

Persistent Speech Sound Disorders: Cognitive Implications for Assessment and Treatment

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Disclosures

- Financial: NESSLP has compensated me for today's presentation. I am a faculty member at Emerson College and receive a salary for that job.
- Nonfinancial: I am the director of the Children's Literacy and Speech Sound (CLaSS) Lab, faculty at Emerson College, and the President of the Massachusetts Speech, Language, and Hearing Association




Learning Objectives

- Identify the role of phonological representations
- Discuss the risk factors and outcomes for children with persistent or remediated speech sound disorders as well as those with dyslexia
- Discuss the SLPs role in facilitating literacy skills for children with speech sound disorder and those with dyslexia




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Observation from a school-based SLP:
Subgroups of SSD????

		Remediates	
		YES	NO
Literacy Problems	NO		Motor Deficit?
	YES	Linguistic Deficit?	True phonological deficit

What is reading?

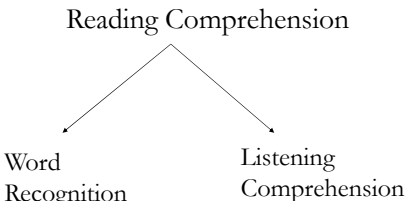


Who is reading?



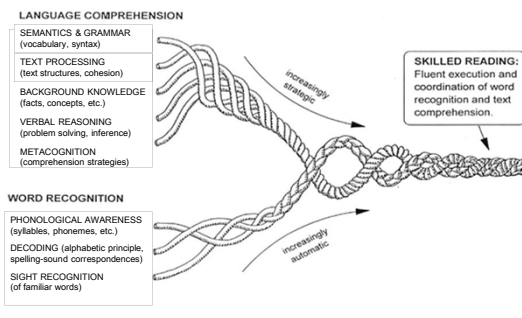
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The Simple View of Reading
(Catts, Hogan, & Fey, 2003; Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990)



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THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING



See Scarborough, H. S. in Neuman, S.B. & Dickinson, D. K. (2001). *Handbook of Early Literacy Research*. New York: Guilford Press.


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Who are children with phonological disorders?



Who are they?

- Speech sound disorders
 - Articulation
 - Phonology
- Dyslexia
 - Word reading
 - Phonemic decoding




Speech sound disorders are characterized by a delay in the acquisition of appropriate speech sounds
(Lewis, Freebairn, Hansen, Shriberg, Stein, Taylor, & Iyengar, 2006).

Children with speech sound disorders are the primary population treated by school-based speech language pathologists
(ASHA, 2014, 2013, 2012; NIDCD, 1994).

Speech sound disorders can impact academic, linguistic, vocational, and socio-emotional skills in children and adolescents
(Hitchock & McAllister-Byun, 2015; Lewis, Freebairn, Hansen, Iyengar & Taylor, 2004)

50-70% of children with speech sound disorders require some level of special education services through the 12th grade
(Felsenfeld, Broen, & McGue, 1994; Shriberg & Kwiatkowski, 1988).

Even once the speech sound disorder has been remediated through speech therapy services
(Anthony, et al, 2007; Overby, Trainin, Smit, Bernthal, & Nelson, 2012; Raitano et al., 2010).



Speech Sound Disorder

- More than half of children with SSD experience difficulties with reading (Bishop & Adams, 1990; Catts, Adlof, Hogan, & Weismer, 2004; Catts, 1986; Catts, 1991; Catts, Fey, Tomblin, & Zhang, 2002; McCardle, Scarborough, & Catts, 2001; Nathan, Stackhouse, Goulandris, & Snowling, 2004; Tomblin, Zhang, Buckwalter, & Catts, 2000).
- Deficits in the phonological system often result in difficulty acquiring phonological awareness (PA) skills, a necessary pre-requisite for reading success (Larrivee & Catts, 1999).

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Prevalence of SSD

- 11-13% of children ages 5-7 years have a speech sound disorder (Cherney, Tomblin, & O'Brien, 2005)
- Approximately 10% of children ages 9-11 have a **persistent speech sound disorder**
Speech errors that persist past the typical age of acquisition (i.e., 5 years old) (Bishop, 2003; Tomblin, Zhang, Buckwalter, & Catts, 2000)
- 18% of 8-year-olds in the UK have unresolved speech sound errors (Boulton, Miller, Wren, & Peters, 2009)
- 1.4% of college freshman have persisting speech sound errors (Culton, 1986)

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Risk of Reading Difficulties

This likely includes children with dyslexia!


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    graph LR
      A[Typically developing] --> B[Speech Sound Disorders only]
      C[SSD + Language impairment] --> B
  
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Dyslexia is...

- A language-based problem
- A phonological processing disorder
- Neurobiological in origin
- Present from birth
- Usually experienced for life




Dyslexia is...

- A spectrum disorder than can range from annoyance to severe limitation
- More common than any other kind of learning disability
- Responsive to expert, informed instruction (Moats, 2008)




Dyslexia is...

- Characterized by weaknesses in word reading, phonemic decoding, and spelling
- Surprising, because this weakness exists in the presence of normal intelligence
- Present in adults who have compensated but are poor spellers, are slow readers, and have difficulty with novel and complex phonological forms



Dyslexia is NOT...

- Characterized or diagnosed by seeing letters backwards
- Indicative of "gifted" status
- A disorder that cannot be diagnosed until 3rd grade
- A visual problem
- Responsive to colored lenses and/or eye tracking exercises



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Phonological processing deficit

- Most commonly associated with dyslexia is difficulty with phonological awareness tasks
- Deficits in phonological memory (i.e., nonword repetition task) also noted

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Phonological processing deficit


- This phonological processing deficit seen across a variety of languages
 - French (Sprenger-Charolles et al., 2000)
 - Greek (Porpodas, 1999)
 - German (Wimmer et al., 1999)
- Manifestation is also different across languages
 - English: word reading
 - Dutch: word reading fluency
 - German: spelling

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Oral language deficits


- Phonological processing problems associated with dyslexia can impact other language skills
- Many studies show that subtle oral language deficits are present in children at risk for dyslexia before formal schooling

(e.g., Lyytinen et al., 2001; Scarborough, 1990, 1991)




Secondary Consequences
(research committee of the IDA, Lyon et al., 2003)

- Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge




Dyslexia Summary

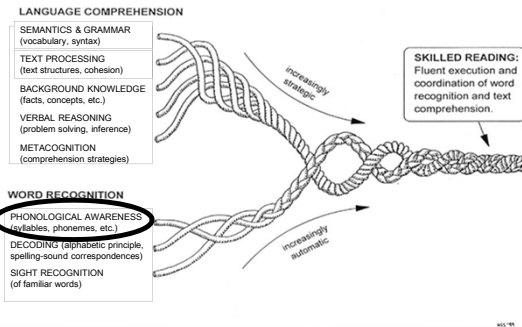
- Classic case is uncommon
- Impairment in phonological processing (not necessarily production)
 - Across the lifespan
- Compensated adults
 - Poor spellers
 - Poor at reading quickly
 - Still have subtle phonological processing deficits



What is phonological awareness?



THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING



LANGUAGE COMPREHENSION

- SEMANTICS & GRAMMAR (vocabulary, syntax)
- TEXT PROCESSING (text structures, cohesion)
- BACKGROUND KNOWLEDGE (facts, concepts, etc.)
- VERBAL REASONING (problem solving, inference)
- METACOGNITION (comprehension strategies)

WORD RECOGNITION


- PHONOLOGICAL AWARENESS (syllables, phonemes, etc.)
- DECODING (alphabetic principle, spelling-sound correspondences)
- SIGHT RECOGNITION (of familiar words)

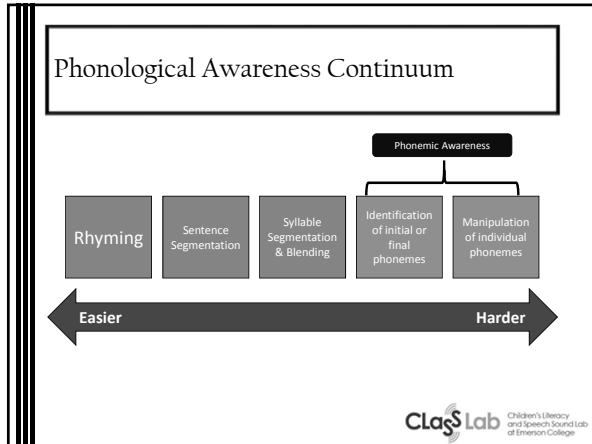
SKILLED READING: Fluent execution and coordination of word recognition and text comprehension.

See Scarborough, H. S. in Neuman, S.B. & Dickinson, D. K. (2001). *Handbook of Early Literacy Research*. New York: Guilford Press.

Phonological awareness

- One's sensitivity to the sound structure of a word
- Measured by rhyming, blending, and deletion tasks
- Research supports causal link between phonological awareness and early reading
 - Good phonological awareness = good readers
 - Poor phonological awareness = poor readers
- The component of reading in which SLPs are most likely to be involved





Phonological Awareness

- EYES SHUT!!

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PA & SSD – Relations over time

Preschool:

- Preschoolers with SSDs are at increased risk for deficits with phonological awareness (Anthony et al., 2011; Bird, Bishop, & Freeman, 1995; Foy & Mann, 2011; Lewis et al., 2011; Lewis & Frechbairn, 1992; Peterson, Pennington, Shriberg, & Boada, 2009; Raitano, Pennington, Tunick, Boada, & Shriberg, 2004; Rvachew, Ohlberg, Grawburg, & Heyding, 2003)
- Atypical speech sound errors and distortions in preschool are predictive of weak PA skills (Preston & Edwards, 2010)
- This is true even when language is normal (Bird et al., 1995; Overby, Trainin, Smit, Bernthal, & Nelson, 2012; Raitano et al., 2004; Rvachew et al., 2003)
- The proportion of speech sounds in error at age 5 is related to the likelihood of persistent errors at age 8 (Roulstone et al., 2009)

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PA & SSD – Relations over time

School-aged:

- Children with persistent speech sound disorders (2-5th grade) have markedly weaker PA skills compared to same-age peers (Farquharson, 2012)
- Children with "residual" SSD, ages 8.5-10, exhibit cortical and subcortical differences during phonological processing tasks (Preston, Felsenfeld, Frost, Mencl, Fulbright, Grigorenko, Landi, Seki, & Pugh, 2012)
- Atypical speech sound errors in preschool are predictive of school-age PA abilities; if more than 10% of the child's speech has atypical errors, the child is likely to have deficits in PA, reading, and spelling (Preston & Hull, 2012)



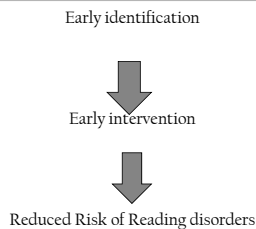
PA & SSD – Relations over time

Adolescents:

- 10-14 year old children with "residual" speech sound errors (no comorbid diagnoses) have weaker phonological processing skills compared to same-aged peers (Preston & Edwards, 2007)
- Phonological processing (word reading and phonological working memory) skills have been shown to be weak even once the speech sound disorder is remediated (Farquharson, 2015; Raitano, Tunick, Pennington, Boada, & Shriberg, 2004)




How do we use this information?



Early Intervention

- Critical because children who start out as poor readers generally continue to be poor readers
- Poor reading achievement quickly leads to a host of negative consequences





Downward Spiral of RD

Low Motivation

Negative Expectations


Limited Practice

Academic Failure



Early Indicators

- Problems in oral language and speech sound development are primary signs of risk for reading disorders



Early signs of risk for Dyslexia

- Family history of reading or language impairment
- Difficulty learning the letter names and sounds
- Consistent use of unusual or nondevelopmental errors
- Multisyllabic words especially difficult

(Catts, 1986; 1989; Dodd, et al., 1995; Magusson & Naucler, 1990, Larrivee & Catts, 1999; Leitao & Fletcher, 2004)



Not early signs of dyslexia

- Reversing letters when writing
 - This is typical until ~2nd grade
- Common errors on long words
 - animal/ animal
 - paskeri/ spageri




New frontiers in early identification of dyslexia

- Speech discrimination at 3-5 days old
 - Guttorm et al., 2005
- Babbling complexity in infants
 - Farquharson, Hogan, Hoffman, Green, Wang, & Green, (under review); Lambrecht-Smith et al., 2008




Dyslexia resources


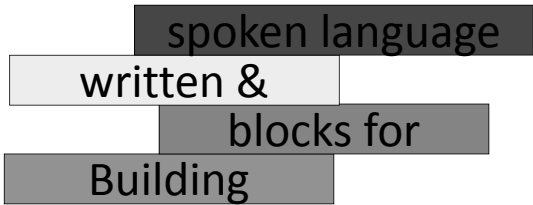
- #saydyslexia
- Decoding Dyslexia



What are phonological representations?



Phonological Representations



Phonological Representations

- How phonological information – like speech sounds – is stored in long term memory



Weak Phonological Representations



Strong Phonological Representations



Phonological Reps + SSD

- Underdeveloped in children with SSD (Catts & Larivee, 1999)
- May be difficult to access for children with SSD because working memory resources are limited
- May be the reason why some children with speech sound disorders experience difficulties with literacy and some do not.



How could this affect reading?

- Learning decoding skills
 - Letter sound correspondence
- Learning sight words



What is a sight word?

- The sight of the word immediately activates its pronunciation and meaning in memory
- To build sight words in memory, orthographic mapping, is required
- What is needed for orthographic mapping?

(Ehri, 2014)



Orthographic Representations

- The storage of orthographic information in long term memory (Apel, 2011).
- Provides information regarding how to represent spoken language in written form.



Weak Orthographic Representations



Strong Orthographic Representations



Orthographic Mappings

- Mappings from phonology to orthography occur early on in reading development.
- Parallel connections between orthography and phonology
 - Phonological awareness appears to provide extra support. (Nilsen & Bourassa, 2008)



SSD and mapping

- Children with SSD often struggle to make the translation between phonology and orthography (Sutherland & Gillon, 2005).
- Long-term difficulties even after the sound is remediated (Farquharson, 2015; Felsenfeld et al.)
 - How will we know if there are strong phonological representations?




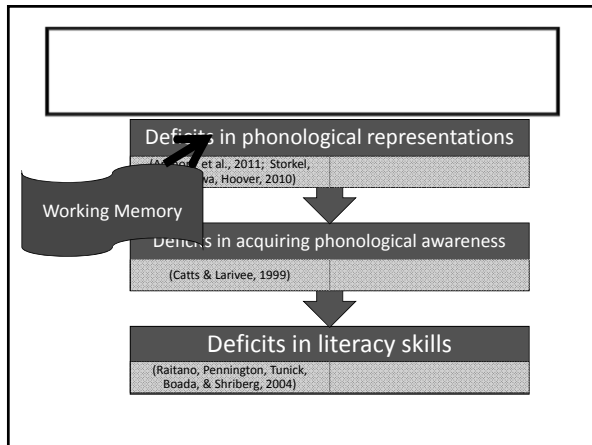
SSD and Literacy

- Children with SSD were found to have poorer performance on the following tasks:
 - Phonological processing
 - Phonological learning
 - Phonological awareness
 - Word recognition
 - Letter knowledge**
- (Carroll & Snowling, 2004)





Does Working Memory play a role?






Baddeley Working Memory Model



Central Executive


- Allocates attentional resources to the appropriate subsystems (i.e., phonological loop or visual-spatial sketchpad)
- (Baddeley, 1992; Reisberg, 2010)



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Visual Spatial Sketchpad

- Stores visually presented information, such as pictures or words



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Phonological Loop

- Stores auditorily presented information, such as speech sounds

"...most involved in language processing and development" (Hartmann, 2008, p. 1216)

Has a positive relationship with speech and language acquisition (Adams & Gathercole, 2000)

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Phonological Loop and SSD

- 12-year old with remediated SSD had poor WM
 - Spidel (1993)
- Preschoolers with low WM had more speech errors than preschoolers with high WM
 - Nonword repetition
 - Adams and Gathercole (1995)
- Preschoolers with SSD had poor WM
 - Nonword repetition
 - Munson, Edwards, & Beckman (2005)



Research Question

Are there differences in the working memory skills of school-aged children with persistent SSD and typically developing children?



Method



Participants

Persistent Speech Sound Disorder	Typically Developing
<ul style="list-style-type: none">n = 20 (13 males)Mean age = 112.3 monthsMean grade = 3.3GFTA M Standard Score = 80.5CTOPP M Standard Score = 91.6	<ul style="list-style-type: none">n = 20 (10 males)Mean age = 113.3 monthsMean grade = 3.3GFTA M Standard Score = 104.45CTOPP M Standard Score = 105.25

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All Participants: Inclusionary Criteria

- Monolingual
- Normal hearing
- Normal vision (corrected)
- Normal non-verbal intelligence
 - Reynolds Intellectual Assessment Scales (RIAS)

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Experimental Tasks

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Phonological Loop Tasks

- Sentence span task
- Nonword repetition task


- Henry Task



Results & Discussion




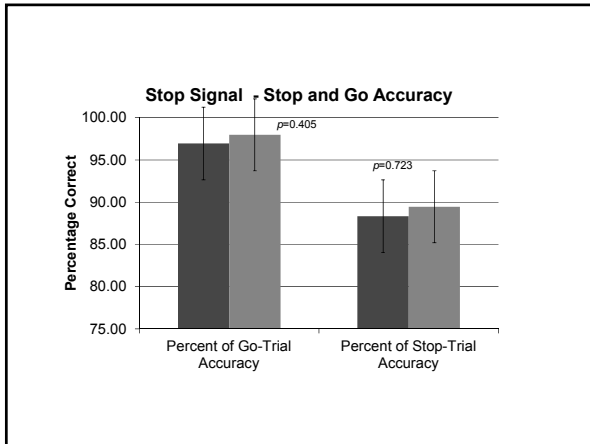
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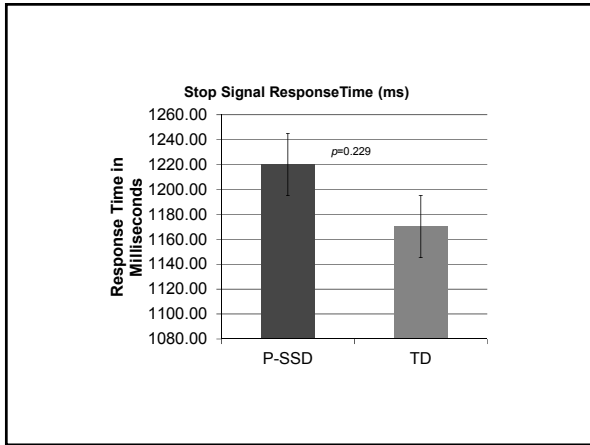


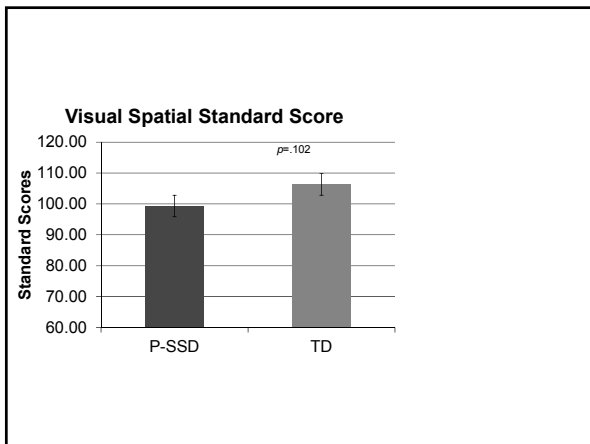
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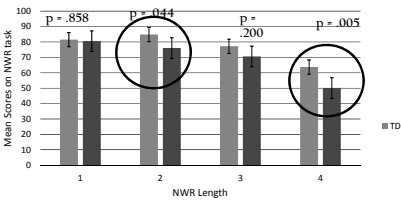


Tasks used for Analysis


- Phonological Loop:
 - NWR ✓
 - Henry Task ✓
 - Sentence Span ✗



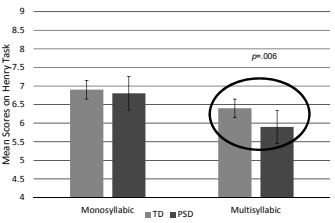
Nonword Repetition




NWR Length	TD Mean Score	PSD Mean Score	p-value
1	~85	~80	.858
2	~85	~75	.044
3	~75	~70	.200
4	~65	~55	.005

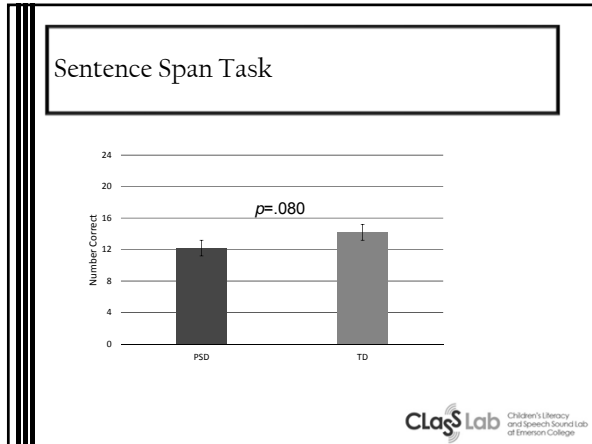


Henry Task



Word Type	TD Mean Score	PSD Mean Score	p-value
Monosyllabic	~6.8	~6.7	
Multisyllabic	~6.5	~6.0	.005





Conclusions

Children with P-SSD appear to have deficits specific to the phonological loop of working memory

Specifically, children with P-SSD struggle with complex word structures (e.g., multisyllabic words; longer lists of words)

Indicates limited phonological representations as well as limited working memory

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Results Summary

- Children with persistent SSD performed poorer than peers on phonological working memory tasks... BUT
- This relation was mediated by their nonverbal IQ scores (not vocabulary)
- It is not common place to test nonverbal IQ in children with SSD, but it may have predictive value for working memory and literacy skills

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Assessment Implications

- Test phonological awareness in all SSD evaluations
- Possibly add a nonword repetition test (see the Comprehensive Test of Phonological Processing-2nd Edition [CTOPP-2] for a possibility)




Assessment Implications

- Obtain material from classroom teacher that gives information on decoding, phonological awareness, or spelling skills
- Screen early and often; and don't screen "just" for speech sound production
- Obtain NVIQ if possible




Treatment Implications

- Include phonological awareness
- Try minimal pairs
- Include reference to orthography




Treatment Implications

- Partner with reading specialists and special educators
- Push in to the classroom
- Use curriculum based vocabulary



Clinical Implications

- Children with SSD will likely have poor phonological representations
- SLPs are on the front lines of defense for these children
 - Early SSD and language impairments put children at risk for later literacy deficits... EVEN IF the issue has remediated
- Be mindful of the warning signs and open to collaboration or consultation





Thank you!

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