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Connections between Speech Sound Production and Literacy Skills

Kelly Farquharson, PhD, CCC-SLP

Moderated by:
Amy Hansen, MA, CCC-SLP, Managing Editor, SpeechPathology.com

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Connections Between Speech Sound Production and Literacy Skills

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Disclosures

- Financial: SpeechPathology.com has compensated me for today’s presentation. I am a faculty member at Florida State University and receive a salary for that job.

- Nonfinancial: No nonfinancial disclosures

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Learning Outcomes

After this course, participants will be able to:

- Describe the phonological relations between speech sound production, decoding, and spelling
- Explain the SLP’s role in literacy
- Discuss the importance of early identification and intervention for speech sound disorders

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

<table>
<thead>
<tr>
<th>Remediates</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Motor Deficit?</td>
<td>Linguistic Deficit?</td>
</tr>
<tr>
<td>YES</td>
<td>True phonological deficit</td>
<td></td>
</tr>
</tbody>
</table>

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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

How Does this Apply to Speech Sound Production?

- 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 (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 12th grade (Felsenfeld, Broen, & McGue, 1994; Shriberg & Kwiatkowski, 1988).
Speech Sound Disorder


• 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 (McSteeley, 1999)

Approximately 10% of children have unresolved speech sound errors at age 9-11 (Shriberg, 2002; Shriberg, Tomblin, & McSweeney, 1999; Wren, Roulstone, & Miller, 2011)

18% of 8-year-olds in the UK have unresolved speech sound errors (Peters, 2009)

1.4% of college freshman have persisting speech sound errors (Culton, 1986)
Risk of Reading Difficulties

This likely includes children with dyslexia!

Typically developing  Speech Sound Disorders only  SSD + Language impairment

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

- 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

Phonematic Awareness

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

Easier
Harder

Phonological Awareness
Test Your Segmentation Skills

Directions: Reverse the sequence of speech sounds and write the word.

1. teach: ________
2. sigh: ________
3. cuts: ________
4. speak: ________
5. jab: ________
6. scene: ________
7. might: ________
8. tax: ________
9. caught: ________

Borrowed with permission from Barbara Hodson

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 & Freebairn, 1992; Peterson, Pennington, Shinberg, & Boada, 2000; Raitano, Pennington, Tunick, Boada, & Shinberg, 2004; Rvachew, Ohberg, Gravburg, & 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, Bremthal, & 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 (Roustone 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 8.5-10, exhibit cortical and subcortical differences during phonological processing tasks (Preston, Felsenfeld, Frost, Menz, Fulbright, Grigorenko, Landi, Sato, & 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)

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 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 disorder
- Nathan, Stackhouse, Goulardris, & Snowling (2004); Pennington (2005); Raitano, Pennington, Tunick, 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

(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 ~2\textsuperscript{nd} grade

- Common errors on long words
  - æmɪnəl/ ænɪməl
  - pəskərɪ/ spəgərɪ
PA & Phonological Representations

- Testing phonological awareness is a robust measure of underlying phonological representations.
Phonological Representations

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

Weak Phonological Representations
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

Share, 1995
Phonological representations

Orthographic representations

PONY = BOLOGNA

COUGH=THROUGH= ROUGH = THOUGH

Orthographic representations

Phonological representations
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, Tunick, Boada, & Shriberg, 2004)

Deficits in phonological representations
(Anthony et al., 2011; Storkel, Maekawa, Hoover, 2010)

Deficits in acquiring phonological awareness
(Catts & Larivee, 1999)

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

Assessment Implications

- Test phonological awareness in all SSD evaluations

- Possibly add a non-word 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

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
References

- Please see “Farquharson_references” for a complete list of references

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
Thank you!

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