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FUTURES AND POSSIBILITIES – Challenges and Opportunities

Expanding utility of a language-based hearing screener for children whom English is an Additional Language

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Presentation Theme: **Diversity and Inclusion**

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Introduction: Mobile Hearing Screening Solution made available in Mandarin

Aim: To Meet Student Screening Needs: including access to screening in regional and remote areas.

- Global popn growth to drive dependence on technology
- Need for culturally and linguistically relevant test materials
- Language barriers can mask hearing deficits

Goal: Provide hearing screening that **incorporates speech in noise** testing for diverse populations including those with language and cultural constraints.

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Why should children be tested with a speech-based hearing assessment?

Research supporting the importance of speech-based screening

Minimal and Mild Hearing Loss in Children: Association with Auditory Perception, Cognition and Communication Problems
D. R. Moore, O. Zobay and M. A. Ferguson 2020

"The results suggest wider use of speech-in-noise measures to diagnose and assess management of hearing loss and reduction of the clinical hearing loss thresholds for children to 15dB HL".

"Hearing loss between 15 and 30 dB PTA is, at ~20%, much more prevalent in 6- to 11-year-old children than most current estimates."

Separating the Causes of Listening Difficulties in Children
H. Dillon and S. Cameron 2021

"...use the term "listening difficulty" as an umbrella term to indicate a reported deficit in recognizing sounds or understanding speech, one possible cause of which is an auditory processing disorder.

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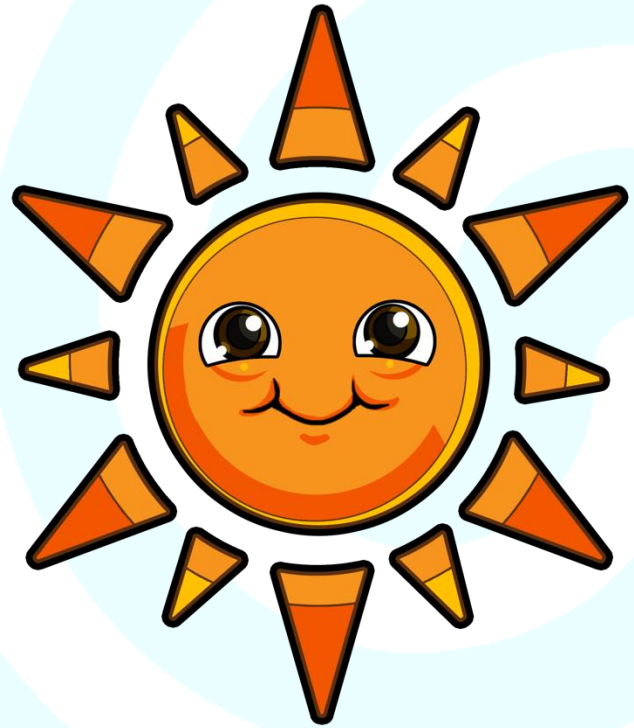
Triple Factor Hearing Screener incorporates: speech in quiet
tone in noise
speech in noise

Hearing tests are just child's play: the Sound Scouts game for children entering school
H. Dillon, C. Mee, J. C. Moreno and J. Seymour 2018

A mobile hearing screener designed to detect:

- Hearing loss
- Type of hearing loss
- Listening difficulties in noise (including spatial processing disorder)



USABLE ON ANY MOBILE DEVICE
- in quiet
- with decent adult headphones

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Triple Factor Hearing Screener available in:

AU English, US English, UK English, LATAM Spanish, Mandarin (and Modern Arabic is coming soon)

Localisation Protocol

Language based test that requires translation and careful selection of target items

- consider phonetics of language
- age appropriateness of items
- early testing with native-speakers

Normative Data : established by testing a group of adults (typically 10) and children who are screened with traditional testing methods to confirm normal hearing

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Why Mandarin?

- One of the most spoken languages globally
- Growing mandarin-speaking communities in Australia
- Demand in educational context to ensure children are screened in first language

Mandarin-speaking children in Australia have a gap in accessing hearing screening tools. Without sufficient English proficiency, these children could miss crucial hearing screenings

Localisation Protocol

Parties:
Sound Scouts (SS)
Sound Scouts (SS_SC)
Local Collaborator (LC)

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Localisation Protocol

1. **Script Review** – identify words or phrases that may not be suitable to the local dialect; local collaborators to suggest appropriate replacement words/phrases. Particular attention is paid to the target words. (NB: Reference to equivalent MacArthur-Bates Communicative Development Inventory: Words and sentences recommended).

2. **New artwork** – artwork is created to replace any items (target or otherwise) that required changing due to the need for new targets or due to cultural consideration (SS)

3. **Final narrative** – recorded in a suitable accent to be accessible to the broadest cross-section of the population (SS)

4. **Level-equalize target items/script and apply HRTFs**

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Localisation Protocol (cont.)

5. Create/build Local version – and make accessible via either Test Flight or the App Store/Google Play. (SS)

6. Test local version

- on at least 10 young to middle aged adults with normal hearing

- 50-60 children with normal hearing in the age range 4 to 12 years (who have passed screening at 20 dB HL - - ideally distributed across the whole age range, with concentration of numbers in the age range for which the test will mostly be used.

Note that if the game produces a results graph and screening result during this normalization test, it should include a note to say that these results are based on normative data from another version and may not be correct. (LC)

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Localisation Protocol (Cont.)

7. Analyse the data - revise item levels to equalise intelligibility and derive formulae to produce z scores. (SS_CS)

8. **Check final version** - on a group of children with known hearing characteristics (LC).

9. List final version – upload to iTunes/App Store etc (SS)

10. Publish the development process and normative data (SS, LC, X). Where possible.

11. **Publicise/promote** availability to achieve take up in market

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"…children remaining particularly vulnerable due to the importance of sound for their social, emotional, and cognitive development (Bess et al., 1998; Moore et al., 2020; WHO, 2021).

Background: This project aimed to validate a Mandarin version of Sound Scouts (a game-based hearing screening app that offers the benefit of assessing listening difficulties in noise) to extend access to hearing screening for Mandarin-speaking children in Australia and internationally.

The Sound Scouts app has been shown to be an effective tool in screening school-aged children as young as four as initially validated by Dillon et al. (2018) and more recently by Bowers et al. (2023).

Since any tool that utilises speech-based material is no longer universal and can only be used by native speakers of that language, this project looked to build upon the app's existing framework to establish a Mandarin version that used Mandarin speech material.

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Method: The research activity involved identifying linguistically suitable Mandarin words and phrases for the test activities

- translation
- recording
- incorporating the content into the app.
- initial testing on 60 children (ages 5 -12) and 20 young adults.

Testing took place at three schools representing a diversity of school types (international government, private) and at Macquarie University

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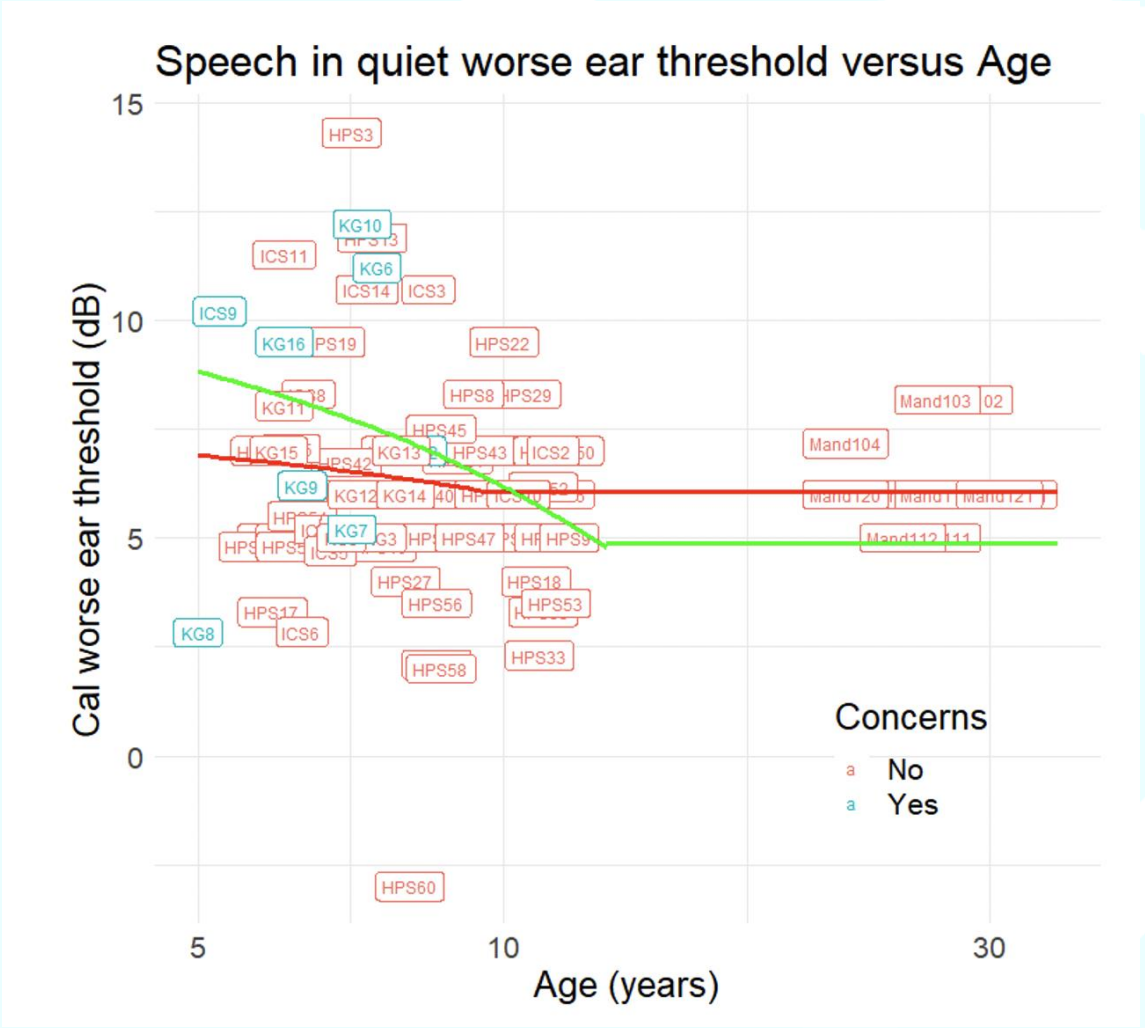
Results:

Speech in Quiet – almost no variation of threshold due to age

The red lines show the regression versus age for the children and the average value for the adults.

The green lines show the regression lines that would be expected were the International formula to apply

Adjustment to the formula required.



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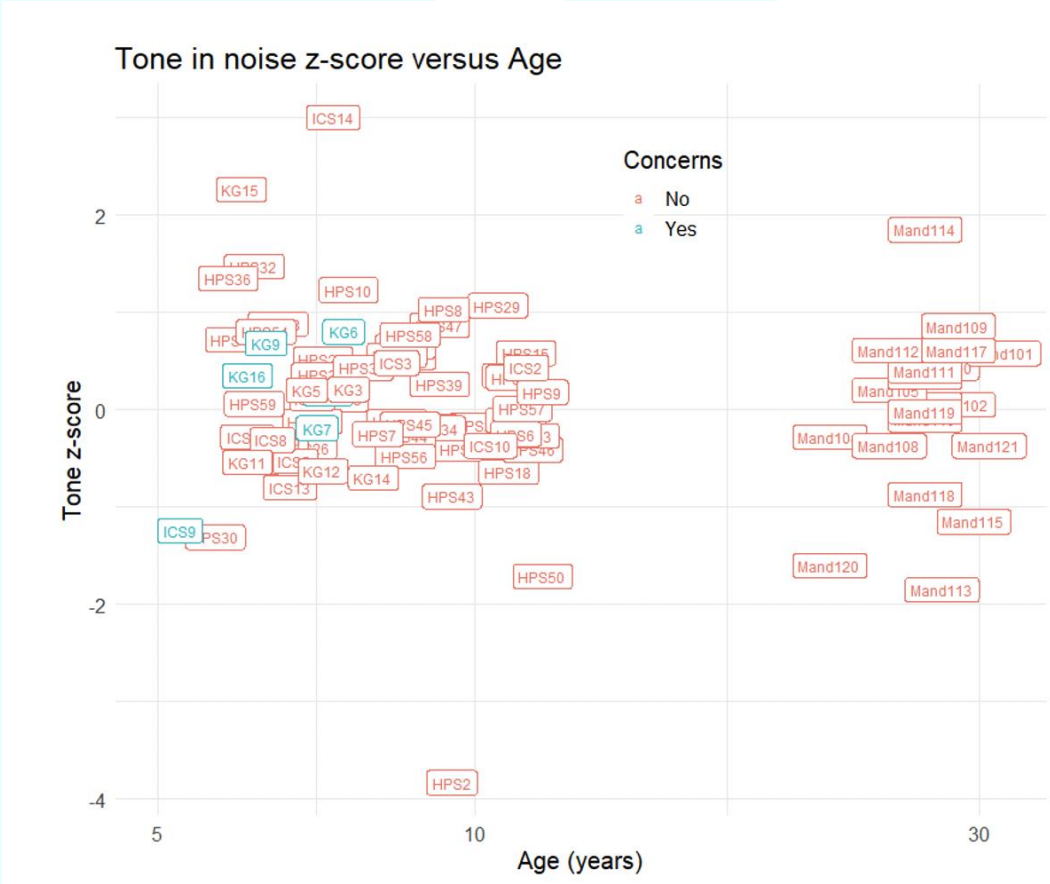
Results:

Tone-in-noise scores were well-distributed around zero for both adults and children

Tone in noise thresholds continue to be converted to z-scores using the formula that was used in the app at the time the Mandarin data were collected.

For children - mean Tone SNR is -22.5 dB
- standard deviation of 2.11 dB.
For adults b - mean Tone SNR is -22.9 dB



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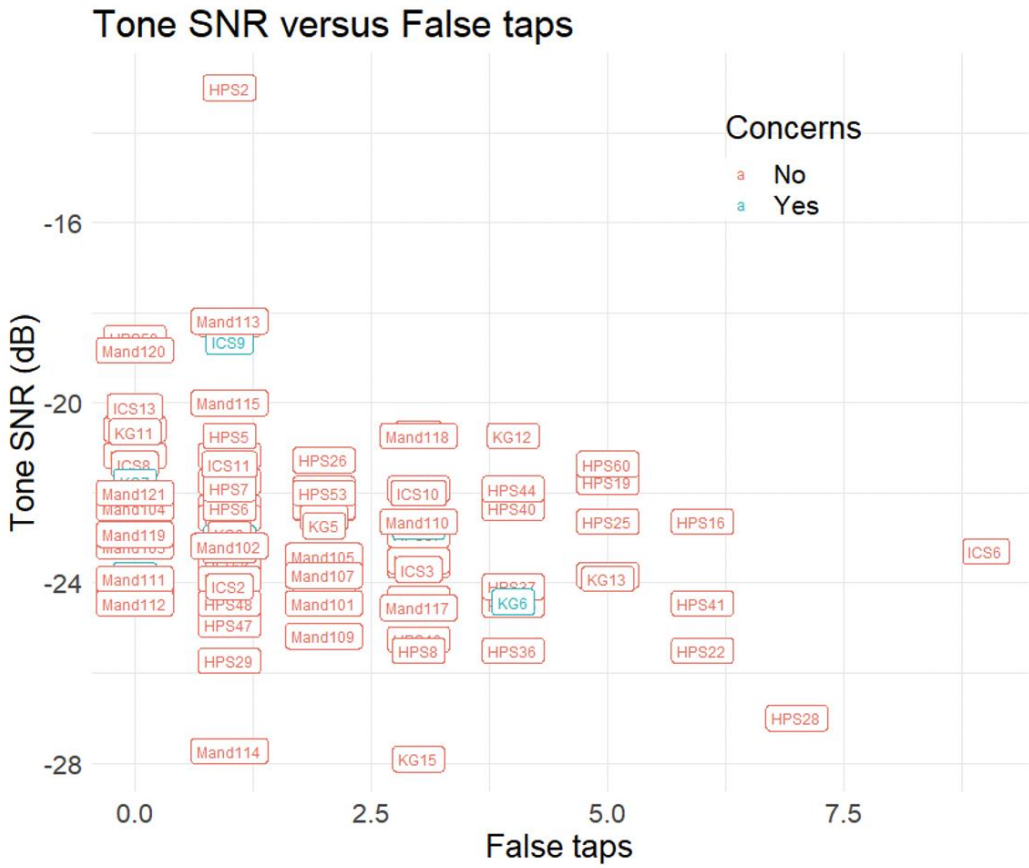
Results:

Tone-in-noise

This graph shows the relationship between the Tone SNR and the number of false taps. It does not appear that the number of false taps has affected the thresholds obtained, but for caution, analysis excluded cases with 5 or more false taps.



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Results:

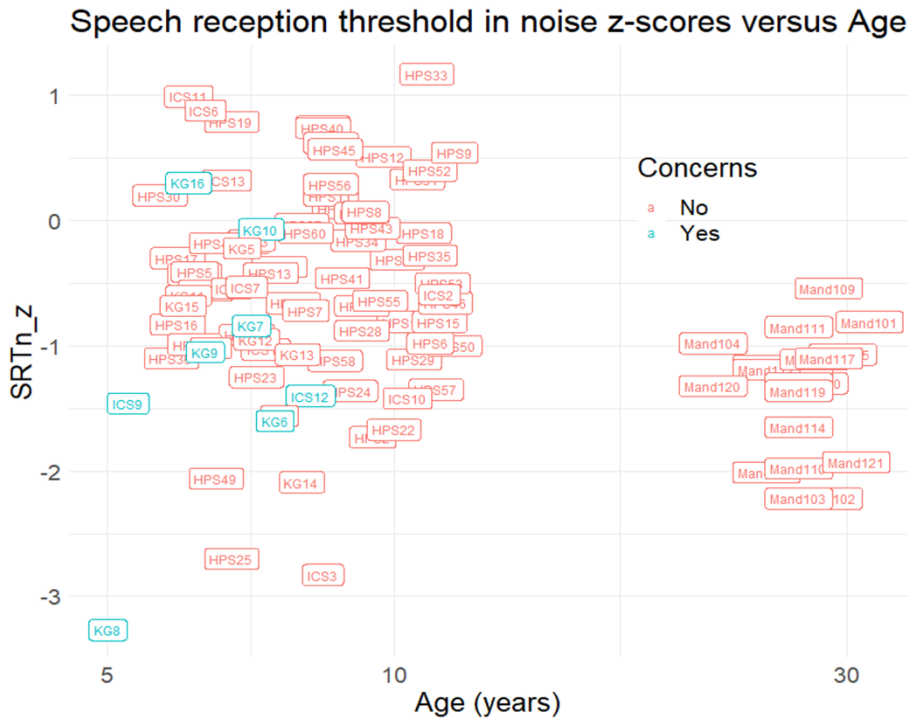
Speech in Noise

Figure shows the z-scores for speech in noise reported by the app (i.e. using the current International formula).

- for all adults and approximately 75% of the children, z scores are negative. Ie the test is harder than for other language versions.

Children (no concerns) – average z score was -0.50.

Adults - average z-score was -1.37



Adjustment to the formula required.

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Discussion:

Validation suggest that the Mandarin language version provides an effective hearing screening tool for Mandarin speaking children.

The inclusion of language-specific versions such as Mandarin, LATAM Spanish and Modern Arabic is key to improving accessibility and promoting equity in global hearing health.

THANK YOU