Poster Session Abstracts – Perspectives on Language in Children with Hearing Loss

Lexical access in primary school-aged children with hearing loss: voicing and place of articulation contrasts

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During spoken-language processing, words overlapping with the speech input are activated in the listeners' mind and compete for recognition. Previous evidence suggests listeners with hearing loss (HL) recognise words more slowly and are more hesitant to commit to lexical candidates than listeners with normal hearing (NH). Since phonemic contrasts involving voicing or particular place of articulation (PoA) seem especially hard to perceive for listeners with HL, we here examined whether these difficulties affect the time course and effort of lexical access. As part of a larger visual world eyetracking experiment with concurrent pupillometry, native English-speaking 9-12-year-olds with HL (*n*=9) and NH (*n*=20) looked at visual displays containing images of two CVC minimal pairs, while audio recordings instructed them to click on a target image. One minimal pair in each display contained the target and an onset competitor (i.e., overlapping from word onset: *cup-cub*), the other served as a distractor (e.g., *head-bed*). Experimental trials contained all voicing and PoA contrasts between all six English plosives (/b,d,g,p,t,k/), while control trials contrasted a plosive with a non-plosive. Although children with HL responded as quickly as children with NH, they did so less accurately. Their fixations to the target image built more slowly and peaked at a lower amplitude than in those with NH, confirming previously-reported recognition uncertainty. Peak baseline-corrected pupil dilation was higher for children with HL than children with NH, suggesting they expend more effort during spoken-word recognition. Although both groups made more mistakes and fixated targets later in experimental than control trials, no significant interactions between trial type and hearing status were found in any of our analyses. While this may be affected by low participant numbers, it suggests that voicing and PoA contrasts slow spoken-word recognition for children in general but not more so for those with HL.

Impact of Video Interaction Guidance on early communication with pre-linguistic profoundly deaf and hard-of-hearing children

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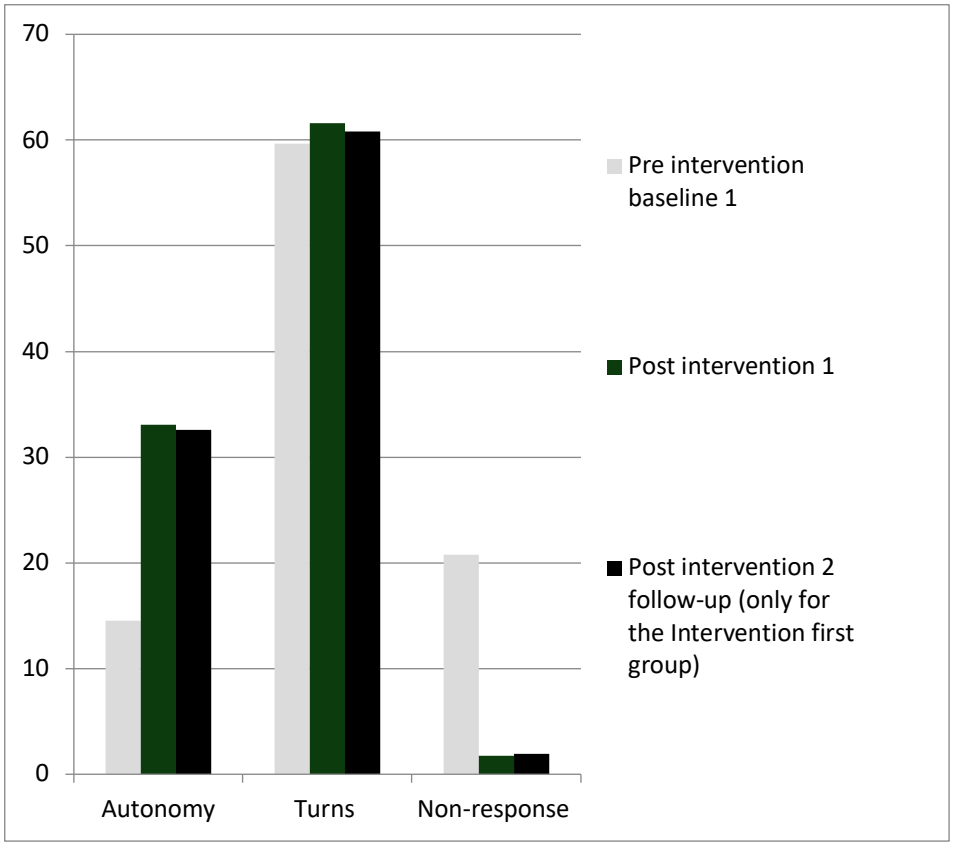
Introduction:
Early interventions for pre-lingual deaf/Deaf or hard-of-hearing children aim to increase communication. Parental involvement and communicative input are key to the development of communication and language skills in childhood. Studies have shown that video-feedback interventions enhance the quality of parent-child social interactions after three to four sessions are complete (e.g., Juffer, Bakermans-Kranenburg, & van IJzendoorn, 2005; Lam-Cassettari, Wadnerkar-Kamble, James, 2015). Identifying how video-feedback shapes pre-linguistic vocalisations is less well understood. This study hypothesized that an evidenced based video-feedback intervention for parents would increase pre-linguistic communication in Deaf or hard-of-hearing children.

Method:
Sixteen families with hearing parents and a congenitally deaf and pre-lingual children were recruited by self-selection from the Nottingham paediatric audiological services after responding to information packs provided at the audiological management services. Families included children with complex developmental needs. The child's pre-lingual status was established from SLT reports and the Vineland Adaptive Behaviour Scale. Families (15 mothers and 1 father) stratified to the intervention group (IG) or the waiting group (WG). Child vocal communication was analysed pre- and post-intervention using the Tait analysis (1993) to code preverbal vocal and gestural communication for a segment of free play between each parent and child once all intervention had ceased.

Results:
Paired t-tests indicated no difference between the pre/post Vineland Adaptive Behaviour Scale for both the groups. The Tait analysis revealed a statistically significant difference between pre and post sessions for Communicative Autonomy $F(1,13)=35.88$, $p<.005$, $\eta^2 = .73$ and for No-Response $F(1,13)=24.49$, $p<.005$, $\eta^2 = .65$ but not for Communicative Turns. See Figure 1.

Conclusions:
The results support the hypothesis that video feedback intervention supports preverbal communication in Deaf/hard-of-hearing children. The Tait analysis showed enhanced child communicative autonomy and a reduction in the number of no-responses (Fig. 1), indicating that video-feedback increased the quality of parent-child communication.



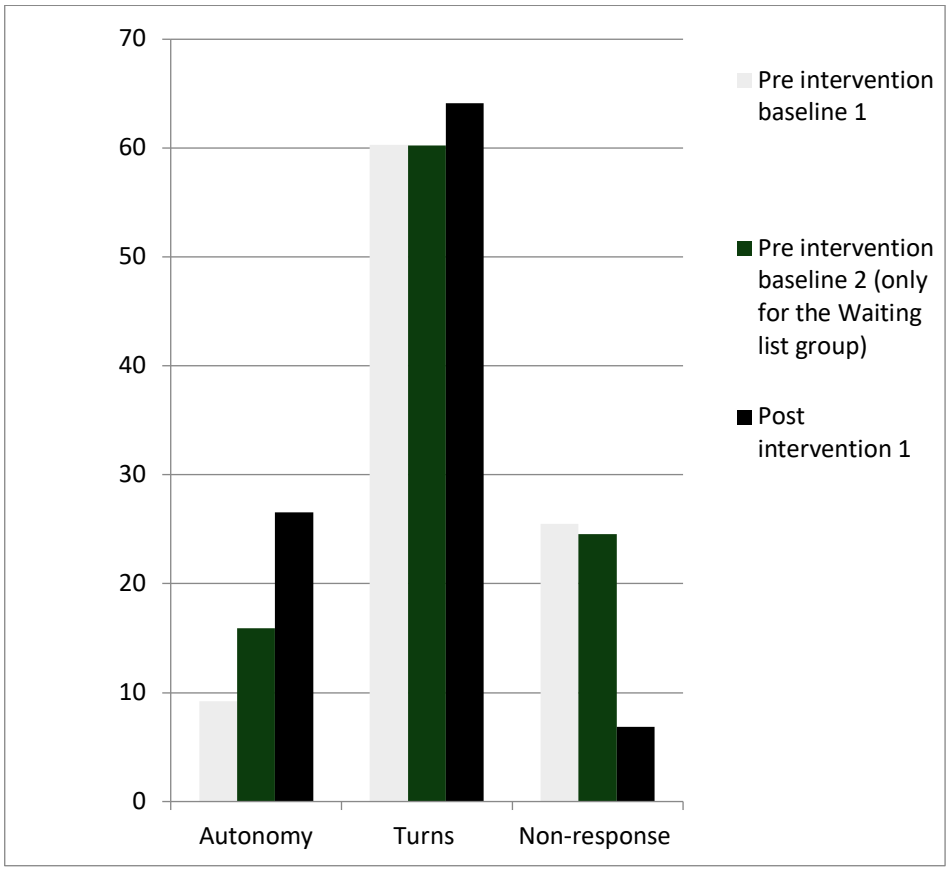


Figure 1: Results from the Tait analysis, the greatest difference between pre- and post-intervention was shown for child autonomy and no-response for the intervention group (top) and waiting group (bottom).

Design of an indirect timed reading test in cochlear implanted children

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Tests carried out in cochlear implanted children are usually perceptions and repetitions (lists of sounds, syllables, words and sentences). But it's also essential to quantify the speed of perception and in the same time, to evaluate the processing of morphological and syntactic cues. From this standpoint, an indirect timed reading test was developed in the cochlear unit of New Caledonia.

The test was designed to lighten the memory load and the lexical level. Two texts were invented to allow a retest. Our preliminary study concerns the realization of a reliable and rapid evaluation in the indirect timed reading test. This test will allow us to obtain an index in number of words repeated per minute (auditory perception of words per minute), but also a score in morphological and syntactic markers, while reducing the lexical and mnemonic load.

Vocal emotion recognition in children with cochlear implants: The EmoHI test for hearing-impaired populations

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Abstract

Although many children with cochlear implants (CIs) nowadays show relatively good speech perception in quiet, the perception of indexical voice-related cues, such as speakers' voice characteristics or emotions, often remains challenging. Traditionally, emotion recognition research has focused on (audio)visual emotion perception using pictures or videos in which the audio quality is relatively poor, and thus, good quality audio test materials are not always readily available. While small acoustic disruptions may be negligible for normal-hearing (NH) listeners, the quality of the audio may be essential for CI users for whom the perceived signal is already spectrotemporally degraded. Hence, we developed a vocal emotion recognition test with high-quality sound recordings of pseudospeech productions from multiple speakers expressing three core emotions (happy, angry, and sad): the EmoHI test. Besides testing prelingually deaf Dutch CI children, we also collected normative data from NH Dutch and English school-age children to examine the age and cross-language effects. Our results show NH children's performance generally improved with age from the youngest group tested on, although it did not reach adult-like values (adults: 94.1%) even for the oldest age group tested (10-12 years: 81.1%). We also did not find any differences across languages (Dutch vs. English), although this may differ for phonologically more distant languages. All except one CI child performed above chance, and 7 out of 14 CI children performed within the NH age-appropriate range, even 9 out of 14 CI children when we measured from their age at CI implantation (hearing age). The performance of CI children varied greatly, ranging from ceiling (97.2%) to below chance-level performance (27.8%), and seems to be heavily affected by factors other than chronological age. We are currently examining how CI children's performance is related to their F0 discrimination thresholds. The EmoHI test stimuli are freely available for research via https://zenodo.org/record/3689710#.XxF2oSgzY2w.

Infants' and Children's Cortical Tracking of Auditory-Visual Speech

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Recent neurophysiological studies with adults show enhanced cortical tracking of continuous speech stimuli when visual speech information is provided in auditory-visual speech than in auditory-only speech (Crosse et al., 2015). No study, to date, has examined whether the same applies to infants and children despite behavioural findings that visual speech information augments infant and child speech perception (Taitelbaum-Swead & Fostick, 2016; Teinonen et al., 2008). Therefore, the aim of this study is to investigate infants' and children's cortical tracking of auditory-visual speech in infants and children.

Recordings of a female native speaker of Australian English talking in infant-directed speech were presented in auditory-only (AO: still photo of speaker's face paired with auditory recordings), visual-only (VO: silent video of the speaker's talking face) and auditory-visual (AV: dynamic video of the speaker talking and the corresponding soundtrack) conditions. Electroencephalography (EEG) data collected from 18 five-month-old infants and 19 four-year-old children were analysed.

Cortical tracking was quantified through backward (decoders) then forward (temporal response functions; TRFs) modelling (Crosse et al., 2015). Backward modelling revealed that infants' cortical tracking was strongest for AV then AO, then VO speech. Four-year-olds' cortical tracking of AV and AO speech did not differ but were both stronger than cortical tracking of VO speech. Additionally, TRF weights suggest that most activity occurred at frontal, occipital and temporal regions. Here, seeing a speaker's talking face significantly benefitted infants.

These findings have important implications particularly for infants and children with hearing impairment, especially since previous behavioural studies with children with hearing impairment have found better performance on speech perception tasks when visual speech information is provided (e.g. Taitelbaum-Swead & Fostick, 2017), suggesting that visual speech information compensates for the degraded auditory signal. These electrophysiological data will assist in determining the neural pathways via which visual speech information augments speech perception.

Do phonological factors explain varying realizations of prelexical morphemes by children with moderate hearing loss?

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Children with moderate hearing loss (MHL) exhibit phonological difficulties, which can persist until the age of seven (Moeller et al, 2010). They also display morphosyntactic delay (Norbury et al, 2001). These morphosyntactic delays might be due to phonological difficulties leading to the use of non-target-like forms, or, alternatively, might reflect that children with MHL experience additional functional difficulties. To shed light on this issue, the present study set out to test two hypotheses implied by a strictly phonological explanation of the non-target-like productions of grammatical morphemes: (1) phonological complexity criteria (Blevins, 1995) such as syllabic structure should affect the similarity between the form produced and the target-form. (2) There should be no influence of syntactic position (preverbal or prenominal) which would indicate functional difficulties.

Ten French speaking children aged from 3;5 to 5;0 with MHL were recorded (wearing their hearing aids) during two semi-spontaneous language tasks, in interaction with one of their parents: a story-telling task; and a symbolic play activity. The children's produced forms in prelexical position were categorized according to their similarity to the target forms. We assessed whether the form of the morpheme depends on the position in the utterance, the syllabic structure of the target-morpheme (presence of a coda and an onset), and the possibility of "liaison" to the following word (implying the re-syllabation of the form and the presence of a heterogeneous syllable).

Results are complex. Two phonological factors, the syllable structure of the target morpheme and the possibility of "liaison" influenced the production of non-target-like-forms. However, grammatical morphemes were particularly non-target-like in preverbal as compared to prenominal position. These results show that phonological difficulties are only one factor explaining the non-target-like production of grammatical morphemes by children with MHL. We argue that a combination of phonological and functional explanations, including factors such as reference, is required to account for the production of non-target-like grammatical morphemes by children with MHL.

A Story-Based Pupillometry Paradigm of Determiner Perception in Children with and without Hearing Loss

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Determiner omissions ("I CUDdle _ DOG" instead of "I CUDdle the DOG") are expected in typically developing toddlers but persist in children with hearing loss. These omissions are attributed to perception for children with hearing loss, while perception-based explanations have been discarded for normal-hearing toddlers. However, insight in the perceptual basis of determiner omissions is incomplete, as it has mainly been studied in "footed" contexts (following a strong syllable: "FIND the BALL"), whereas omissions are more prevalent in "unfooted" contexts (following another weak syllable: "CARry the BALL"; Demuth et al., 2006). This study will, therefore, test whether children's perception of determiners is modulated by footedness.

In contrast to previously used intermodal preferential looking paradigms (e.g., Kedar et al., 2006; 2017), we will use pupillometry in a story-based paradigm. This provides a sensitive measure (Tamási et al., 2017) with high ecological validity, might increase children's sustained attention, and is less cognitively demanding than overt response tasks (e.g., Titterington et al., 2006). These features make this innovative method a promising tool for assessing perception in children with hearing loss.

Children will listen to stories in which each object is labelled in two consecutive sentences (e.g., "I use a blue spoon. Daddy washes the spoon"). The determiner in the second sentence is either footed or unfooted ("CLEANS the SPOON" vs. "WASHes the SPOON") and omitted in half of the sentences ("CLEANS the SPOON" vs. "CLEANS __ SPOON"). Children will look at a screen with object drawings while their pupil sizes are recorded.

If perceptual processing of determiners mirrors production patterns, determiner omissions will elicit greater pupil dilation compared to their realisations (Qiyuan et al., 1985) with a larger effect in the footed compared to the unfooted condition. This prediction will first be tested with normal-hearing toddlers and then with pre-schoolers with hearing loss.

Improving language outcomes with bilateral cochlear implants

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Introduction: Bilateral cochlear implantation (CI) is the standard of care for children with severe to profound hearing loss. Compared to unilateral CI, bilateral implantation improves receptive and expressive spoken language outcomes (e.g. Boons et al. 2012, Sarant et al. 2014). To date, it remains unclear whether the improved language outcome result from having bilateral input or true binaural processing (Sarant et al. 2014). The latter requires auditory inputs from both ears to be well-matched. Differences in, for instance, electrode insertion depth and electrode-nerve interface will generate mismatches in the input between the ears, reducing, or removing altogether, binaural benefits that might accrue from bilateral implantation. Here, we propose a technique that may be used to assess neural binaural processing in bilateral CI-users.

Methods: CI stimulation was simulating in eleven normal-hearing listeners, employing bandpass filtered click trains. Binaural stimuli consisted of periodic changes in the timing between the two ears (i.e. interaural time differences or ITDs). EEG responses were recorded to these changes in ITD and this for binaural input that was either matched or mismatched across the ears.

Results: Responses to changes in ITD could be obtained in seven out of eleven participants. Our results reveal significantly smaller responses for mismatched compared to matched binaural inputs ($t(8.2)=-2.71$, $p=0.03$).

Conclusions: This technique can be used to assess binaural processing from a neural perspective. The results of this study are promising, showing that mismatched auditory inputs alters the EEG-responses to binaural stimuli. This technique will be used in future research that aims at assessing whether children with matched bilateral CIs have superior language outcomes.