Adolescent and Adult Outcomes of Early Childhood Speech Sound Disorders

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Grant Acknowledgement

This research was supported by the National Institutes of Health on Deafness and Other Communication Disorders, Grant DC 000528
Outline of Presentation

• Why are children with early childhood SSD at risk for literacy difficulties?
• School-age outcomes for children with early childhood SSD
• Long-term language and literacy outcomes at adolescence and adulthood for individuals with early SSD
• Long-term psychosocial outcomes at adolescence and adulthood for individuals with early SSD
• Genetic influences on SSD, LI and Reading

Learning Objectives

After this course, participants will be able to:
• Identify predictors of persistent and recovered speech sound disorders.
• Describe the relationships among speech, language, reading and ADHD.
• Explain clinical implications for improving adolescent and adult outcomes for children with speech and language disorders.
WHY ARE CHILDREN WITH SSD AT RISK FOR READING DIFFICULTIES?

Simple View of Reading
(Hoover & Gough, 1990)

- **Decoding**: translating printed words into sounds
  - Requires letter recognition, phoneme awareness, alphabetic principle.

- **Linguistic Comprehension**: Extracting meaning from lexical information, sentences and discourse.
  - Requires skills in decoding, vocabulary, morphosyntax, syntactic parsing, and social communication
  - Also draws on higher level thinking and reasoning, including integrating background knowledge, synthesizing, problem solving and interpretation.

- **Decoding skills may be acquired in a brief period of time while comprehension skills may develop in adulthood.** (Paris, 2005)
Predictors of Reading

• Phonological Awareness: Best predictor of reading in early elementary school but at 3rd and 4th grade other language skills such as vocabulary and narrative skills are more important. Phonological Awareness skills may still be useful in decoding new words.

• Overall Language Skills: Morphological awareness and syntax skills aid in both decoding and comprehension. Language skills may account for differences in reading in older students as text increases in complexity.

• Vocabulary: Assists with both decoding and comprehension; Predictive of reading speech and fluency.

• Nonlinguistic Cognitive Skills: Working memory, executive functioning, processing speed, inhibition and attention aid reading comprehension.

Phonological Processing Deficits of Poor Readers

• Phonological awareness-explicit awareness or sensitivity to the structure of speech;
  – Poor reading may result in PA deficits.
  – PA in Kindergarten is the best predictor of 2nd grade reading skills
  – PA training improves reading skills.

• Phonological retrieval
  – Dyslexic children are poorer at naming tasks; children perform more poorly on RAN tasks
  – Double deficit hypothesis: difficulty with both PA and RAN; 60% of poor readers in 2nd grade had both

• Phonological memory-encoding and storage of phonological in memory.
  – Specific to speech sound information
  – Independent of phonological awareness skills
  – Due to underspecified phonological representations (lack of phonetic detail).

• Phonological production
  – Poor readers have difficulty producing complex phonetic sequences
  – May be due in part to poor memory and deficits in speech planning
Why are children with early SSD at risk for literacy difficulties?

• “Fuzzy” phonological representations
• Poor phonological awareness skills
• Poor verbal short-term memory
• Reduced vocabulary and slow lexical retrieval
• Attentional problems
• Co-morbid language impairments
• Poor orthographic awareness
• Reduced narrative abilities

Two possible explanations for the relationship of SSD to reading (Ramus & Szenkovits, 2009)

• Phonological representations may be degraded, fuzzy and underspecified resulting in loss of some phonetic features before they are compared or repeated leading to poor decoding skills.
• Phonological representations are intact and phonetic features are correctly encoded but phonological short-term memory processes are limited and transfer of information into working memory is disrupted resulting in poor linguistic comprehension.
Clinical note: Not all children with SSD have reading difficulties!

• 22% of 7-9 yr. old children with SSD have reading difficulties (Peterson et al., 2009)
• Children with SSD may have phonological deficiencies but no reading difficulties.
• Overall children with SSD score poorer than peers on phonological awareness skills and single word reading (Anthony et al., 2011).
• Children with non-developmental phonological process errors are more likely to have decoding difficulties (Leitao & Fletcher, 2004)

SCHOOL-AGE OUTCOMES FOR STUDENTS WITH HISTORIES OF EARLY SSD
The Cleveland Family Speech, Language and Reading Study

- Families were identified through a child (4-6yrs old) receiving therapy for a moderate to severe SSD
- All available family members (proband, siblings, parents) were tested on speech, language and reading measures.
- Families were followed longitudinally and tested at school-age, adolescence and adulthood.
- Genetic testing was conducted to search for genes influencing these disorders.
- Participants were grouped as typical, SSD alone, SSD + LI

Predictors of reading skills at Early Elementary School (Skebo et al., 2013)

Findings

- PA predicted reading decoding of both real and nonwords
- Vocabulary predicted reading of real words
- Vocabulary and language predicted reading comprehension

Clinical Note:

Children use both phonological and semantic pathways in reading during early elementary school
Predictors of reading skills at Middle School
(Skebo et al., 2013)

Findings
- Overall language predicted decoding of real and nonwords.
- Vocabulary and IQ predicted reading comprehension.

Clinical Note
- Students have mastered phonological decoding and have stored letter and word patterns in semantic memory.
- As nonwords were patterned after real words, students search for an analogy of nonword in their lexicon to decode.

Predictors of reading skills at High School
(Skebo et al., 2013)

Findings
- A single predictor of nonword decoding was not identified.
- Decoding of real words was predicted by vocabulary.
- Overall language predicted reading comprehension.

Clinical Note:
- Students differ in their strategies to decode nonwords.
- Students employ semantic pathways to decode real words.
- As complexity of text increases, students continue to rely on linguistic skills for comprehension.
Comparisons of children with SSD only and children with SSD + LI
(Skebo et al., 2013)

**Children with SSD only**
- At early elementary school, vocabulary and not PA predicted decoding.
- At middle school, children with SSD performed poorer than typical children on comprehension.
- At high school similar to typical students, language and vocabulary predict decoding.

**Children with SSD + LI**
- At early elementary, middle school and high school, children with SSD + LI perform more poorly on reading measures than SSD only or typical students.
- Poor language skills predict reading skills at each grade level.
- Students with SSD + LI use reading strategies of younger children.

WHAT ARE THE LONG-TERM OUTCOMES FOR INDIVIDUALS WITH HISTORIES OF EARLY SSD?
Factors that may affect long-term outcomes for individuals with early SSD

- Co-morbid LI: Individuals with SSD and co-morbid LI are more at risk for long-term reading and spelling problems than individuals with SSD alone (Bishop et al., 2003; Lewis et al. 1998).
- Type of Speech errors: Individuals with non-developmental phonological process errors and atypical errors are more at risk possibly due to poor PA skills (Leitao & Fletch, 2004; Preston et al, 2013).

Factors that may affect long-term outcomes for individuals with early SSD

- Persistent Speech Sound Disorder (PSD):
  - PSD are speech sound errors that persist beyond 8-9 years.
  - Rates of PSD vary and are reported as high 27% in 7-10 yr olds (Glogowska et al, 2006)
  - Children with PSD demonstrate linguistic, literacy and social deficits and have higher rates of LI (Bishop et al., 2003).
  - Children with PSD may have poorer phonological representations (Nathan et al., 2004).
  - Children with motor speech deficits are more likely to persist (Vick et al, in press).
Rates of PSD may vary depending upon:

- If the sample was population based or clinically referred
- Age at follow-up
- Criteria for defining PSD
  - Include minor common distortions?
  - Difficulty with multisyllabic words?
  - Errors in conversational speech?

Adolescent Outcome Study

- Participants followed from early childhood
  - 137 had no SSD
  - 105 the SSD had resolved
  - 33 had difficulty with multisyllabic words
  - 41 had difficulty with multisyllabic words and persistent speech errors.
- Assessments: vocabulary, spoken language, decoding, reading comprehension, spelling
Comparisons of Groups on Literacy Measures at Adolescence

Comparisons of Groups on Language Measures at Adolescence
Performance of Adolescent Groups on Oral Motor Skills

Percentage of Co-morbid Conditions for Each Group at Adolescence
Adolescent Outcomes: Literacy Measures

• The No SSD and Resolved SSD groups performed better than the Low MSW and PSD on all measures.
• The No SSD group performed better than the Resolved group on Word Attack and Reading Comprehension.
• The Low MSW and PSD groups did not differ on any of the literacy measures.

Adolescent Outcomes: Language Measures

• The Resolved SSD group did not differ from the No SSD group on any of the language measures.
• The Resolved and No SSD groups differed from the Low MSW and PSD groups on the vocabulary measures.
• The Low MSW differed from the PSD group on the CELF.
Adolescent Outcomes: Oral Motor Measure

• The No SSD, Resolved, and Low MSW groups differed from the PSD group.

• Clinical Note:
  – The PSD group seems to have Motor Speech Difficulties as well as other language and literacy problems!

Adolescent Outcomes: Co-morbidities

• Individuals with PSD and difficulty with the repetition of multisyllabic words had higher rates of comorbid LI and reading disorders than the Resolved group or No SSD group.
• Individuals with PSD had lower PIQ scores than the Resolved or No SSD groups.
Adolescent Outcomes: Early History of Co-morbid LI

- Adolescents with a history of SSD and comorbid LI had more severe deficits than those with a history of SSD only or no SSD.
- Adolescents with a history of SSD only performed more poorly in repetition of multisyllabic words than those with no history of SSD.

Clinical Note

- Early childhood SSD have long-term effects on language and literacy skills with differences persisting into adolescence.
- Individuals with disorders that resolve before adolescence have better outcomes.
- Difficulties repeating multisyllabic words may indicate poor phonological representations that are related to language and literacy outcomes.
- Other factors such as comorbid conditions, PIQ, attentional abilities, SES and gender may also affect outcomes.
Clinical Note

• Individuals with PSD have poor literacy skills at adolescence than those students whose SSD resolves.
• Deficits may be due to weak phonological representations, difficulties encoding and sequencing syllables, and/or motor deficits.
• The co-morbidities of LI and reading disorders suggest cognitive and genetic overlap of these disorders.

Clinical Notes

• SLPs should participate in the prevention and treatment of literacy problems as they are language experts
• Literacy demands and skills needed to meet these demands change from elementary to middle to high school.
• Students with SSD are at risk for literacy problems. Co-morbid LI increases this risk.
• Individuals whose SSD persist past 8-9 years of age are at greatest risk for life-long literacy difficulties.
PSYCHOSOCIAL OUTCOMES AT ADOLESCENT AND ADULTHOOD

Do early histories of speech and language disorders have long-term psychosocial effects?

**Psychosocial difficulties experienced by children with communication disorders**

(Durkin & Conti-Ramsden, 2010)

- Poorer peer relationships
- Increased victimization and bullying
- Less social competence
- Difficulty with emotional and self regulation
- Decreased adaptive functioning
- Somatic symptoms
- Depression
- Anxiety
Factors that affect psychosocial outcomes

- Comorbid conditions of RD, ADHD, or low IQ
- Type of communication disorder (Snowling et al, 2006):
  - *Children with LI may have poorer outcomes than children with SSD-only*
  - *Children with expressive problems may have attentional difficulties*
  - *Children with combined expressive/receptive may have social difficulties*
  - *Children with Low IQ may have both attentional and social problems*
- Resolved versus persistence disorders
- Clinical note: If disorder resolves by age 5, child usually has good psychosocial outcomes

Systematic Review of 19 studies
(N=553; Yew & Kearney, 2012)

- Children with LI are twice as likely as typical children to report:
  - Anxiety, mood disorder and depression.
  - Conduct disorder, oppositional defiant disorder, and anti-social personality
  - ADHD

Clinical note: Boys are more at risk for conduct disorder and depression than girls.
Why are children with LI at risk?

• Children with LI might have limited working memory and processing skills that impact social skills (Bishop, 1997).
• Neurodevelopmental immaturity might underlie both LI and poor social competence (Beitchman et al., 1996).
• Poor pragmatics skills
• More global deficits

A Word of Caution

• Most children with communication disorders do not present with a clinical psychiatric diagnosis.
• Since they do not exhibit symptoms they are rarely referred to mental health specialists.
• Specific types of communication disorders have not been related to a specific type of psychiatric diagnosis.
Psychosocial outcomes at adolescence

Psychosocial Outcomes at Adulthood
Adult Quality of Life Outcomes

• Some studies report lower educational attainment, lower occupational status, and lower income level for individuals with LI compared to typical adults (Johnson, Beitchman, & Brownlie, 2010).
  – We did not find this possibly due to our normal IQ requirement.
• However, most studies report no differences in perception of the quality of their life!
• Clinical note: Quality of life ratings are related to strong social networks of family and friends.

Predictors of Psychosocial Outcomes

• Adolescence:
  – LI was the strongest predictor of all psychosocial outcomes.
• Adults:
  – RD predicted inattention and ADHD
  – ADHD predicted internalizing, externalizing and thought problems.
  – LI was NOT predictive once comorbid conditions were accounted for.
• Clinical Note:
  – LI may not influence outcomes as much as at adulthood, possibly due to coping strategies, choice of activities with less emphasis on language skills, or less victimization by peers.
GENETIC INFLUENCES ON SSD, LANGUAGE IMPAIRMENT AND READING DISORDERS

Influence of Genetics on Outcomes

1. Identify genes  2. Expression in Brain  3. Behavior
Genetic Architecture of a Complex Trait

Linkage Results for Spoken Language and Written Expression (Lewis et al., 2011)

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<th>Chromosome</th>
<th>Spoken Language at Early Childhood</th>
<th>Written Expression at School-age</th>
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<td>Written vocabulary</td>
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<td>Vocabulary</td>
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What are specific genes that may underlie speech sound disorders?

- **FOXP2**: Located on 7q13; a brain expressed transcription factor that affects brain development; identified in the KE family (Ligeios et al., 2003).
- **ROBO1 and ROBO2**: Located on chromosome 3; guides axons and influences neuronal axon growth; identified in dyslexics in Finland (Nopola-Hemmi et al., 2001).
- **KIAA0319, TTRAP, and DCDC2**: Located on chromosome 6; genes disrupt neuronal migration; identified in dyslexic by numerous research groups (Grigorenko et al., 2000; Smith et al., 2007).
- **BDNF**: Brain-derived neurotrophic factor related to nerve growth and differentiation in the brain (Stein, unpublished).
- **DYX8**: Region on chromosome 1 that demonstrates pleiotropy for SSD and dyslexia (Miscamarra et al., 2007).
- **Aromatase (CYP19A1)**: Located on 15q21.2; This gene regulates estrogen synthesis in specific brain areas. It is related to synaptic plasticity and axonal growth (Anthoni et al., 2012).

On the left, controls without a history of speech and language disorders show the expected activation in the language areas while repeating nonsense words. On the right, participants with a history of speech sound disorders show under activation of the language areas during repetition of nonsense words (Tkach et al., 2011).
Clinical Notes

- Similar deficits in underlying skills or endophenotypes impact early childhood SSD and later school-age spoken and written language.
- Genes as well as the environment contribute to deficits in these endophenotypes.
- Some genes have a broad effect on neural development and influence many skills while other genes may have specific effects on a single skill.
- Some skills may be more genetic than other skills.
- Disorders such as SSD and comorbid LI, RD, and ADHD may result from shared genetic influence as well as a unique genetic component.

Clinical Note

- Speech language pathologists (SLPs) may be the first professional contact with the family when the child does not acquire first words as expected. Knowledge of genetic etiologies including syndromes may assist the SLP in making appropriate referrals including referrals for genetic testing and counselling.
- Construction of an accurate and detailed family history and pedigree may aid in the identification of at-risk children prior to speech and language onset. The child may be followed and monitored for speech and language development and enrolled in early intervention programs if necessary.
Clinical Note

• SLPs may also educate the parents on typical language abilities and communication disorders associated with genetic conditions such as syndromes. They may assist parents with understanding their child’s condition.

• SLPs are not a replacement for genetic counselors who are trained to provide detailed information on medical aspects of a genetic condition and recurrence risk for subsequent children.

Clinical Note

• To date, only a few genes for speech and language disorders have been discovered and genetic testing is not routinely performed for these genes. For most children with speech and/or language disorders a genetic basis for the disorder is not identified. However, the lack of a known gene(s) for a disorder does not mean that the disorder is not genetic; rather the genetic cause has not yet been discovered. As more genes for speech and language disorders are discovered, a genetic subtype of speech and/or language disorders may be characterized with specific features, treatments, and prognoses.
References


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