


Why speech sounds  
matter for  
**LITERACY**

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Disclosures

- Financial: I am a faculty member at Florida and receive a salary for that job.
- Nonfinancial: I am the director of the Children's Literacy and Speech Sound (CLaSS) Lab




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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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Children's Literacy and Speech Sound (CLaSS) lab

- <http://classlab.cci.fsu.edu>
- Instagram: @classlab\_FSU
- Twitter: @literacyspeech
- [www.facebook.com/literacyspeech](http://www.facebook.com/literacyspeech)




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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

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What is reading?




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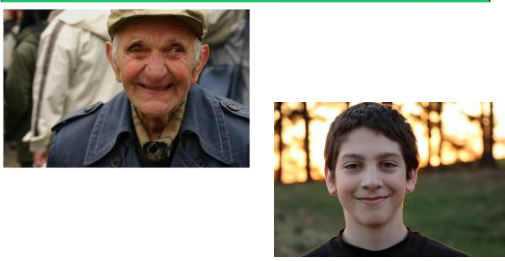
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Who is reading?



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The Simple View of Reading

(Catts, Hogan, & Fey, 2003; Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990)

Reading

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The Simple View of Reading

(Catts, Hogan, & Fey, 2003; Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990)

Reading

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Word Recognition

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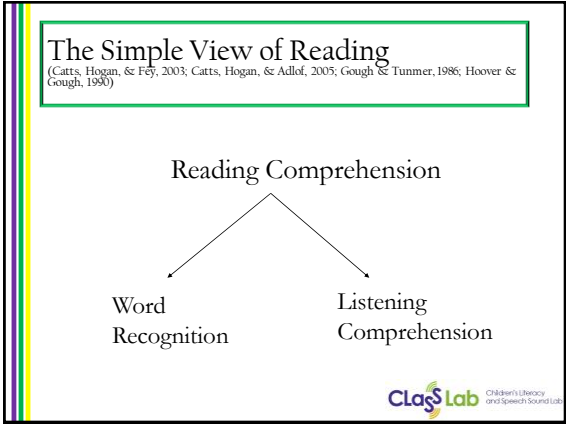
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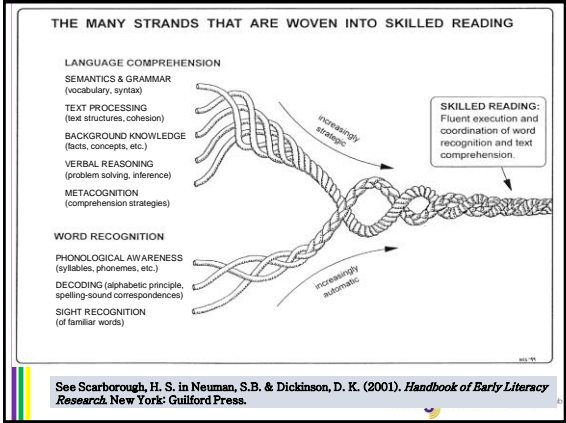
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How does this apply to phonological impairments?

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Who are they?

- Speech sound disorders (Pennington, 2006)
  - Articulation
  - Phonology
- Dyslexia
  - Word reading
  - Phonemic decoding




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Speech Sound Disorders

" SSD was formerly called *articulation* disorder (which emphasized putative problems in the motor programming of speech) and *phonological* disorder (which emphasized putative problems in the cognitive representations of speech). Since each of these terms made a premature commitment to the underlying processing deficit that causes the speech production problem, the neutral and descriptive term SSD is now preferred."

- Pennington (2006)




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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).

Even once the speech sound disorder has been remediated through speech therapy services  
(Anthony, et al, 2007; Farquharson, 2015; Overby, Trainin, Smit, Bernthal, & Nelson, 2012; Raitano et al., 2010).

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




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### 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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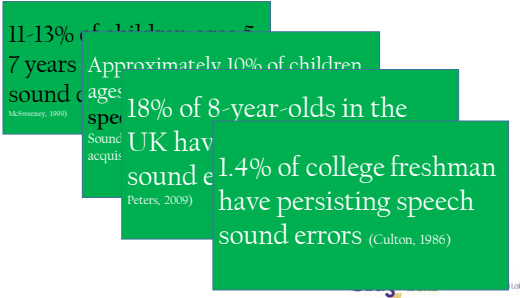
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### Prevalence of SSD




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### Risk of Reading Difficulties




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Dyslexia is...

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




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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)




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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




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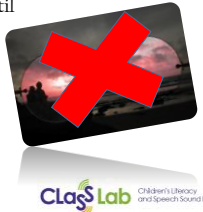
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Dyslexia is NOT...

- 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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What is phonological awareness?




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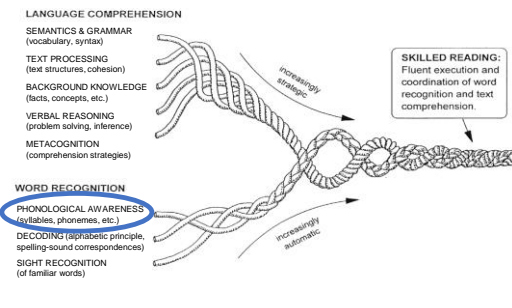
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THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING



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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### 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 (Hogan, Catts, & Little, 2005)
  - Good phonological awareness = good readers
  - Poor phonological awareness = poor readers



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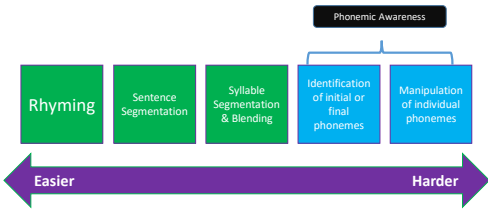
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### Phonological Awareness Continuum



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### Phonological Awareness

EYES CLOSED  
PICTURE



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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 & Firebairn, 1992; Peterson, Pennington, Shriberg, & Boada, 2008; Raitano, Pennington, Tunick, Boada, & Shriberg, 2004; Roachew, Ollberg, Grawburg, & Heyling, 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., 1997; Overby, Trainin, Smit, Bernthal, & Nelson, 2012; Raitano et al., 2004; Roachew 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 (2-5<sup>th</sup> 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, Feherfeld, Frost, Mend, Fulbright, Grigorenko, Lindi, 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 & Hall, 2012)




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### 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)




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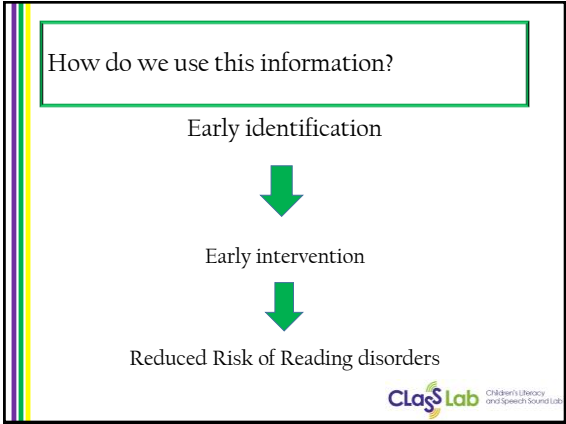
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Early Indicators

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

• Nathan, Stackhouse, Goulandris, & Snowling (2004); Pennington (2005); Raitano, Pennington, Tunick, Bada, and Shriberg (2004)

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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)

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Not early signs of dyslexia

- Reversing letters when writing
  - This is typical until ~2<sup>nd</sup> grade
- Common errors on long words
  - æmmal/ ænimæl
  - paskeri/ spogeri




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PA & phonological representations

- Testing phonological awareness is a robust measure of underlying phonological representations




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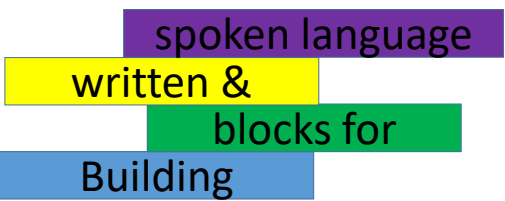
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Phonological Representations




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Phonological Representations

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




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Weak Phonological Representations




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Strong Phonological Representations




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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.




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How could this affect reading?

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




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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)




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Orthographic Representations

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




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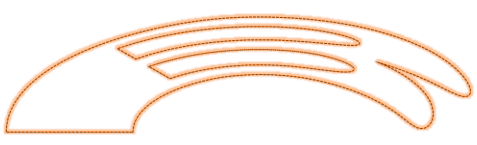


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Weak Orthographic Representations




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Strong Orthographic Representations




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### 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)




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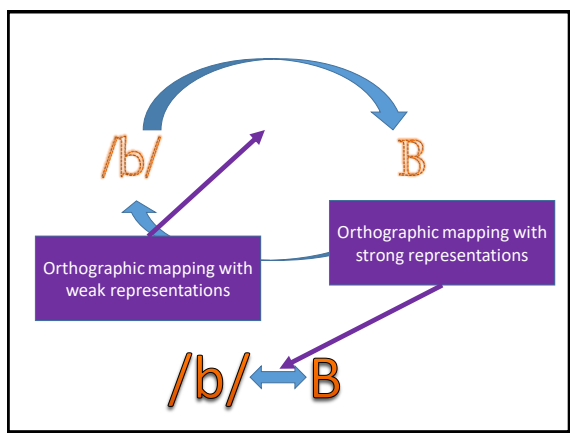
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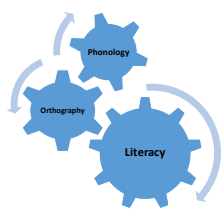
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### Self-teaching hypothesis



Share, 1995




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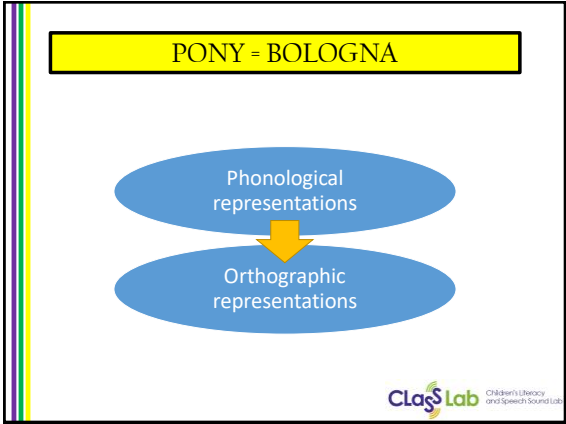
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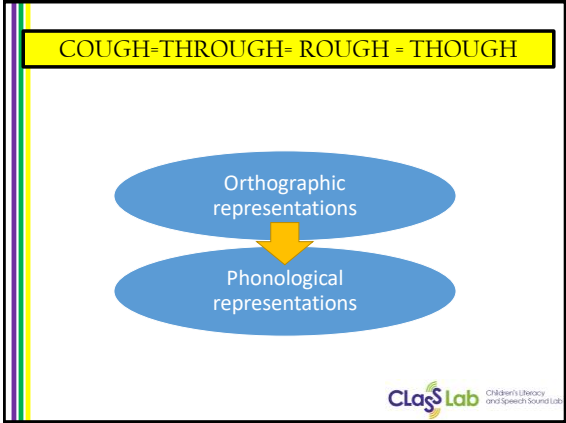
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SSD and mapping

- 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?

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Does Working Memory play a role?




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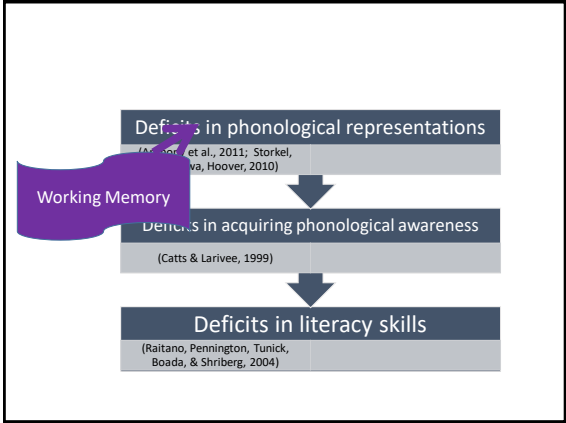
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Baddeley Working Memory Model


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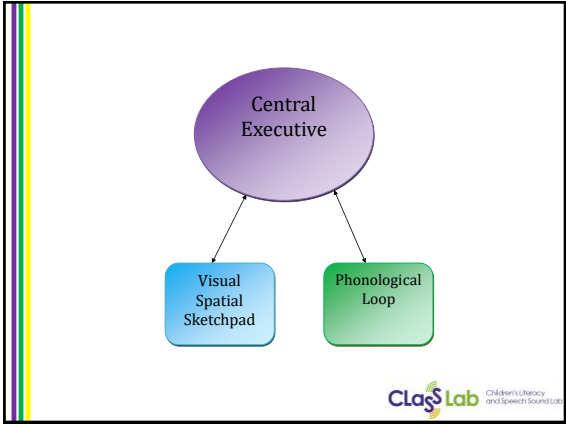
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Central Executive

- 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 information temporarily presented in the environment such as

“...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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Farquharson, Hogan, & Bernthal (2017)

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

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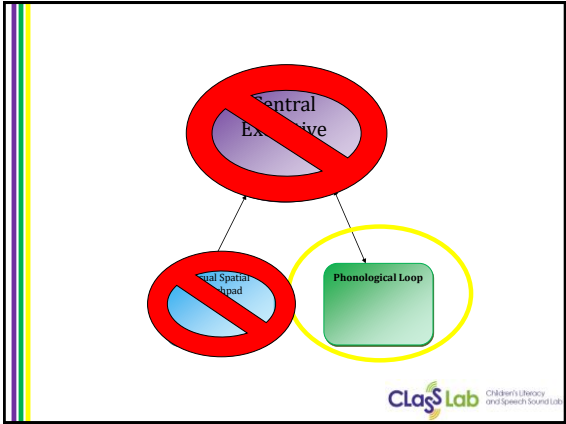
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### Conclusions

- 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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### Additional Resources

- Florida Center for Reading Research
- National Center on Intensive Intervention
- International Dyslexia Association
- Decoding Dyslexia (national and state-based chapters)
- Facebook group: Clinical Research for SLPs
  - Search #week9 for a discussion I lead
  - Search #week16 for a discussion on dyslexia lead by Dr. Tiffany Hogan
- See also supplemental materials provided for SLP Summit




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### Thank you!

- [kfarquharson@fsu.edu](mailto:kfarquharson@fsu.edu)
- Instagram: @classlab\_FSU
- Facebook and Twitter: @literacyspeech
- <http://classlab.cci.fsu.edu>




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