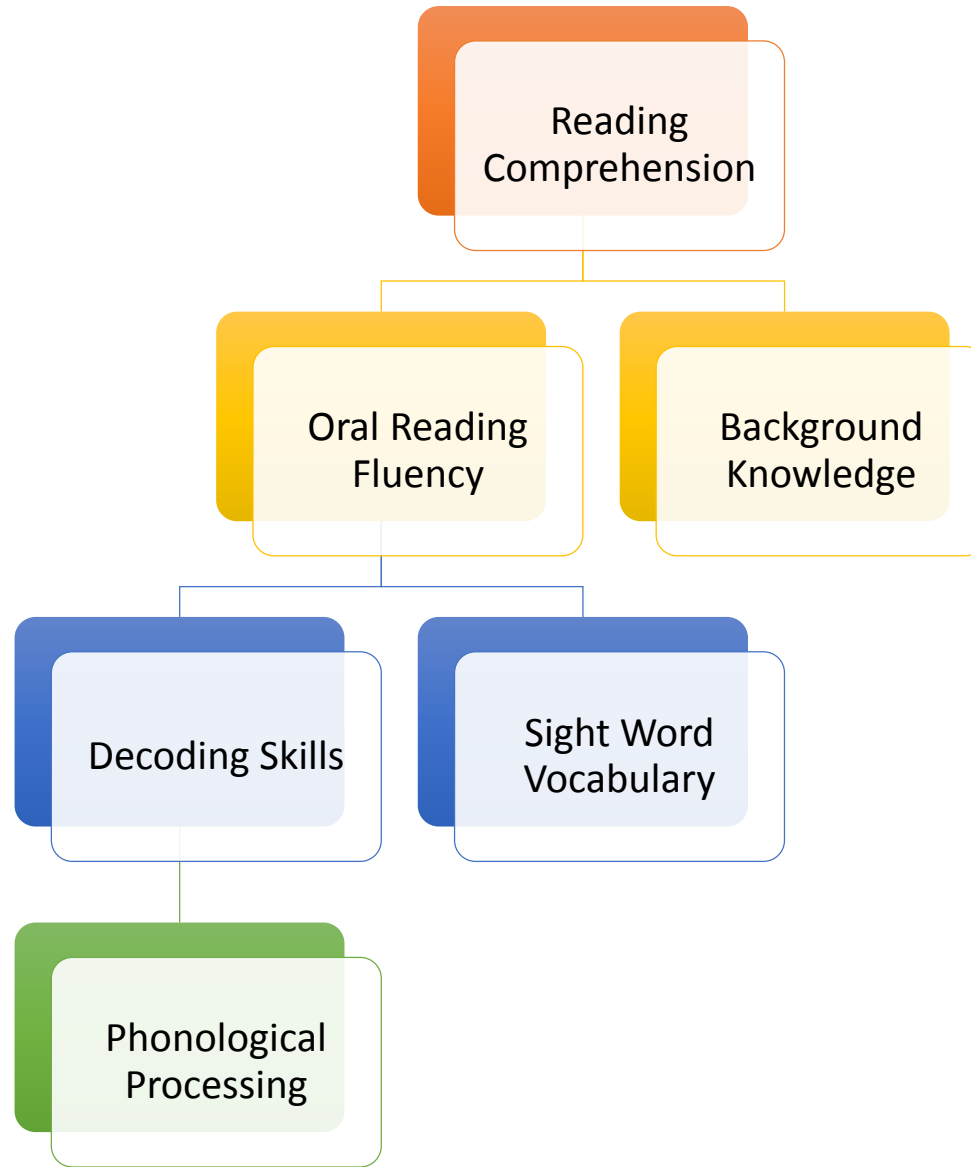
# Reading Disability

- "Unexpected difficulty in reading in children and adults who otherwise possess the intelligence, motivation, and schooling considered necessary for accurate and fluent reading" (Shaywitz, 1998 p. 307).

- Search for the core deficit(s)

  - Vocabulary

  - Auditory Processing

  - Working Memory

  - Phonological Processing

# Phonological Processing

- Auditory processing skills that are relevant to the phonological nature of language

- Three main subdomains of phonological processing relevant to reading disability:

  - Phonological awareness

  - Phonological memory

  - Rapid automatic naming

# Phonological Awareness

- The ability to attend explicitly to the phonological structure of spoken words, rather than just to their meanings and syntactic roles." (National Research Council, 1999 p. 111).

# Phonological Awareness

- ## Greaney and Reason (1999)
  - Children. Better than expected on PA, worse than expected on ORF, Reading Comp

- ## Simon and Asensio (1997)
  - Adults. Poor PA and poor ORF/Comprehension, but PA overpredicts ORF

- ## Gillon and Young (2002)
  - Children. Equally delayed in their reading/PA

# Sample Phonological Awareness Tasks

## Elision

**PRACTICE ITEMS:**                                                          **Correct Response**

a.   Say *toothbrush*. Now say *toothbrush* without saying *tooth*.               brush

If correct say, "That's right. Let's try the next one."
If incorrect say, "That's not quite right. *Toothbrush* without saying *tooth* is *brush*."

Continue to give correct/incorrect feedback as before. Say, "Let's try some more."

b.   Say *airplane*. Now say *airplane* without saying *plane*.                    air
c.   Say *doughnut*. Now say *doughnut* without saying *dough*.                    nut

8.  Say *time*. Now say *time* without saying /m/.                                  tie
9.  Say *tiger*. Now say *tiger* without saying /g/.                               tire

19.  Say *split*. Now say *split* without saying /p/.                             slit
20.  Say *fixed*. Now say *fixed* without saying /k/.                             fist

13

# Sample Phonological Awareness Tasks

## Blending Words

|  |  | Correct Response |
|---|---|---|
| b. What word do these sounds make? | hăm-ə́r | hammer |
| c. What word do these sounds make? | s-ŭn | sun |
| d. What word do these sounds make? | t-āk | take |
| e. What word do these sounds make? | n-ō | no |
| f. What word do these sounds make? | m-ă-d | mad |

# Phonological Memory

- The ability to hold and manipulate verbal information in memory

- Beginning readers
  - Decode each letter
  - Blend letters
  - Compare to lexicon

# Phonological Memory

- ## Tillman (1967)
  - Stronger digit span skills than CA matched sighted, overpredicts IQ

- ## Smits and Mommers (1976)
  - Stronger digit span skills that CA matched sighted, overpredicts IQ

- ## No known research comparing these skills to reading outcomes

# Sample Phonological Memory Tasks

## Memory for Digits

1. _____ 1 6 _____
2. _____ 7 2 _____
3. _____ 9 4 _____
4. _____ 5 2 1 _____
5. _____ 6 4 8 _____
6. _____ 8 3 6 _____
7. _____ 5 3 1 8 _____
8. _____ 3 7 4 1 _____
9. _____ 7 5 9 6 _____
10. _____ 4 1 8 3 9 _____
11. _____ 6 3 2 5 8 _____

12. _____ 9 2 4 8 3 _____
13. _____ 8 4 9 7 1 3 _____
14. _____ 6 4 1 3 9 7 _____
15. _____ 4 3 8 9 7 5 _____
16. _____ 3 1 9 7 4 2 6 _____
17. _____ 9 2 5 1 6 3 8 _____
18. _____ 7 1 4 5 2 8 3 _____
19. _____ 4 6 3 5 9 2 7 1 _____
20. _____ 9 7 4 1 2 5 3 6 _____
21. _____ 4 9 6 7 3 1 6 5 _____
_____ **Total Raw Score**

# Sample Phonological Memory Tasks

## Nonword Repetition

**PRACTICE ITEMS:** Say, "I want you to listen to some made-up words on the CD player. After you hear each made-up word, I want you to say it exactly as you heard it and as clearly as you can. Even if it's hard to say, give it your best try. Listen carefully because I can't repeat the words. Okay? Let's try some." Start CD.

If correct say, "That's right. Now try the next word."
If incorrect say, "That's not quite right. The word was _____. Let's try another word."

a. ral (răl)
b. sart (särt)
c. ballop (băl-ōp)

# Rapid Automatic Naming (RAN)

- More loosely defined

- Letters only?
  - Numbers? Colors? Objects?

# Rapid Automatic Naming (RAN)

- Bliss, Kujala, and Hamalainen (2004)
  - Adults. Rapid naming for braille letters for adults who are blind indistinguishable as rapid naming for print letters for sighted adults

- Kikuchi, Yamashita, Sagawa, and Wake (1979)
  - More opportunities for reversal errors than in printed English

- Barlow-Brown & Connelly (2002)
  - Knowledge/familiarity with braille letters correlated with phonological awareness

# Sample RAN Tasks

## Rapid Letter Naming

| s | t | n | a | k | c | t | s | c | **Time** _____ |
|---|---|---|---|---|---|---|---|---|---|
| k | a | n | c | k | t | a | n | s | **Errors** _____ |
| t | k | c | s | n | a | t | c | n | |
| k | a | s | n | c | k | s | t | a | |

# Sample RAN Tasks

## Rapid Digit Naming

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 7 | 8 | 5 | 2 | 3 | 7 | 4 | 3 | **Time** _____ |
| 8 | 2 | 5 | 3 | 5 | 7 | 2 | 8 | 4 | **Errors** _____ |
| 7 | 5 | 3 | 4 | 8 | 2 | 7 | 3 | 8 | |
| 5 | 2 | 4 | 8 | 3 | 5 | 4 | 7 | 2 | |

# Assessment of Reading Disability in Sighted Population

- Most widely used assessment tools include subtest(s) in all three domains
- Caveat: 3 areas of phonological processing are predictive of RD in alphabetic languages
  - Syllabic (Japanese Kana)
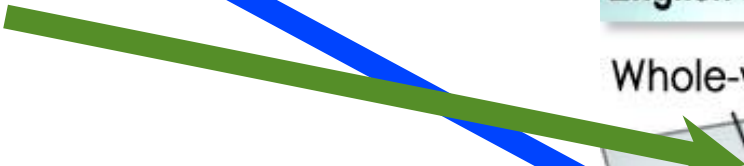  - Logographic (Mandarin)

# Braille

* Alphabetic

* Syllabic

* Logographic

A B C D E F G H I J

K L M N O P Q R S T

U V W X Y Z

English Braille, American Edition

Whole-word Contractions

but   the   people   can

Partial-word Contractions

for   ch   / sh   ing

24

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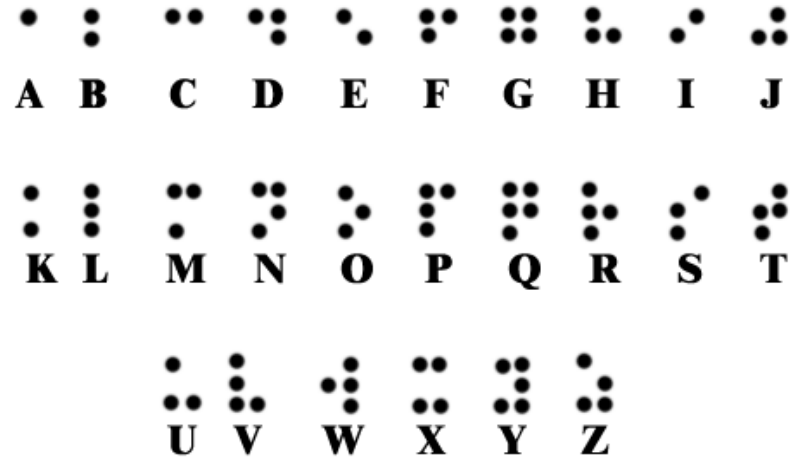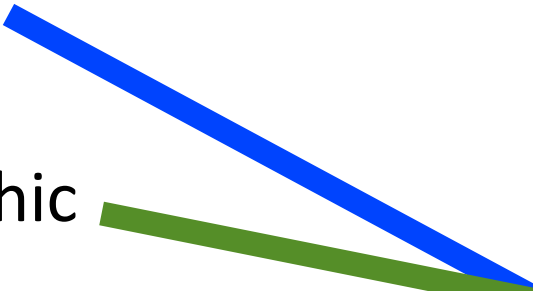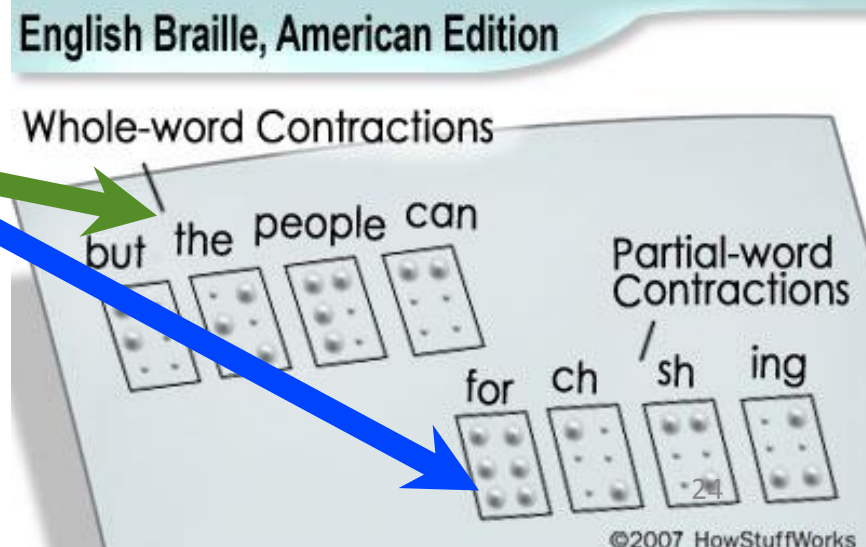
# Assessment of Reading Disability Among Braille Readers

- ???

- Not just important for the sake if diagnosing/SpEd eligibility
  - Need to understand what's going wrong for kids who are struggling to learn to read so we know where to intervene

# Measures

- DIBELS Oral Reading Fluency (ORF) - braille
  - 2 passages
  - Score = correct words per minute
  - All participants used sixth grade level passage (contracted)

- CTOPP (Comprehensive Test of Phonological Processing) Core Battery
  - Phonological Awareness (Elision, Blending Words)
  - Phonological Memory (Memory for Digits, Nonword Repetition)
  - Rapid Automatic Naming (Letters, Digits)*

# CTOPP Validity with Sighted Students

- CTOPP Composites vs. the Woodcock Reading Mastery Test-Revised (WRMT-R)
  - after one year in kindergarten: .71 for Phonological Awareness, .42 for Phonological Memory, and .66 for Rapid Naming
  - assessed after first grade, showed better values: .80, .52, and .70 respectively

- Among adults, CTOPP vs. ORF
  - .70 for RAN, .57 for Phonological Awareness, .59 for Phonological Memory
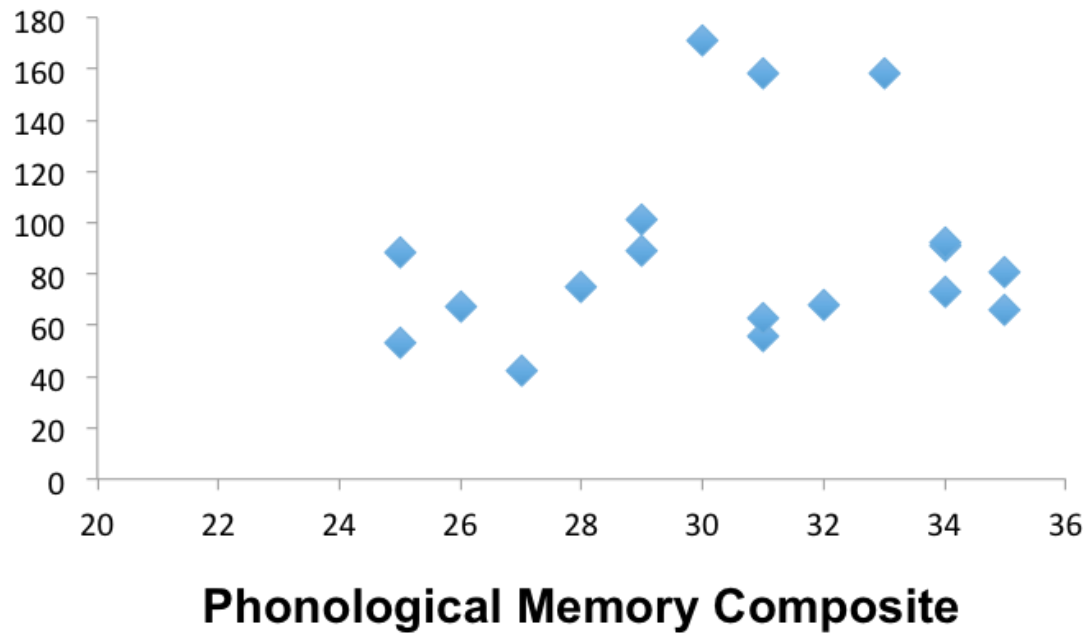
# Results – Phonological Awareness

**Phonological Awareness Composite vs
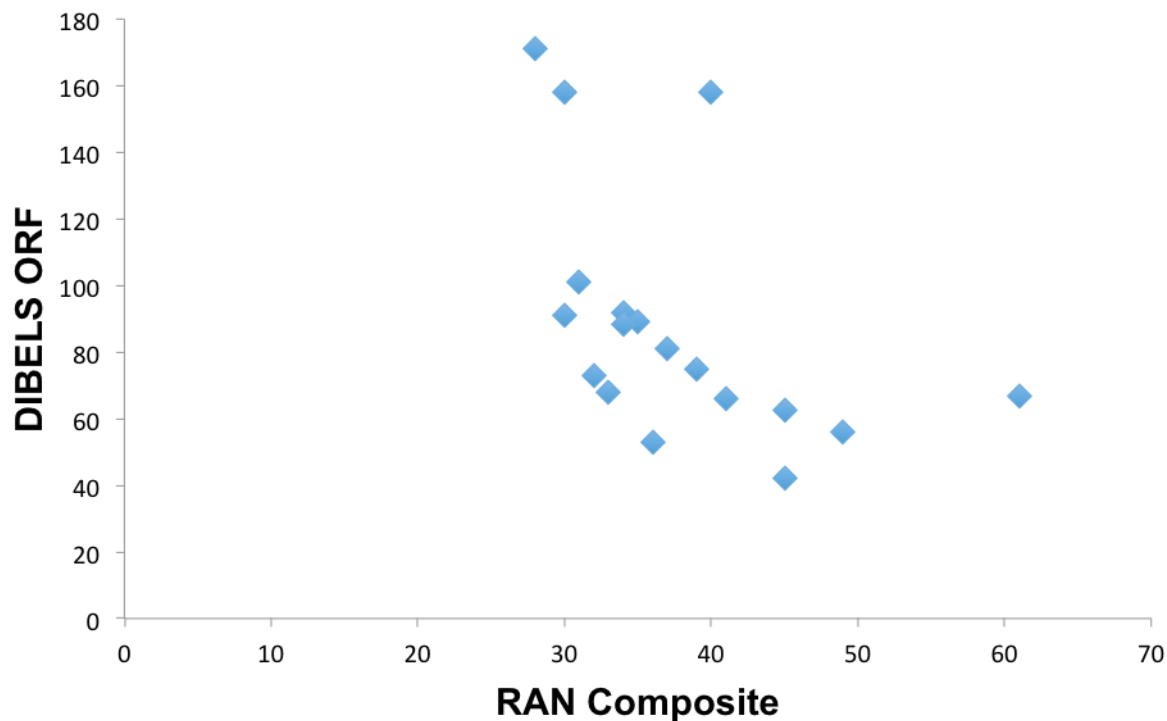DIBELS ORF**



*r* = .444
*p* = .056
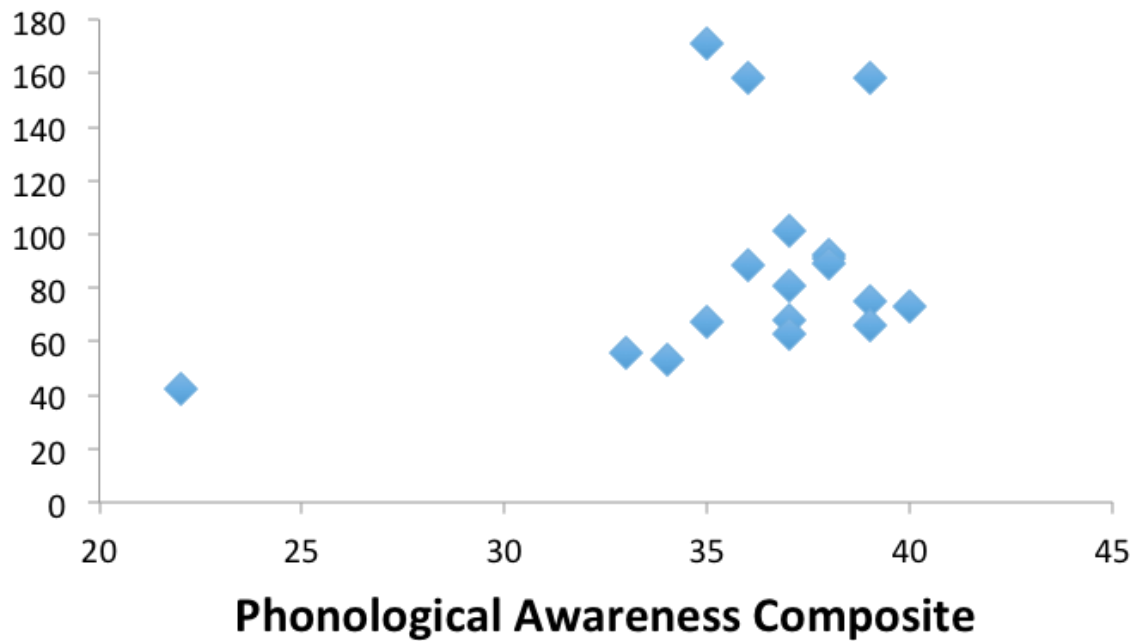
# Results – Phonological Memory

**Phonological Memory Composite
vs DIBELS ORF**



*r* = .388
*p* = .100

# Results – Rapid Automatic Naming



**Rapid Automatic Naming Composite
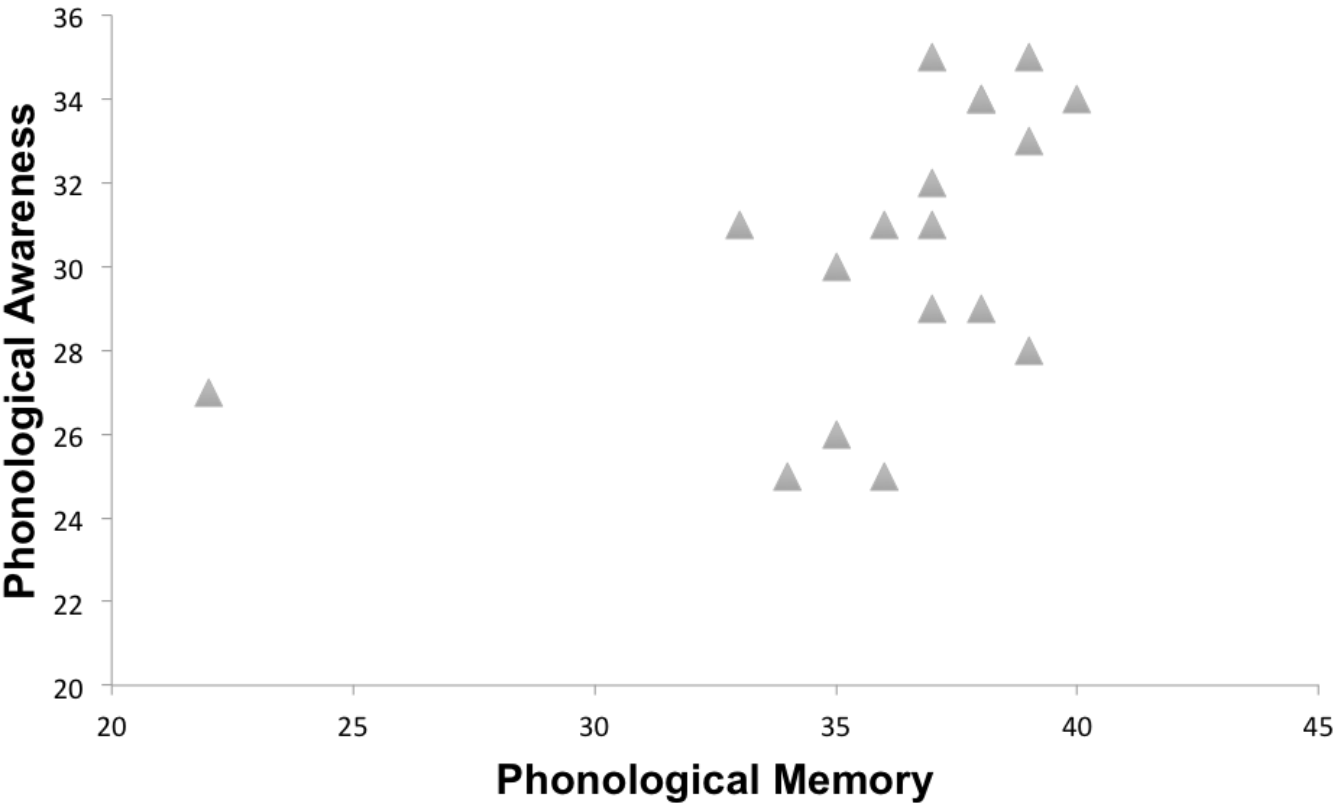vs DIBELS ORF**

$r = -.500$
$p = .029$

# Stepwise Regression and Model Selection

- ## Stepwise Regression
  - regression models in which the choice and ordering of predictive variables in the model is carried out by an automatic procedure

- ## Best predictive model includes RAN only

# Shared Variance
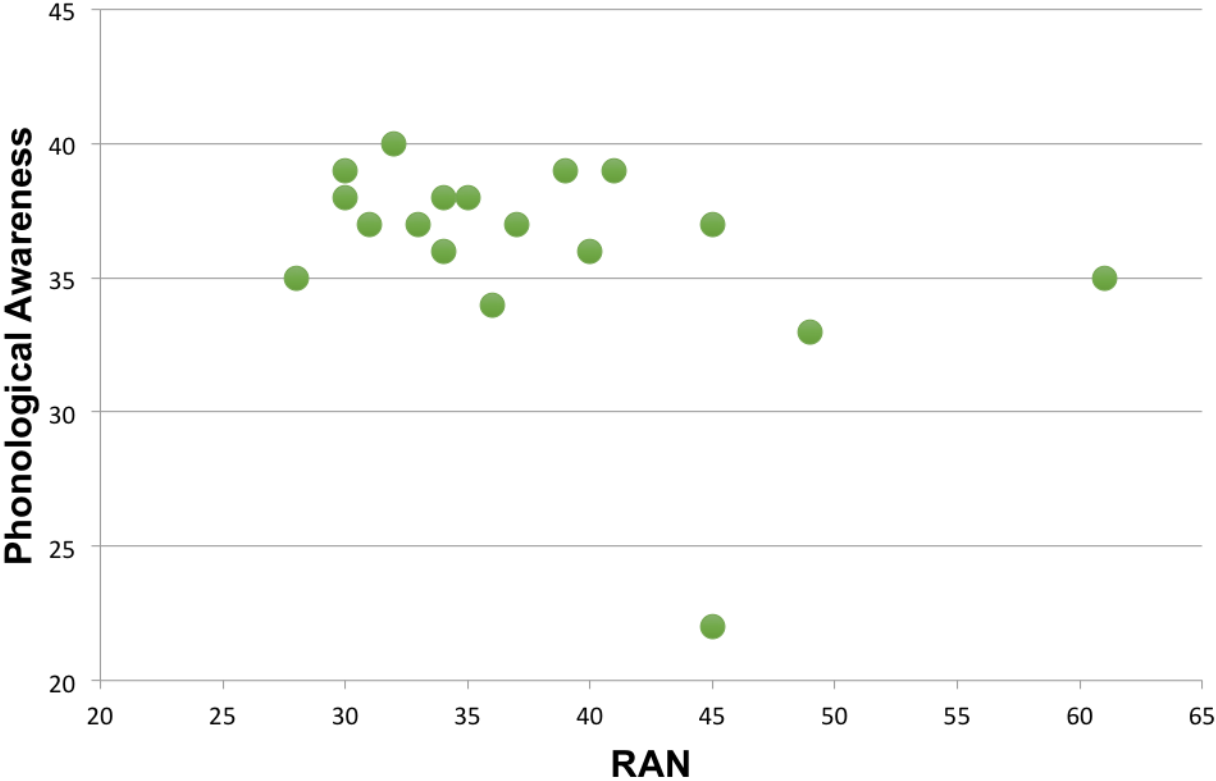
**Phonological Awareness vs Phonological Memory**
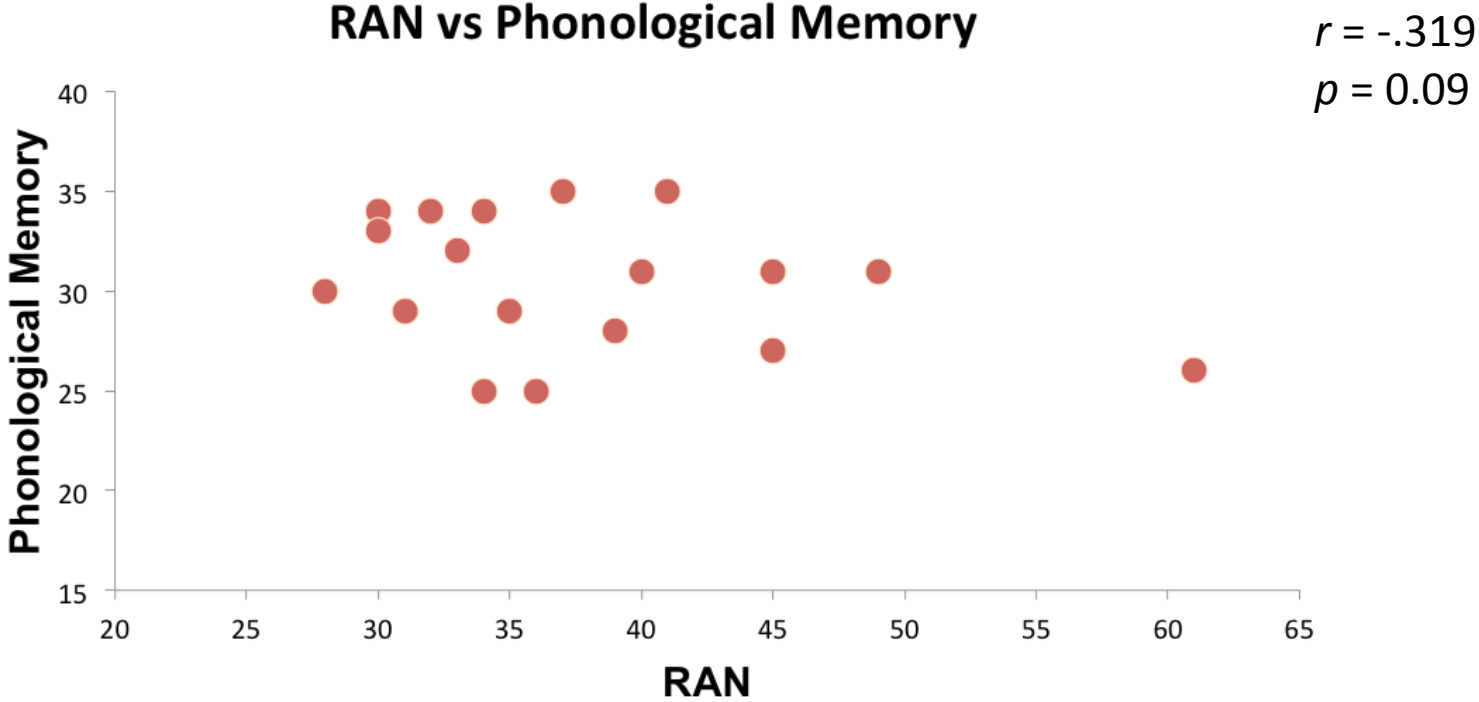


*r* = .638
*p* = 0.003

# Shared Variance



**RAN vs Phonological Awareness**

$r$ = -.380
$p$ = 0.09

# Shared Variance

### RAN vs Phonological Memory



$r$ = -.319
$p$ = 0.09

# Discussion

- Phonological Awareness, Phonological Memory, and Rapid Automatic Naming are all *more weakly correlated* with Oral Reading Fluency in our sample than among previously reported sighted samples

# Discussion

- Weak and non-statistically significant correlations between phonological awareness/phonological memory and oral reading fluency
  - Not that they're not important, but they do not capture the "core" underlying skill of contracted braille reading as they do for reading printed English or other alphabetic languages

# Discussion

- Moderate correlation between Rapid Automatic Naming and Oral Reading Fluency

- Best model for predicting Oral Reading Fluency included only Rapid Automatic Naming
  - Captures the importance of speeded symbol recognition in contracted braille reading
  - Likely need RAN tasks that measure symbol recognition in a more complex/subtle way

# Instructional Considerations

- Phonological awareness/memory likely quite important for students learning uncontracted braille (either first or only)

- If a student is struggling to master uncontracted braille, it likely IS due to phonological awareness/memory

- If a student is struggling to master contracted braille, it's likely due to other factors
  - "Visual" memory/sight words

# Instructional Considerations

- Psychoeducational assessment
  - Be sure when your students are assessed as part of initial or triennial assessments, psychologist is aware of limitations of their instruments for braille reading students
  - Need to consult with school psychologists with a deep knowledge of this population
  - TVI will probably have a better understanding of underlying skill deficits when children are struggling to learn to read

# Questions/Comments?

# Thank you!

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