Challenges and opportunities in the assessment of auditory processing disorders in young children

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Introduction

- Auditory detection is the first essential step in the process of language processing: ‘Although it is true that mere detection of a sound does not ensure its recognition, it is even more true that without detection the probabilities of correct identification are greatly diminished’ (Pascoe).

- However, ‘Auditory processing is what we do with what we hear’ (Katz)
Introduction

- The importance of early detection and intervention in case of a hearing loss has been established firmly in the past decades.
- Similarly, the assessment of auditory processing disorders at an early age is important in order to plan appropriate intervention.
- The challenge lies in reliably determining whether a young child indeed has an auditory processing disorder.
Definition of APD

- ‘(Central) auditory processing disorder [(C)APD] refers to difficulties in the processing of auditory information in the central nervous system …’ (ASHA (2005). (Central) Auditory Processing Disorders - The Role of the Audiologist [Position Statement]).
- An APD can be defined as a deficit in the processing of sounds that cannot be explained on the basis of a (peripheral) hearing loss.
How could an APD present itself?

- An APD may be suspected if a person demonstrates poor performance in one or more of the following skills (ASHA, 2005):
  - sound localization and lateralization
  - auditory discrimination
  - auditory pattern recognition
  - temporal aspects of audition, including temporal integration, temporal discrimination (e.g. temporal gap detection), temporal ordering, and temporal masking
  - auditory performance in competing acoustic signals
  - auditory performance with degraded acoustic signals
Assessment of APD in school children

- No ‘gold standard’ for APD
- Interdisciplinary approach (audiologist, speech-language pathologist, and other professionals, e.g. psychologist or teacher) necessary:
  - to put the auditory deficits in broader perspective (e.g. the relationship between APD and language impairment)
  - to determine whether more general processing disorders are present (mental retardation, ADHD, PDD-nos, etc.)
- Use combination of questionnaires and auditory test battery in assessment of APD
Use of questionnaires in the assessment of APD

- In the Netherlands, a translated version of the CHAPS (Children’s Auditory Performance Scale, Smolski et al., 1998) is used on a regular basis in several audiologic centres.

- The CHAPS contains 36 questions divided into 6 sections:
  1. Speech understanding in noise (7 questions)
  2. Speech understanding in quiet (7)
  3. Speech understanding in optimal listening conditions (3)
  4. Integration of listening and watching (3)
  5. Auditory short term memory (8)
  6. Auditory attention span (8)
´Profiling´ a child with the CHAPS

- With the CHAPS the teacher of a child can help determine if a child has an APD.
- The 6 sections may allow for a rude ´profile´ of the specific auditory problems of the child.
- Listed below are some of the behaviors the child may show that are addressed by the CHAPS:
  - Problems with speech understanding in noise and/or rooms with much reverberation
  - Problems following verbal instructions
  - Problems with the auditory discrimination and identification of speech sounds
Assessment of APD with an auditory test battery

- An auditory test battery should comprise several tests to inform us about the auditory skills listed by the ASHA:
  - sound localization and lateralization
  - auditory discrimination
  - auditory pattern recognition
  - temporal aspects of audition, including temporal integration, temporal discrimination (e.g. temporal gap detection), temporal ordering, and temporal masking
  - auditory performance in competing acoustic signals
  - auditory performance with degraded acoustic signals
Present state of affairs in NL concerning auditory test batteries

- An auditory test battery suitable for children aged 8 years and older and for adults is available (Nijmegen auditory test battery, K. Neijenhuis)
- An auditory test battery for children aged 6 years and older is available (H. Simkens)
- An auditory test battery for preschool children (4 to 7 years of age) is the object of an ongoing study
Criteria for an auditory test battery for preschool children

- Test material should be varied and ‘attractive’
- Total test duration should not be too long
- Limited influence of linguistic competency on outcome
- Responses should be obtained by pointing to pictures
- An index for auditory attention should be obtained
- Special attention should be given to establishing normal peripheral hearing function (considering the high prevalence of OME in this age group)
Assessment of APD in preschool children

- Pilot study with 28 children in the age of 4 to 7 years (grades 1 to 3) (Stollman et al. (2004), IJA 43).
- Standardization study with 133 children in grades 1 to 3 (two primary schools).
- Retest data were collected for 21 children (15 children per test)
Assessment of APD in preschool children

- Selection criteria:
  - normal peripheral hearing (pure tone thresholds < 25 dB at 500, 1000, 2000 and 4000 Hz)
  - no history of frequent middle ear problems
  - normal language development
  - normal cognitive development
Assessment of APD in preschool children

- Of the 133 children tested, 21 were excluded from the analyses:
  - 20 children (15%) showed elevated pure tone thresholds
  - in 1 child, the passive vocabulary was found to be poor (score below the 10th percentile)
### Distribution of children in norm group

<table>
<thead>
<tr>
<th>Grade</th>
<th># of children</th>
<th>Age (yrs;mnths)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>36</td>
<td>4;1-5;6</td>
</tr>
<tr>
<td>Grade 2</td>
<td>38</td>
<td>5;1-6;7</td>
</tr>
<tr>
<td>Grade 3</td>
<td>38</td>
<td>6;0-7;7</td>
</tr>
</tbody>
</table>
Auditory test battery for preschool children

- Sustained auditory attention test (Keith, 1986)
- Dichotic words test (CVC words)
- Words-in-noise test (spondaic words)
- Binaural masking level difference test
- Auditory discrimination test (ADIT, Crul & Peters 1976)
- Random gap detection test (Keith, 2000)
- Lindamood auditory conceptualization test (Lindamood and Lindamood, 1979)
Binaural masking level difference with spondaic words

= words-in-noise

= words-in-noise, but with a phase difference of 180° between the right ear and the left ear (for the speech signal)
Results for the words-in-noise and the BMLD test

words-in-noise test

BMLD test
Summary of age effects

- Sustained auditory attention test  YES
- Dichotic words test (CVC words)  YES
- Words-in-noise test (spondaic words)  YES
- Binaural masking level difference test  NO
- Auditory discrimination test  YES
- Random gap detection test  NO
- LAC test  YES
Retest results

- 21 children were retested
- All tests were administered twice in 15 children
- Mean time between test and retest was 8 weeks (4-13)
- Retest scores were significantly better for only 3 of the 11 variables:
  - sustained auditory attention test (total score)
  - dichotic words test (total score)
  - random gap detection test
Interpreting test scores

- Calculate percentile scores:
  - for each age group (4-, 5-, 6- and 7-year olds)
  - for each grade (1st grade, 2nd grade, 3rd grade)

- 10th percentile = cut-off score
Conclusions and clinical implications

- Early assessment of APD is important.
- Assessment of APD requires an interdisciplinary approach.
- It is possible to assess APD in young children (below the age of 6).
Research needs

- Validation studies
- Test-retest reliability studies
- Profile analyses
- Evidence based studies of the efficacy of different intervention programmes for APD
APD assessment in the future?