

Investigating the agreement between 4kHz ABR and PTA thresholds: A review of the data used to inform the BSA Guidelines

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Introduction

BSA practice guidance for Early Audiological Assessment and Management of Babies referred from the Newborn Hearing Screening Programme (2021) indicates that when using supra-aural earphones to present 4kHz tonepips to infants ≤ 12 weeks old:

- the dBnHL to dBHL correction factor is -10dB
- there is a 90% probability that an infant's hearing threshold will be within +10/-15dB of the ABR threshold

Stapells et al (2000) meta-analysis was used to determine this correction factor and the range of possible hearing thresholds.

This study analysed data from the 5 original papers in the meta-analysis which investigated adult participants with hearing loss, to determine the reliability of the guidance.

Method

Of the 84 ears in the 5 studies, threshold-specific data for 47 ears was extracted.

A Binomial distribution was used to test the hypothesis that 90% of the PTA thresholds would be within +10/-15dB of the ABR thresholds.

Bland-Altman analysis was used to investigate whether there was a systematic difference between ABR and PTA thresholds, and to identify the limits either side of the ABR thresholds within which 90% of the PTA results were expected (90% coverage limits).

Results

Analysis showed that a statistically significant number of the PTA thresholds were outside the range of +10/-15dB of the ABR thresholds.

Bland-Altman analysis indicates that results measured by ABR may be 19dB above or 23dB below behavioural audiometry results.

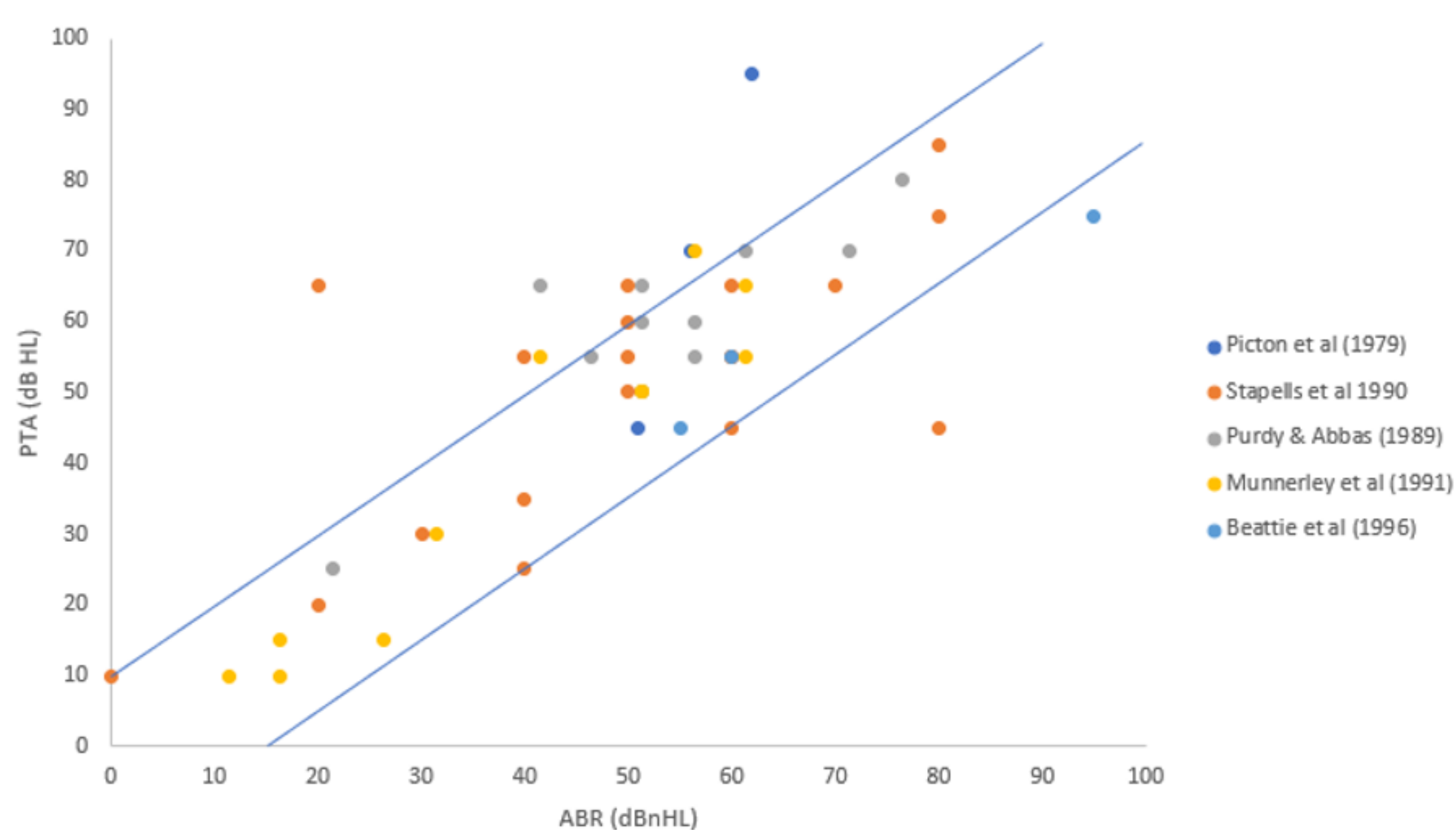


Figure 1: Threshold data from Stapells meta-analysis
37/47 behavioural thresholds were within +10/-15dB of ABR threshold (shaded area).
2-tailed test. H_0 : 90% of behavioural results will be within +10/-15dB of ABR threshold.
 H_0 is rejected. $p=0.016$

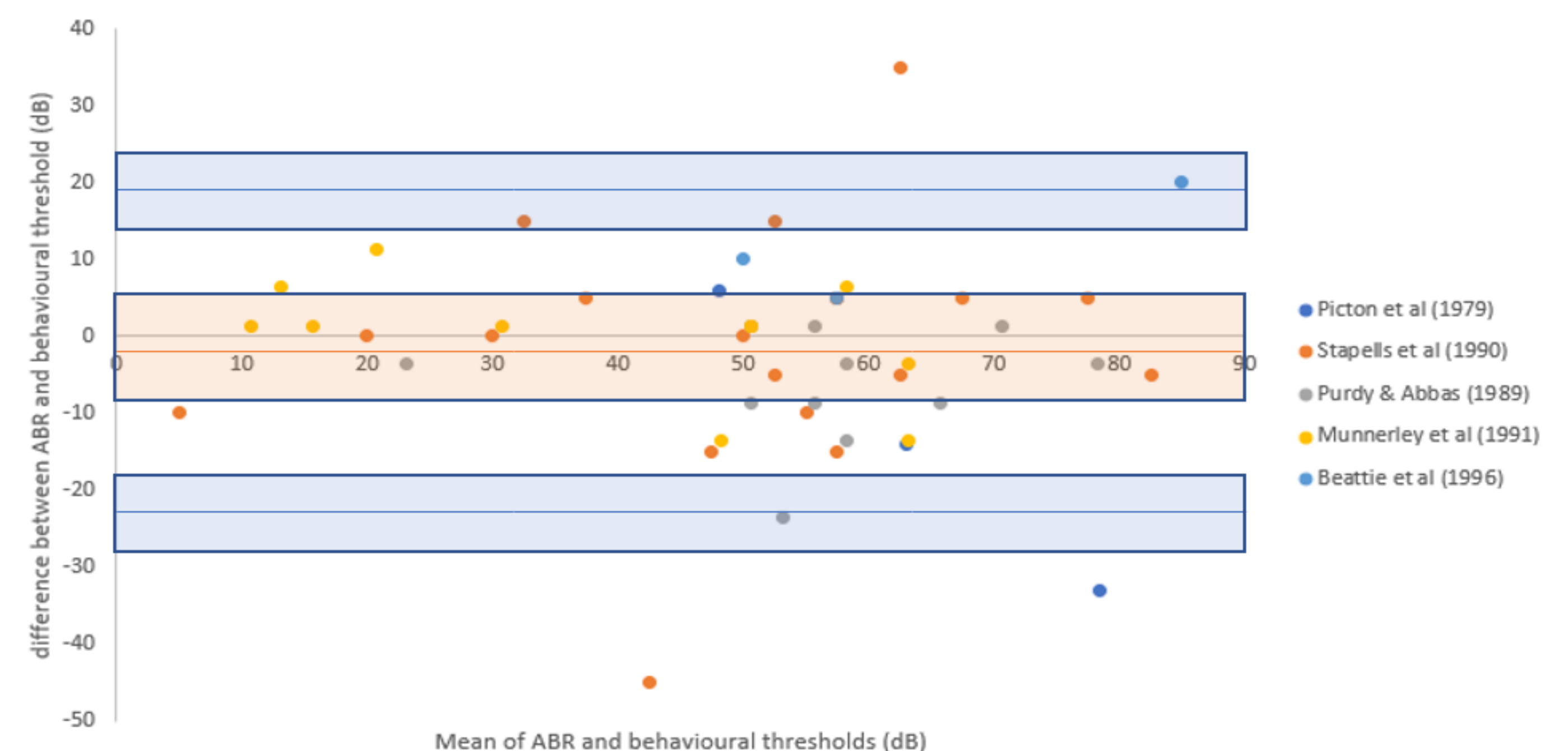


Fig 2. Bland-Altman plot of differences between ABR and PTA results.
The orange line shows the mean difference; the orange shaded area shows the 95% confidence intervals for the mean. 90% limits of agreement are shown as blue lines; 95% confidence intervals for the limits of agreement are shown as blue shaded areas. Upper limit of agreement: 19dB (95% CI 13, 23), Lower limit of agreement: -23dB (95% CI: -27, -17) of ABR result measured in dBnHL.

Conclusions

The evidence base for the current national guidance for assessment of newborn hearing thresholds relies on small samples of data published at least 25 years ago, obtained from subjects aged 8-85 years. Those ABRs were recorded using long out-dated equipment and test parameters.

Analysis of all available data from the original studies cited in the Stapells (2000) meta-analysis used as the basis of the current BSA guidelines indicates that:

- PTA results were approximately 2dB higher than ABR results in dBnHL, this is not significant; a correction factor of zero could therefore be acceptable. The current correction factor of -10dB should be considered with caution.
- 90% of behavioural results were within +23/-19dB of the ABR dBnHL result, this is a significant difference from the guidance that suggests that 90% of behavioural results are expected to be within +10/-15dB of the ABR dBHL result.
- It is possible that following the current BSA guidance may lead to an underestimation of 4kHz behavioural thresholds

Similar investigations into insert earphones and chirp stimuli were not possible because the published data could not be found.

References

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