The Effect of Delayed Phonological Development on Sublexical and Lexical Processing in Preschool Children

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  - NIDCD 006545 (Storkel)
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- Data Collection & Preparation
  - Word & Sound Learning Lab at the University of Kansas

Phonological Delay

- Significant delay in the acquisition of speech sounds with no obvious cause
- Other language skills are typically developing (Shriberg, Tomblin, & McSweeney, 1999)
- Group differences between children with phonological delays and typical development are observed in word learning (Storkel, 2004) but not in nonword repetition (Gathercole, Frankish, Pickering & Peaker, 1999; Munson, Edwards & Beckman, 2005)
- Are there differences in the processes that are tapped by these tasks in children with phonological delays?

Sublexical Processing

- Entails processing of individual sounds and sound pairs, e.g. / k i w i /
- Nonword repetition and short-term word learning tap sublexical processing (Gathercole et al., 1999; Munson et al., 2005, cf Roodenrys & Hinton, 2002)
- Sublexical processing is influenced by phonotactic probability (Vitevitch & Luce, 1999)
- Phonotactic probability is the frequency of occurrence of individual sounds or sound pairs
  - Common → “coat”
  - Rare → “watch”

Lexical Processing

- Entails processing of word forms as a whole unit, e.g. / k i w i /
- Short-term and long-term word learning tap lexical processing
- Lexical processing is influenced by neighborhood density (Vitevitch & Luce, 1999)
- Neighborhood density is the number of similar sounding words based on a one phoneme difference
  - Dense → “sit”
  - Sparse → “these”

Purpose of Current Research

- To compare sublexical and lexical processing by children with phonological delays to children with typical development by manipulating phonotactic probability and neighborhood density in three tasks:
  - Nonword repetition (sublexical processing)
  - Short-term word learning (sublexical & lexical processing)
  - Long-term word learning (lexical processing)
Participants

<table>
<thead>
<tr>
<th></th>
<th>*Children with Phonological Delays (n = 17)</th>
<th>*Children with Typical Development (n = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFTA-2 Percentile Rank</td>
<td>75 (1 – 164)</td>
<td>72 (27-93)</td>
</tr>
<tr>
<td>Chronological Age</td>
<td>58 (41-49)</td>
<td>56 (36-68)</td>
</tr>
<tr>
<td>ROWPVT Standard Score</td>
<td>103 (88-118)</td>
<td>105 (90-115)</td>
</tr>
<tr>
<td>EOWPVT Standard Score</td>
<td>102 (79-117)</td>
<td>104 (84-126)</td>
</tr>
</tbody>
</table>

*Significant difference (t(32) = 9.52, p < .001
* All children were native speakers of English

Nonword Repetition Task (Sublexical Processing)

<table>
<thead>
<tr>
<th>Common – Dense</th>
<th>Common-Sparse</th>
<th>Rare-Dense</th>
<th>Rare-Sparse</th>
</tr>
</thead>
<tbody>
<tr>
<td>war</td>
<td>hbr</td>
<td>hst</td>
<td>hsp</td>
</tr>
<tr>
<td>ham</td>
<td>jib</td>
<td>maud</td>
<td>haup</td>
</tr>
<tr>
<td>mouh</td>
<td>nep</td>
<td>naut</td>
<td>nub</td>
</tr>
<tr>
<td>nub</td>
<td>jem</td>
<td>waq</td>
<td>nmt</td>
</tr>
<tr>
<td>wot</td>
<td>jin</td>
<td>wup</td>
<td>wib</td>
</tr>
<tr>
<td>wep</td>
<td>mib</td>
<td>wim</td>
<td>waut</td>
</tr>
<tr>
<td>jad</td>
<td>wom</td>
<td>jad</td>
<td>jeb</td>
</tr>
<tr>
<td>jep</td>
<td>wab</td>
<td>jid</td>
<td>jem</td>
</tr>
<tr>
<td>joust</td>
<td>jid</td>
<td>jip</td>
<td>jood</td>
</tr>
<tr>
<td>jam</td>
<td>harn</td>
<td>jir</td>
<td>jop</td>
</tr>
</tbody>
</table>

Nonword Repetition Task Stimuli

Nonword Repetition Task Procedure

- Brief training
- 4 list lengths
- 16 trials per list length
- Dependent Variable = proportion of phonemes correct

Nonword Repetition Task Results

- 2 (neighborhood density) x 2 (phonotactic probability) x 4 (length) x 2 (group) repeated measures ANOVA
  - Main effect of phonotactic probability was significant
    - Supports initial hypothesis that nonword repetition taps sublexical processing
  - Main effect of neighborhood density was not significant
    - Supports initial hypothesis that nonword repetition does not tap lexical processing
  - Main effect of group and interactions with group were not significant
    - No group difference in sublexical processing in this task

Phonotactic Probability: Rare > Common
**Short Term Word Learning Task**
(Sublexical & Lexical Processing)

**Short-term Word Learning Stimuli**

<table>
<thead>
<tr>
<th>Common-Dense</th>
<th>Rare-Sparse</th>
<th>Common-Sparse</th>
<th>Rare-Dense</th>
</tr>
</thead>
<tbody>
<tr>
<td>paun</td>
<td>wap</td>
<td>paib</td>
<td>nad</td>
</tr>
<tr>
<td>jet</td>
<td>nib</td>
<td>hoom</td>
<td>wud</td>
</tr>
<tr>
<td>mid</td>
<td>tom</td>
<td>jasm</td>
<td>jerm</td>
</tr>
<tr>
<td>woun</td>
<td>hub</td>
<td>meb</td>
<td>haud</td>
</tr>
</tbody>
</table>

**Short-term Word Learning Procedure**

- Nonword stimuli were paired with novel object referents
- Embedded in the context of a three-episode story
- Number of exposures increased with the three story episodes
- Retention of the nonword was measured via picture naming after 1-week following exposure

**Short-term Word Learning Results**

- 2 (neighborhood density) x 2 (phonotactic probability) x 2 (group) repeated measures ANOVA
  - Main effect of phonotactic probability was significant
    - Supports initial hypothesis that short-term word learning taps sublexical processing
    - Similar sublexical processing across groups
  - Interaction of neighborhood density and group was significant
    - Supports initial hypothesis that short-term word learning taps lexical processing
    - Differences in lexical processing across groups

**Phonotactic Probability: Common > Rare**

**Neighborhood Density**

PD: Dense > Sparse
TD: Sparse > Dense
Long Term Word Learning (Lexical Processing)

Long-term Word Learning Procedure

- 121 real nouns
  - Orthogonally varying phonotactic probability and neighborhood density
  - Matched on other phonological (e.g., canonical structure), lexical (e.g., age of acquisition, word frequency), and semantic characteristics (e.g., imagery, semantic set size)

- Expressive Task
  - Children named the target noun

- Receptive Task
  - Children selected the target noun from a field of 4 pictures

Long-term Word Learning Stimuli

<table>
<thead>
<tr>
<th>Matched Variables</th>
<th>Common-Dense</th>
<th>Rare-Sparse</th>
<th>Common-Sparse</th>
<th>Rare-Dense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early AoA, High freq</td>
<td>car</td>
<td>fish</td>
<td>pig</td>
<td>duck</td>
</tr>
<tr>
<td>Early AoA, Mid freq</td>
<td>pants</td>
<td>frog</td>
<td>dress</td>
<td>swing</td>
</tr>
<tr>
<td>Mid AoA, Mid freq</td>
<td>ladder</td>
<td>tiger</td>
<td>hammer</td>
<td>turtle</td>
</tr>
<tr>
<td>Mid AoA, Low freq</td>
<td>mitten</td>
<td>beaver</td>
<td>hanger</td>
<td>feather</td>
</tr>
<tr>
<td>Late AoA, Low freq</td>
<td>toaster</td>
<td>donkey</td>
<td>banjo</td>
<td>thimble</td>
</tr>
</tbody>
</table>

Neighborhood Density: Dense > Sparse

Summary of Results

<table>
<thead>
<tr>
<th>Nonword Repetition</th>
<th>Short-term Word Learning</th>
<th>Long-term Word Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sublexical</td>
<td>Lexical</td>
</tr>
<tr>
<td>Phonological Delay</td>
<td>Rare &gt; Common</td>
<td>Common &gt; Rare</td>
</tr>
<tr>
<td>Typical Development</td>
<td>Rare &gt; Common</td>
<td>Common &gt; Rare</td>
</tr>
</tbody>
</table>

* Significant Group Difference Observed
Sublexical & Lexical Processing Tasks

- The effects of phonotactic probability and neighborhood density confirmed the role of sublexical and lexical processing across tasks
  - Phonotactic probability affects nonword repetition confirming the hypothesis that it taps sublexical processing (Gathercole et al., 1999; Munson et al., 2005)
  - Phonotactic probability and neighborhood density affect short-term word learning confirming the hypothesis that it taps both sublexical and lexical processing
  - Neighborhood density affects long-term word learning confirming the hypothesis that it taps lexical processing

Sublexical Processing

- Performance on nonword repetition and novel word learning tasks is influenced by sublexical processing
  - Sublexical processing appears to be similar between children with phonological delays and children with typical development
  - Despite delays in sound development, sublexical processing may be intact for children with phonological delays

Lexical Processing

- Performance by preschool children on short- and long-term word learning tasks is influenced by lexical processing
  - Differences are observed in lexical processing between children with and without phonological delays on a short-term word learning task
    - Processing of nonwords in a short-term word learning task may be influenced by phonological development status
    - Performance on vocabulary measures may not capture the nuances of lexical development in children with delayed phonological development

Lexical Processing Cont.

- Lexical processing by children with phonological delays and typical development is similar in a long-term word learning task
  - Recalling known vocabulary words may be unaffected by phonological development status

Future Directions

- Examine sublexical & lexical processing across a wider range of development
- Examine lexical processing in children whose phonological delay has resolved
- Compare sublexical and lexical processing by children with typical development to children who show delays in other aspects of language (e.g. vocabulary, grammar)

Thank you!

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