New Frontiers in Clinical Practice: Children with Phonological Disorders

Word & Sound Learning Lab
www.ku.edu/~wrdlrng/
University of Kansas

Phonological Disorder
- Breakdown in the production and/or knowledge of the sound system of the surrounding speech community
- Focus: Children with Functional Phonological Disorders
  - No obvious cause of their deficit
  - Normal oral-motor function/structure, hearing, intelligence
- Can co-occur with other language disorders
- Past studies measured language skills in broad terms
- More recent evidence suggests potential weaknesses
- Areas to be considered in this session
  - Word learning
  - Morphosyntax
  - Reading
  - Bilingual context

Introduction and Overview
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University of Kansas

Finding Evidence: Evidence Reviews
- Cochrane Collaboration
  http://www.cochrane.org/index0.htm
- Campbell Collaboration
  http://www.campbellcollaboration.org
- What Works Clearinghouse

Finding Evidence: Special Reports/Lists
- ASHA
  http://www.asha.org
- National Institute on Deafness and Other Communication Disorders
  http://www.nidcd.nih.gov
- Bamford-Lahey Children’s Foundation
  http://www.bamford-lahey.org/ebp.html
- National Reading Panel
  http://www.nationalreadingpanel.org/Publications/publications.htm
Finding Evidence: Databases for Searches

- PubMed
- ASHA full text journals (1990 ff)
  http://www.asha.org/members/deskref-journals/journals/journals-default
- Google Scholar
  http://scholar.google.com
- Ingenta Connect
  http://www.ingentaconnect.com
- http://www.science.gov

Finding Evidence: Full-Text Articles

- PubMed Central
  http://www.pubmedcentral.nih.gov
- ASHA full text journals (1990 ff)
  http://www.asha.org/members/deskref-journals/journals/journals-default
- Author’s website
  use Google Scholar, University digital archive, or OAIster
  http://oaister.umdl.umich.edu/o/oaister
- Ingenta Connect (for a fee)
  http://www.ingentaconnect.com

Finding Evidence: TOC Alerts

- PubMed’s “My NCBI”
  Click “My NCBI”
- ASHA Journals TOC Alerting
  http://www.asha.org/about/publications/journal-abstracts/journal-list.htm
- Ingenta Connect
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Word Learning

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- http://www.science.gov

Children Rapidly Acquire Words

- Diary/Checklist
  - Add ~2-5 words per day (expressive)
  - Add ~9 words per day (receptive)
- Fast mapping
  - Associate form with referent with 1 exposure
- Extended mapping
  - Initial representations retained and modified with subsequent exposure

Why so fast?

- Constraint Account
  - Born with innate principles
- Associationistic Account
  - Learn regularities in the environment
- Emergentist Coalition Account
  - Innate principles help learn first words
  - Extract cues or regularities from learned words
  - New principles emerge

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7
8
9
10
11
12
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Phonological Regularities: Phonotactic Probability

- Likelihood of occurrence of sound sequence
  - Common = sounds frequently occur in that word position; Adjacent sounds frequently co-occur
  - Rare = sounds infrequently occur in that word position; Adjacent sounds infrequently co-occur
- Common (e.g., "coat") vs. Rare (e.g., "watch")

See Storkel & Morrisette (2002), LSHSS, 33 (1), 24-37 for review

Phonotactic Probability Influences:

- Word recognition and memory in adults
  (e.g., Frisch, Large, & Pisoni, 2000; Vitevitch & Luce, 1998; 1999)
- Nonword repetition in childhood
  (e.g., Beckman & Edwards, 1999; Gathercole et al., 1999)
- Word learning in typically developing children
  (e.g., Storkel, 2001, 2003, 2004; Storkel & Rogers, 2000)
- Common > Rare

Does phonotactic probability influence word learning by children with phonological delays?

Storkel (2004), JSLHR, 47 (5)

Participants

<table>
<thead>
<tr>
<th>Phonological Delay (PD)</th>
<th>Normal Comparison (NC)</th>
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<tbody>
<tr>
<td>Number</td>
<td>20</td>
</tr>
<tr>
<td>Age</td>
<td>5.0</td>
</tr>
<tr>
<td>PPVT-3 Standard Score</td>
<td>105</td>
</tr>
<tr>
<td>EVT Standard Score</td>
<td>105</td>
</tr>
<tr>
<td>GFTA-2 Percentile Rank</td>
<td>10</td>
</tr>
</tbody>
</table>

Stimuli

- 16 CVC nonsense words
  - ½ common
  - ½ rare
- Paired with unfamiliar objects
- Incorporated into narrative and pictures
Storkel (2004) Summary

- PD & CN groups learned a similar number of words, BUT
  - PD group learned rare sound sequences
  - CN group learned common sound sequences
- PD group may have difficulty differentiating common sound sequences
- PD lexicon may differ from the CN lexicon

Both groups scored within normal limits on vocabulary tests

- Vocabulary tests may not be sensitive to underlying word learning mechanisms

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Standardized Vocabulary Tests

- Reportedly insensitive to word learning differences
  (e.g., Gray, Plante, Vance, & Henrichsen, 1999)
- May be culturally biased
- Examine the products, not the process of learning
  (e.g., Dollaghan & Campbell, 1998)
  - Represents exposure & ability

<table>
<thead>
<tr>
<th>Form</th>
<th>Referent</th>
<th>Item 1</th>
<th>Item 2</th>
<th>Item 3</th>
<th>Item 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common</td>
<td>Rare</td>
<td>Item 1</td>
<td>Item 2</td>
<td>Item 3</td>
<td>Item 4</td>
</tr>
<tr>
<td>Known</td>
<td>mæb</td>
<td>Item 1</td>
<td>Item 2</td>
<td>Item 3</td>
<td>Item 4</td>
</tr>
<tr>
<td>Unknown</td>
<td>røuf</td>
<td>Item 1</td>
<td>Item 2</td>
<td>Item 3</td>
<td>Item 4</td>
</tr>
</tbody>
</table>

Procedure

<table>
<thead>
<tr>
<th>Test 0</th>
<th>Story 1</th>
<th>Test 1</th>
<th>Story 1</th>
<th>Test 2</th>
<th>Story 1</th>
<th>Test 3</th>
<th>Test 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episode 1</td>
<td>1 exposure</td>
<td>3 exposures</td>
<td>3 exposures</td>
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<td>3 exposures</td>
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<tr>
<td>8 stimuli</td>
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<td>8 stimuli</td>
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</tbody>
</table>

- Picture Naming

Naming Correct at Post-Test
Can the sensitivity of vocabulary tests be improved by examining the types of words that kids know? 

Storkel & Giles (in progress)

Examine Phonotactic Probability Subscale Scores

- Peabody Picture Vocabulary Test – 3A
  Expressive Vocabulary Test

- Code items as common or rare

- For each child, compute
  - % Common correct
  - % Rare correct

Are these subscale scores better predictors of word learning than overall scores?

Regression Analysis

Predictors:
CA, PPVT raw, PPVT common, PPVT rare, EVT raw, EVT common, EVT rare

Significant Predictors of Word Learning

<table>
<thead>
<tr>
<th></th>
<th>PD</th>
<th>CN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common</td>
<td>PPVT rare</td>
<td>PPVT raw score</td>
</tr>
<tr>
<td>Rare</td>
<td>Ø</td>
<td>PPVT raw score</td>
</tr>
</tbody>
</table>
Summary: Utility of Subscale Scores

- Show promise in predicting word learning in typically developing children
- Warrant further exploration
  - Not all outcomes were as expected
  - For PD, PPVT rare predicted learning of common
- Need to consider how correlated variables may affect outcome
  - Tests not designed to investigate phonotactic probability

Alternative Processing Measures

- Nonword repetition
  (Storkel & Hoover, in progress)
- Nonword processing task
  (Storkel & Hoover, in progress)
- Still need sensitivity to factors that influence word learning

Conclusion

- Findings from basic science research can be used to build better diagnostic tools
- Increase the sensitivity of diagnostic tools
- Influence treatment planning in a more direct way

For More Information

- www.ku.edu/~wrdlrng
  Scoresheets for subscale scores (in progress)
- To compute phonotactic probability
  http://www.people.ku.edu/~Emvitev/PhonoProbHome.html (link available from www.ku.edu/~wrdlrng)
- Search strategies & TOC Alerts:
  Search by author Storkel HL (or HL Storkel)
  Search by author Munson B or Edwards J
  Search for phonotactic probability (and phonological disorders)
  Alternative terms for phonological disorder: speech disorder, speech sound disorder

Acknowledgements

- NIDCD 004781, 006545, 005803
- Contributors: Aaron Brown; Wade Burtchet; Rebecca DeLong; Stephanie Gonzales; Heather Hines; Tiffany Hogan; Jill Hoover; Dana Lazar; Andrea Perdue; Mariza Rosalez; Maki Sueto; Mariam Syeda; Kelli Stanfield; Dr. Michael Vitevitch; Junko Young
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Grammatical Morphology

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Grammar Morphemes

- Present progressive (–ing)
- Prepositions 'in' and 'on'
- Plural (-s)
- Past irregular e.g., 'ran', 'went'
- Possessive (-s)
- Uncontractible copula e.g., 'there it is'
- Articles e.g., 'the', 'a'
- Past regular (-ed)
- 3rd person singular e.g., 'walks'
- 3rd person irregular, e.g., 'does', 'has'
- Uncontractible auxiliary (be), e.g., 'Are you going?'
- Contractible copula (be), e.g., 'I'm sick'
- Contractible auxiliary (be), e.g., 'She's leaving'

Language Impairment

- Present progressive (–ing)
- Prepositions 'in' and 'on'
- Plural (-s)
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Assessment

- Problematic in children with co-occurring speech & language impairments
  - Late acquired sounds
    - /s/ & /z/
  - Phonological processes
    - Final consonant deletion

Assessment cont..

- Production tasks
  - Imitation of a sentence with a target morpheme
    - "The boy walk to the store"
- Receptive tasks
  - Grammaticality judgments
    - "He run to the school bus"
- Standardized Assessment
  - Rice Wexler Test of Early Grammatical Impairment (TEGI)

Phonological Disorders & Language Impairment

- Shriberg, Tomblin, & McSweeny (1999)
  - At 6 years, 11-15% of children with persisting speech delay had a language impairment (LI)
  - At 6 years, 2-8% of children with persisting LI had a speech delay
- Clinical implications for assessment and treatment of children with co-occurring speech and language impairments

TEGI (Rice & Wexler, 2001)

- Phonological probe
  - Assesses /s/, /z/, /t/, /d/ in final position
  - Can the child use the sounds to produce morphemes?
How should we co-treat phonology and morphology?

Tyler, Lewis, Haskell, & Tolbert (2003), JSLHR 46 (5)

Participants

- 3;0–5;11
- Intervention group and control group
- Impairments in speech & language
  - Greater than 1 standard deviation below the mean on the PLS-3 or CELF or greater than 1.5 standard deviations below the mean on MLU
  - Greater than 1 standard deviation below the mean on the BBTOP
  - Normal cognition, hearing, and oral motor functioning

Goal Selection

- 24-week intervention schedule
- 4 phonology goals
- 4 morphology goals
- Time-based rather than criterion-based

Co-targeting Phonology & Morphology in Treatment

- Which goal attack strategy produces the greatest change in phonology & morphology?

Phonology 1st or Morphology 1st Goal Attack Strategies

Repeated 3 times for phonology and 3 times for morphology
Alternating Phonology & Morphology Goal Attack Strategy

- Weekly alternation of a phonology & a morphology goal in three 8-week periods

Simultaneous Phonology & Morphology Goal Attack Strategy

- 1 phonology & 1 morphology goal co-targeted in each session a week for six 4-week periods

Intervention Activities

- Receptive Activities
  - Naturalistic Activities
    - e.g., songs and books loaded with the target morpheme and sound
  - Feedback
    - e.g., expanding child’s productions or modeling correct production of target morpheme and sound
- Production Activities
  - e.g., eliciting target morpheme and sound

Treatment Efficacy Results

- All interventions resulted in significant change in phonology and morphology when compared to the control group

Phonology Change

- After 12 and 24 weeks, there were equal significant gains in phonology across the 4 goal attack strategies

Morphology Change

- After 12 weeks, greatest gains with morphology first and alternating goal attack strategies
- After 24 weeks, greatest gains with alternating goal attack strategy
  - No difference in morphology gains between the remaining three goal attack strategies after 24 weeks
Conclusion

- Intervention in morphology can facilitate change in phonology
- Intervention beginning with morphology first results in the greatest immediate gains in morphology
- Weekly alternations of phonology & morphology goals results in the greatest gains in morphology overall

For More Information

- Additional studies:
  - Tyler (1997), Topics in Language Disorders, 17 (4)
  - Tyler, Lewis, Haskill, & Tolbert (2002), LSHSS, 33 (1)
  - Tyler, Lewis, & Welch (2003), AJSLP, 12 (3)
  - Tyler, Lewis, Haskill, & Paul (2003), Clinical Linguistics & Phonetics, 17 (1)
- Search Strategies & TOC Alerts:
  - Author: Tyler A
  - Phonology & morphology
  - Co-occurring speech & language impairment
- Rice Wexler Test of Early Grammatical Impairment:
  - http://www.dp.ku.edu/mabelrice/Default.htm

Phonological Disorder & Reading

- Are children with phonological disorders in preschool going to have reading difficulties in the later years?
  - Maybe
    - Some go on to have reading impairments and some do not

Which kids with phonological disorder are at risk for reading impairment?

- Five main factors to consider
  - Types of phonological production errors
  - Persistence of phonological disorder
  - Co-occurrence of language impairment
  - Pre-reading skills
  - Family history of reading impairment

Reading

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University of Kansas
Types of errors

- Reversal errors vs. substitution errors
  - “aminal” for animal rather than “wabbit” for rabbit
- Consistent use of unusual or nondevelopmental errors
- Multisyllabic words especially difficult

Persistence of the Problem

- Most children with speech sound disorders resolve their problems by 6 years of age (approximately 75%)
- Children with more persistent problems have poorer literacy outcomes
- These children are more likely to have poor phonological representations at the beginning of formal reading instruction.
  (Bishop & Adams, 1990; Larrivee & Catts, 1999; Nathan et al., 2004).

Pre-reading Skills

- Top predictors
  - Phonological awareness
  - Letter knowledge
- Do all children with phonological disorders have phonological awareness deficits?
- Not necessarily – two different domains

Co-occurrence of Language Impairments

- A child with a phonological disorder & language impairment is more at-risk for literacy problems than one with only a phonological disorder
- Late talkers are also at risk

Phonological Awareness

- Phonological Awareness
  - The explicit awareness of the sounds of speech independent of meaning (Stanovich, 1988; Torgesen, 1996, 1999)
  - Usually measured by rhyming, deleting, or segmenting parts of words
    - Example, say “cowboy” without “boy”

PreCTOPP (in press)
Family history of reading impairment

- If a child has a family history of reading impairment, he/she is more likely to have a reading deficit

(Catts & Sittner, 2005; Lyytinen, et al., 2004)

Assessment Implications

- Preschool children
  - Assess pre-reading skills
  - Ask about child & family history
  - Assess language skills

- School age children
  - Assess reading skills
  - Assess language skills

Literacy intervention for children with phonological impairment

- Preschool children
  - Incorporate phonological awareness activities and letters into phonological therapy

- School age children
  - Definitely at risk
  - Incorporate reading and language activities into phonological therapy

- Phonological therapy alone won’t do it!

- Illusionary recovery – reading changes over time

THE MANY STRANDS THAT ARE WOVEN INTO SKILLED READING

- Search strategies
  - Phonological disorders and reading, literacy
  - Pre-reading
  - Author: Gillon, Catts

- TCC Alerts
  - Dyslexia (not reading)
  - Phonological awareness

- Catts website: http://www.ku.edu/~splh/Catts/
  - Gillon website: http://www.cmds.canterbury.ac.nz/people/gillon.shtml

- Coming Soon
  - Special issue of LSHSS on new phonological awareness research

For More Information
Bilingual Children

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Language Spoken in Kansas

- 8.7% (>5 years) speak language other than English at home.
- 9.5% are linguistically isolated.

Difference vs. Disorder

- Difference, not disorder
  - Influence of native languages
    - /r/ and /l/ for Japanese speakers
    - /T/ and /D/ for Spanish speakers
- Disorder

Phonological Development:
Bilingual vs. Monolingual Children

- Lower intelligibility rating, more consonant and vowel errors overall, more distortion, more uncommon error patterns (Gildersleeve, Davis, & Stubbe, 1996)
- Differences decrease overtime (Gildersleeve-Neumann & Davis, 1998)
How do we assess phonology of bilingual children?


- Single-word phonological assessment
  - English and Spanish
  - Analyses
    - Phonetic inventory
    - PCC
    - PCC for voicing, place of articulation, manner of articulation
    - % occurrence for phonological processes
    - Comparison to monolingual data

Goldstein & Washington (2001): Participants

- n = 12 (10 girls, 2 boys)
- Age = 4;0-4;11 (M = 4;7)
- Spanish-English bilinguals
- Typically developing

Goldstein & Washington (2001): Results - Bilingual data

- No significant difference between Spanish and English in accuracy and % phonological processes
- Sounds not mastered:
  - Fricatives, affricates (English)
  - Flaps, trills (Spanish)
- Phonological processes
  - Stopping, final consonant deletion (English)
  - Liquid simplification, cluster reduction (Spanish)

Goldstein & Washington (2001): Results – Bilingual vs. Monolingual

- Generally similar in phonological systems
  - Some exceptions: e.g., liquid simplification in Spanish (bilingual > monolingual)
- Different types of errors, substitution patterns
  - e.g., Error / substitution patterns for flaps and trills in Spanish
    - Bilingual: deletion, [l], [R] (for /r/), etc.
    - Monolingual: [r] (for /r/)

Goldstein & Washington (2001): Clinical implication

- Bilingual children may differ from monolingual children
  - Types of errors, substitution patterns
- Assessment
  - Different norms
  - Nature/quantity for substitution types
  - Assess both languages
Do we need to treat one language or both?

Holm & Dodd (2001), *Folia Phoniatrica et Logopaedica,* 53 (3)

Holm & Dodd (2001)

- Do bilingual children with articulation and phonological disorder generalize treated sounds to another language?
- Jason (5;2)
  - Cantonese (L1) – English (L2)
  - Interdental lisp
  - Cluster reduction, substitutions

Holm & Dodd (2001)

- /s/ (treatment target) → improved
- Generalization to Cantonese? → YES
  - Jason produced /sl/, /tl/, and /th/ correctly in Cantonese in 70% of opportunities.

Holm & Dodd (2001)

Articulatory Therapy - Outcome

- Cluster reduction and gliding (Cantonese and English)
- Treatment with phonological contrasts in minimal pairs/triplets in English
- 45 minutes x 8 weeks
- Treatment target:
  - cluster reduction and gliding

Holm & Dodd (2001)

Articulatory Therapy

- Interdental lisp (Cantonese & English)
- Treatment of English /s/
- (20 minutes x 2/wk) x 7 weeks
- Sound monitored
  - /s/: treatment target

Holm & Dodd (2001)

Phonological Therapy - Outcome

- Cluster reduction and gliding → improved
- Generalization to Cantonese? → NO

Holm & Dodd (2001)

Phonological Therapy

- Cluster reduction and gliding (Cantonese and English)
- Treatment with phonological contrasts in minimal pairs/triplets in English
- 45 minutes x 8 weeks
- Treatment target:
  - cluster reduction and gliding
Holm & Dodd (2001) Summary

- Cross-language generalization
  - Articulation → Yes (universal)
  - Phonology → No (language specific)

- Articulation may be treated in only one language, but phonology may need to be treated in both languages.

For More Information

  - Cultural and linguistic differences
  - Assessment and intervention

- US Census Bureau (www.census.gov)

- Search terms
  - Multicultural
  - Bilingual
  - Spanish & phonology

Conclusion

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Assessment of Children with Phonological Disorders

- Need to consider language skills at both initial assessment as well as later
  - Word learning: may need to augment vocabulary tests
  - Grammatical morphology: need to consider impact of phonological errors on morphemes
  - Reading:
    - Preschool: assess pre-reading skills, family history, language
    - School: assess reading

- Bilingual children
  - Assess in both languages
  - Monolingual norms inadequate

Treatment of Children with Phonological Disorders

- If co-occurring deficits or at-risk for future deficits, need to treat both
  - Alternate grammatical morphology and phonology treatment targets
  - Treat pre-reading or reading skills simultaneously with phonology

- For bilingual children,
  - If motor deficit, treat one language and monitor the other
  - If phonological deficit, treat both languages

Staying Current

- Find more current evidence on these topics by searching databases such as PubMed, ASHA journals, Ingenta Connect, Science.gov

- Set-up table of contents alerts at the above websites so you’ll always know when new information is available
Acknowledgements

- NIDCD 04781, 06545, 00052, 06749

- Contact information:
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