VALIDATION OF RECORDED SINGAPORE VERSION OF THE CID W-1 AND CID W-22 FOR ENGLISH SPEECH AUDIOMETRY

MSc Audiology Thesis

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BACKGROUND

- Colloquial Spoken English (CSE) is different from American & British English
  - Reduced vowel system (Bao, 1998; Deterding, 2007)
  - Regular rhythm pattern (Ling, Grabe, & Nolan, 2000; Deterding, 2001)
  - Stress placement (Ling & Grabe, 1999; Schaetzel, Lim, & Low, 2010)

- Dialectal influence
- Bilingualism

BACKGROUND

- To a L2 speaker, speech intelligibility of another L2 speaker of the same linguistic background is equal to that of a L1 speaker (Bent & Bradlow, 2003)

- Non-native speakers of L2 had poorer SRTs and word recognition when tested with L2 material compared to L1 material (Marinova-Todd et al., 2011; Shimizu et al., 1998)

- CID W-1 and W-22 word lists have been recorded using a Singaporean male speaker (Soo, 2013)

L1 – Native Language
L2 – Second Language

AIMS

- Validate a Singapore recording of the CID W-1 and CID W-22
  - CID W-1
    - Test-retest reliability
    - List equivalence
    - SRT – PTA agreement
  - CID W-22
    - Test-retest reliability
    - List equivalence
    - Reference curves
    - Effects of linguistic background

HYPOTHESES

- CID W-1
  - H_{0-1}: There is no difference between the test and retest SRTs using the Singapore recordings.
  - H_{0-2}: There is no difference between the SRTs obtained from the two CID W-1 lists in the Singapore recording

- CID W-22
  - H_{0-3}: There is no difference between the test and retest word recognition scores (WRS) using the Singapore recordings
  - H_{0-4}: There is no difference between the WRS obtained from any of the eight CID W-22 lists in the Singapore recording

STUDY DESIGN - SUBJECTS

Subject recruitment:

- 30/40 otologically normal subjects between age 21-55
- At least 12 years of formal English education in Singapore
- No significant hearing health history
- No language, learning or auditory processing disorders
- Pass the screening battery of otoscopy, tympanometry and pure tone audiometry

STUDY DESIGN - MEASURES

- SRTs (CID W-1)
  - Method based off the modified Hughson-Westlake technique
    - Test & retest
  - ASHA recommended method (R. H. Wilson et al., 1973; ASHA, 1988)

- Word Recognition Scores (CID W-22)
  - Full lists were used
  - 8 lists, 1 list at each of the 8 intensities (PTA + 5, 10, 15, 20, 25, 30, 35, 40dB)
  - Test & retest

RESULTS: DEMOGRAPHICS

- Mean age: 27.0 ± 4.8 y/o
- Gender mix: ~ 2:1 (F:M)
- Racial mix: 97% Chinese, 3% Indian
- Mean years of English education: 16.0 ± 2.0 yrs
- Mean Age of English acquisition: 3.3 ± 2.4 y/o
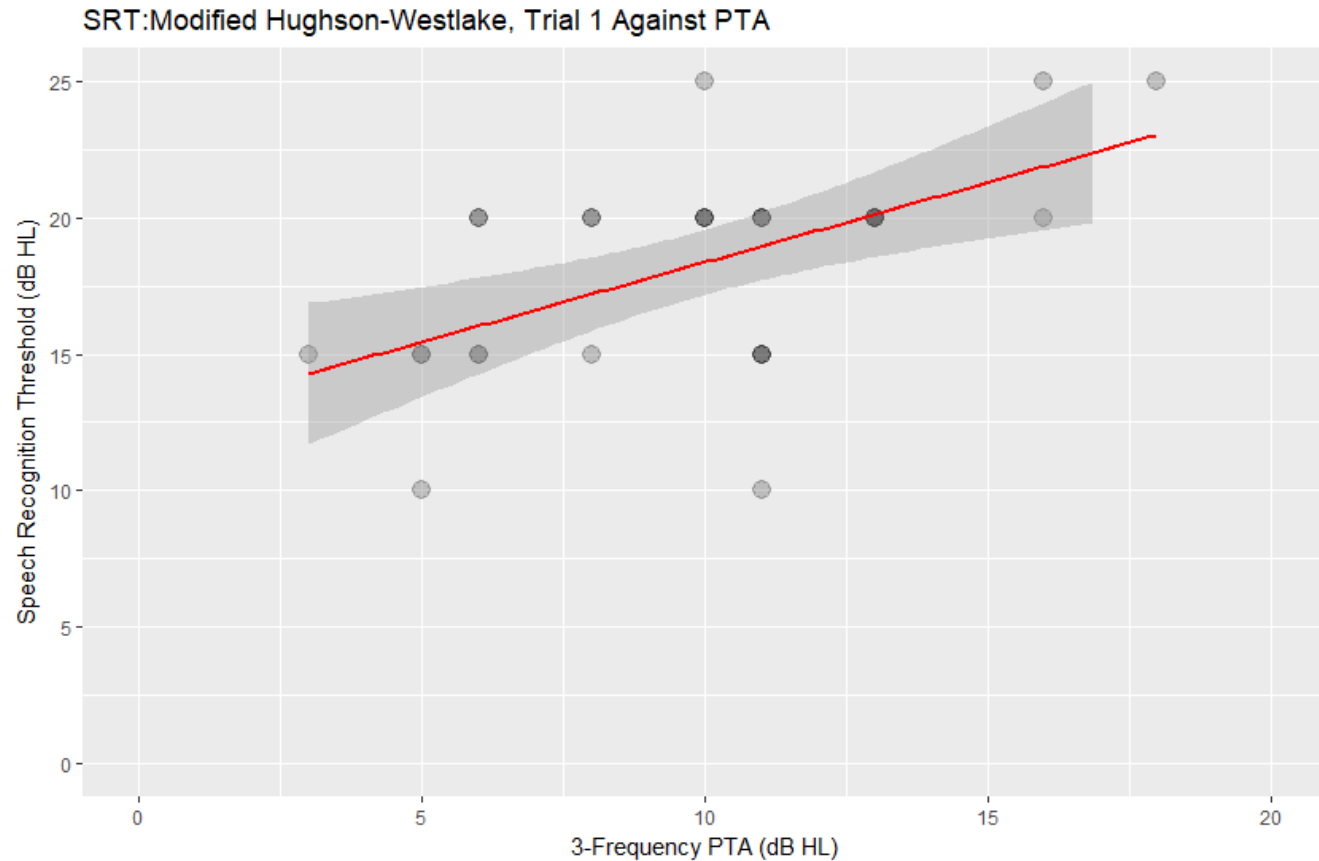- Mean number of spoken languages: ~ 3

- ASHA: SRT – PTA correlation
 - Strong correlation is maintained between SRT and PTA
  - Pearson's r = 0.721

SRT:ASHA Against PTA
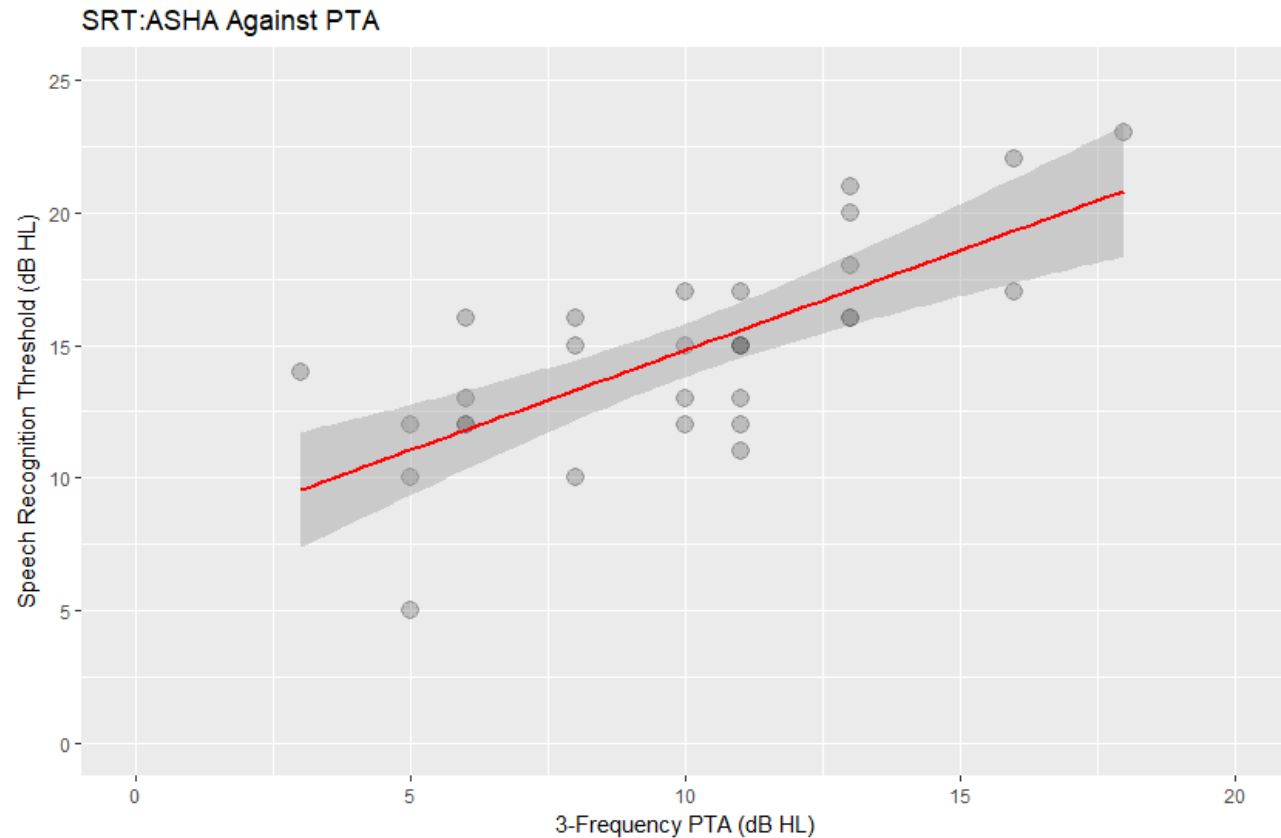
- mHW: SRT – PTA correlation
  - Spearman's ρ = 0.527
  - SRTs were less strongly correlated with PTA compared to ASHA method

mHW – method based on modified Hughson-Westlake technique

SRT:Modified Hughson-Westlake, Trial 1 Against PTA

- SRT – PTA agreement
  - SRTs obtained using mHW method were 3.6 dB higher* than ASHA method
  - Likely due to the use of 5dB steps and reduced resolution
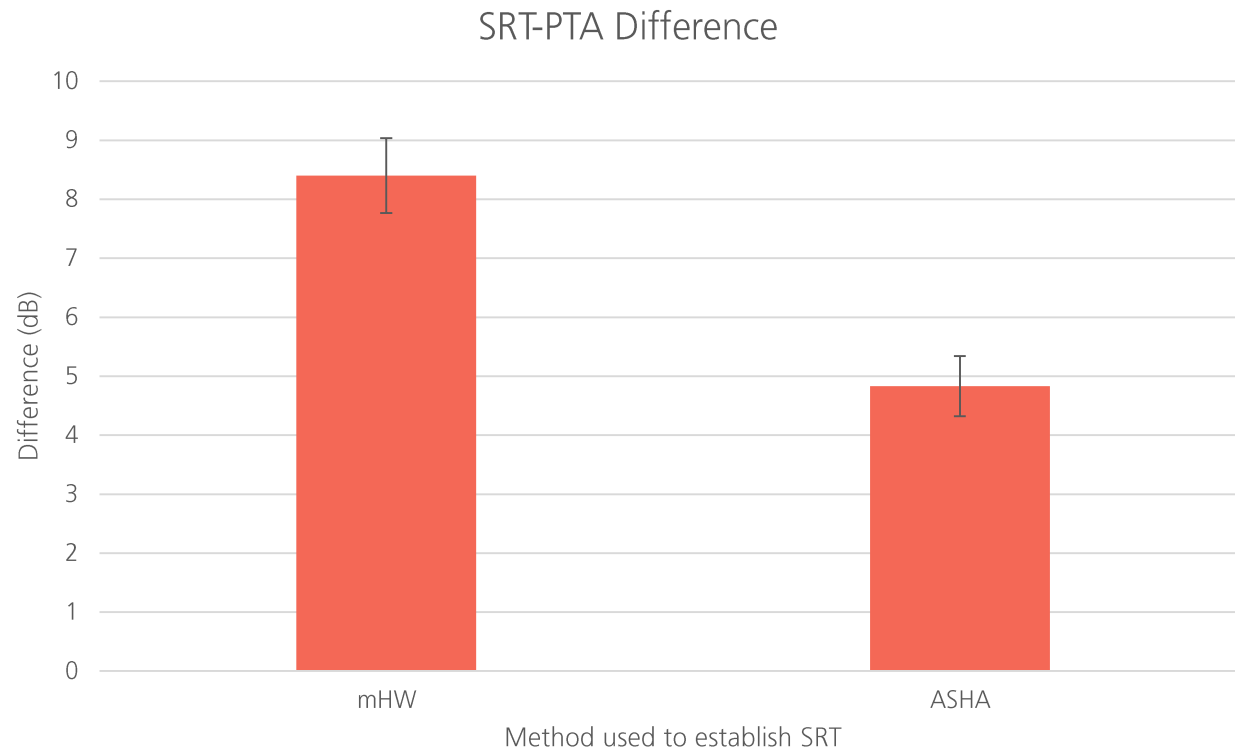
mHW – modified Hughson-Westlake method
* p <0.05

SRT-PTA Difference

- Test-retest reliability
  - Correlation: Spearman's ρ = 0.746
  - Paired Wilcoxon signed-rank test reveals no significant difference between Trial 1 and Trial 2 SRTs*

* SRTs were determined using the modified Hughson-Westlake method

- List Equivalence
  - SRT-PTA difference was used as parameter to compare List A and List B
  - Unpaired t-test on the parameter showed no significant difference between List A and List B

* SRTs were determined using the modified Hughson-Westlake method

RESULTS: CID W-22

- List Equivalence
  - Curves fitted for each list using a logistic model
  - Sensation levels required for 20, 30, 40, 50, 60, 70, 80 % scores were determined for each list

Probability-Intensity Function, CID W-22
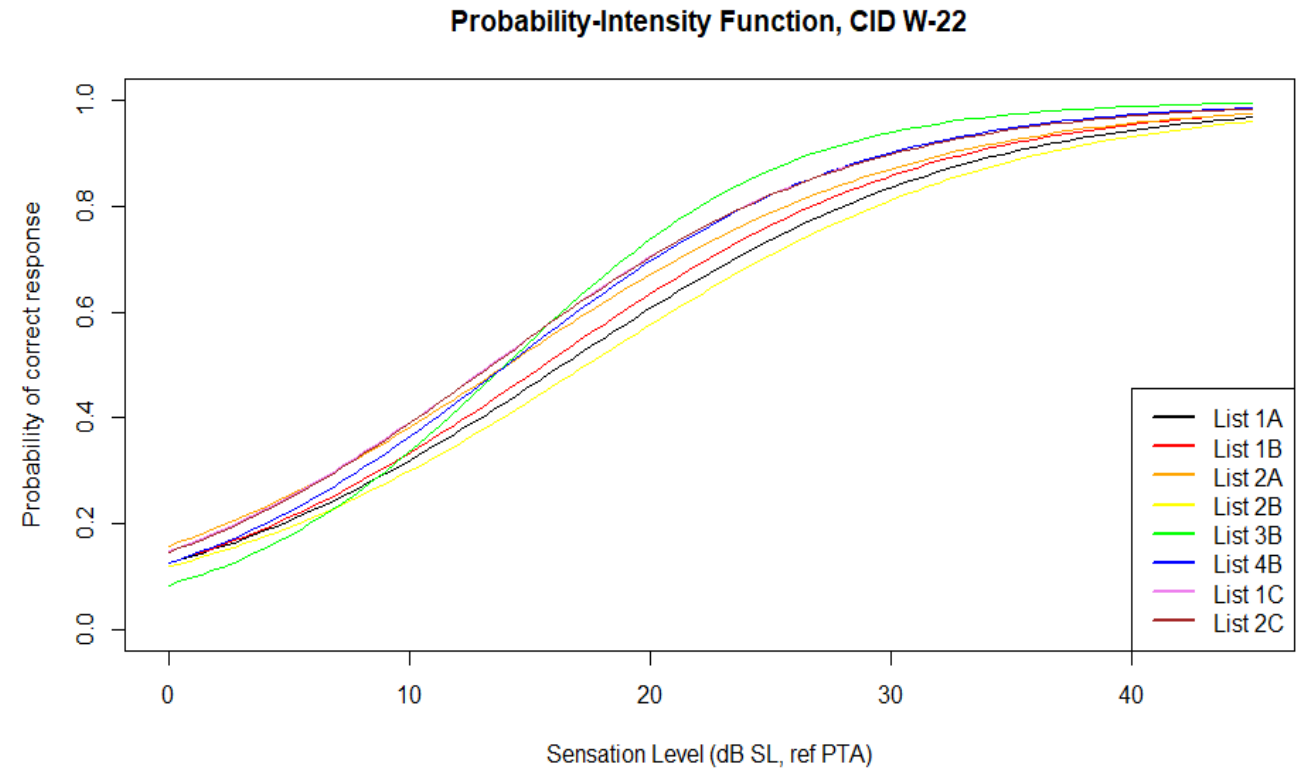
RESULTS: CID W-22

- List Equivalence
  - List number was used as a factor-type predictor of performance at the different percentage levels
 - List 1A, 1B and 2B were found to produce significantly different performance

Probability-Intensity Function, CID W-22
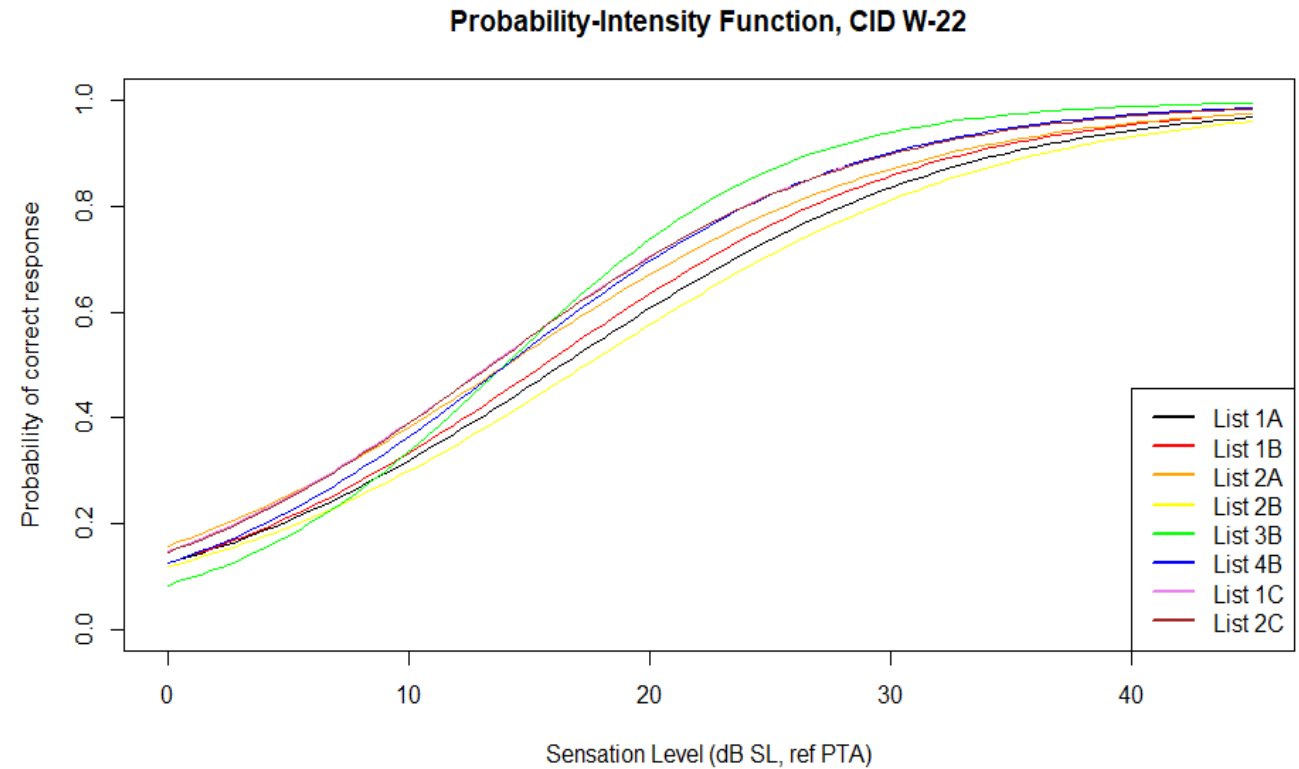
- Test-retest reliability
  - Correlation: Spearman's ρ > 0.9 for Trial 1 & Trial 2
  - Paired Wilcoxon signed-rank test revealed a significant difference between Trial 1 and Trial 2 for all lists ($p<0.05$)
  - Probability scores were roughly 5% higher on Trial 2 compared to Trial 1 (~ 2-3 more correct responses)

RESULTS: CID W-22

- Individual performance
  - Sensation level required for 0.5 probability of correct response obtained for each individual
  - Subject linguistic & education background were examined as predictors of SL required

Individual P-I Functions
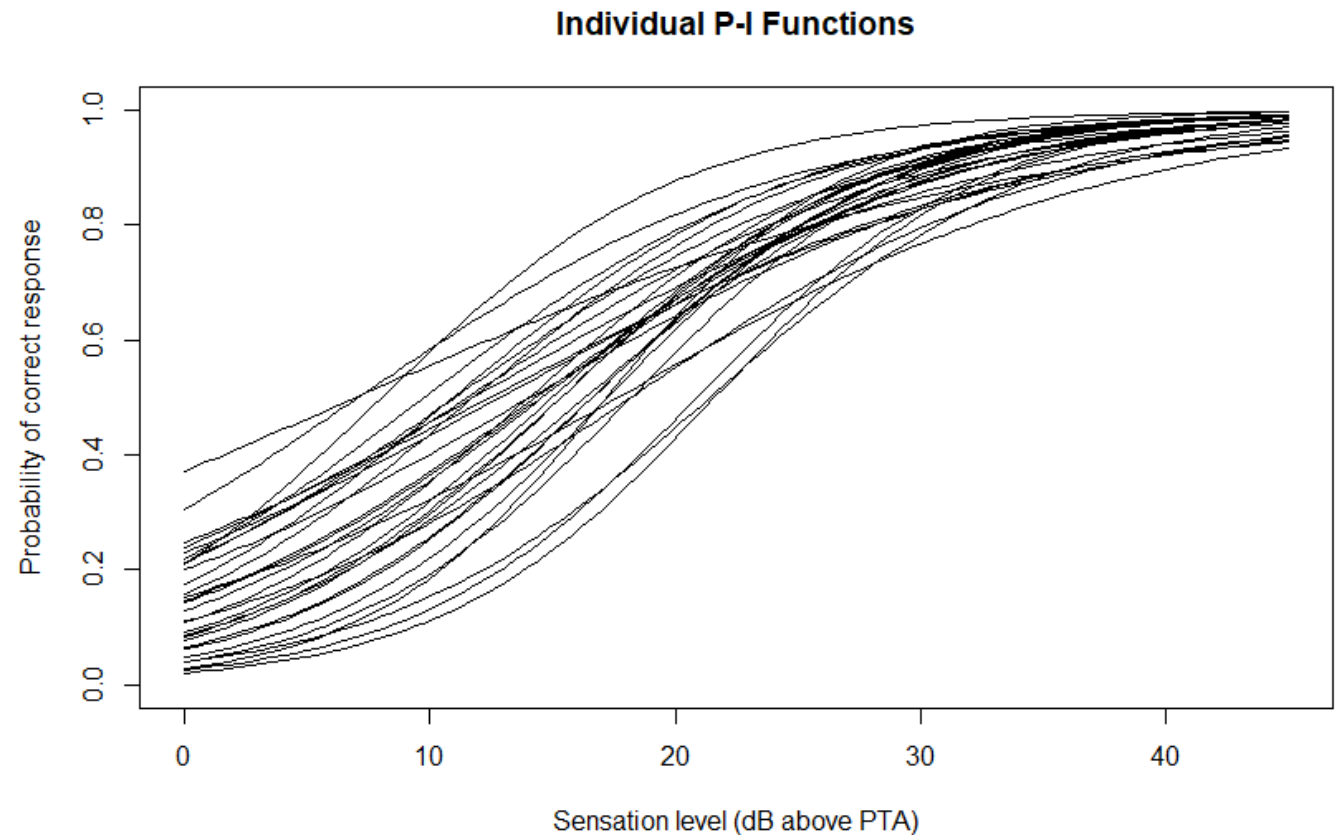
RESULTS: CID W-22

- Higher sensation level required with better pure tone hearing
  - Likely due to minimum audible field required for word recognition
- This requirement was reduced by greater years of English education

Table 8	Predictors of sensation level required for 0.5 probability	
	Effect sizes and p-values	
	Effect Size	p-value
Test Ear PTA	-0.6747	0.000146 ***
Years of English Education (interaction effect)	-0.7097	0.018483 *

Significance level: '***' p< 0.001| '**' p<0.01| '*' p<0.05, all p-values are adjusted values

LIMITATIONS OF STUDY

- Sample population is small
  - Convenience sample results in skew in average age, race and education attainment
- Speaker and Grader Bias
  - Male Chinese was used for both speaker and grader. This may not represent the diversity of racial and linguistic backgrounds in Singapore

CONCLUSION

- The Singapore recording of the CID W-1 possesses list equivalence and retest reliability

- The CID W-22 possesses list equivalence for five of the eight lists. A learning effect was present for all lists on retest.

- Biases arising from linguistic background of the speaker, listener and grader will require novel materials and grading schemes to overcome

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