Development of a learning task for a process-oriented diagnostics of developmental speech sound disorders: a pilot study

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INTRODUCTION

Background

- Differential diagnosis and treatment planning of speech sound disorders (SSD) is one of the major bottlenecks in the field of pediatric speech-language pathology
- Intervention methods aim at specific parts of the speech production process, where diagnostic instruments consist of tests that measure knowledge and skills, and lack a direct relation with the underlying processes

Research goal

- An individualistic, process-oriented approach for the diagnosis and treatment of pediatric SSD

Aim of the present study

- Development and evaluation of a learning task as an instrument to assess the acquisition of sensori-motor representations of novel speech sound units

METHODOLOGY

Participants

- 6 normally developing children: 3 male, 3 female; aged 4.8-7.8 yrs
- 5 children with SSD: 2 male, 3 female; aged 4.3-7.5 yrs (Table 1)

TABLE 1: Diagnostic classification of the children with speech sound disorders

<table>
<thead>
<tr>
<th>ID</th>
<th>Classification</th>
<th>Sex</th>
<th>Word discrimination</th>
<th>Evaluation procedure</th>
<th>PCCCI</th>
<th>PSSC</th>
<th>CAS/PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLI1</td>
<td>PD</td>
<td>m</td>
<td>1</td>
<td></td>
<td>0.50</td>
<td>0.69</td>
<td>0.69</td>
</tr>
<tr>
<td>CLI2</td>
<td>PD</td>
<td>f</td>
<td>1</td>
<td></td>
<td>0.88</td>
<td>0.73</td>
<td>0.85</td>
</tr>
<tr>
<td>CLI3</td>
<td>PD</td>
<td>f</td>
<td>1</td>
<td></td>
<td>0.88</td>
<td>0.73</td>
<td>0.85</td>
</tr>
<tr>
<td>CLI4</td>
<td>PD</td>
<td>f</td>
<td>1</td>
<td></td>
<td>0.88</td>
<td>0.73</td>
<td>0.85</td>
</tr>
<tr>
<td>CLI5</td>
<td>PD</td>
<td>f</td>
<td>1</td>
<td></td>
<td>0.88</td>
<td>0.73</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Procedure (Table 2)

- Learning paradigm: repetition task of nonwords from a soundboard presented via headphones
- Stimuli: 3 non-native speech sounds in 4 context conditions, each item repeated 3 times

TABLE 2: Schematic overview of the learning task

<table>
<thead>
<tr>
<th>Stage</th>
<th>Goal</th>
<th>Conditions</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Explain target representation</td>
<td>Auditory and visual input</td>
<td>Auditory and visual input</td>
</tr>
<tr>
<td>Baseline measurement</td>
<td>10’s attempts to produce target syllable in isolation</td>
<td>/ga/</td>
<td></td>
</tr>
<tr>
<td>Training 1</td>
<td>Practice target stimuli in different conditions</td>
<td>- Sequencing -Prosody -Alternation following constraint -Embedding</td>
<td>/gaga/ /gaga/ /gaga/ /gaga/</td>
</tr>
<tr>
<td>Break</td>
<td>2 min. minutes of play time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training 2</td>
<td>Repeat training stage 1</td>
<td>- Sequencing -Prosody -Alternation following constraint -Embedding</td>
<td>/gaga/ /gaga/ /gaga/ /gaga/</td>
</tr>
<tr>
<td>Endpoint measurement</td>
<td>10’s attempts to produce target syllable in isolation</td>
<td>/ga/</td>
<td></td>
</tr>
</tbody>
</table>

| Data analysis & Results |

- Convergent transcription of all utterances by two experienced speech therapists
- Dependent variables:
  - Percentage consonants correct (PCC)
  - Percentage word-stress correct (PWSC; Prosody condition)

Statistics

- Repeated measures analysis of variance
- Pearson correlations

FIGURE 1: Group comparison of mean percentage consonants correct (PCC) in the different training conditions.

- Mean PCC for ga [F(1,9) = 12.646, p < .01]
- Not for mla or sja

- PCC per condition
  - Prosody [F(1,9) = 20.919, p < .001]
  - Embedding [F(1,9) = 4.359, p = .072]

Correlations

- ΔPCC & auditory discrimination overall
  - Word discrimination & overall learning effect [r = 0.636, p < .05]
- ΔPCC & auditory discrimination per target
  - Non-word discrimination & learning effect for ga [r = 0.649, p < .05]
  - Word discrimination & learning effect for ga [r = 0.661, p < .05]
- No significant correlations for mla or sja
- PCC & PWSC in Prosody condition
  - SSD Group [r = 0.671, p < .05]

Learning effects

- PCC overall
  - Main effect for mla [F(1,9) = 5.417, p < .05]
  - Not for ga or sja

- PWSC
  - No significant effects
- No learning effect by group interactions

FIGURE 2: Prosody condition: mean percentage consonants correct (PCC) and percentage words correct (PWSC)

FIGURE 3: Overall ΔPCC vs. Word discrimination score.

DISCUSSION

- Underlying profiles vary widely per child with SSD
- Results highlight important role of perception abilities
  - Strong correlation between non-word discrimination score and learning effect
- Results highlight important role of word-stress in SSD
  - Higher PCC in the prosody condition for ga and sja in SSD vs controls

Future directions

- More data needed
  - Promising results for the profiling of SSD, suggesting that a detailed assessment of the acquisition of novel sensori-motor representations could provide direct starting points for therapy planning
  - Focus assessment on Embedding, Sequencing & Prosody

REFERENCES


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