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A little story from about 10 years ago . . .

Listen Up! Highlights from recent research in pediatric audiology

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continued
The Impact of Degree of Hearing Loss on Auditory Brainstem Response Predictions of Behavioral Thresholds


What they asked...

- Is the relationship between ABR and behavioral thresholds affected by degree of HL?
- Does adjusting correction factors for degree of HL result in more accurate prediction of behavioral thresholds over conventionally used corrections?
Why do ABR and Behavioral thresholds differ?

- **Temporal Integration** – describes affect of stimulus duration on behavioral threshold
  - Long stim = lower threshold; stable 300 – 500 ms +
  - Frequency dependent in NH ears
  - Impaired in ears with SNHL

Estimating behavioral thresholds from ABR thresholds:

1) **BEHAVIORAL** (Gorga et al., 2006)
   - Behavioral threshold to ABR stim (NH adults)

2) **BEHAVIORAL/ ABR** (Vander Werff et al., 2009; Bagatto et al., 2010)
   - Behavioral threshold to ABR stim (NH adults)
   - Further subtraction based on observed ABR thresholds in same (NH adults)

3) **LINEAR REGRESSION** (McCreery et al., 2015)
   - Further subtraction based on observed ABR thresholds in children with hearing loss
Why it matters...

Inaccurate estimates of behavioral threshold can lead to:

1) Inappropriate diagnosis of HL, and
2) Errors in gain prescriptions for amplification devices

What they did...

• Retrospective record review of ABR and behavioral threshold data obtained from clinic visits at BTNRH
• **Participants**: 309 ears (n = 177 children) with SNHL (no ANSD), excluded NR at equipment limits
• **ABR**: Click & 250*, 1k, 2k, 4k TBs
• **Behavioral**: VRA, CPA, Conventional; Good/ Fair reliability
  - Data acquired separate visits (Avg ages: ABR= 18 mos, behavioral = 38 mos)
What they found...

- Linear Regression (LR) correction resulted in better match between ABR and behavioral thresholds
- Extent of improved predictability varied across freq and degree of HL

What they found...

- What are the LR corrections?
- Correction factors vary by freq and ABR threshold

TABLE 4. Linear regression equations and correction factors for each test frequency

<table>
<thead>
<tr>
<th>Example of Corrections for Specific ABR Thresholds</th>
<th>20 dB</th>
<th>40 dB</th>
<th>60 dB</th>
<th>80 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABR Threshold (dB)</td>
<td>nHL</td>
<td>nHL</td>
<td>nHL</td>
<td>nHL</td>
</tr>
<tr>
<td>500 Hz</td>
<td>y = -0.22x + 5.90</td>
<td>5</td>
<td>-3</td>
<td>-7</td>
</tr>
<tr>
<td>1000 Hz</td>
<td>y = -0.13x + 8.32</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2000 Hz</td>
<td>y = -0.14x + 7.31</td>
<td>5</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>4000 Hz</td>
<td>y = -0.16x + 9.32</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>
Why is this important?

- “Inaccurate estimates of behavioral threshold...could lead to...”

- Inaccurate ABR Corrections
- Inaccurate Behavioral Estimates
- Misdiagnosis of HL
- Inaccurate Gain Targets
- Compromised audibility = Poorer Outcomes

Does it really matter clinically?

- Who do we really want to test?
- But, by how much can LR corrections really improve behavioral thresholds from ABR (over other approaches)?
  - Depends on freq and deg of HL, but could result in improvements in threshold estimation by as much as 25 dB
Evaluation of the Benefits of Binaural Hearing on the Telephone for Children with Hearing Loss


What they asked...

• Do children with hearing loss understand better on the telephone with binaural versus monaural phone input to HAs?
Background from the article...

- **Kochkin, 2010**: 30% adult HA users are unsatisfied with ability to understand on phone

- **Picou & Ricketts, 2011; 2013**:  
  - Adults with severe - profound HL have substantial difficulty understanding using monaural acoustic phone input  
  - Improved understanding with binaural versus monaural telephone speech input

Why it matters...

- **Telephone communication**:  
  - important means for staying connected family and friends  
  - Critical for emergency situations
PARTICIPANTS:
• n = 14 bilateral HA users (6 – 14 yrs)
• English speaking, (at or near) age-appropriate sp/lang skills

PROCEDURES:
• Phonak Bolero Q90-M13 BTEs
• Tcoil program (10 dB mic atten)*
• CNC words delivered via phone
• Quiet and classroom noise

CONDITIONS:
1) Monaural Phone – Q, 2) DuoPhone – Q
3) Monaural Phone – N, 3) DuoPhone - N

What they did...

CD player → handset interface → Landline
What they found...

- Binaural is the Bees Knees!
- Approximate 30% improvement in understanding with DuoPhone in Q & N

**SIDE NOTES:**

- Most children and parents reported difficulty understanding on phone and avoidance of phone use
- Many children didn’t orient telephone to HA properly (earmold versus aid)
- Lack observable difference in Q v. N may be partly due to environmental mic attenuation
Why is this important?

- Phones...everybody’s doing it!
- Telephone provides important means communication.
- Phone challenges reported by adults may be even greater peds.

![Diagram showing frequency ranges for voice and data communication.](image)

Does it really matter clinically?

- Why is optimizing phone input for kids clinically important?
  - Lack visual cues
  - Children require more favorable SNRs and wider bandwidths than adults
- It’s not an adult feature!
  - Mobile phone use by kids on rise
Pediatric Hearing Aid Use: Parent-Reported Challenges


What they asked?

- Investigate parent challenges with HA management and use, and psychosocial experiences birth - 3 years
- Distinguish report from moms and dads
• family-centered care,

• primary health care that includes an assessment of the health of an entire family...and implementation of interventions needed to maintain or improve the health of the unit and its members.

• Identification of HL can cause parent grief (Kurtzer-White & Luterman, 2003)

• Gender differences in grief experience (Martin & Doka, 2000)

• Increased risk of depression in moms of children with disabilities

• Mixed findings in studies of parents with children with HL
  – Severe - profound HL: Increased stress, reduced over time (Meadow-Orlans, 1995)
  – Mild – profound: No increased stress relative to moms with NH children (Lederbeg & Golbac, 2002)
10/18/17

Why it matters...

• Fitzpatrick et al. (2008): Study of parents with children with HL indicated support from professionals is important!
• Cornerstone of family-centered care
• Little known about needs of parents with HI children (especially dads)
• Emotional wellness *may* impact HA management (device use) and ultimately patient outcomes

What they did...

• Mailed questionnaires to 80 English speaking families with children (birth – 3 yrs) with bilateral HL who use HAs
• Recruited through EI agencies
• Instruments:
  – *Demographics Form*
  – *Parent HA Management Inventory*
  – *Acceptance and Action Questionnaire*
  – *Patient Health Questionnaire*
INFORMATION:

• Audiologist was primary info source on hearing loss and hearing aids, **but...**
  – 30% recalled no discussion of referrals, or HA wear schedule
  – 43% no info about other types of devices (e.g., FM)

HA MANAGEMENT SKILLS:

• Moms received more instruction than dads
• Audiologists were primary educators
  – Skills taught: listening check (66%) (only 1/3 perform daily)
  – Skills not taught by Audiologists: HA troubleshooting (64%), Ling 6 test (41%), how to teach others listening check (43%), and insert aids (56%)
INFO DELIVERY & TEACHING SKILLS:
- Majority parents indicated info delivered in preferred learning mode
  - Caveat - more written info and access to videos helpful

AMOUNT INFO:
- 40% overwhelmed, but 84% wanted all info upfront
  - 25% wanted more info

PARENT CONFIDENCE:
- A+ on battery changes!

EXPECTATION(s):
- Told - Expected HA benefit
- Not told - Expected emotional response to diagnosis of HL; what HAs can’t provide

COMMUNICATION:
- Only ~½ respondents felt audiologists gave adequate time to talk about/understand their emotions
Communication...

**HEARING AID USE:**
- Moms reported higher HA use challenges
- Most moms and dads “accepted” child’s HL, but...
  - 20% HAs not needed/ occasional use okay
  - 25% were concerned about appearance
  - 50% confused about how keep on
  - 75% concerned about child’s feelings wearing HAs

What they found...
What they found...

• Almost ¼ parents reported depressive symptoms
• Positive correlations between HA use and...
  – Parent challenges with HAs (skills/ confidence)
  – HA use challenges (keeping them on)
  – Perceived HA benefit

Does it really matter clinically?

• Family-centered care
  – Are we asking about parent emotions?
  – Providing resources?
  – Addressing parent needs is addressing child’s needs; parent emotional wellness and HA use (compliance) is connected
Infant cortical electrophysiology and perception of vowel contrasts


What they asked?

• Can CAEP measurements in infants show vowel discrimination?
• Are electrophysiologic measures related to behavioral discrimination performance?
Behavioral speech feature perception:
- VRA-SPAC (Eisenberg)
- VRISD (IHS)
- Habituation paradigms

• Eisenberg (2004, 2007) – speech discrim infants with HL lagged behind infants with NH*

Electrophysiologic speech perception:
• Can measure speech feature discrimination with ABR, ASSR and CAEPs

CAEP Basics -
• Discrimination measured using oddball paradigm
• Acoustic change complex – response to abrupt change
• Amp, latency, topography*, difference waveform (MMN)
• Not sleepy, no problem!

• Relationship between behavioral and electrophys measures...it’s complicated!
Why it matters...

- Electrophys and behavioral speech discrimination measures in infants could influence diagnostic and rehabilitative efforts
  - Diagnostic (prognostic) insight (ANSD)
  - Success of intervention (device programming, speech therapy)

PARTICIPANTS
- 20 infants, 4 – 11.8 mos, FT, passed NHS

CAEPs:
- collected (awake) using oddball paradigm
- Oddball, 2 rates (1Hz, 2Hz)
- Standard = 75% (/a/), deviant = 25%
- Vowels = /a, i, u, o/
- P1, N1, P2, N2; latency, amp & derived waveforms

VRISD
- Training phase – 2 or 3/ 5 for criterion
- Testing phase – no feedback (monitor off)
- Hits, Misses, FAs, CRs (d’)

What they did...
What they found...

**ELECTROPHYS**
- Larger amp to deviant(s) re: standard (/a/)  
- Amp difference (original) greater at 2/s (/a/ flatter)  
- Derived waveforms: Amp ~ 2x greater for contrast (/a/-/i/) vs control (/a/-/a/); longer latency for contrast (2/s)

What they found...

**BEHAVIORAL**
- Overall, 68.5% hit rate, 25.7% FA  
- Hit rate and FA rate differed across contrasts  
- Highest hit rate /a/-/u/ (77%), lowest /a/-/o/ (59%)

- Some correlations between CAEP parameters (amp, latency) from derived waves and hit rate

- But...some infants showed evidence of electrophysiological but not behavioral discrim
“Can he hear?”

Can he understand?

CAEP testing not routinely performed in clinic.

Pros-

- Less affected patient state
- Can sometimes be measured in patients with absent ABR
- Useful for patients where behavioral info limited

Challenges in ototoxicity monitoring in the pediatric oncology population

What they asked?

Tutorial on ototoxicity monitoring in pediatric cancer patients

CISPLATIN

– **Mechanism**: Binds to cell’s DNA, disrupts fxn/ repair → apoptosis damages to organ of Corti
– **Presentation**: Bilat, symmetric high-freq HL observed during or shortly after treatment*
– **Increased HL risk**: young age (< 5yrs), cumulative dose (> 400 mg/m²)

Background from the article…
CARBOPLATIN

- **Mechanism:** OHC damage, conflicting reports regarding IHC damage
- Less ototoxic than cisplatin*
- **Higher incidence HL:** younger patients, carboplatin/cisplatin combo
- **Presentation:** Delayed onset HL (1–3.5 yrs after last dose)

CRANIAL RADIATION

- “Standard of care” childhood brain tumors
- Alone or combined with surgery/chemo
- Focal radiation, surrounding tissue spared
- **Increased risk HL:** auditory structures in treatment field, higher dose, concurrent cisplatin/radiation treatment, younger children
- **Presentation:**
  - Acute OM (40% patients) following head/neck radiation
  - CHL, Mixed, SNHL (retrocochlear)
  - HF HL, manifests years after treatment
• Different ototoxicity grading scales used to categorize HL
  – ASHA, NCI, Brock, CHB, Chang ➔ SIOP

<table>
<thead>
<tr>
<th>GRADE 0</th>
<th>GRADE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>Severe HL</td>
</tr>
</tbody>
</table>

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Why it matters...

• Cure rate pediatric cancer rising, more consideration to minimizing & managing later side effects (HL)
• Cancer drugs cause acquired HF HL can affect receptive & expressive speech/language
• Childhood survivors of neuroblastoma dx with HL were 2x as likely have difficulty with reading, math &/or attn as survivors with NH (Gurney et al., 2007)
What they did...

- Created guidelines based on expert opinion and peer-reviewed published works

What they said...

- SF not ideal
- Bone is important (esp. radiation)
- DPOAEs - Pair with other measures (e.g., SF)*
- Behavioral gold standard
- Ultra-high-freq- helpful detecting early change, but unlikely change regimen until key speech freqs affected

BASELINE: the usual...(click & TB ABR for those unable to participate behaviorally)
• Sample hierarchy: tymps, audio, OAEs
  – Skip SRT
  – Order PT testing: 8k, 4k, 6k, 3k, 2k Hz
  – Coordinated sedated ABR/ASSR*

What they said...

• Platinum derivatives
  – After each cycle (at least every 2 – 4 cycles)

• Cranial radiation
  – Baseline & post-, not monitored throughout

MONITORING

POSTTREATMENT

• Platinum derivatives
  – ASAP last dose, 3, 6, 9, 12 mos post, then annually

• Cranial radiation
  – High-risk (≥ 35 Gy) - 6 mos for 5 yrs; annually 10 yrs
  – Low-risk- annually 10 yrs*
• Sick, fatigued, potentially cognitively impaired
• Efficiency and accuracy are essential

Questions?