Single-sided deafness (SSD) refers to a condition in which people have normal or near-normal hearing in one ear and little to no usable hearing in the other ear. With SSD, most SSD patients experience aural dissonance in locating sounds in the horizontal plane, their errors are generally greater when sounds originate on the poorer ear side, and sounds presented on the poorer ear side are less likely to be localized to the better ear side than when presented on the better ear side. A research suggests that these patients’ localization accuracy improves from 30° to 10° error (Andt et al., 2011), and that their speech reception thresholds (SRTs) significantly decrease (15-45 dB) in 18 constant spatial configurations when implemented under SSD conditions (Courtney, 2016). However, little is known about the specific SSD issues patients with SSD use to locate sound and improve speech understanding in spatial environments. Moreover, recent studies suggest that the spatial configurations in which research-sourced SSD patients' SRTs do not produce optimal performance (Courtney, 2011; Talbot, Garhack, & Backhouse, 2012).

In this pilot study, normal-hearing (NH) listeners completed localization and speech understanding in noise tasks in sound field and with masking noise presented to one ear to simulate SSD. Our listeners were tested for SSD to observe the maximum benefit of the implant, to obtain baseline measures to serve as ‘upper limits’ for the benefit we may expect to observe in patients with SSD, and to obtain estimates of the speech understanding levels on the masked ear side in the speech in noise.

The results will provide a benchmark for potential improvement when a CI is combined with contralateral hearing aid.

### General Methods

**University of Minnesota Multi-Sensory Perception Lab, Minneapolis**

- **Sound-treated booth with capacity to simulate real-world acoustic environments via 48-binaural array**
- **In localization, we used 18 subjects along the front horizontal from 90° to 90° azimuth (adjacent speakers separated by 30°).**

**Latin Square Design:** For each experiment, we used a Latin square design to balance conditions across subjects.

### Adaptive Speech Understanding in Noise (SPIN) Experiment

#### Methods/Stimuli

- **2 masker types X 3 spatial configurations x 2 listening conditions = 12 lists**

**Stimulus presentation:**

- **1. Time-reversed, two-talker babble (TTB), taken from the target sentences**
- **2. Gaussian noise spectrum filtered at 1500 Hz**
- **3. Speech at 60° azimuth and masker at 60° azimuth (S6N6)**
- **4. Speech at 60° azimuth and masker at 120° azimuth (S6N12)**

**Listening conditions:** With and without masking noise presented to the right (to simulate SSD).

- **Listeners:** NH listeners, native American English speakers.

- **Task:** While fixing gaze toward 0° azimuth, listeners were presented with a sentence in a masker and verbally repeated the sentence they heard to an examiner in the sound booth.

- **Hypothesis:** In NH listeners, listening with two ears (binaural) will improve speech understanding when speech and noise are spatially separated. These improvements will extend beyond the better ear advantage and encompass the benefits of perceived separation associated with informational masking.

### Localization Experiment

#### Methods/Stimuli

- **6 normal hearing (NH), native speakers of American English.**
- **Stimulus type and cues tested in the localization experiment.**

- **1. Methods/Stimuli:**
  - **2. Speech at 60° azimuth and masker at 60° azimuth (S6N6)**
  - **3. Speech at 60° azimuth and masker at 120° azimuth (S6N12)**

**Listening conditions:** With and without masking noise presented to the right (to simulate SSD).

- **Hypothesis:** Monitor NH listeners to determine the threshold at which spatial cues and via ITD cues in the temporal envelope, but not via ITD cues in the low frequency envelope, and all ITD/ILD information occurring from 0° to 100 ms raised CIs in the speech in noise task.

### References