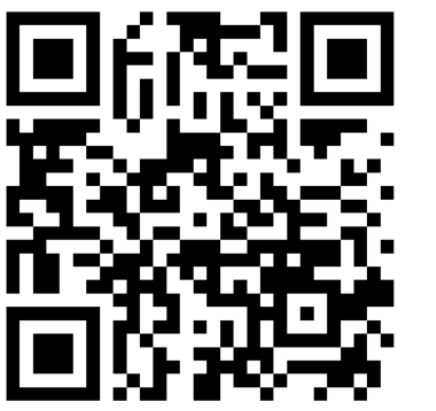
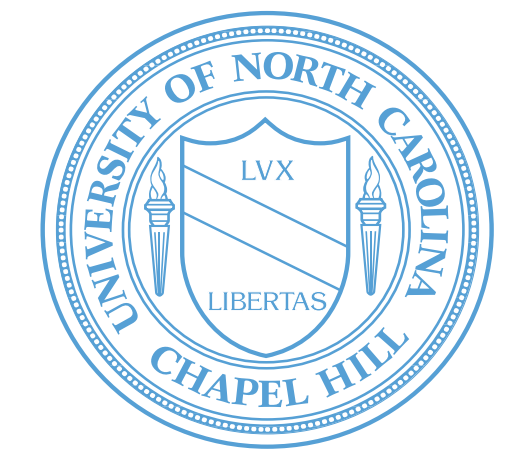




# Influence of individualized mapping procedures for cochlear implant recipients with unilateral hearing loss

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## Background

Most adult cochlear implant (CI) users with late-onset unilateral moderate-to-profound sensorineural hearing loss (UHL) experience significant improvements in speech recognition and sound source localization with their CI than without (Daher et al., 2023), though individual outcomes vary.

One source of the variability in outcomes is the individual's age, with poorer performance typically observed with advanced age. The influence of age may change over time, with some reporting significant improvements in performance for older adult CI users with UHL after prolonged listening experience (Thompson et al., 2023).

Another source of the variability in outcomes may be the mapping procedure used to assign the bandpass filters. Default mapping procedures do not account for the wide variability in electrode array placement across CI recipients, which results in tonotopic mismatches for most CI users (Landsberger et al., 2015). Results from simulation studies suggest that individualizing the bandpass filters to match cochlear tonotopicity and eliminate tonotopic mismatches may support better outcomes for CI users with UHL (Wess et al., 2017). A consideration of comparing outcomes between default and individualized (e.g., place-based mapping) procedures is that the magnitude of the tonotopic mismatches with default maps will be influenced by the range of angular insertion depths for the sample and by the specific cochlear place. Thus, there is also a need to assess outcomes at the participant-level, considering group comparisons will be influenced by the range of tonotopic mismatches within the sample of default map listeners and the specific cochlear place (e.g., mid- versus apical region).

The present study investigated the influence of device (map; tonotopic mismatches) and patient variables (age, cognition) on the speech recognition and sound source localization of adult CI users with UHL.

## Materials & Methods

### Inclusion / Exclusion Criteria

- Adult CI recipient of a MED-EL device; between 18-80 years of age at surgery
- Passed Mini Mental State Examination (Folstein et al., 1975)
- Contralateral pure tone average (.5, 1, 2, & 4 kHz)  $\leq$  30 dB HL
- Exclusions: Cochlear malformations, ossification, revision surgery

### Randomization

- Exclusive listening experience with a default or place-based map starting at activation
- Participant and testing audiologist were blinded

### Procedures

- Intervals: activation, 1, 3, 6, and 12-months post-activation
- Default maps: 70-8500 Hz
- Place-based maps: Low- and mid-frequency information aligned to cochlear place using CT imaging and the OTOPLAN software (see Dillon et al., 2022)
- CNC words: Presented at 60 dB SPL, masking to contralateral ear
- Vowel recognition: Stimuli from TigerSpeech Technology © were presented via DAI
- Sound source localization: 200-ms stimuli; broadband noise (BBN; 125-6000 Hz) and low-pass filtered noise (LP; 126-500 Hz). Assessment in a soundbooth using 11 loudspeakers positioned -90 to 90°
- Cognition: (1) Montreal Cognitive Assessment – Hearing Impaired version (MoCA-HI; Lin et al., 2017), and (2) Flanker Inhibitory Control and Attention Test from the NIH Toolbox (Hodes et al., 2013).

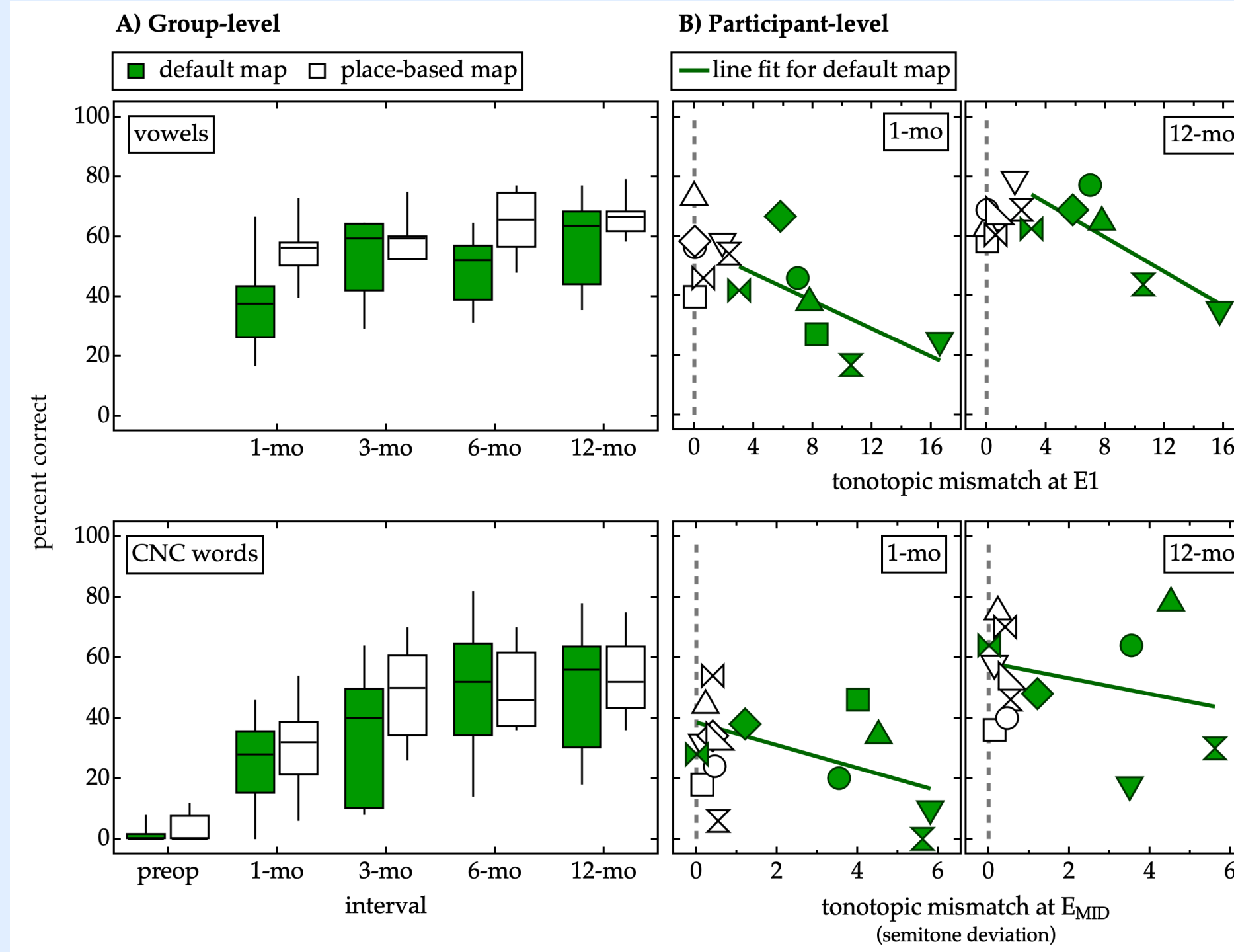
### Data analyses

- (1) Group Level: Influence of mapping procedure (default vs place-based) on performance
- (2) Participant Level: Influence of tonotopic mismatch for listeners of default maps on performance

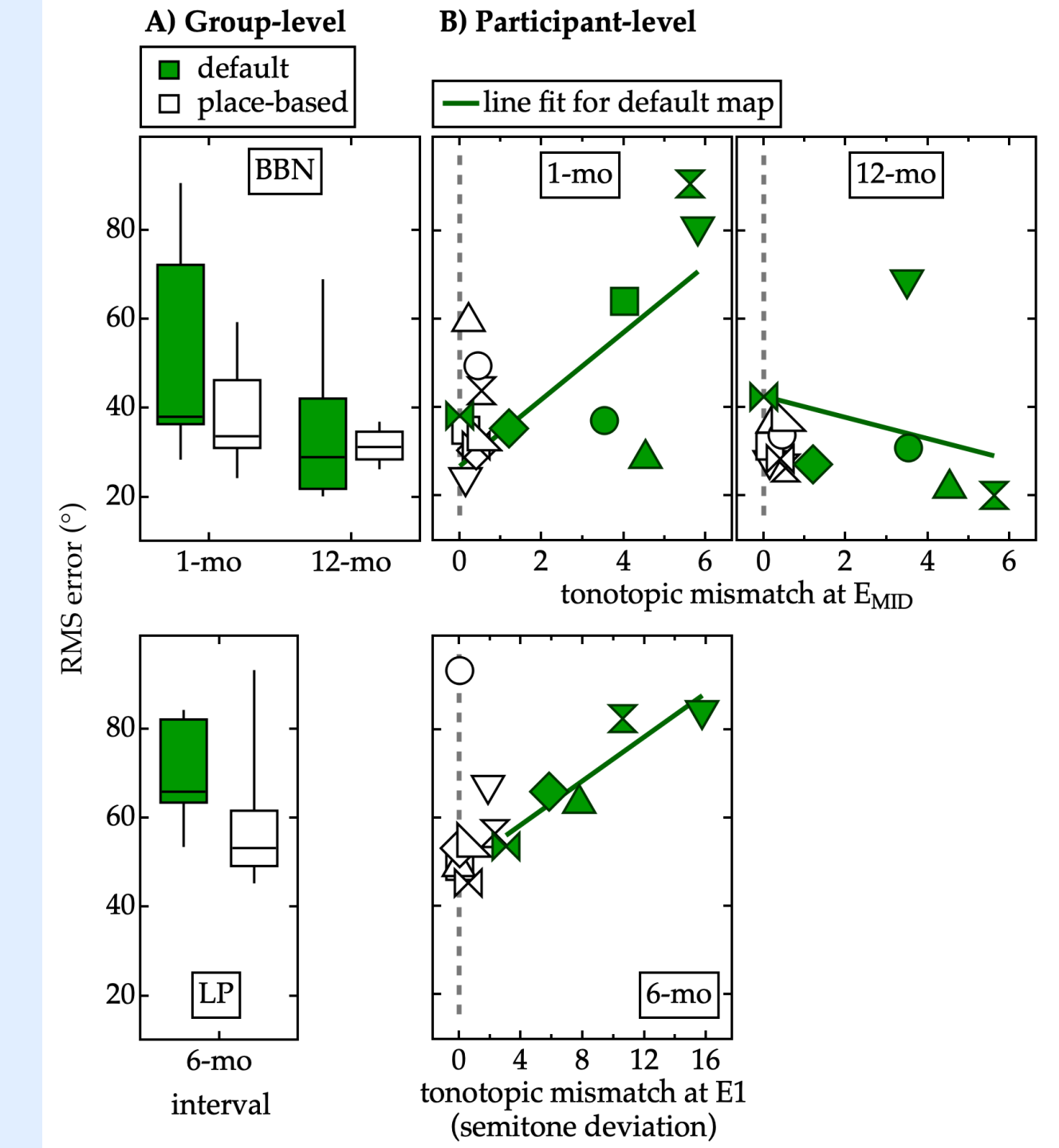
## Results

Fifteen participants (8 female) were included. They were recipients of a Flex28 (n=1) or FlexSOFT (n=14) array, with a mean age at surgery of 57 years. The default (n=7) and place-based (n=8) groups did not differ significantly for preoperative ipsilateral or contralateral PTA, age, AID of E1, or MoCA-HI. **Figure 1** plots the speech recognition results. For the group level, there were significant effects of interval and age for both measures. For vowels, the place-based group had better performance than the default group. For CNC words, there was a significant effect of cognition. For the participant level, there was a significant effect of tonotopic mismatch for vowels and CNC words. **Figure 2** plots the sound source localization for each stimuli. For the BBN stimulus, the place-based group had better performance than the default group. Interval and biological sex were also significant (better performance over time; better performance for males). For the LP stimulus, the place-based group had better performance than the default group. For the participant level, those with larger magnitudes of tonotopic mismatch had poorer RMS error with the LP stimulus.

**Figure 1.** Percent correct scores over the study period for vowel recognition (top row) and word recognition (bottom row). Panel A plots the data by map group, with green filled boxplots showing the scores for the default group and open boxplots showing the scores for the place-based group. Panel B plots the data at the 1- and 12-month intervals for individual participants. Trend lines show the association between tonotopic mismatch and the scores for default maps.



**Figure 2.** Sound source localization plotted in RMS error (lower values indicate better performance) for the BBN stimulus (top row) and the LP stimulus (bottom row). Plotting conventions are similar to Figure 1.



## Conclusions

The present results support that the speech recognition and spatial hearing abilities (i.e., sound source localization) of CI users with UHL are influenced by the mapping procedure used for filter frequency assignments and negatively impacted by larger magnitudes of tonotopic mismatch.

- Place-based map group experienced significantly better vowel recognition and sound source localization (BBN and LP stimuli) than the default group.
- For listeners of default maps, the magnitude of the tonotopic mismatch significantly influenced vowel recognition, word recognition, and sound source localization (LP stimulus).

*Participants who had larger magnitudes of tonotopic mismatches experienced poorer performance.*

Some participants with smaller magnitudes of tonotopic mismatch (e.g., < 3 semitones) demonstrated an ability to acclimate to the mismatched information within the initial months of CI use.

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### Poster Abstract

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