

Speech perception outcomes of 5-year-old children using hearing aids or cochlear implants: findings of the LOCHI study

Teresa YC Ching^{1,2}, Vicky W Zhang^{1,2}, Christopher Flynn^{2,3}, Lauren Burns^{1,2}, Laura Button^{1,2}, Sanna Hou^{1,2}, Karen McGhie^{2,4}, Patricia Van Buynder^{1,2}, Harvey Dillon^{1,2}, Robert Cowan^{1,5}

1. The Hearing CRC, Melbourne, Australia
 2. National Acoustic Laboratories, Sydney, Australia
 3. Australian Hearing, Brisbane, Queensland, Australia
 4. Australian Hearing, Upper Mt Gravatt, Queensland, Australia
 5. The University of Melbourne, Melbourne, Australia

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Introduction

- The presence of permanent childhood hearing loss (PCHL) has a negative impact on children's speech and language outcomes.
- With the advances in UNHS technology, earlier amplification for children with hearing loss is possible.
- It is expected that early intervention will lead to improved outcomes in spoken language and speech perception.
- Most studies in literature focus on the efficacy of early intervention on speech and language development, but few studies specifically look at speech perception outcomes.

Current literature on children using HAs

Sample	Age Fit	Age Axs	Measures	Significant predictors		
Blamey et al 2001	40 using HA	Not known (0 - 4.6 yrs)	9 yrs (4.5-13.5 yrs)	CNC word lists, BKB sent.; Live voice	Severity of hearing loss (PTA), language ability, Age	
Sininger et al, 2010	44 (16 received CI during study)	1 - 72 months (median age at CI=28.5m, R: 12.8-76.5)	3 - 8 yrs	Pediatric speech intelligibility test, Online Imitative Test of Speech Contrast	Age at fitting of hearing aids; Negatively related to use of CI. Not PTA.	
McCreery et al, 2015	Multiple age cohorts - 306; 105	Mean 13.4m (14.6)	4-5 yrs:	LNT, open set, 25 monosyllabic words; PBK Live voice	Age, receptive vocab, aided audibility, phon working memory (5yrs): 43% var. Not mat edn, HA use, PTA.	
			164, 5 yrs	4-8 yrs	PBK - 50 words, at 65 dBA; Live voice	Higher receptive vocab and aided audibility at 3 yrs predicted 5 yr scores
				7 - 9 yrs	CASPA - 10 monosyllabic word recognition in SSN, at -5,+10, +20dB SNR	Correlations - SNR, aided vs unaided, mat edn, working memory, receptive vocab, Age at evaluation.

Current literature on children using CIs

Sample	Age at CI	Age at Axs	Measures	Significant predictors	
Blamey et al, 2001	47	3.5 (1.5), Range 1.2 to 8.2 yrs	7.7 (2.0)	CNC words, BKB sentences Live voice	Age, Language ability, age at CI, onset of hearing loss
Geers, Brenner & Davidson, 2003	181	3.3, between 1.8 and 5.4 yrs (M-PEAK, SPEAK strategy)	8-9 yrs	VIDSPAC - feature contrast; ESP (12 pictures); WIPI, LNT - 50 monosyllabic words; BKB sentences	Nonverbal cognitive ability, family size, longer experience of CI, updated strategy, no. of active electrodes, oral-aural communication
Davidson et al, 2011	112 of the 181 cohort	As above,	15 - 18.5 yrs	LNT, BKB, AV enhancement test,	Age, intensity level, SNR; Language ability

Introduction

S_0N_0

- Testing in quiet or with both the target speech and noise presented from the front does not represent real world environments.
- For NH children, speech perception in noise improves when the target source is spatially separated from competing sounds - 'spatial release from masking' (SRM).

Introduction


S_0N_{90}

- SRM (dB) = $S_0N_0 - S_0N_{90}$
- For NH children, SRM was about 3 dB or greater
- Children with HAs did not demonstrate SRM benefit

Ching et al., 2011

Objectives

- Does early intervention improve speech perception in noise for children with hearing aids?
- What factors influence speech perception outcomes for children with hearing aids?
- What factors influence speech perception outcomes for children with cochlear implants?



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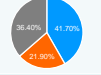
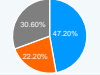
Methods

Participants

- N = 252 hearing-impaired children in LOCHI study (HA: n= 168; CI: n=84)
- All children received their first HAs or CIs before 3 years of age.
- HA fitting according to the national paediatric amplification protocol.
- CIs were programmed at cochlear implants centers.

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Methods

Characteristics	Hearing Aid (n=168)	Cochlear Implant (n=84)
Gender (Male %)	59.5%	41.7%
Presence of additional disabilities (AD), No. (%)	55 (32.7%)	26 (31.0%)
Age at hearing aid fitting (months), Mean (SD)	10.6 (9.9)	5.7 (6.2)
Maternal Education		
Cognitive ability (WNV)®	N 136 Mean (SD) 104.4 (16.3)	N 61 Mean (SD) 102.1 (14.1)
Language score: Mean (SD)	85.7 (19.9)	78.2 (23.2)
Communication Mode - Early intervention	Oral 80.6% Mixed 19.4%	Oral 69.9% Mixed 30.1%

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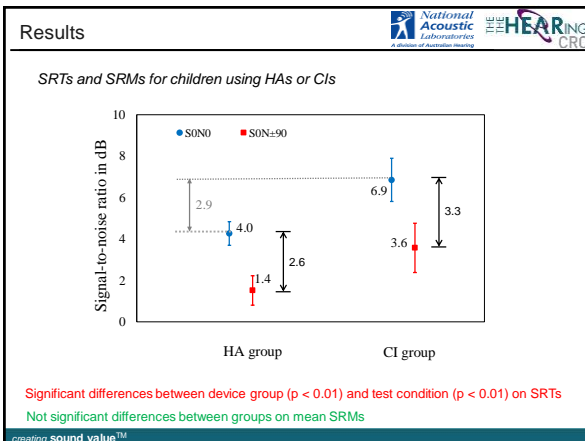
Methods: Speech Perception measure

- Words (NU-CHIPS) or sentences (BKB-like) in babble noise



- Speech reception threshold (SRT) for 50% correct, expressed in terms of SNR (dB)
- SRM (dB) = $S_0N_0 - S_0N_{90}$

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Results: Factors that influence children using HAs

$R^2 = 0.41$ $R^2 = 0.54$

Predictors	Model 1	
	Impact	p
Age at hearing aids fitting	0.07 (-0.60, 0.74)	0.85
Additional disabilities (AD)	1.05 (-0.60, 2.7)	0.24
Maternal Education	-0.28 (-1.03, 0.48)	0.47
Communication mode (ELA)	0.51 (-0.25, 1.27)	0.26
ANSD	0.75 (-1.55, 3.06)	0.53
4FA HL in better ear	0.02 (-0.02, 0.07)	0.33
Nonverbal cognitive ability (WNV)	-0.12 (-0.16, 0.09)	<0.001
Language Score (averaged PLS-4)	-	-
Aided audibility (rSID)	-	-

The analyses were repeated with SRM as the dependent variable, but the models did not account for significant variance in scores.

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Results: Factors that influence children using CIs

R² = 0.46 **R² = 0.54**

Predictor	Model 1	
	Impact	p
Age at cochlear implantation	3.27 (1.26, 5.27)	<0.001
Additional disabilities (AD)	2.47 (0.00, 4.95)	0.06
Maternal Education	-1.15 (-2.25, -0.06)	0.04
Communication mode (EIA)	-0.36 (-1.52, 0.79)	0.58
ANSD	1.79 (-0.85, 4.42)	0.18
Nonverbal cognitive ability (WNV)	-0.09 (-0.13, -0.04)	<0.001
Language score (averaged PLS-4)	-	-

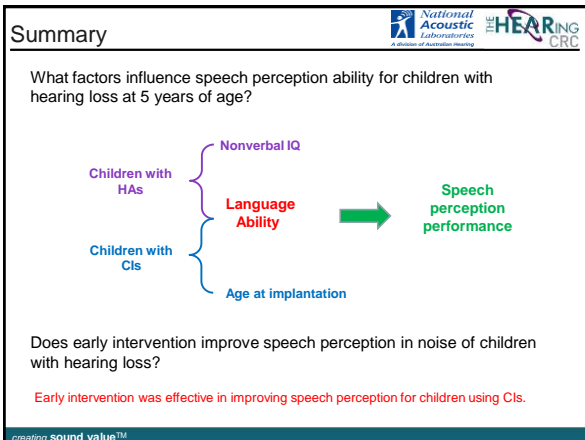
The analyses were repeated with SRM as the dependent variable, but the models did not account for significant variance in scores.

Summary

Speech perception outcomes in noise for children with hearing loss

Compared to NH peers, children with HL

- (1) required higher SNR to achieve the same level of performance;
- (2) demonstrated a similar magnitude of SRM



- ### Acknowledgements
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