Encouraging skilled word reading and spelling in children with speech sound disorder

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Rm Riverchase A

Dr. Anna M. Ehrhorn, CCC-SLP

Auburn University

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The many participants, families, and professionals that have inspired and made this study possible!

Speech sound disorder puts children at risk for reading and spelling difficulties **but does not guarantee these difficulties**

(Burgoyne et al., 2019; Cabbage et al., 2018; Miller & Lewis, 2022; Wren et al., 2021)

Previous Reading Disorder Research Findings

An estimated 25-30% of children with disordered word reading have a history of SSD in preschool, suggesting that SSD is a risk factor for future reading and spelling difficulties.

(Lewis et al., 2000; Pennington & Lefly, 2001; Raitano et al., 2004)

Previous SSD Reading Research Findings

Children with SSD demonstrate speech sound deficits, in production and often in perception, not only when compared to children with typical development, but also children who have word reading difficulties with no history of SSD.

(Brosseau-Lapré et al., 2020; Benway et al., 2021; Burgoyne et al., 2019; Cabbage & Hitchcock, 2022; Cabbage et al., 2018; Mari et al., 2022; Miller & Lewis, 2022; Roepke & Brosseau-Lapré, 2021; Rvachew et al., 2003 Wren et al., 2021)

Even after speech sound production has improved, children with SSD have *persistent deficits* in using their speech representations to build their foundation for learning the written English language.

- E.g., phonemic awareness
- E.g., phonics knowledge

(Raitano et al., 2004; Rvachew et al., 2003; Sutherland & Gillon, 2007)

Children who had a history of previous or have current speech sound disorder are at risk for word reading and spelling difficulties.

**However, SSD is not the <u>only</u> risk factor.**

In the rest of this session…

❑Review Theoretical Frameworks.

❑Review SSD literacy research.

❑Discuss the findings of my recent research.

❑Briefly review intervention research in SSD that implemented word reading components.

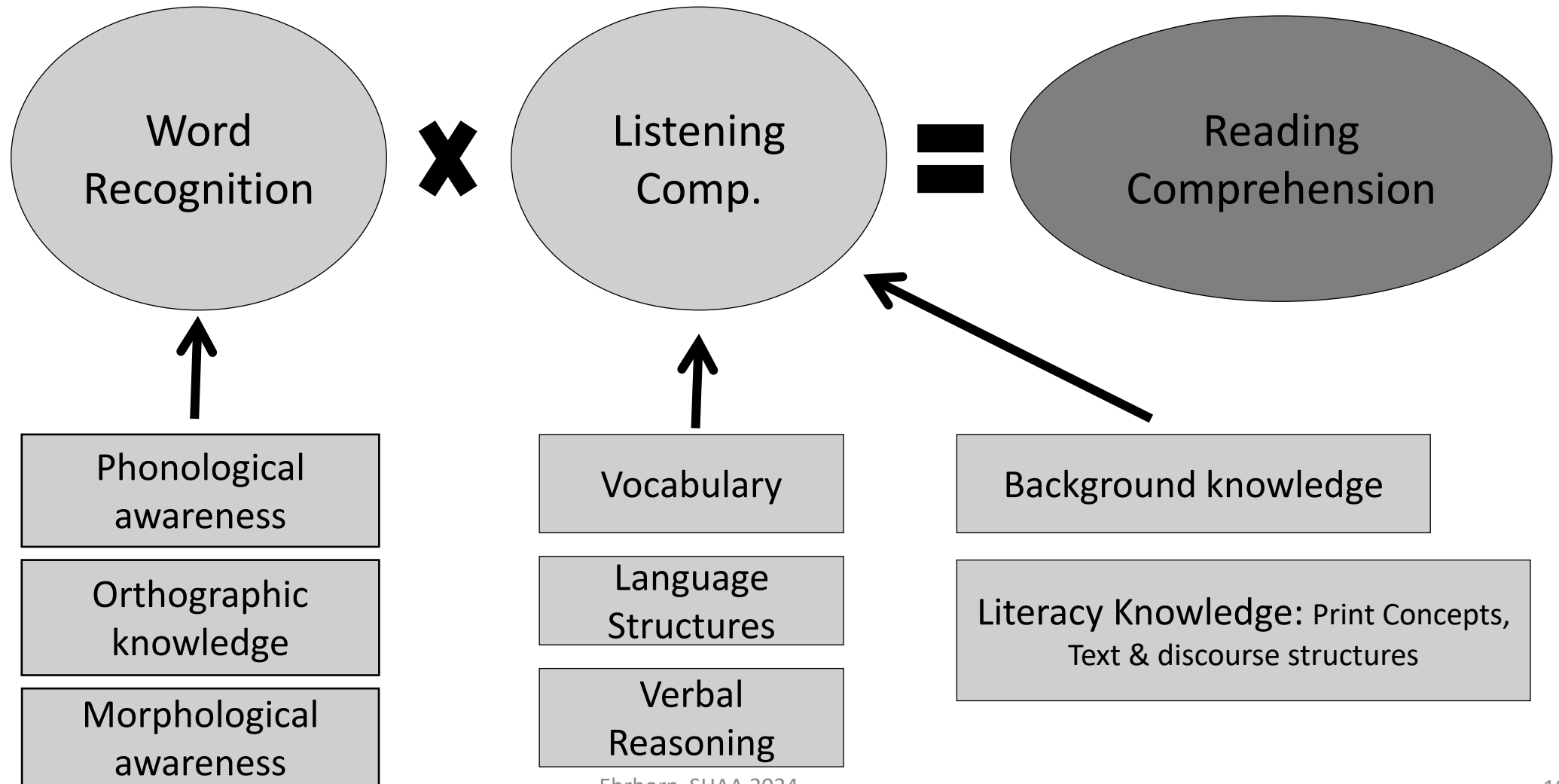❑Discuss what word reading components SLPs could encourage while targeting speech sound production.

The Simple View of Reading
(Gough & Tunmer, 1986; Hoover & Gough, 1990)

Word Recognition **X** Listening Comp. **=** Reading Comprehension
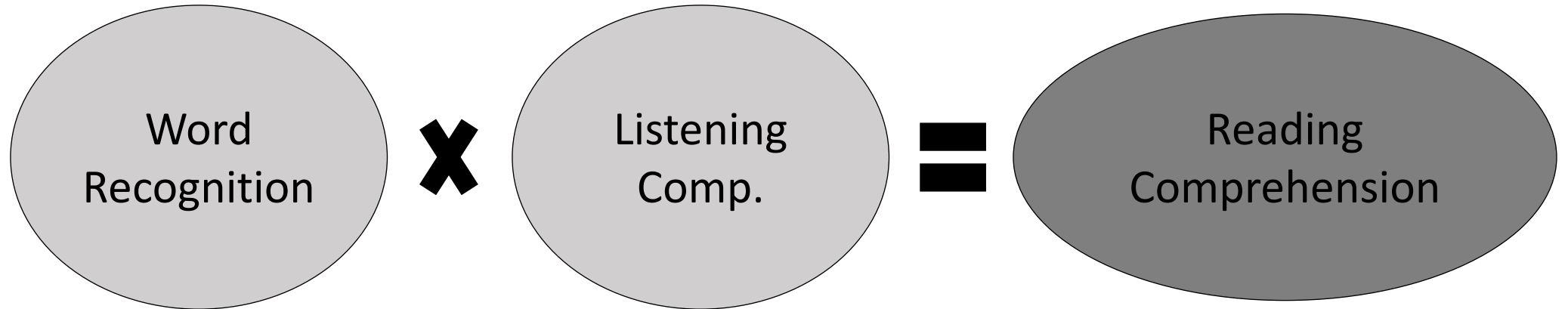
The Language basis of reading within a simple view framework

Word Recognition **✗** **Listening Comp.** **=** **Reading Comprehension**

Phonological awareness	Vocabulary	Background knowledge
Orthographic knowledge	Language Structures	Literacy Knowledge: Print Concepts, Text & discourse structures
Morphological awareness	Verbal Reasoning	

THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING

LANGUAGE COMPREHENSION

BACKGROUND KNOWLEDGE
(facts, concepts, etc.)

VOCABULARY
(breadth, precision, links, etc.)

LANGUAGE STRUCTURES
(syntax, semantics, etc.)
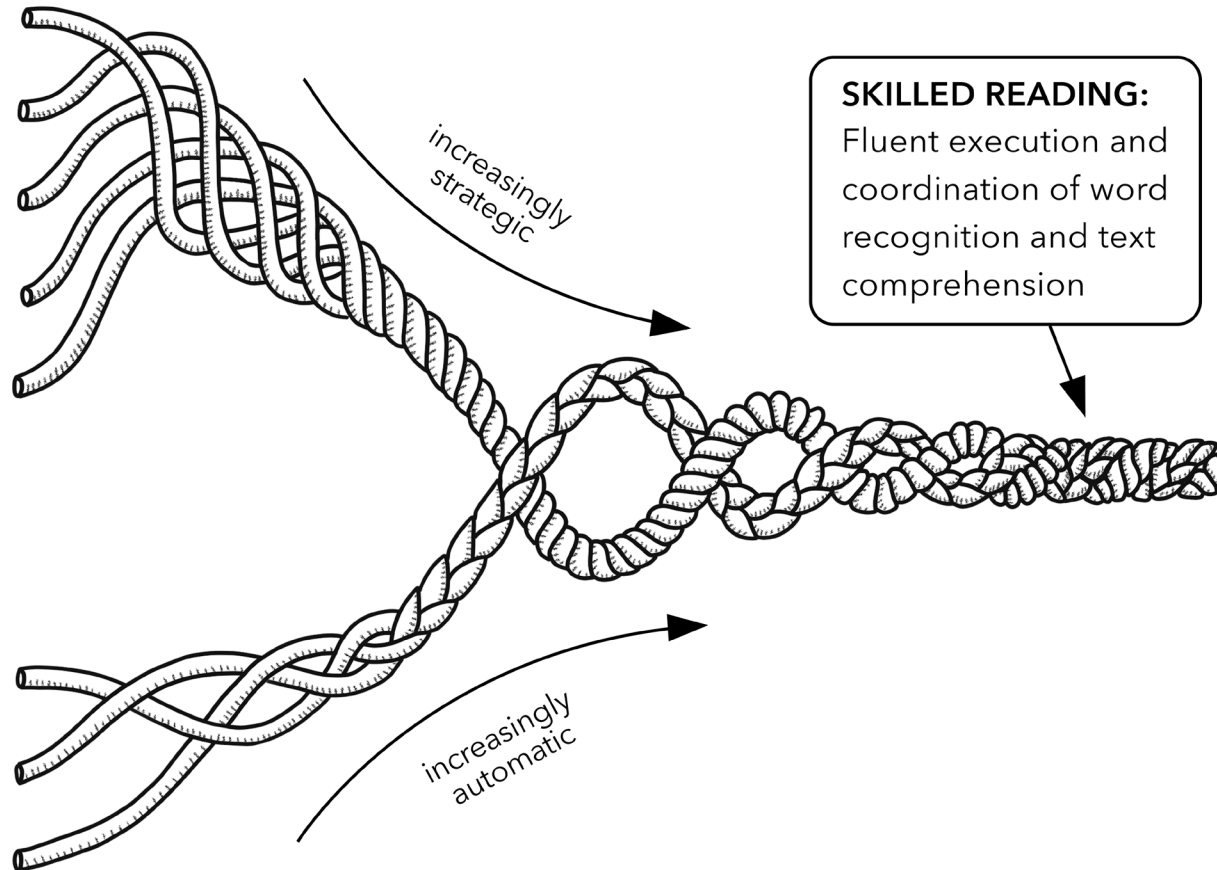
VERBAL REASONING
(inference, metaphor, etc.)

LITERACY KNOWLEDGE
(print concepts, genres, etc.)

WORD RECOGNITION

PHONOLOGICAL AWARENESS
(syllables, phonemes, etc.)

**DECODING** (alphabetic principle, spelling-sound correspondences)

SIGHT RECOGNITION
(of familiar words)

increasingly strategic

increasingly automatic

SKILLED READING:
Fluent execution and coordination of word recognition and text comprehension

Triangle Model

(Seidenberg, 2005)

Phonological Awareness

/kæt/

cat

Orthographic Knowledge

Language Component
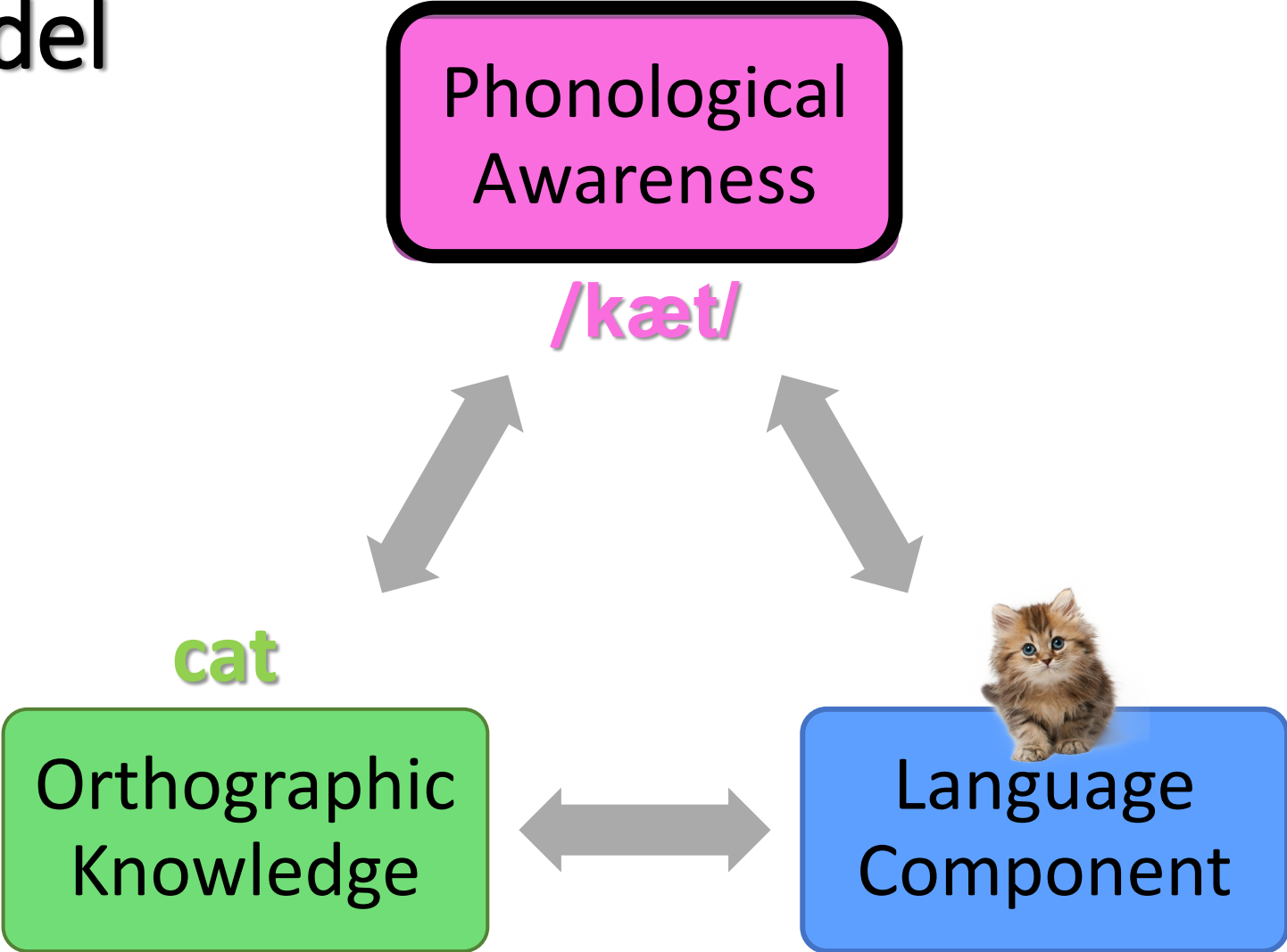
Phonological Awareness in SSD

Some research suggests that children with SSD have lower phonological awareness performance as compared to their peers with typical development, and their peers with only disordered word reading.

(Apel & Lawrence, 2011; Brosseau-Lapré & Roepke, 2019; Miller & Lewis, 2022; Skebo et al., 2013)

Other research suggests that some children with SSD develop good phonological awareness.

(Hesketh et al., 2000; Lewis et al., 2018; Markikainen et al., 2021; Nathan et al., 2004)

Examine other factors that impact word reading.

Oral Language & **Orthographic knowledge**

Combined SSD and **oral language** difficulties increase risk for word reading difficulties.

(Burgoyne et al., 2019; Jin et al., 2020; Miller & Lewis, 2022; Tambyraja et al., 2020)

Orthographic Knowledge (Apel, 2011)

Letter Knowledge

This is the letter 'm'.   Letter 'm' makes the /m/ sound.

Mental Representations of Specific Words

Using Orthographic Choice Tasks

(e.g., Olson, Forsberg, & Wise, 1994; Olson et al., 1989)

Select the correct spelling of the word --- 'h-o-p-e' not 'h-o-a-p'.

Statistical Regularities of Phoneme-Grapheme Pairs

Frequency and Positional constraints in syllables

'ge' or 'dge' = /ʤ/ at the final syllable position (e.g., cage, fudge)

'j' = /ʤ/ in initial syllable position (e.g., jump)

Orthographic Knowledge in SSD

Most children with SSD have difficulty learning their letters and learning phoneme-grapheme correspondences.

(Anthony et al., 2011; Apel & Lawrence, 2011; Bird et al., 1995; Carroll & Snowling, 2004; Carson et al., 2015; Raitano et al., 2004; Treiman et al., 2008)

Only one SSD study has examined knowledge of orthographic rules that suggests that children with SSD have similar orthographic pattern knowledge (statistical probabilities) as younger peers.

(McNeill et al., 2017)

Reduced orthographic knowledge may be another risk factor of word reading difficulties in SSD.

Orthographic knowledge and phonological awareness are separate skills but should become interconnected during reading instruction.
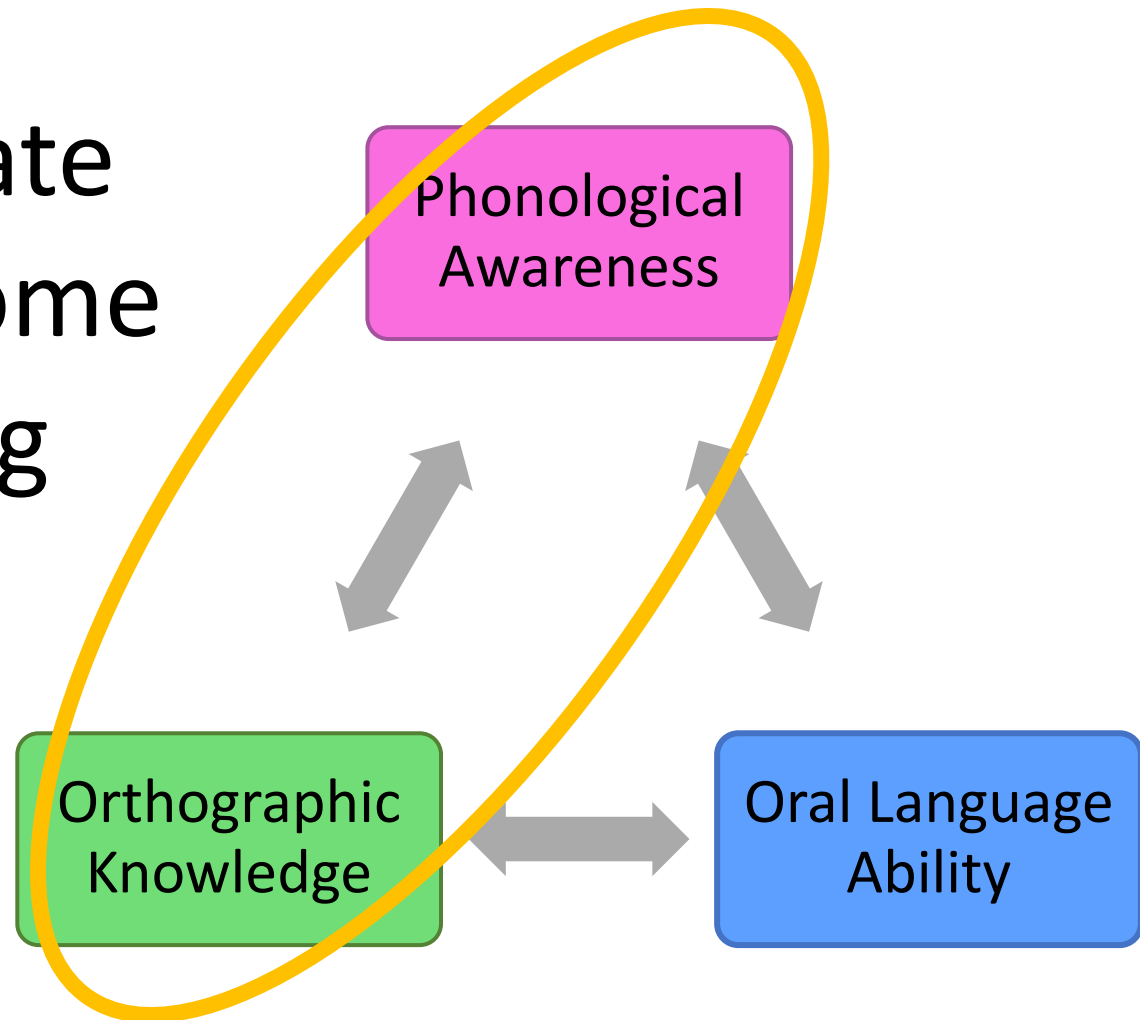
Orthographic knowledge is automatically activated during spoken language tasks.

(Castles et al., 2003; Castles et al., 2011; Frith, 1998; Port, 2010; Seidenberg & Tanenhaus, 1979; Ziegler & Ferrand 1998)

Orthographic Influence on Spoken Language Performance in Disordered Word Reading

Some research suggests that children with disordered word reading do not experience orthographic influence to the same extent as their peers with typical reading abilities.

(Landerl et al., 1996; van der Leij & van Daal, 1999)

E.g., Phonological awareness performance in two conditions

Phonologically transparent spellings   **Silent letter spellings**

ham   *lamb*

Fewer errors in the silent letter condition occurred in the dyslexia group than in age-matched peers and spelling-age-matched peers.

This suggests that children with disordered word reading have a weaker connection between orthographic and phonological representations decreasing performance.

It is unknown…

- whether orthographic knowledge explains why some children with SSD may have better phonological awareness than others, and

- why some children with SSD may have good word reading despite lower phonological awareness than typically developing peers.

Phonological Awareness

/kæt/

cat

This study examined…

Children with SSD

Orthographic Knowledge

Oral Language Ability

This study specifically compared children with SSD and children with typical speech (TSD) to evaluate:

- Group differences in phonological awareness and orthographic knowledge

- The influence of orthography on phonological awareness performance within and between groups

- The extent to which group differences are explained by differences in oral language abilities

Participants

Sixty children between ages 6-8 years old completed speech, language, and various foundational literacy tasks.

30 children with SSD

30 children with TSD

Participant Group Classification

Assessment	TD Criteria	SSD Criteria
Speech Sound Production Intake Questionnaire: History and Report of Speech Sound Difficulties	None	Current
Sounds-in-Words subtest *Standard Score* on the *GFTA-3*	≥ 90	≤ 85
50-word speech sample using SALT's Story Retell protocol *Percent Consonants Correct (PCC)*	≥ 99%	< 95%
Oral Language Ability *CELF-5 Core Language Score*	Range of Abilities	
Word Reading and Spelling Outcomes *WRMT-III Basic Skills Composite Score* *Adapted Real Word Spelling task* (Masterson & Apel, 2010; Wolter & Apel, 2010)	Range of Abilities	

Measures

1. CTOPP-2 Phonological Awareness Composite

   The composite score derived from scores on the Elision, Blending, and Sound Matching/Phoneme Isolation.

2. Experimental Phonological Awareness Task

3. Phoneme-Grapheme Correspondence Task

4. Orthographic Pattern Knowledge Task

Experimental Phonological Awareness Task

Objective: To compare the final phonemes in spoken words and identify the words that have matching final phonemes
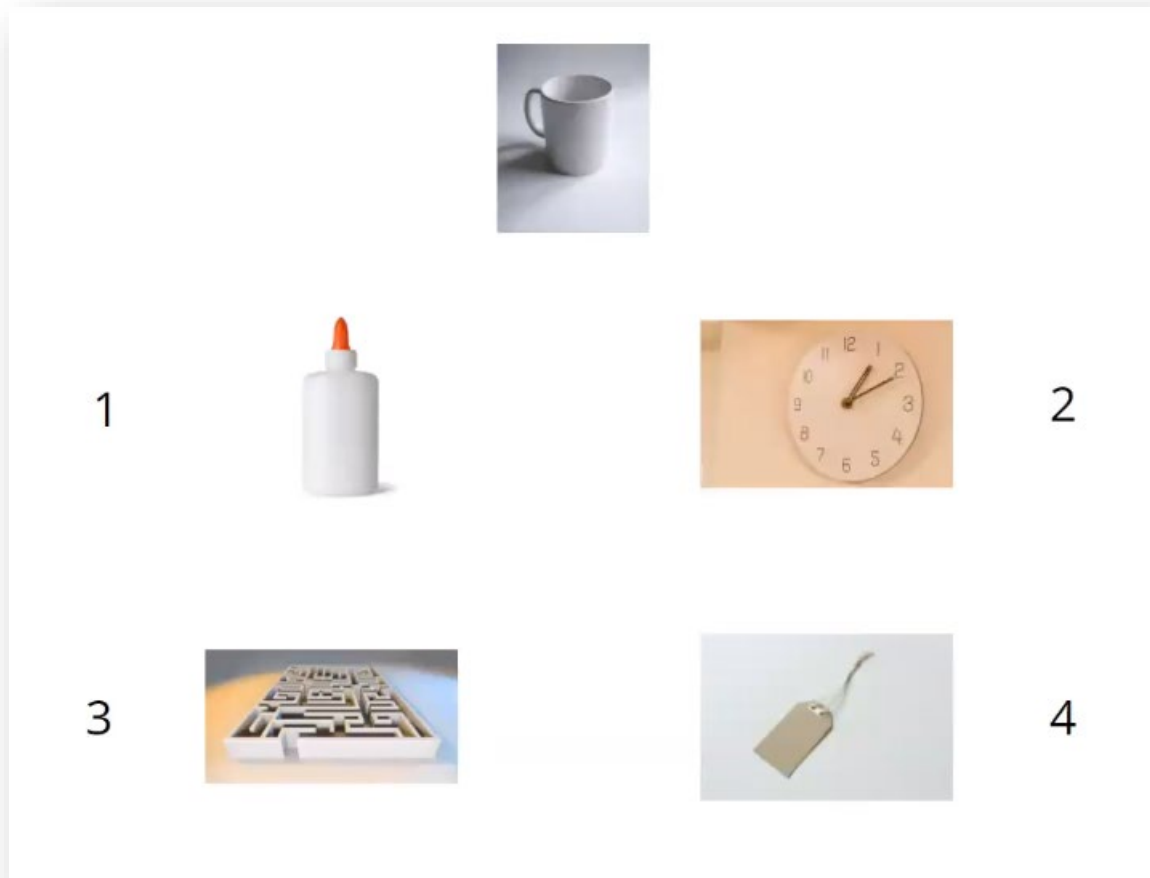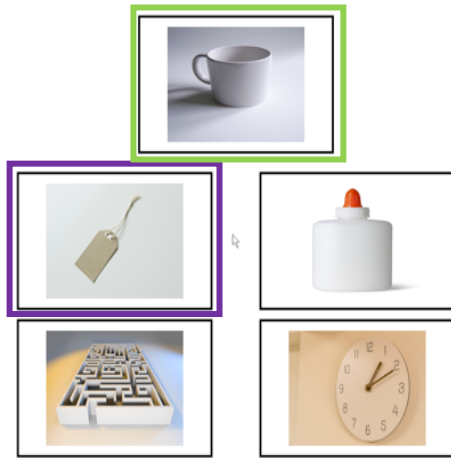

*Designed to measure phonological awareness ability receptively.

*Designed to measure the influence of orthography by manipulating the orthographic properties of words.

Orthographic congruency and **consistency**

27

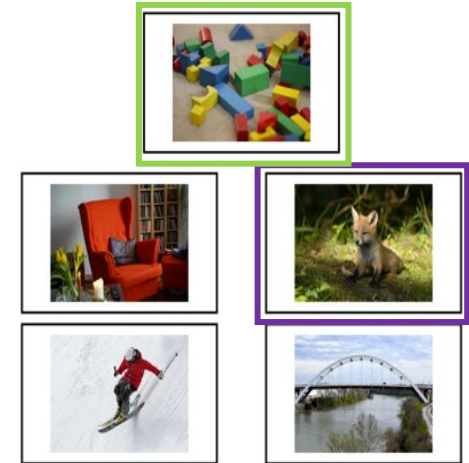# Experimental Phonological Awareness Task Conditions

CONGRUENT-CONSISTENT   **CONGRUENT-INCONSISTENT**   **INCONGRUENT-INCONSISTENT**

mug - tag

N trials = 12
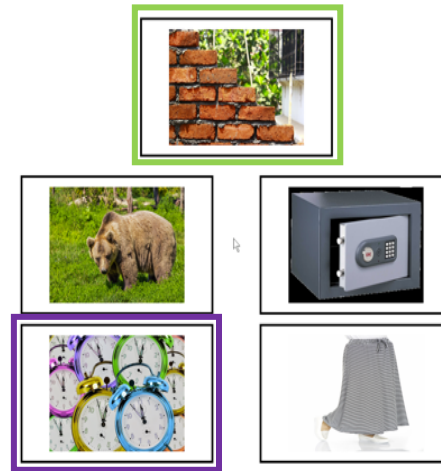
bricks - clocks

N trials = 12

blocks - fox

N trials = 12

Congruency refers to the spelling of the *stimulus* and the *target*.

(top picture)   (an option at the bottom)

**Consistency** refers to the spelling pattern throughout the *task.*

Phoneme-Grapheme Correspondence Task

Objective: To determine whether the letter set presented matched the sound heard

Total of 48 trials half TRUE and half FALSE.
- Measured single phoneme-letter correspondences (e.g., t, /t/)
- Measured more complex graphemes (e.g., 'nn' & /n/, 'ph' & /f/)

*Designed to measure beyond the one-sound to one-letter correspondences, and presented the recorded sound(s) through live presentation

ge
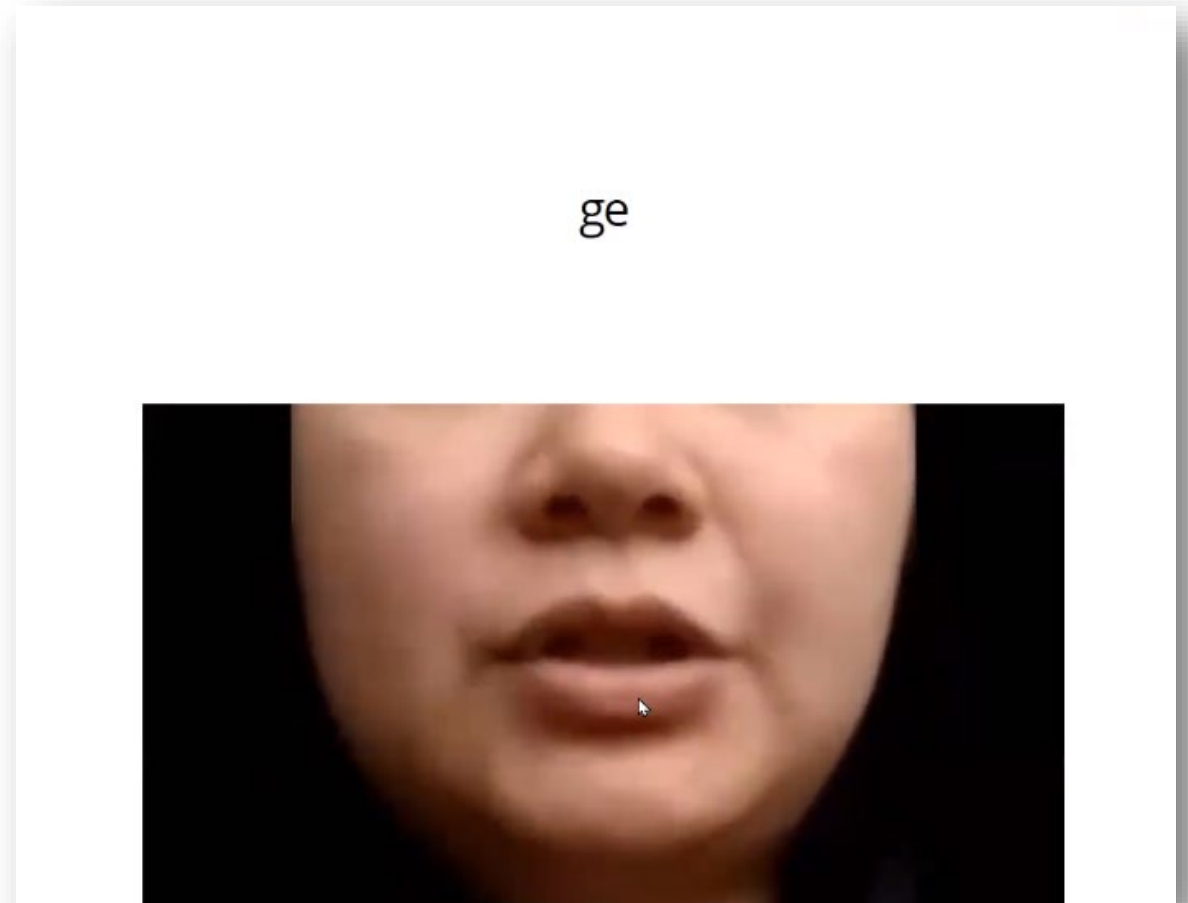
Orthographic Pattern Knowledge Task

Objective: To determine which set of letters looks *MOST* like a real English word

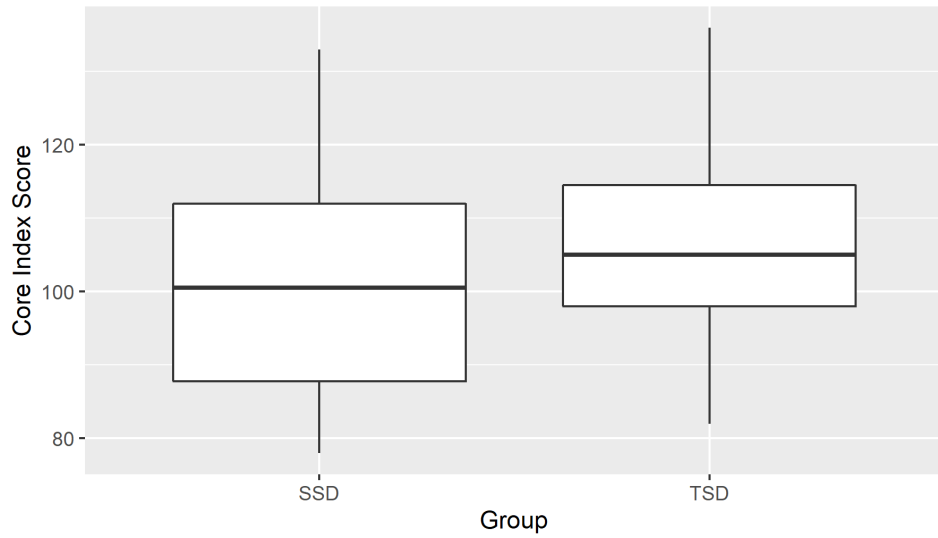| **HIGH-ILLEGAL (HI)**	**LOW-ILLEGAL (LI)**	**HIGH-LOW (HL)**
rean rsdi	aper rsdi	rean aper
1 2	1 2	1 2

Forced-choice task with three conditions measuring sensitivity to orthographic pattern regularities.

Oral Language Ability
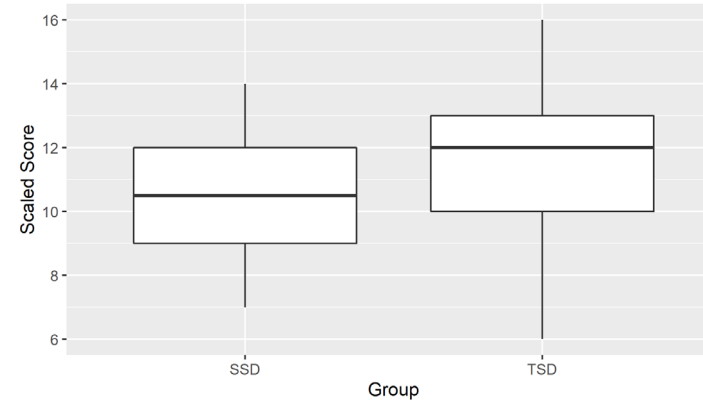
Groups did not significantly differ in their oral language ability.

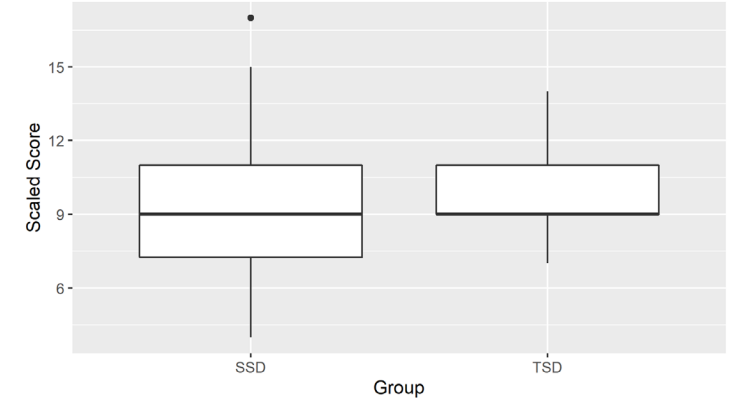**CELF-5 Sentence Comprehension Subtest**

$t_{Welch}(54.26) = -1.59$, $p = 0.12$, $\widehat{g}_{Hedges} = -0.41$, $CI_{95\%}$ [-0.91, 0.10], $n_{obs} = 60$

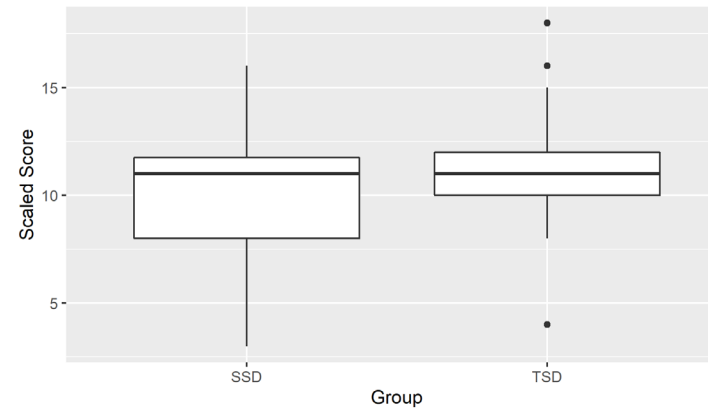**CELF-5 Word Structure Subtest**

$t_{Welch}(49.78) = -0.52$, $p = 0.61$, $\widehat{g}_{Hedges} = -0.13$, $CI_{95\%}$ [-0.63, 0.37], $n_{obs} = 60$

CELF-5 Core Language Score

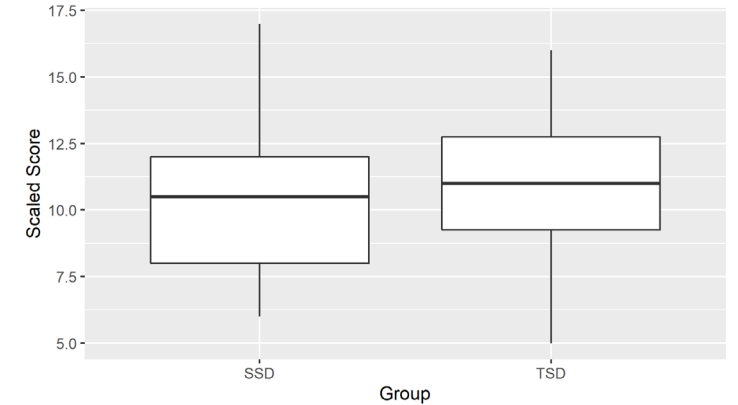$t_{Welch}(55.25) = -1.11$, $p = 0.27$, $\widehat{g}_{Hedges} = -0.28$, $CI_{95\%}$ [-0.78, 0.22], $n_{obs} = 60$

CELF-5 Formulated Sentences Subtest

$t_{Welch}(56.93) = -1.52$, $p = 0.13$, $\widehat{g}_{Hedges} = -0.39$, $CI_{95\%}$ [-0.89, 0.12], $n_{obs} = 60$

CELF-5 Recalling Sentences Subtest

$t_{Welch}(54.78) = -0.22$, $p = 0.83$, $\widehat{g}_{Hedges} = -0.06$, $CI_{95\%}$ [-0.55, 0.44], $n_{obs} = 60$

Word Reading and Spelling

WRMT-III Basic Skills Composite
$t_{\text{Welch}}(52.72) = -3.29$, $p = 1.77\text{e-}03$, $\widehat{g}_{\text{Hedges}} = -0.84$, $\text{CI}_{95\%}$ [-1.36, -0.31], $n_{\text{obs}} = 60$
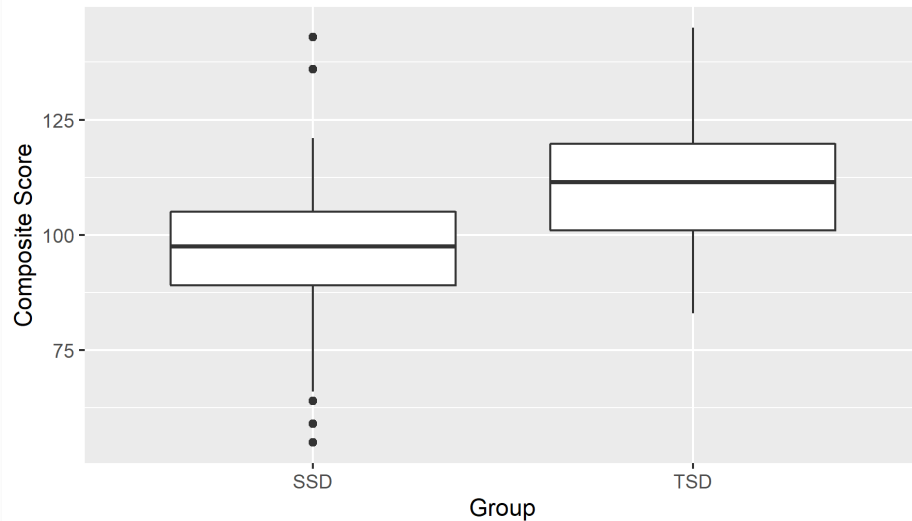
Children with SSD were found to have significantly poorer <u>word reading</u> and <u>spelling</u> as compared to their peers with TSD.
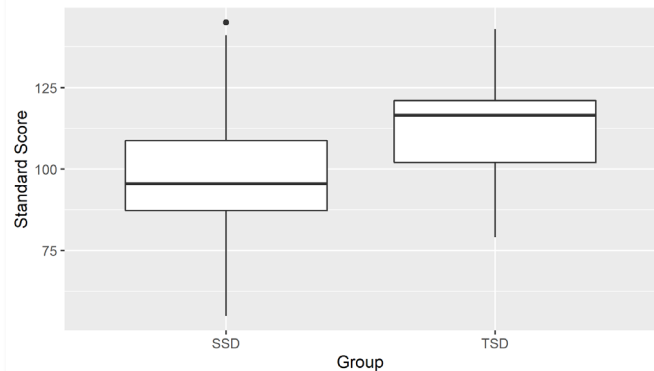

Spelling Task
$t_{\text{Welch}}(50.42) = -2.34$, $p = 0.02$, $\widehat{g}_{\text{Hedges}} = -0.60$, $\text{CI}_{95\%}$ [-1.11, -0.08], $n_{\text{obs}} = 60$
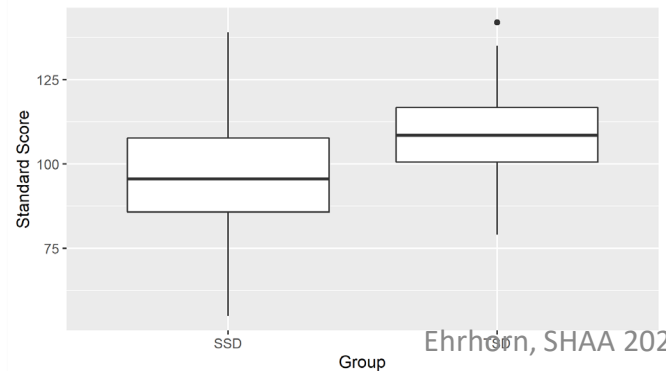

WRMT-III Word Identification Subtest
$t_{\text{Welch}}(52.17) = -3.36$, $p = 1.45\text{e-}03$, $\widehat{g}_{\text{Hedges}} = -0.86$, $\text{CI}_{95\%}$ [-1.38, -0.33], $n_{\text{obs}} = 60$
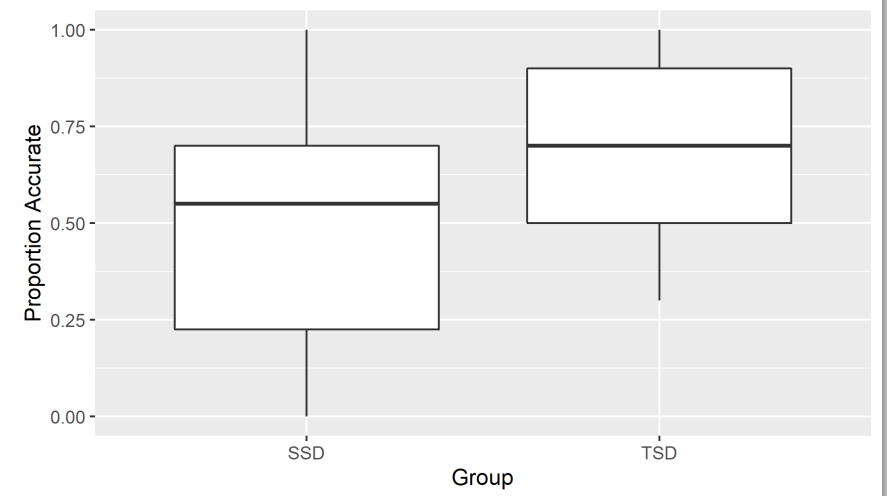

WRMT-III Word Attack Subtest
$t_{\text{Welch}}(51.78) = -2.85$, $p = 6.29\text{e-}03$, $\widehat{g}_{\text{Hedges}} = -0.72$, $\text{CI}_{95\%}$ [-1.24, -0.20], $n_{\text{obs}} = 60$

PA: CTOPP-2

Children with TSD had higher performance by 9.63 points on the CTOPP-2 phonological awareness composite than peers with SSD (*p*=.026).
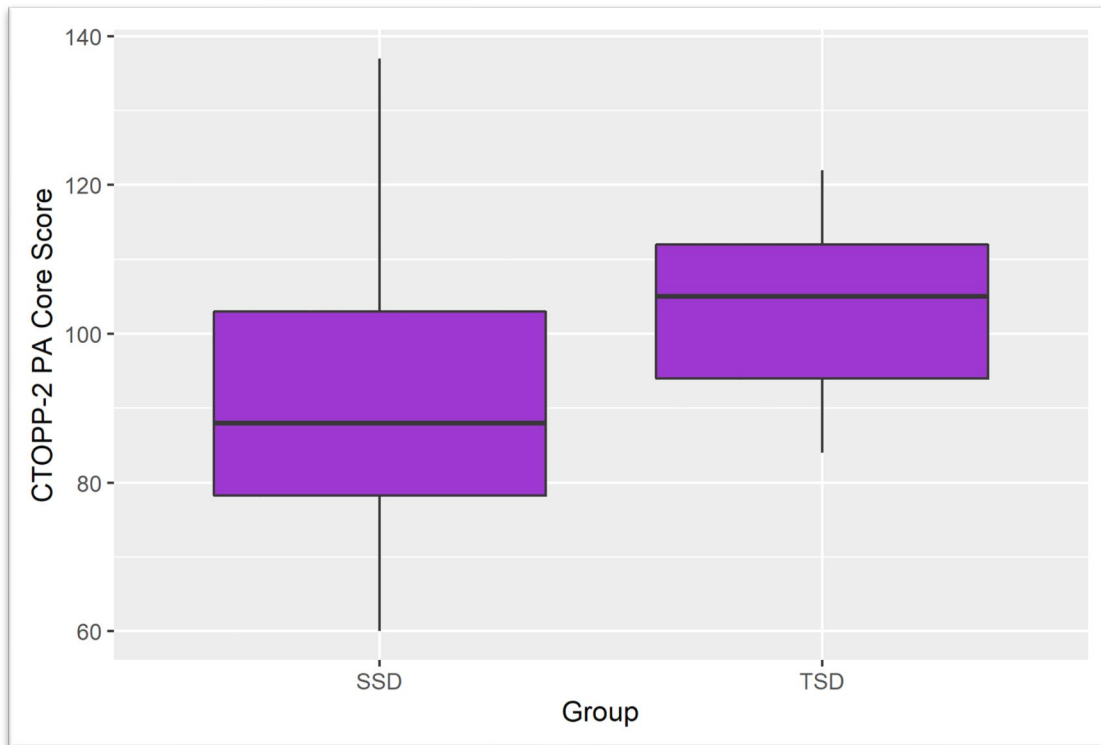
After controlling for **oral language ability**,
- Group differences were no longer significant, and
- Oral language ability significantly predicted performance.

PA: Experimental

Children with TSD had 22% higher performance on the experimental phonological awareness task as compared to their peers with SSD (*p*<.001).

After controlling for **oral language ability**,

- Group differences remained significant, and
- Oral language ability significantly predicted performance.
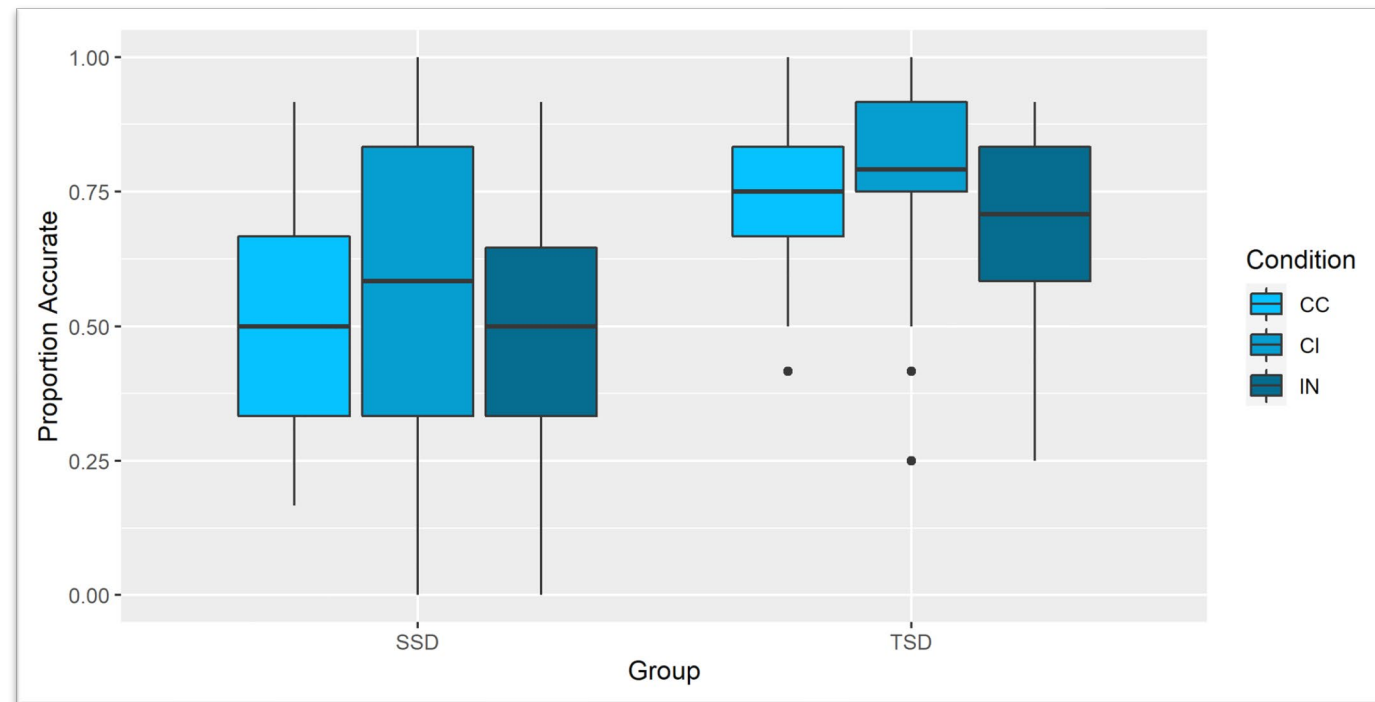
OK: Phoneme-Grapheme

Children with TSD were better at determining whether the phoneme(s) and grapheme(s) presented matched as compared to peers with SSD (p=.023).

After controlling for **oral language ability**,
- Group differences remained significant, and
- Oral language ability significantly predicted performance.

OK: Orthographic Patterns

Children with TSD were better at identifying the accurate orthographic string as compared to peers with SSD (*p*=.045).

After controlling for **oral language ability**,

- Group differences were no longer significant, and
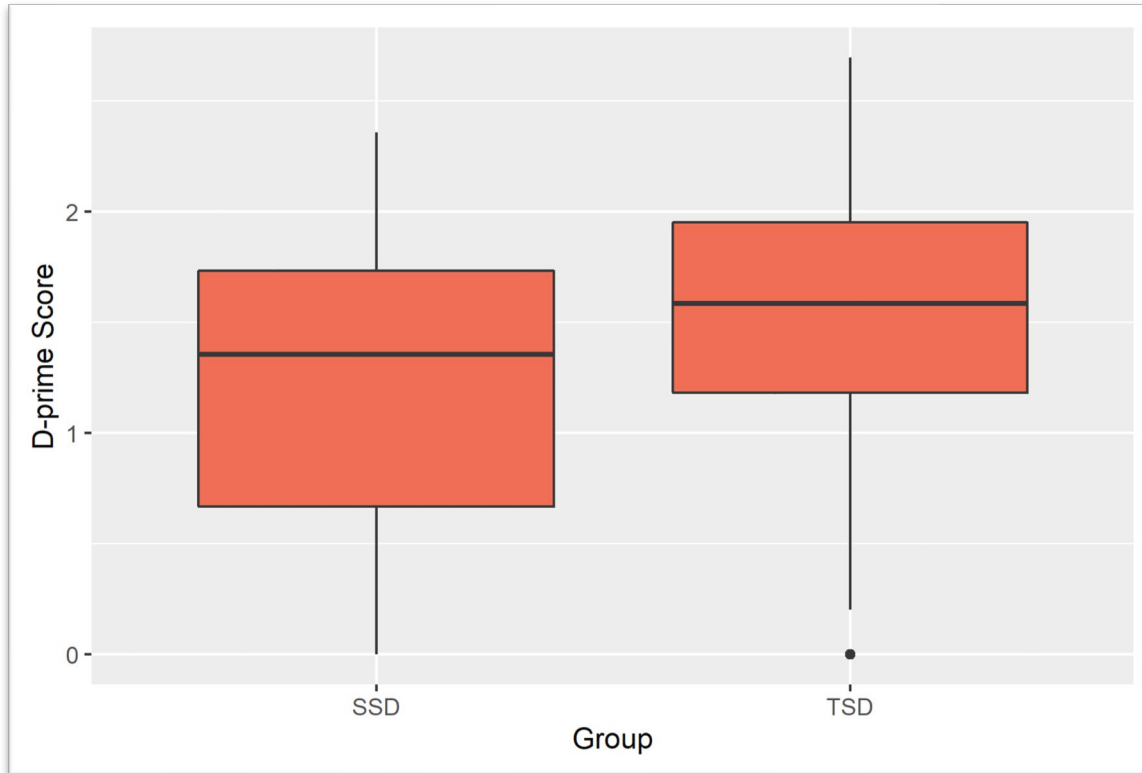- Oral language ability significantly predicted performance.
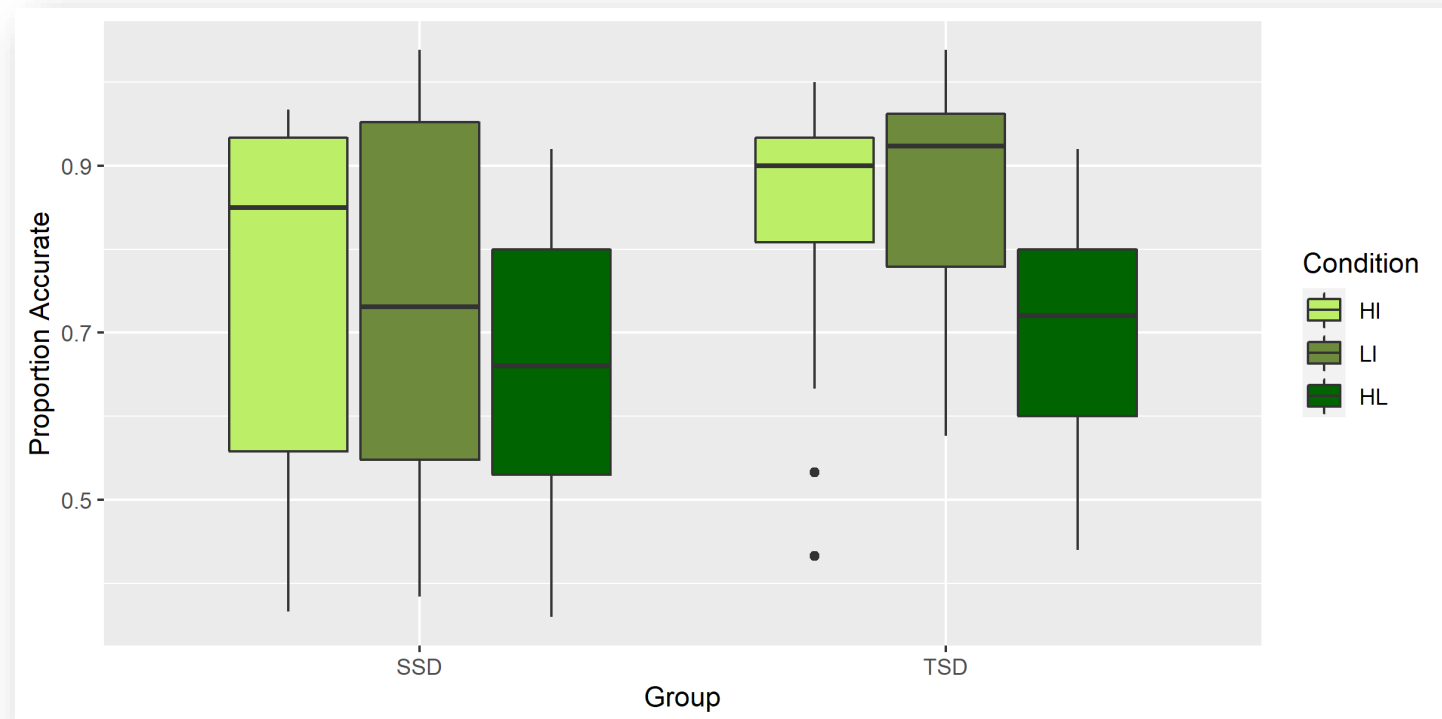
Does orthography influence phonological awareness performance within each group?
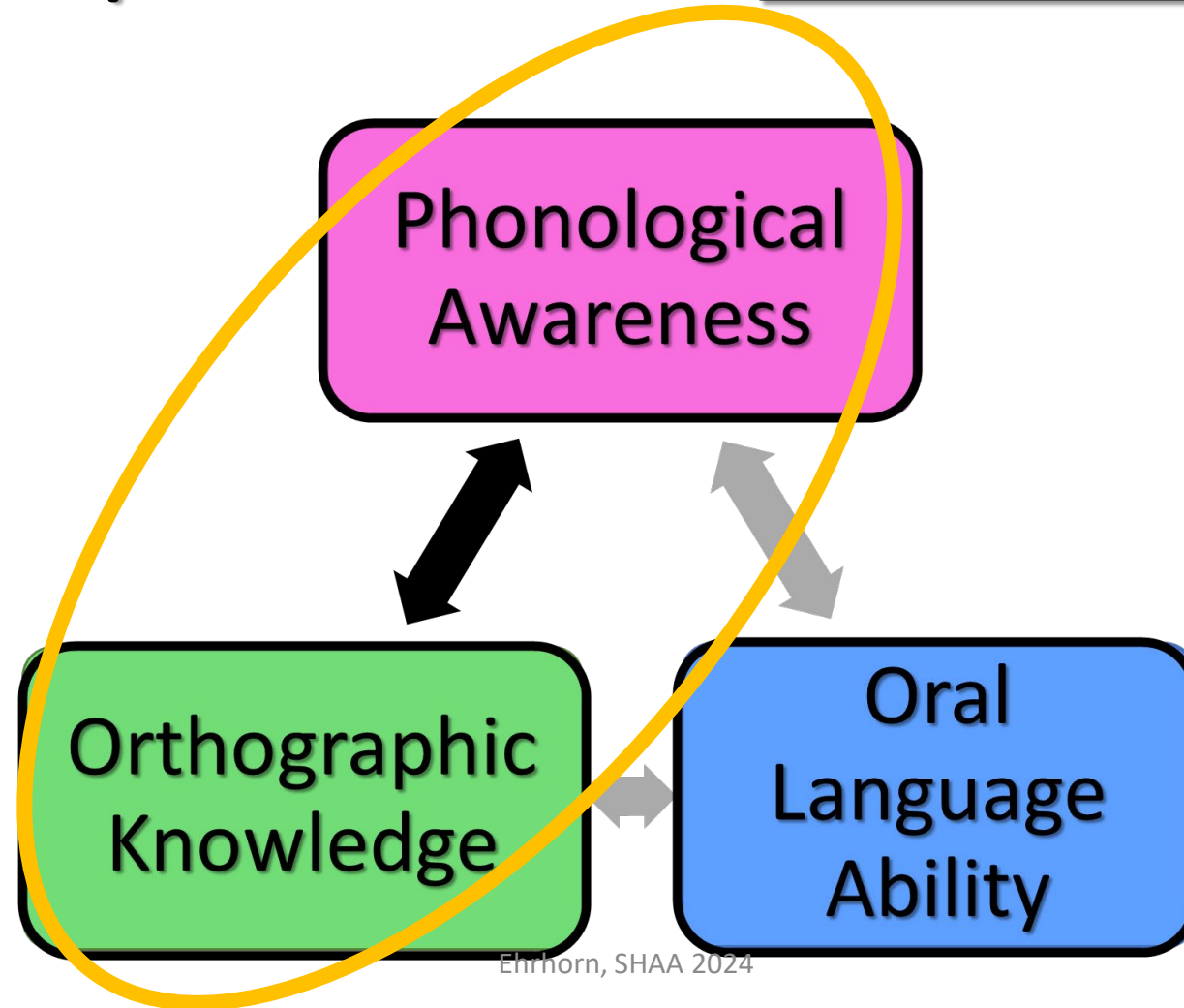
Children with <u>TSD</u> were found to have better phonological awareness performance when the phoneme-grapheme pairs were CC (mu<u>g</u> – ta<u>g</u>) as compared to when they were IN (blo<u>ck</u>s – fo<u>x</u>; *p*=.016).
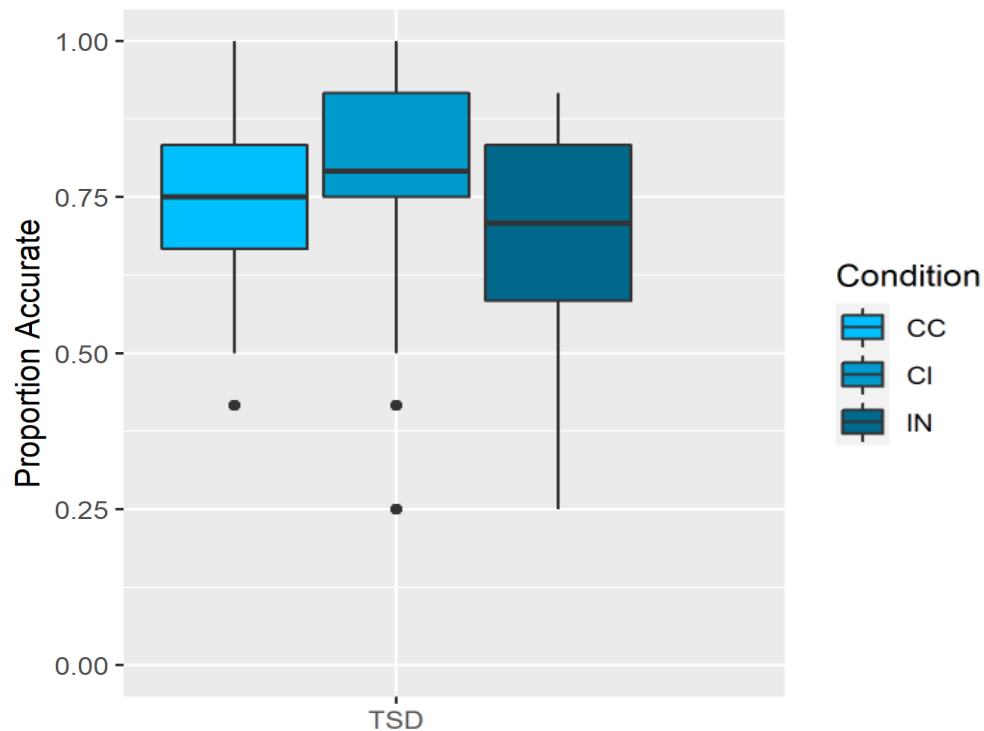
After controlling for **oral language ability**,

- Phonological awareness performance was no longer significantly influenced by orthographic properties of words, and
- Oral language ability was not significant.

Children with <u>SSD</u> were found to have similar phonological awareness performance no matter the phoneme-grapheme congruency and consistency (all $p>.05$).

After controlling for **oral language ability**,

- Still did not show any influence from orthographic properties of words on their phonological awareness performance, but
- Oral language ability was a significant factor ($p<.05$).
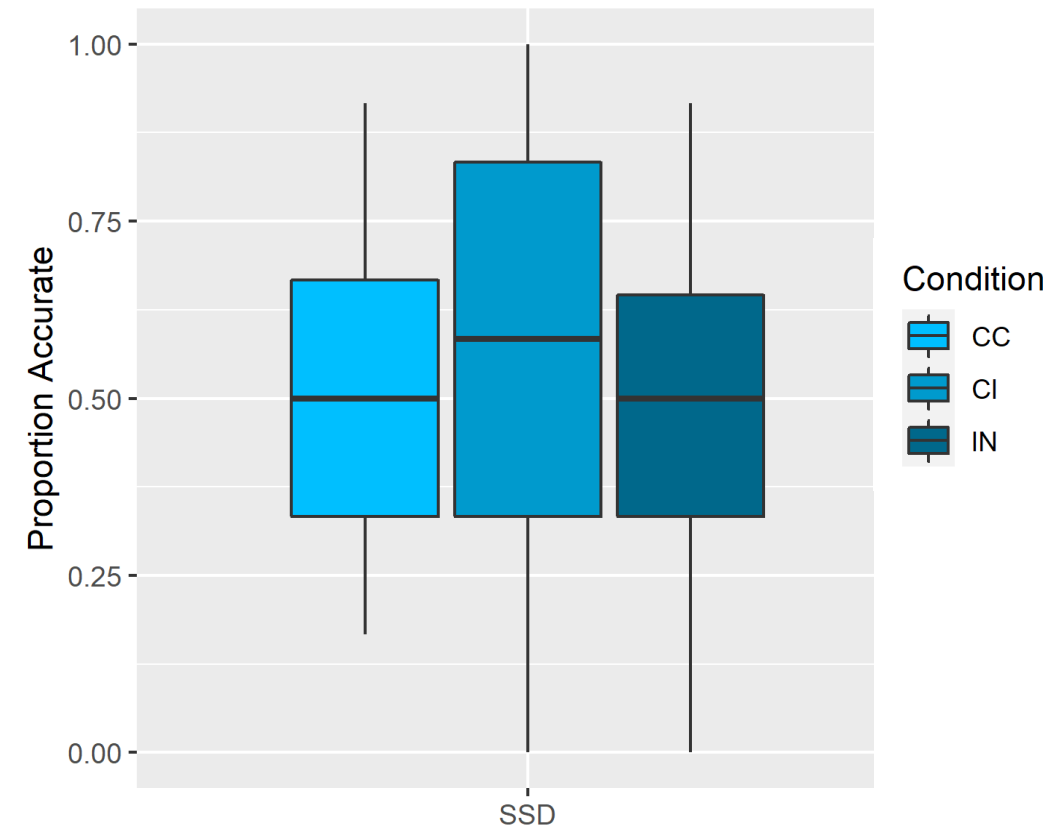
Comparison of these differing orthographic influence patterns between groups

Orthographic properties of words were not shown to significantly influence phonological awareness performance...

Across the groups
or
Between the groups

Before and After controlling Oral Language Ability
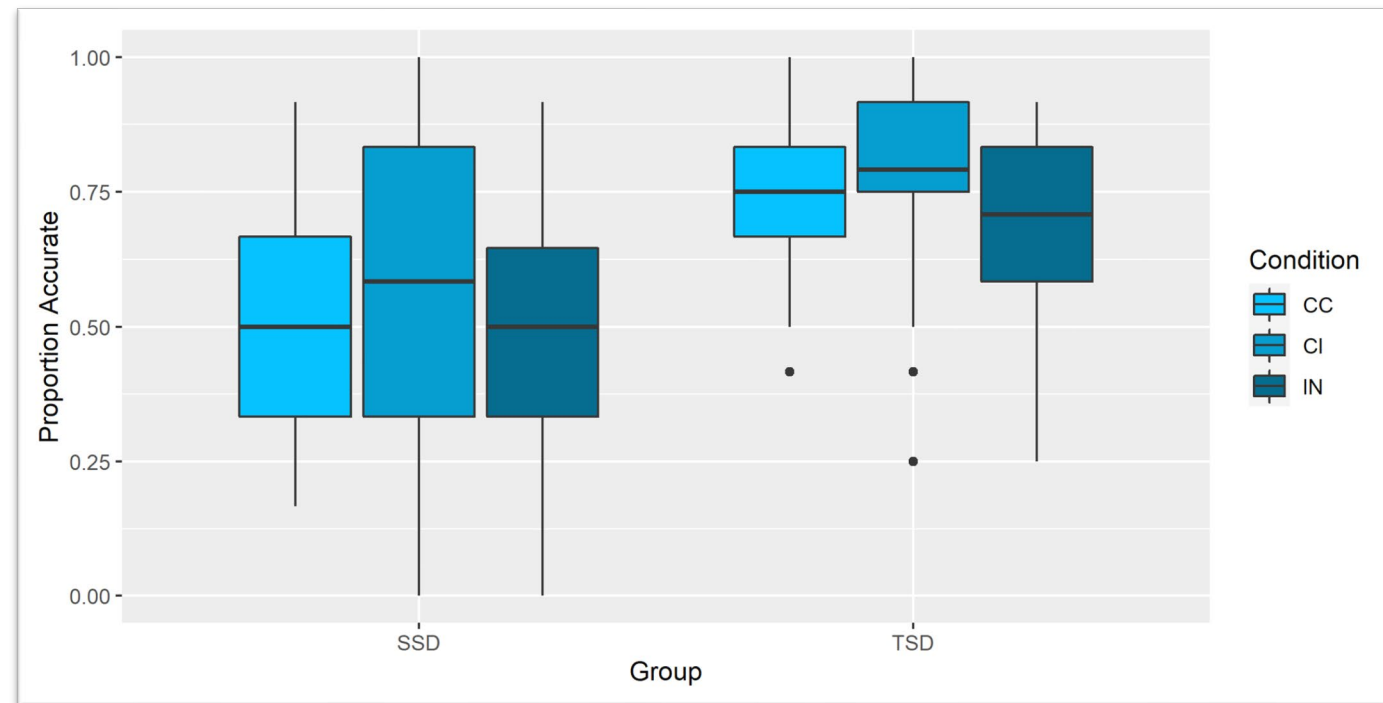
Research Findings

SUMMARY

Findings that align with previous studies

✓Children with SSD have…
- lower word reading and spelling skills as compared to peers with TSD, but there is individual variability.
- lower phonological awareness performance as compared to their peers with TSD.
- less phoneme-grapheme correspondence knowledge than their peers with TSD.

✓Oral language ability is a prominent factor in predicting early literacy skill development.

Findings that need further investigation

- Knowledge of orthographic regularities was better predicted by oral language ability than the presence of SSD.
  - This suggests that the ability to learn/recognize the orthographic regularities is dependent on your oral language knowledge.

- Phonological awareness performance was influenced by orthographic properties of words in children with TSD, but children with SSD did not demonstrate an influence on their phonological awareness performance.
  - Oral language explained SSD performance but not TSD performance.

Research Takeaways

Oral language ability is essential to measure in children with SSD when examining early literacy development.

Implicit orthographic rule learning/recognition is associated with general language ability.

Children with SSD have less orthographic knowledge than peers with TSD resulting in minimal influence on their spoken language processing.

How can we promote word reading and spelling in children with SSD?

Assessment and Intervention

Understanding Strengths and Difficulties Beyond Speech Sound Production Deficits

Measurement of language needs to be included in our assessment even if primarily concerned with speech sound production.

Screening for orthographic rules/recognition may provide insight into current implicit knowledge of written language.

Measurement of Letter Identification and Phoneme-Grapheme Correspondences would provide current knowledge and reading instruction stage to guide the integration of orthography.

Integration of Foundational Literacy Skills and Related Areas into Speech Sound Production Intervention

Promoting word reading and spelling in children with SSD may require more explicit instruction in the following:

Phonological Awareness

Orthographic Knowledge

Phonological Awareness

Figure 1 (Schuele & Boudreau, 2008)

More Complexity

Delete, manipulate phonemes

Segment words into sounds

Less Complexity

Blends sounds into words

Segment initial and final sounds

Onset-rime segmentation

Alliteration: Initial and Final Sounds Sorts

Rhyme

Words into syllables

Foundation critical to early literacy success

Phonological Awareness

Phonemic Awareness
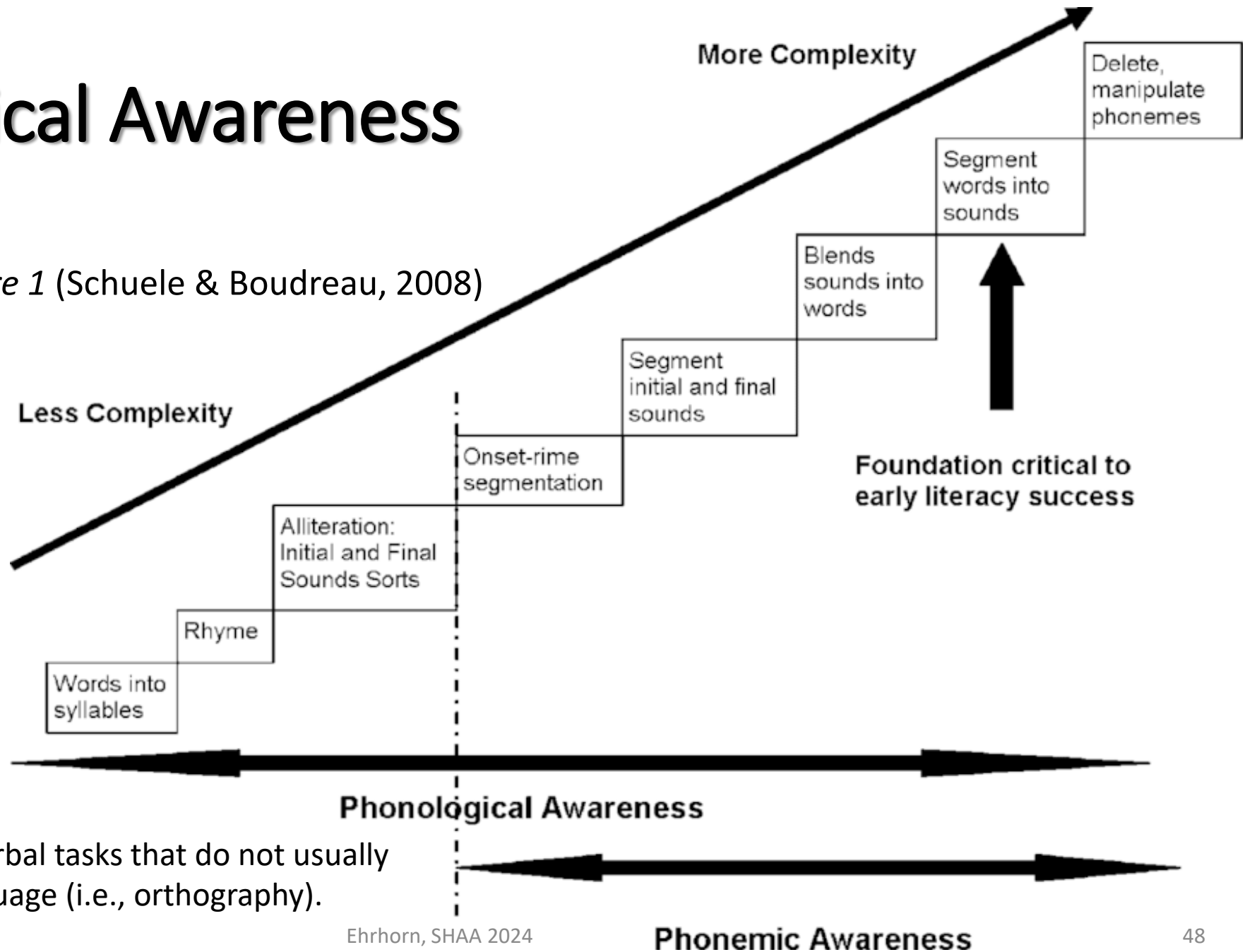
Remember: These tasks are verbal tasks that do not usually involve the use of written language (i.e., orthography).

Most SSD intervention research indicates that the integration of phonological awareness and perception tasks increases speech production accuracy and phonological awareness skills while decreasing risk of word reading difficulties.

(Gillon, 2000; 2002; 2005; Schneider et al., 2000)

Some studies did not find significant improvements in all areas but this may be due to variations in phonological awareness skills targeted and the amount of intervention.

(Denne et al., 2005; Hesketh et al., 2000)

Recommendations of how to integrate Phonological Awareness into Speech Production Intervention

McNeill and Gillon (2021) reviewed the current evidence and suggest...

- Phonological awareness tasks need to focus at the phoneme-level.

- Speech production needs to be incorporated within the phonological awareness tasks.

- Intervention intensity should be between 18-20 hours, ideally 2x/week.

- Collaboration with the child's team members to maximize effects.

- Incorporation of orthography to support phoneme-grapheme knowledge for decoding and encoding (i.e., reading and spelling) and eventually could be used a cue during speech production tasks.

This SSD intervention research primarily examined speech production and literacy-related skills if phonological awareness was integrated in speech production intervention.

Per the recommendations, many studies also included tasks considered part of phonological awareness that integrated orthography.

(Denne et al., 2005; Ehri et al., 2001; Gillon, 2000; 2002; 2005; Hesketh et al., 2000; Schneider et al., 2000)

So were the improvements in children with SSD due to the integration of...

Phonological awareness

Orthography

Both areas combined

Integration of Orthography to Support Word Reading and Spelling in SSD

Minimal SSD research has measured whether the explicit use of orthography during speech sound intervention improves both speech production and orthographic knowledge.

Pedro and colleagues (2018) developed a flashcard intervention for Portuguese pre-school children with phonological delay to target phoneme-grapheme correspondences while also examining impact on speech production.

Results suggest that explicit and systemic orthographic knowledge instruction improves phoneme-grapheme correspondences and speech production at the word level, but there was no follow-up to examine the longitudinal impact on word reading or spelling.

Intervention targeting phoneme-grapheme correspondences can improve this aspect of orthographic knowledge and speech production, but there may be possibly more improvement and generalization if phonological awareness and perception were also present in the intervention.

Why may combining phonological awareness and orthography within intervention be important for children with SSD?

Many children with SSD also may have deficits in phonological awareness and/or their representations.

(Apel & Lawrence, 2011; Brosseau-Lapré & Roepke, 2019; Miller & Lewis, 2022).

Children with SSD have less orthographic knowledge than peers with typical speech, especially targeting phoneme-grapheme correspondences.

(Ehrhorn & Adlof, in preparation).

/t/ /f/ /s/ /a/ /m/ /p/

t tt   ff f ph   s c ss   o a   m mm   p pp
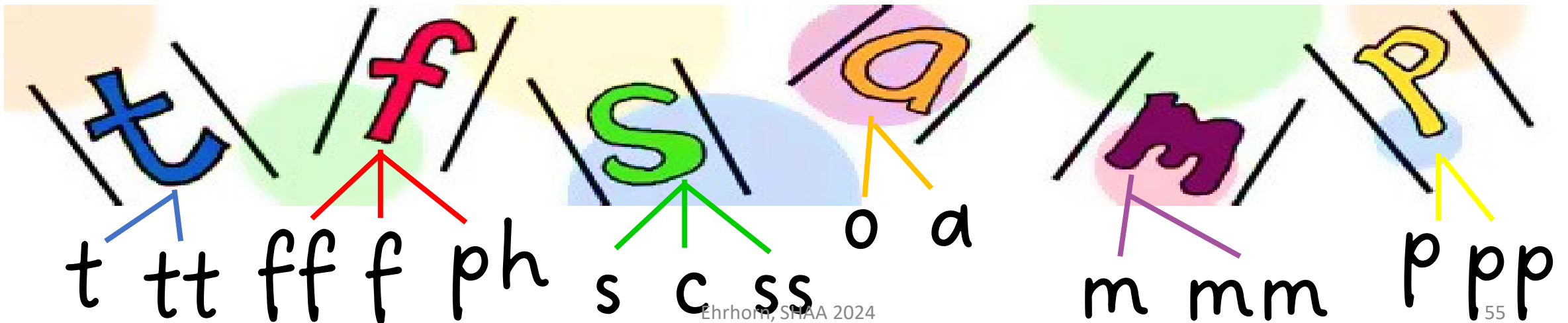
Ideas for How To Integrate Orthography

Spoken Language	Stimuli Cards	Reading Written Language	Spelling Written Language
Target the perception of phonemes through minimal pairs or near minimal pairs. Target phonological awareness but present letters/graphemes to support identification and manipulation of phonemes. *Is this true phonological awareness?* • Not exactly. • This may support the integration of these two separate, but related skills needed for reading and spelling.	Stimuli cards often have a picture and the written word. • You point to the grapheme(s) that correspond with the phoneme. • You point and add an explicit verbal explanation. • Comparison of same or different phonemes with the graphemes. • Integration of some phonological awareness skills may also occur!	*Text to Speech* Identification of graphemes and corresponding speech sounds. • Dialogic reading. • Ear reading with the text to read along. • Prior identification of graphemes that may contain target phoneme. Awareness that there are patterns/rules tell us when certain phonemes-graphemes occur in a word	*Speech to Text* Identification of phonemes and recalling graphemes and orthographic rules/regulations • Support inventive spelling development (i.e., Spell the words as they sound). Replace the grapheme(s) to make a minimal pair (e.g., Clinician presents "moth" and asks them to change the word to "math")

Consideration of Additional Areas

Auditory Discrimination or Perception	Phonological Awareness	Orthographic Knowledge	Types of Speech Sound Production Errors
Progress in speech sound production intervention	Word reading and Spelling Instruction Stage	Instructional Approach(es) Implemented	Other Deficits and Co-occurring Disorders
Areas of Strength	Additional Services	Zone of Proximal Development (ZPD)	Individual Characteristics

Intervention Research Takeaways

Integration of Auditory Discrimination and/or Phonological Awareness into SSD intervention can be beneficial.

More research is needed to examine the speech production and literacy impacts when orthography is explicitly integrated into speech sound production intervention.

Consideration of multiple aspects needs to occur when integrating phonological awareness and/or orthography into speech sound production intervention.

Thanks for joining me and hope to connect with you soon!

Anna M. Ehrhorn, Ph.D., CCC-SLP
(she/her/hers)

AUBURN UNIVERSITY

Assistant Professor

Speech, Language, and Hearing Sciences

aehrhorn@auburn.edu

Email sllac@auburn.edu
Website https://cla.auburn.edu/sllac-lab/

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