Why speech sounds matter for LITERACY

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Disclosures

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• Nonfinancial: I am the director of the Children’s Literacy and Speech Sound (CLaSS) Lab

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
Children’s Literacy and Speech Sound (CLASS) lab

- http://classlab.cci.fsu.edu
- Instagram: @classlab_FSU
- Twitter: @literacyspeech
- www.facebook.com/literacyspeech

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

- Remediation
  - YES
  - NO
- Literacy Problems
  - NO
  - YES
- True phonological deficit?
- Motor deficit?
- Linguistic deficit?

What is reading?
Who is reading?

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

Reading

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

Reading Comprehension

- Word Recognition
- Listening Comprehension

Reading Comprehension

THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING

LANGUAGE COMPREHENSION
- Grammar: syntax
- Text processing
- Background knowledge
- Verbal reasoning
- Metacognition

PHONOLOGICAL AWARENESS
- Phonemes, syllables

WORD RECOGNITION
- Sight recognition

DECODING
- Alphabetic principle
- Spelling-sound correspondences

SEMANTICS & GRAMMAR
- Vocabulary, syntax
- Text structures
- Coherence

TEXT PROCESSING
- Text structure
- Coherence

BACKGROUND KNOWLEDGE
- Facts, concepts

VERBAL REASONING
- Problem solving
- Inference

METACOGNITION
- Comprehension strategies


How does this apply to phonological impairments?
Who are they?

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

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)

Speech sound disorders are characterized by a delay in the acquisition of appropriate speech sounds (Swar, Freebairn, Hansen, Shriberg, Stein, Taylor, & Lyngir, 2000).

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, Travis, Smit, Bernthal, & Nelson, 2012; Gatens et al., 2010).

50-70% of children with speech sound disorders require some level of special education services through the 12th grade (Feastaird, Brian, & McGuire, 1984; Shriberg & Fastenlow, 1988).
Speech Sound Disorder

• More than half of children with SSD experience difficulties with reading (Bishop & Adams, 1990; Catts, 1991; Catts, 1999; Catts, Fey, Tomblin, & Zhang, 2002; Catts, Fey, Tomblin, & Zhang, 2001; Nathan, Stackhouse, Goulaud, & Reading, 2004; Tomblin, Zhang, Brockmeier, & 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).

Prevalence of SSD

11-13% of children ages 5-7 years have a speech sound disorder (Shriberg, Tomblin, & McSweeney, 1999).

Approximately 10% of children have persistent speech sound disorders.

18% of 8-year-olds in the UK have unresolved speech sound errors (Calton, 1996).

1.4% of college freshman have persisting speech sound errors (Culton, 1986).

Risk of Reading Difficulties

Typically developing Speech Sound Disorders only SSD + Language impairment

This likely includes children with dyslexia!
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.

What is phonological awareness?

PHONOLOGICAL AWARENESS (syllables, phonemes, etc.)

DECODING (alphabetic principle, spelling-sound correspondences)

SIGHT RECOGNITION (of familiar words)


THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING

LANGUAGE COMPREHENSION
- Semantics & Grammar
- Test Processing
- Background Knowledge
- Verbal Reasoning
- Metacognition

WORD RECOGNITION
- Phonological Awareness
- Decoding
- Sight Recognition

SKILLED READING
- Fluency
- Comprehension
- Orientation at word recognition and text comprehension.
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

Phonological Awareness Continuum

Rhyming  Sentence Segmentation  Syllable Segmentation & Blending
Identification of initial or final phonemes  Manipulation of individual phonemes
Easier  Harder

Phonological Awareness

EYES CLOSED
PICTURE
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; Earle, 2011; Levin & Fischbacher, 1992; Pennington, Bishop, & Brade, 2009; Raitano, Pennington, Brade, Brade, & Bishop, 2004; Rvachew, Ohberg, Grawburg, & Heyding, 2003)
- Atypical speech sound errors and distortions in preschool are predictive of weak PA skills (Preston & Edwards, 2007)
- This is true even when language is normal (Overby, Trotter, & Pennington, 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)

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 5–10, exhibit cortical and subcortical differences during phonological processing tasks (Preston, Fulbright, Felsenfeld, Frost, & Mencl, 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, 2013; Raitano, Tunrid, Pennington, Brade, & Brade, 2004)
How do we use this information?

Early identification

Early intervention

Reduced Risk of Reading disorders

Early Indicators

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

  • Nathan, Stackhouse, Goulard, & Stroving (2004); Pennington (2005); Rattawee, Pennington, Turick, Boada, and Shriberg (2004)

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

Not early signs of dyslexia

• Reversing letters when writing
  • This is typical until ~2nd grade

• Common errors on long words
  • ammm/ammall
  • medd/meddel

PA & phonological representations

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

Phonological Representations

spoken language
written &
blocks for
Building
Phonological Representations

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

Weak Phonological Representations

/b/

Strong Phonological Representations

/b/
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)

Orthographic mapping with weak representations

Orthographic mapping with strong representations

Self-teaching hypothesis
Phonological representations → Orthographic representations

PONY = BOLOGNA

Orthographic representations → Phonological representations

COUGH=THROUGH=ROUGH=THOUGH

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?
Does Working Memory play a role?

- Deficits in literacy skills (Raitano, Pennington, Turuck, Rosado, & Urberg, 2004)
- Deficits in acquiring phonological awareness (Catts & Lerner, 1999)
- Deficits in phonological representations (Anthony et al., 2011; Storkel, 2011; Hoover, 2010)

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)

Visual Spatial Sketchpad

- Stores visually presented information, such as pictures or words
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)

Farquharson, Hogan, & Bernthal (2017)

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

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

Thank you!

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