HEARING AND AUDITORY PROCESSING

Devon Barnes
Director
Lindfield Speech Pathology and Learning Centre
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
HEARING ACUITY

- INTENSITY- LOUDNESS  \(\text{quiet} \rightarrow \text{loud}\)
  + measured in Decibels (db)

- FREQUENCY-PITCH  \(\text{low} \rightarrow \text{high}\)
  + measured in Hertz (Hz)
TESTING HEARING

- AUDIOGRAM
- TYMPANOMETRY
- ACOUSTIC REFLEX
- ELECTROPHYSIOLOGICAL TESTS
HEARING ACUITY

AUDI OGRAM INDICATING NORMAL HEARING

INTENSITY (in dBHL)

FREQUENCY (in Hertz)

O Right Ear  X Left Ear
MIDDLE EAR FUNCTION

- TYMPANOMERTY
  + measures middle ear pressure

- ACOUSTIC REFLEXES
  + measure stapedius muscle reaction
TESTING HEARING

- ELECTROPHYSIOLOGICAL TESTS
- OTOACOUTIC EMISSIONS
- BRAIN STEM EVOKED RESPONSES
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
AUDITORY PROCESSING

- WHAT THE BRAIN DOES WITH WHAT IT HEARS
Auditory Processing Disorder

- When something is wrong with what the brain does with what it hears
Auditory discrimination (*same/different*)

Auditory closure (*fill in missing bits*)

Auditory pattern recognition

Temporal aspects of audition (*timing*)

Auditory localisation (*locate source of sound*)

Auditory performance with degraded acoustic signal

Auditory figure-ground (*perceiving sounds in background noise*)
APD BY WHAT WE SEE

- Normal hearing acuity
- Difficulty understanding verbal directions
- Needs information to be repeated
- Often says “what” or “huh”
- Difficulty understanding speech in background noise
- Suffers from auditory “overload” leading to
  - Distractibility / Inattentiveness
- Very tired at end of school day
- Academic underachievement and literacy difficulties
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
DIFFERENTIAL DIAGNOSIS

- APD/CAPD

- ADHD
  - ADHD-C(combined)
  - ADHD-HI (predominantly hyperactive and impulsive)
  - ADHD-PI (predominantly inattentive type)

- SLI (Specific Language Impairment)
IS IT APD OR ADHD?

AUDITORY PROCESSING DISORDER?

OR

ATTENTION DEFICIT DISORDER?
<table>
<thead>
<tr>
<th>APD/CAPD</th>
<th>ADHD-PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asks for things to be repeated</td>
<td>Inattention</td>
</tr>
<tr>
<td>Poor Listening skills</td>
<td>Academic Difficulties</td>
</tr>
<tr>
<td>Difficulty following oral instructions</td>
<td>Daydreams</td>
</tr>
<tr>
<td>Difficulty discriminating speech</td>
<td>Distracted</td>
</tr>
<tr>
<td>Difficulty hearing in background noise</td>
<td>Poor Listening Skills</td>
</tr>
<tr>
<td>Difficulty maintaining auditory attention in quiet</td>
<td>Disorganised</td>
</tr>
<tr>
<td>Academic difficulties</td>
<td>Asks for things to be repeated</td>
</tr>
<tr>
<td>Slow to process information</td>
<td>Auditory divided attention deficit</td>
</tr>
</tbody>
</table>

Chermak, Tucker, Seikel 2002
IS IT APD OR SLI?

AUDITORY PROCESSING DISORDER?

OR

SPECIFIC LANGUAGE IMPAIRMENT?
AUDITORY PROCESSING

- Behavioural manifestations of APD often appear as language comprehension disorders
IDENTIFICATION OF SLI

- Delayed or disordered language
- Poor comprehension
- Limited or use of unspecific vocabulary
- Poor grammar
- Difficulty with sentence formulation
- Poor pragmatic skills
AUDITORY PROCESSING DISORDER

- Specific to perception of the auditory signal
- Can co-exist with ADHD, language impairment, Aspergers
- Can underlie language and learning difficulties
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
Only audiologists are qualified to diagnose APD. However, to diagnose accurately, one needs to have background information:

- Cognition
- Behaviour
- Oral and Written Language
ASSESSMENT

- **Bottom–up**
  - Pathway mode
    - Mechanisms and processes that occur in auditory system beyond the ear, along auditory pathway to auditory cortex

- **Top-down**
  - Functional assessment
    - Receptive and expressive language
    - Phonological awareness
    - Literacy skills
ASSESSMENT TEAM

- **Bottom-up**
  - Audiologist

- **Top-down**
  - Speech Pathologist >>> oral and written language
  - Psychologist >>> cognitive skills
  - School Counsellor >>> academic skills
  - Pediatrician >>> attention etc
AUDITORY PROCESSING ASSESSMENT

- General
  - Hearing Acuity
  - Middle ear function

- APD assessment
  - Screening
  - Questionnaires
  - Diagnostic
AUDIOLOGY ASSESSMENT FOR APD

Screening
SCAN-C

Questionnaires
Fishers, CHAPS

Diagnostic
dichotic tests
temporal patterning
auditory discrimination
integration tests

Hearing in background noise
Sound localisation
Separating competing signals
Auditory closure
(filling in gaps)
Detecting patterns
Temporal processing
SPEECH PATHOLOGY ASSESSMENT

- Receptive and expressive language
- Tests of vocabulary and word-finding
- Phonological awareness and auditory processing skills
- Literacy tests
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
# ASSESSMENT OF APD

<table>
<thead>
<tr>
<th>Problems</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing in background noise</td>
<td>Coping in a noisy classroom</td>
</tr>
<tr>
<td>Sound localisation</td>
<td>Difficulty ignoring background noise</td>
</tr>
<tr>
<td>Separating competing signals</td>
<td>Following classroom discussions</td>
</tr>
<tr>
<td>Auditory closure- (filling in gaps)</td>
<td></td>
</tr>
<tr>
<td>Problem</td>
<td>Implications</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Detecting patterns</td>
<td>Understanding rhythm, stress and intonation</td>
</tr>
<tr>
<td></td>
<td>Sentence types-questions v statements</td>
</tr>
<tr>
<td></td>
<td>Don’t touch that <em>book</em>. Don’t touch <em>that</em> book.</td>
</tr>
<tr>
<td>Syllable stress</td>
<td><em>Convict/convict, object/object</em></td>
</tr>
<tr>
<td>Sarcasm: “That was smart!”</td>
<td></td>
</tr>
</tbody>
</table>
**ASSESSMENT OF APD**

<table>
<thead>
<tr>
<th>Problems</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal Processing Discrimination</td>
<td>“Fuzzy phonological system”</td>
</tr>
<tr>
<td></td>
<td>Problems with phonemic awareness</td>
</tr>
<tr>
<td></td>
<td>Sequencing sounds &amp; syllables for decoding and spelling</td>
</tr>
<tr>
<td></td>
<td>Poor auditory discrimination</td>
</tr>
<tr>
<td></td>
<td>✷ Sound and word discrimination</td>
</tr>
<tr>
<td></td>
<td>✷ decoding, spelling, vocabulary</td>
</tr>
<tr>
<td></td>
<td>✷ following instructions</td>
</tr>
</tbody>
</table>
CONTENT

- HEARING
- AUDITORY PROCESSING
- CAPD? ADHD? SLI?
- ASSESSMENT
- IMPLICATIONS FOR LEARNING
- REMEDIATION
REMEDIATION

- Environmental modifications

- Compensatory Strategies
  + Active Listening
  + Linguistic Strategies

- Direct Intervention
  + Therapy specific to sub-profile
  + Computer programs
REMEDIATION OF APD

- Environmental modifications
  + Reduce ambient noise
  + Preferential seating
  + FM systems
    - Personal
    - Sound field
  + Frequent checks for comprehension
REDUCE NOISE

- CARPET
- RUBBER TIPS ON CHAIRS
- CLOTH AND MAT POSTER BOARDS
- AWAY FROM SOURCES OF NOISE
  - FANS
  - CORRIDORS
  - OUTSIDE TRAFFIC
PREFERENTIAL SEATING

- FACE TEACHER
- AWAY FROM NOISE
- STRUCTRED SETTING RATHER THAN OPEN CLASSROOM
REMEDIATION OF APD

- Environmental modifications
  - Reduce ambient noise

- Preferential seating

- FM systems
  - Sound field
  - Personal
SOAPS
S = Subject (general topic, ideas, content)
O = Occasion (place, current situation)
A = Audience (who is article directed to)
P = Purpose (behind article will describe)
S = Specific example (TREM)
COMPENSATORY STRATEGIES

- ACTIVE LISTENING
- CHECKS FOR COMPREHENSION
- MULTISENSORY INSTRUCTION
- MNEMONIC DEVICES TO ASSIST MEMORY
REMEDICATION

- Direct Intervention
  - Therapy specific to deficits
- Computer programs
  - Earobics
  - Fast ForWord
REMEDICATION

- Direct Intervention
  - Therapy specific to deficits
    - Auditory training
    - Speech in noise
    - Phonological awareness
    - Language therapy
REMEDIATION

- Computer programs
  - Earobics
  - Fast ForWord
MORE INFORMATION?

Audiological Society of Australia
03 9416 4606

National Acoustic Laboratory Research
Sharon.Cameron@nal.gov.au

Devon Barnes
devon@lindfieldspeech.com.au
REFERENCES

“When the Brain Can’t Hear” Teri James Bellis

“Like Sound Through Water” Karen J Foli

“Assessment and Management of Auditory Processing Disorders in the Educational Setting” Teri James Bellis

“Central Auditory Processing Disorders” Jack Katz with Masters and Stecker

“Central Auditory Processing Disorder- Strategies for Use with Children and Adolescents” Dorothy Kelly