UHL IMPact: Examining the effect of unilateral hearing loss on infant vocal development

Robyn Cantle Moore, PhD
Precis

- UHL pilot study – infant vocal progress relative to IMP hearing norms <12 mths.
  a) Which UHL infants ‘at greater risk’ for speech and language delay, relative to peers?
  b) Any factors associated with ‘at risk’ potential?

- Study in context
  - Working definition of Unilateral Hearing Loss
  - UHL prevalence at birth
  - Perspectives in the literature
Working definition of UHL

- UHL = hearing loss in one ear only.

\[ \text{PTA} > 20 \text{ dB HL in the affected ear} \]

or

\[ > 25 \text{ dB HL at 2 or more frequencies above 2 kHz} \]

Prevalence of congenital UHL

• A unilateral hearing loss (UHL) is reported in approx. 15-30% of infants diagnosed with HL through newborn hearing screening. (De Capua et al., 2007; Fitzpatrick et al., 2014; Johnson et al., 2005; Vohr et al., 2002; SWISH, 2010).

• Healthy Hearing Q’land (2010)
  UHL: 0.52/1000 births

• SWISH (NSW) (2010)
  UHL: 0.65/1000 births
Perspectives in the literature

- Some young children with UHL experience delays in speech & language development (Lieu et al., 2010) while others do not (Briggs et al., 2011).

- “…59% of the infants with UHL were within or above ±2SE of normal preverbal vocalizations” (p. 1132) however, “delayed auditory behaviour and preverbal vocalizations were approximately four and nine times more common in infants with UHL compared to BNH respectively” (p. 1134).

Kishon-Rabin et al., 2015.
UHL IMPact pilot study

- Infants identified with UHL through state-wide newborn screening.
- Diagnosis & follow-up at RIDBC Jim Patrick Audiology Centre (JPAC), Sydney.
- IMP assessment completed in conversation with parents during infant ear & hearing health appointments at 5 mths, 8 mths, and 12 mths of age.
Materials and Method

- Infant Monitor of vocal Production (IMP) is a normed assessment tool (Cantle Moore & Colyvas, in prep.)
- IMP guides parent understanding as to nature & pace of their infant’s progress toward speech.
- IMP systematically monitors & documents audition-led features of production in the pre-linguistic vocalizations of infants <12 mths.
- IMP supports informed parent-professional decision making in early intervention.
IMP: Typical infant vocal development

(Kuhl, 2004; Lewkowicz & Hansen-Tift, 2012 *).
IMP assessment procedure

Chronological Age (corrected)

Question ceiling

Hearing Age (HA) (CI)

Innate … Transition to Audition-Production … Integrity of A-P Loop Loop
## Subject ages

<table>
<thead>
<tr>
<th>Range</th>
<th>1: Baseline 4-5 months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2: Transition 8-10 months</td>
</tr>
<tr>
<td></td>
<td>3: Integrity 11-18 months</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean</th>
<th>1: Baseline 4.3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2: Transition 8.4 months</td>
</tr>
<tr>
<td></td>
<td>3: Integrity 12.4 months</td>
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<table>
<thead>
<tr>
<th>Mode</th>
<th>1: Baseline 4 months</th>
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<tr>
<td></td>
<td>2: Transition 8 months</td>
</tr>
<tr>
<td></td>
<td>3: Integrity 11 months</td>
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</table>
### Subject characteristics

<table>
<thead>
<tr>
<th>Case No.#</th>
<th>Gender</th>
<th>Birth history</th>
<th>Birth order</th>
<th>Aetiology</th>
<th>Degree HL</th>
<th>Ear (L/R)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>WB</td>
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<td>ANSD (ABR)</td>
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<td>L</td>
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<tr>
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<td>WB</td>
<td>Sibling</td>
<td>ANSD (ABR)</td>
<td></td>
<td>R</td>
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<tr>
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<td>WB</td>
<td>Sibling</td>
<td>ANSD (ABR)</td>
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<td>R</td>
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<tr>
<td>4</td>
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<td>WB</td>
<td>Sibling</td>
<td>Sensorineural</td>
<td>Mild-Mod</td>
<td>R</td>
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<tr>
<td>5</td>
<td>Male</td>
<td>WB</td>
<td>Singleton</td>
<td>Sensorineural</td>
<td>Sev-Prof</td>
<td>L</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>CMV</td>
<td>Sibling</td>
<td>Sensorineural</td>
<td>Sev-Prof</td>
<td>R</td>
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<td>Intervene</td>
<td>Sibling</td>
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<td>L</td>
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<td>Conductive</td>
<td>Sev-Prof</td>
<td>R</td>
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<td>Male</td>
<td>Premature</td>
<td>Singleton</td>
<td>Sensorineural</td>
<td>Sev-Prof</td>
<td>L</td>
</tr>
</tbody>
</table>
Individual subject results, IMP trend plots

Perception?  Processing?  Production?
Trend in vocal progress: IMP norms
(10/13 infants, UHL pilot study)
Trend in vocal progress: IMP norms
(13/13 infants, UHL pilot study)
Aetiology

Transition to A-P Loop
Integrity of A-P Loop

Q_{ceiling}

Age - months

$p=0.04$

Conductive
Sensorineural
ANSD
Trend plots X trajectory & aetiology

- ANSD
- Conductive
- Mild-Moderate SNHL
- Severe-Profound SNHL
Gender

Rate $p=0.57$
Robustness $p=0.44$
Matched cases, variable (M/F) Gender

- ANSD
- Well baby
- Left ear UHL
- Sibling

Age - months

Q ceiling

Transition to A-P Loop

Integrity of A-P Loop

M Infant #10

F Infant #1
Degree of HL < 65 dB HL : > 65 dB HL

Transition to A-P Loop
Integrity of A-P Loop

<65 dB HL
>65 dB HL
UHL Ear

\[ p = 0.57 \]

Left UHL
Right UHL

Transition to A-P Loop
Integrity of A-P Loop

Age - months

Q ceiling
Matched cases, variable (L/R) Ear

- ANSD
- Well baby
- Left ear UHL
- Sibling

Graph showing Q ceiling against age in months. Lines indicate different ears:
- Blue: Left ear (#10)
- Red: Left ear (#1)
- Cyan: Right ear (#2)
- Pink: Right ear (#9)

Transition to A-P Loop and Integrity of A-P Loop are highlighted.
Birth Order

- Transition to A-P Loop
- Integrity of A-P Loop

Singleton
Sibling
Birth History

- Transition to A-P Loop
- Integrity of A-P Loop
- Premature
- Intervention
- CMV
- Well baby
Trend plots X trajectory & birth history

- Premature
- Intervention
- CMV

Well baby
‘At greater risk’

Female WB Mild-Moderate SNHL
Female Prem. Severe-Profound SNHL
Male Prem. Severe-Profound SNHL
Female CMV Severe-Profound SNHL

p = 0.04
Limitations of study

- Small sample size, limited statistical analysis
- No controls for socio-economic status, parent education, language environment; however... No relationship found in IMP normative study between trajectory of vocal progress and:
  - (a) maternal work status,
  - (b) maternal education,
  - (c) language environment.
Acknowledgement

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References

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