# Listening in Spatialized Noise – Universal Test (LiSN-U)

Sharon Cameron, Harvey Dillon, Nicky Chong-White, Kiri Mealings and Taegan Young

National Acoustic Laboratories

## Aim

- To develop and evaluate a spatial listening test that is built upon the Listening in Spatialized Noise – Sentences Test (LiSN-S), but can be used with children and adults around the world for whom English is not their main language (including Indigenous Australians).
- The Listening in Spatialized Noise – Universal Test (LiSN-U) uses consonants and vowel (CV) pairs occurring with high frequency across most languages as the target and distracter stimuli.
- All stimuli were level normalized for equal intelligibility (n=20).

## Test Stimuli and Administration

- **Target** = 30 CV tokens in pairs (e.g. /hi pu/) presented adaptively.
- **Distracters** = 2 x strings of 30 CV1-CV2-CV3-CV4 pseudo-words: (E.g. /ba di nu sa/) recorded in same voice (SV) as target CVs and presented at a constant level of 65 dB SPL.
- **Test Conditions**:
  1. SV90 – Target at 0°; Distracters at ± 90° azimuth
  2. SV0 - Target and Distracters both at 0° azimuth
- **Speech Reception Threshold** (SRT) = signal-to-noise ratio (SNR) that yields 75% intelligibility. *See Figure 1.*
- **Stopping criteria** = estimated SE < 1 dB and ≥ 17 measured trials.
- **Reporting:** z-scores for SV90, SV0 and spatial advantage (SA). SA is calculated in dB as SV0 SRT - SV90 SRT.

## Normative and Test-Retest Reliability Data

### Participants – Test (n=150)

- 127 children (5y;0m – 12y;0m); 23 adults (19y;1m – 56y;3m)

### Participants – Retest (n=132)

- 109 children (5y;0m – 12y;0m); 23 adults (19y;1m – 56y;3m)

## Results

Gender: There were 76 females and 74 males. No effect of gender was identified for SV90, SV0 or SA (p = 0.290 to 0.447).

Age: There was a significant effect of age on SV90, SV0 SA score (dB) (p < 0.0001). *See Figure 2.*

Test-Retest Reliability: Mean changes in performance on retest on LISN-U measures ranged from 0.4 dB to 1.3 dB. Reliability (r) ranged from 0.37 to 0.63. All correlations were significant (p < 0.00001).

## Conclusions

The ability to understand LiSN-U phonemes presented in noise improves with age. Cut-off scores, calculated as 2 standard deviations below the mean adjusted for age, were calculated for each performance measure. These scores represent the level below which performance on LISN-U is considered to be outside normal limits.

## Future Research

To evaluate sensitivity of the LiSN-U, a study is currently in progress to compare LiSN-U and LiSN-S performance in children diagnosed with LiSN-S as having spatial processing disorder.

## References:

1. Cameron S, Glyde H, & Dillon H. (2011). Listening in Spatialized Noise - Sentences Test (LiSN-S): Normative and retest reliability data for adolescents and adults up to 60 years of age. J Am Acad Audiol, 22(10), 697-709.

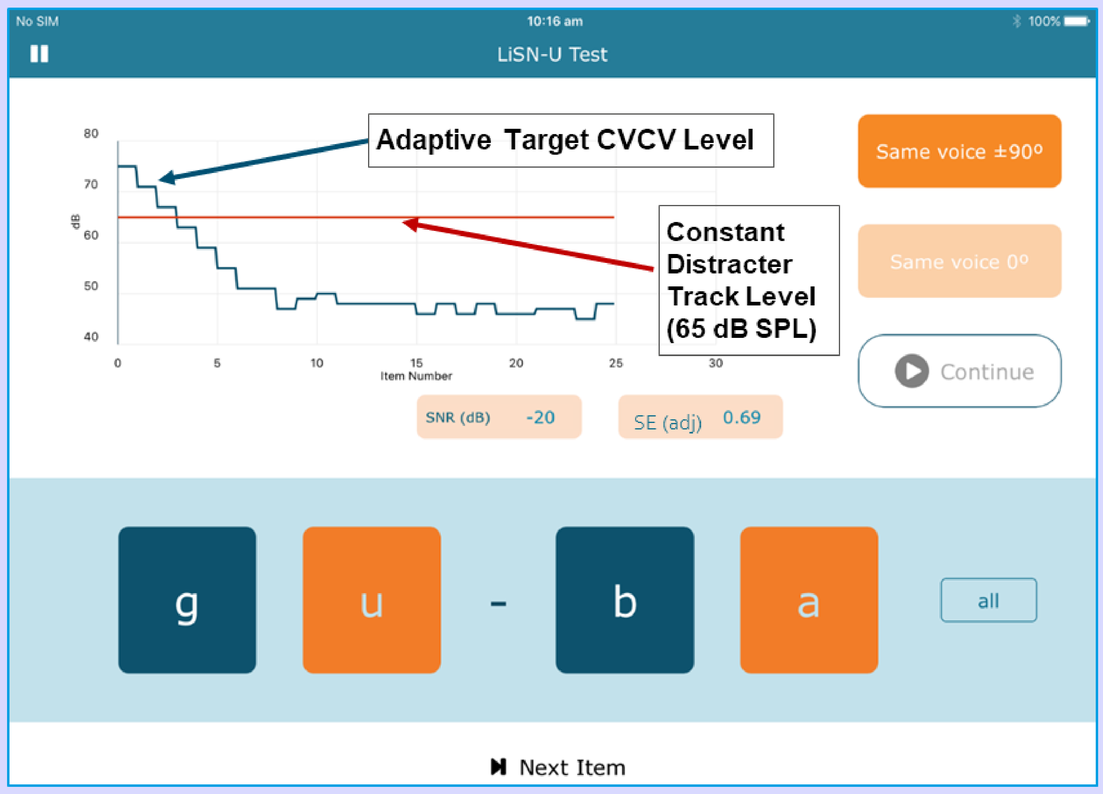


**Figure 1**. LiSN-U test screen showing adaptive track of target stimuli.

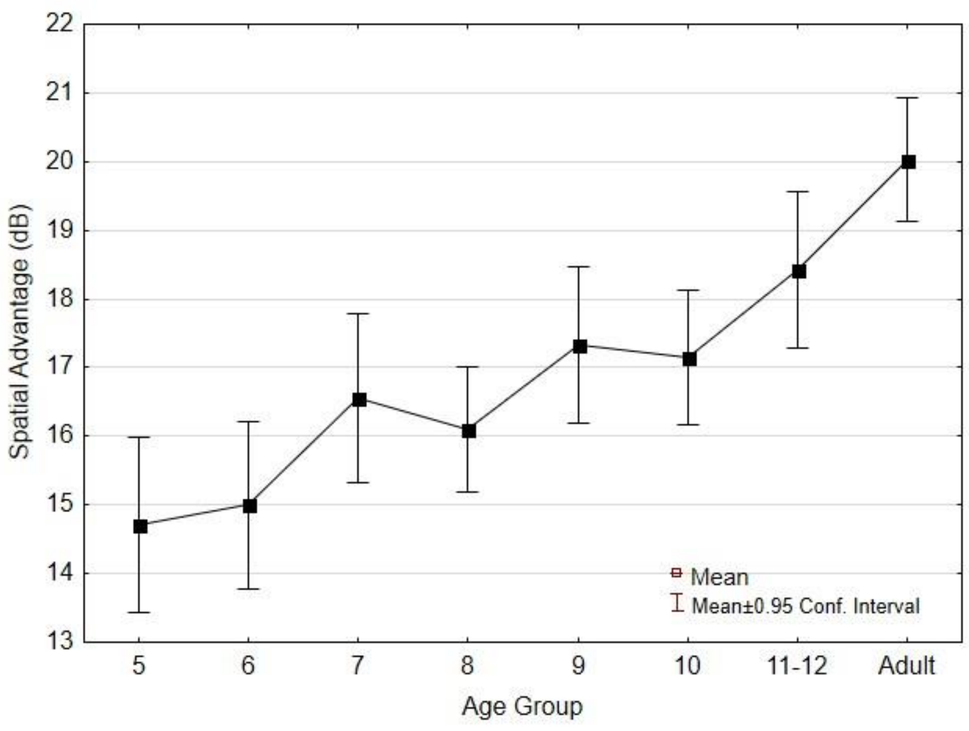


**Figure 2**. LiSN-U spatial advantage (in dB) as a function of age (n = 150).

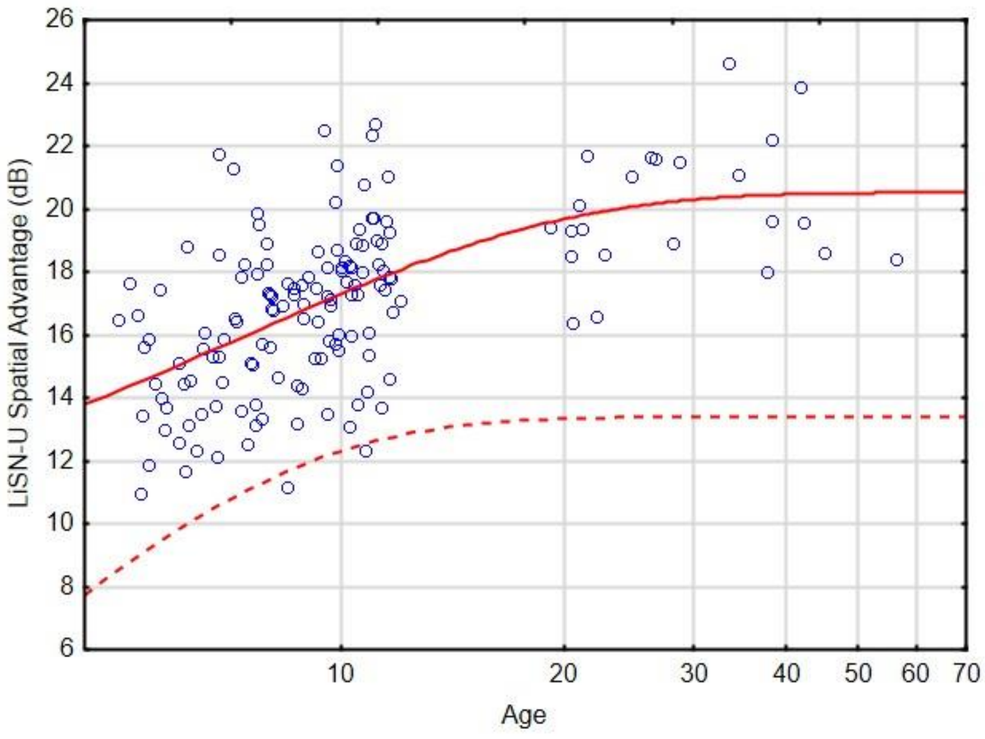


**Figure 3**. LiSN-U spatial advantage (dB) with smoothed exponential curve (solid red line) fitted to data (n=150). Superimposed is the exponential curve (dashed red line) fitted to LiSN-S data (n=202) from Cameron et al. (2011)[1].

## LiSN-U vs LiSN-S

Analysis of LiSN-U data compared to previously published LiSN-S data[1] reveals that from age 6;0 to 12;0 improvement on spatial advantage (SA) is approx 3.5 dB for both tests. SA is approx 6 dB bigger in LiSN-U than LiSN-S. Presumably this is because there are fewer differences between target and distractor in LiSN-U than in LiSN-S (and hence more informational masking). If so, this may make LiSN-U an even more sensitive detector of SPD than LiSN-S. *See Figure 3.*

**Contact:** Sharon.Cameron@nal.gov.au