Assessing Children’s Speech Processing Ability using a New Analytical Method: The Listen-Say Test

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Introduction
Impaired speech perception occurs in several groups of children enrolled at Speech Language Pathology and Audiological clinics. These may be children with language impairment, attentional difficulties, hearing impairment and children with (Central) Auditory Processing Disorders (CAPD).

At present no standardized speech perception test provides information about how children discriminate, identify and produce phonetic contrasts in words.

Objective
The first purpose of the study was to examine the speech perception performance of normally hearing children 7-9 years of age in quiet and in 4T speech background (SB) with an analytic linguistic approach using minimal word pairs. See Figure 1 for the phonetic categories.

The second purpose was to analyze the influence of word fluency skills and academic achievement on children’s speech perception performance.

Procedure
Twenty-seven children (11 girls) 7-9 years of age (&plusmn;0.8 years, range=7.0-9.4) from three mainstream schools in the mid-east of Sweden participated in the study. Children were quasi randomly selected to ensure a range of socioeconomic groups. Seven of the participating children attended grade 1 and 20 children attended grade 2.

First, hearing screening was performed for the key-frequencies for speech at 20 dB HL. All participants received normal hearing thresholds.

The minimal word pairs were presented in quiet and in 4T SB. The 4T SB is a competing speech background. It consists of recordings of two male and two female native Swedish speakers reading different paragraphs of a newspaper text. The 4T SB has been post-filtered to resemble the long-term average spectrum of the HINT (Hearing in Noise Test; Häggren et al., 2006). The sound level of the 4T SB is 65 dB SPL and the speech signal is 70 dB SPL. The comparable louder level of the speech signal than earlier studies on adults (Magnusson, 1995, +4dB) was chosen with the intention of using the test for individuals with hearing loss in clinical assessment.

The duration of the Listen-Say test for each background was approximately 20 minutes.

Results

Table 1 presents an example of three of the 62 minimal word pairs containing the dental-velar contrast /t/ and /k/ in each position of the word. The words in the column “Listen to” are the target words. The target word and the contrasting word are presented in total 3 times. After each presentation the child decides by pressing an USB-dual button control whether it is the target word (blue button) or the contrasting word (red button). At the end of each test round, the child produces the target word after having heard the instruction “Say the word”.

Table 1
| Consonant | Listen to... | 1 | 2 | 3 | Say the word...
|-----------|-------------|---|---|---|-------------
| Initial   | kina (cat)  | tuina (3lm) | tuina | kina   |
| Medial    | rika (rich) | rika   | rika | rita (draw) |
| Final     | rätt (raw)  | rätt   | rock (coat) | rock |

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Teacher questionnaire
Four 4-graded questions regarding the child’s attentional- (1), mathematical- (2), learning- (3), and reading (4) ability were asked to the teacher. 1 corresponded to poor ability and 4 to high ability.

Figure 2

Overall, children obtained high scores discriminating consonant contrasts in both quiet (Mdn 95%) and against speech (Mdn 91%). Less accurate scores were found for voiceless fricatives in both conditions (quiet: 79%, speech: 81% correct). Significantly longer reaction times for correctly identified target words were observed in quiet compared to speech. Phonemic fluency, but not semantic fluency, was associated with several aspects of speech discrimination, and particularly with dental-velar contrasts and voiceless fricatives. Teacher’s scores of children’s academic achievement proved a sensitive tool that distinguished between children with higher and lower attention and reading skills. Children with high attention skills also had the highest speech perception scores in both conditions, indicating a close relationship between executive function and speech perception.