Current Issues in Auditory Processing Disorders

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Controversy

"...there is currently great divisiveness in the field of audiology concerning CAPD. There is no broadly accepted definition of CAPD. No one really knows what causes CAPD. Despite lofty claims to the contrary, there is no clear consensus concerning the battery of tests that lead to a diagnosis of CAPD. Similarly, there is no widely accepted auditory (re)habilitation program that has been conclusively shown to help those with CAPD...We are hamstrung by the lack of agreement in definitions and test batteries in the area of CAPD" (Burkard, 2009, p. vii).

Kamhi (2011)

"Given the lack of consensus about how to diagnose APD, it should not be surprising that there is still some question about whether APD is truly a distinct clinical entity...[the] alternative is to view auditory processing problems as one of a number of deficits that are commonly found in developmental disorders" (p. 268).

ASHA (1996)—Definition

"central auditory processes are the auditory system mechanisms and processes responsible for the following behavioral phenomena:
- sound localization and lateralization
- auditory discrimination
- auditory pattern recognition
- temporal aspects of audition: resolution, masking, integration, ordering
ASHA (1996)—Definition

- Auditory performance decrements with competing acoustic signals
- Auditory performance decrements with degraded acoustic signals” (p. 5).
- “A Central Auditory Processing Disorder (CAPD) is an observed deficiency in one or more of the above-listed behaviors” (p. 5).

ASHA (2005a)—Definition

- (C)APD: “difficulties in the perceptual processing of auditory information in the CNS as demonstrated by poor performance in one or more of the above skills” (p. 2)
  - referencing the same skills as ASHA (1996)
- The same auditory deficit will impact individuals differently
  - Some will show problems with speech, language, reading, spelling, or learning, and others will not

ASHA (2005b)

- Multidisciplinary assessment is appropriate
  - Audiologist, SLP, educational psychologist
- Because it is an auditory deficit, audiologists should diagnose it
- SLPs may assist in determining other language or communicative ramifications of (C)APD

Bellis (2003)

- Common indicators of APD (p. 173)
  - Behaves as if a peripheral hearing loss is present when it is not
  - Demonstrates scatter across the subtests of speech/language and cognitive tests
  - Verbal IQ lower than performance IQ
  - Requires a highly organized classroom
  - Difficulty following multistep directions
Bellis (2003)

- poor reading and spelling skills
- refuses to participate in class discussions
- responds inappropriately during class discussions
- withdrawn or sullen
- positive history of otitis media or other otologic or neurologic disorders
- poor singing or music skills
- poorer gross and fine motor skills

Testing for APD

- “sensitized” tests employ auditory stimuli that are challenging to perceive
  - limit stimulus redundancy or increase stimulus complexity
  - the difficulty inherent in the tasks makes them susceptible to measuring non-auditory factors
  - e.g., sustained or divided attention, memory, linguistic processing, cognition

Typical Categorization

- dichotic speech tests
- temporal processing tests
- monaural low-redundancy
- binaural interaction

Screening Measures

- SCAN-3: C (ages 5 to 12 years)
- SCAN-3: A (ages 13 to 50 years)
- contain subtests assessing:
  - gap detection
  - speech-in-noise
  - competing words
  - filtered words
  - competing sentences
  - time-compressed sentences
Screening Measures

- Differential Screening Test for Processing (DSTP)
  - assesses three levels of processing:
    - acoustic: dichotic digits, temporal patterning, auditory discrimination
    - acoustic-linguistic: phonemic and phonic manipulation
    - linguistic: antonyms, prosodic interpretation, language organization
  - norms for ages 6 to 12 years

Auditory Skills Assessment (ASA)

- assesses three areas of processing:
  - speech discrimination: speech-in-noise and mimicry
  - phonological awareness: blending and rhyming
  - nonspeech processing: tonal discrimination and tonal patterning
- norms for ages 3:6 to 6:11 years

Testing of Related Skills

- prior to or in conjunction with an auditory processing assessment, clients/parents should pursue assessments of any other areas of concern
  - speech
  - language and phonological processing
  - auditory perception and memory
  - literacy
  - intelligence
  - achievement
  - attention

Potential Contraindications to Assessing (C)APD

- any degree of hearing loss
- mental age below 7 or 8 years
  - young children or those with developmental delay
- significant traumatic brain injury
  - veterans
- extreme hyperactivity
- emotional or behavioral disorders that limit cooperation
- non-native speaker of English
Auditory Development

Whitelaw and Yuskow (2006), p. 30

Neuroplasticity

- experience-expectant development
  - stimulation is necessary during sensitive periods to ensure proper brain function and structure
- experience-dependent development
  - unique personal experiences shape brain modifications throughout the entire lifetime
- if auditory skills are delayed, therapy may provide the stimulation necessary to improve brain function

Etiology

- children may appear to have APD for one of the following reasons:
  - delayed auditory development
    - some children may “catch up” with age, whereas others may remain “disordered”
  - lesion or disease
    - seizures, TBI, concussion, demyelinating disease
  - cerebral morphologic abnormalities
    - genetic differences in brain morphology

APD in Older Adults

- even when audibility is accounted for, older adults show declines in auditory processing:
  - speech recognition of fast speech or speech-in-noise
  - temporal processing
  - gap detection
- declines also occur for cognitive factors
  - processing speed
  - sustained and divided attention
  - working memory
APD vs. ADHD

- significant overlap in the behaviors used to describe the two conditions
- possible options:
  - separate clinical entities
  - part of the same disorder
  - comorbid disorders
  - mistaken for one another
  - causally related to one another

Chermak et al. (2002)

- survey mailed to 100 audiologists and 100 pediatricians
- contained 58 behaviors compiled from checklists designed to evaluate APD or ADHD
- rating scale from 1 (never observed) to 5 (always observed)
- 26 pediatricians and 38 audiologists responded
- mean ratings calculated for each behavior

Chermak et al. (2002)

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Rating</th>
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</thead>
<tbody>
<tr>
<td>Auditory processing disorder</td>
<td>6.14</td>
</tr>
<tr>
<td>Academic difficulties</td>
<td>4.12</td>
</tr>
<tr>
<td>Daydreaming</td>
<td>4.05</td>
</tr>
<tr>
<td>Poor attention</td>
<td>4.04</td>
</tr>
<tr>
<td>Apraxia of speech</td>
<td>3.06</td>
</tr>
<tr>
<td>Auditory hallucinations</td>
<td>3.00</td>
</tr>
<tr>
<td>Auditory discrimination deficit</td>
<td>5.07</td>
</tr>
<tr>
<td>Auditory working memory deficit</td>
<td>4.00</td>
</tr>
<tr>
<td>Auditory processing disorder</td>
<td>2.63</td>
</tr>
<tr>
<td>Organic mean</td>
<td>3.11</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.91</td>
</tr>
</tbody>
</table>

Cacace and McFarland (2003) criticize the analysis of Chermak et al. (2002) when all the data is included in the statistical analysis (not just the top-ranked data), the data sets for the two disorders are highly correlated although Chermak et al. address the conceptual overlap of the disorders, their data do not adequately address the diagnostic overlap.
**Medwetsky (2011)**

- spoken language processing model
  - acoustic signal transduction
  - decoding
  - short-term memory
  - attentional allocation
  - selective attention
  - auditory-linguistic integration
  - sequencing
  - phonological awareness

**Medwetsky (2011)**

- processing breakdowns
  - impaired neural transmission
  - poor temporal resolution
  - slow lexical-decoding speed
  - lack of interhemispheric transfer to integrate linguistic and suprasegmental information
  - difficulty sequencing
  - fading short-term memory
  - issues with selective auditory attention

**Sharma et al. (2009), p. 714**

**Moore et al. (2010), p. e384**

**FIGURE 1.** Schematic diagrams of individual (BM0, BM50, SM, SMN, and FD) and derived (TR and FR) AP tests. Each set of 3 boxes designates successive sound presentation intervals of noise or quiet. Lines are target tones. The “odd one out” is shown in the middle interval but could occur (randomly) in any interval.
Moore et al. (2010), p. e385

FIGURE 2. Box plot distributions of AP thresholds among children 6 to 11 years of age for 3 individual tests of AP (A) and derived tests of AP (B), demonstrating variations in AP with age and across tests. Box plots show the median (horizontal line), the interquartile range (25%–75%, box) and the minimum and maximum values (whiskers).

Moore et al. (2010), p. e386

FIGURE 3. Reduced cognitive performance for children with poorer AP. Mean standard scores and 95% confidence intervals for each cognitive test for children in the upper 95% (typical) or lower 5% (poorer) of performance (threshold) on each AP test are shown. NVIQ indicates nonverbal IQ; NW-rep, nonword repetition test; TOWRE, Test of Word Reading Efficiency.

Moore et al. (2010), p. e387

FIGURE 4. Reduced communication, listening, and speech-in-noise skills for children with poorer AP. A. Histograms of standardized, whole-population scores for each presentation test. B. Mean scores (or median CHAPPS scores) and 95% confidence intervals for each test. Arrows in A mark the mean scores for the tests in B with the greatest difference between typical (T) and poorer (P) performers.

Ferguson et al. (2011), p. 221

Figure 4. ACC group outperformed both clinical groups in all tasks except task 2. Mean age-equivalent scaled scores and 95% CI for tasks of all intelligence, language and reading, and (C) repetition of nonwords and memory.
Wallach (2011)

- “Professionals may look at children and adolescents with language-learning, literacy, and academic problems through different lenses, but behind the lenses is the common goal of helping the children develop the knowledge, skills, and strategies needed to survive and thrive in their classrooms and communities” (p. 275).

Kamhi (2011)

- current clinical categories: APD, ADHD, Sensory Integration Disorder (SID)
- processing abilities that most affect language and reading: working memory, speed of processing, phonological memory, phonological awareness, and rapid serial naming
  - Why are these areas not labeled with their own clinical category? Professional territory and lack of “meme” status.

Richard (2011)

- “Do problems in accurately processing an acoustic signal always lead to language-learning difficulties? No. Can problems in accurately processing an acoustic signal lead to language-learning difficulties? Yes. The 2007 ad hoc committee members were in agreement that APD as a clinical entity probably served no purpose if educational or life functions were not negatively impacted. Individuals with diagnosed APD might compensate well, resulting in no experienced deficits or academic problems” (p. 299).

ASHA Ad Hoc Committee

- in 2007, ASHA formed the Ad Hoc Committee on the Role of the Speech-Language Pathologist in Identifying and Treating Children with Auditory Processing Disorders
- LSHSS published a series of articles in July 2011 regarding APD and SLPs
Fey et al. (2011)
- systematic review of 25 studies documenting the effects of auditory vs. language interventions for children with APD or spoken language disorder
- auditory interventions: traditional auditory training, auditory integration training, Fast ForWord, and Earobics
- “...we found no compelling evidence that existing auditory interventions make any significant contributions to auditory, language, or academic outcomes…” (p. 254)

Fast ForWord vs. Traditional Therapy
- Gillam et al. (2008)—four groups:
  - Fast ForWord
  - academic enrichment
  - computer assisted language intervention
  - individualized language intervention
- all groups improved on global language testing and backward masking
- children with backward masking issues who engaged in Fast ForWord did not show differential effects

Kamhi’s (2011) Suggestions to SLPs (p. 270)
- “Do not assume that a child who has been diagnosed with APD needs to be treated any differently than children who have been diagnosed with language and learning disabilities.”
- “Do not provide auditory intervention for a child who has been diagnosed with APD...Language interventions are just as effective as auditory interventions in improving a child’s auditory abilities.”
- “Perform a comprehensive assessment of the child’s speech, language, and literacy abilities…”

Kamhi’s (2011) Suggestions to SLPs (p. 270)
- “Consider non-auditory reasons for listening and comprehension difficulties, such as limitations in working memory, attention, motivation, language and conceptual knowledge, and inferencing abilities.”
- “Target speech, language, literacy, and knowledge-based goals in therapy.”
- “Avoid goals that target...auditory discrimination, phonological memory, working memory, or rapid serial naming. There is no compelling evidence that targeting these skills significantly improves a child’s language or reading ability.”
**Angerman & DeRuiter (2011)**

- **purpose:**
  - to examine the relationship between oral language skills and measures of auditory processing

- **hypothesis:**
  - performance on tests of oral language will correlate highly with performance on tests of auditory processing, indicating that the disorders either commonly co-exist or are one in the same

- **participants:**
  - 18 children ages 8 to 17 years (11 females and 7 males)
  - 9 adults ages 19 to 44 years (7 females and 2 males)
  - all were self-referred or referred for testing by a professional in the community through word-of-mouth

- **preliminary testing:**
  - audiological evaluation including pure-tone audiometry and supra-threshold word recognition in quiet
  - tympanometry and acoustic reflexes
  - otoacoustic emissions
  - auditory brainstem and middle latency responses
  - vision screening
  - Test of Nonverbal Intelligence-III
  - Auditory Continuous Performance Test
  - case history

- **auditory processing test battery:**
  - SCAN-C or SCAN-A
  - Dichotic Digits Test (DDT)
  - Competing Sentences Test (CST)
  - Staggered Spondaic Words Test (SSW)
  - Time-Compressed Speech Test (TCS)
  - Speech-in-Noise Difference (SND)
  - Frequency or Duration Pattern Test (F/DPT)
  - Random Gap Detection Test (RGDT)
  - Spondee Binaural Fusion (SBF)
  - Masking Level Difference-Spondees (MLD-S)
Angerman & DeRuiter (2011)

- language processing test battery:
  - Expressive Vocabulary Test-2nd Edition (EVT)
  - Peabody Picture Vocabulary Test-4th Edition (PPVT)
  - Comprehensive Assessment of Spoken Language (CASL Comp)
  - Comprehensive Test of Phonological Processing (CTOPP)
    - Phonological Awareness (CTOPP PA)
    - Phonological Memory (CTOPP PM)
    - Rapid Naming (CTOPP RN)

Angerman & DeRuiter (2011)

- language processing test battery (cont.):
  - Gray Oral Reading Test-4th Edition (GORT ORQ)
  - Test of Auditory-Perceptual Skills-Revised (TAPS-R APQ)
  - Woodcock-Johnson-3 Test of Achievement
  - Token Test or Revised Token Test
  - Symbol Digit Modality Test

Angerman & DeRuiter (2011)

- categorizing test results:
  - auditory processing testing
    - “failure” is defined as below normal performance on multiple tests designed to assess the same auditory skill
    - “borderline” performance is defined as failure on several tests, but passing scores on other tests designed to assess the same auditory skills

Angerman & DeRuiter (2011)

- categorizing test results:
  - language processing testing
    - “failure” is defined as full-scale performance greater than or equal to 2 SD below the mean on two or more tests
    - “borderline” performance is defined as failure on one test accompanied by failure on a cluster score from a second test
Angerman & DeRuiter (2011)

Matrix showing the number of children and adults who passed, failed, or showed "borderline" results for the auditory processing and language tests.

<table>
<thead>
<tr>
<th>Auditory Tests</th>
<th>Pass</th>
<th>Borderline</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>8</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Adults</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Language Tests</th>
<th>Pass</th>
<th>Borderline</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Adults</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

9 of the 18 children passed the auditory testing, 7 were considered “borderline,” and 2 failed

11 of the 18 children passed the language testing, 4 were considered “borderline,” and 3 failed

4 of the 9 adults passed the auditory testing, 1 was considered “borderline,” and 4 failed

8 of the 9 adults passed the language testing and 1 failed

Angerman & DeRuiter (2011)

Histogram showing the percentage of children and adults who failed each auditory processing test. Numbers in the bars indicate the number of participants who were administered the test.

Angerman & DeRuiter (2011)

Histogram showing the percentage of children who failed each language test. Numbers in the bars indicate the number of children who were administered the test.
as a group, the children showed more difficulty with expressive than receptive vocabulary (EVT vs. PPVT).

• the language measures that produced the greatest difficulty for children involved rapid naming (CTOPP RN), reading (GORT APQ), and auditory memory (TAPS-R APQ)

Anecdotal findings:

• two of the child participants who had IQ scores in the superior range (144 and >160) showed normal results for all auditory and language measures.
  - they were referred by teachers who were concerned about distractibility in the classroom.
  - these children may have simply been under-challenged, and therefore more inclined to become off-task.

• anecdotal findings:
  - two of the adults who failed the auditory processing testing reported a history of concussion during a motor vehicle accident, which suggests the presence of traumatic brain injury.
  - both participants showed normal language findings, but auditory processing deficits.

• anecdotal findings:
  - one of the child participants demonstrated inconsistent results suggestive of malingering.
  - pseudohypacusis.
  - the child then showed conflicting results on the auditory processing assessment (e.g., time-compressed word recognition scores that were 20% higher than the word recognition scores obtained for words presented at the normal rate)
Angerman & DeRuiter (2011)

- clinical implications:
  - communication difficulties may be misinterpreted by parents, professionals, and patients
  - what may appear to be an auditory processing weakness may actually be a language impairment or vice versa
  - evaluations of auditory processing should be paired with speech-language assessments to confirm the true deficit

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References


References