

# Investigation of the effect of distractors on localization abilities with a visual-to-auditory substitution device

Camille Bordeau<sup>1</sup>, Florian Scalvini<sup>2</sup>, Cyrille Migniot<sup>2</sup>, Julien Dubois<sup>2</sup>, Maxime Ambard<sup>1</sup>

<sup>1</sup>LEAD-CNRS UMR5022, Université de Bourgogne, Dijon, France

<sup>2</sup>ImViA EA 7535, Université de Bourgogne, Dijon, France



bordeau.camille@gmail.com

## Visual-to-auditory SSD

- Sensory substitution devices (SSDs) convey spatial information for the blind using sound spatialization and pitch modulation (Bordeau et al., 2023).

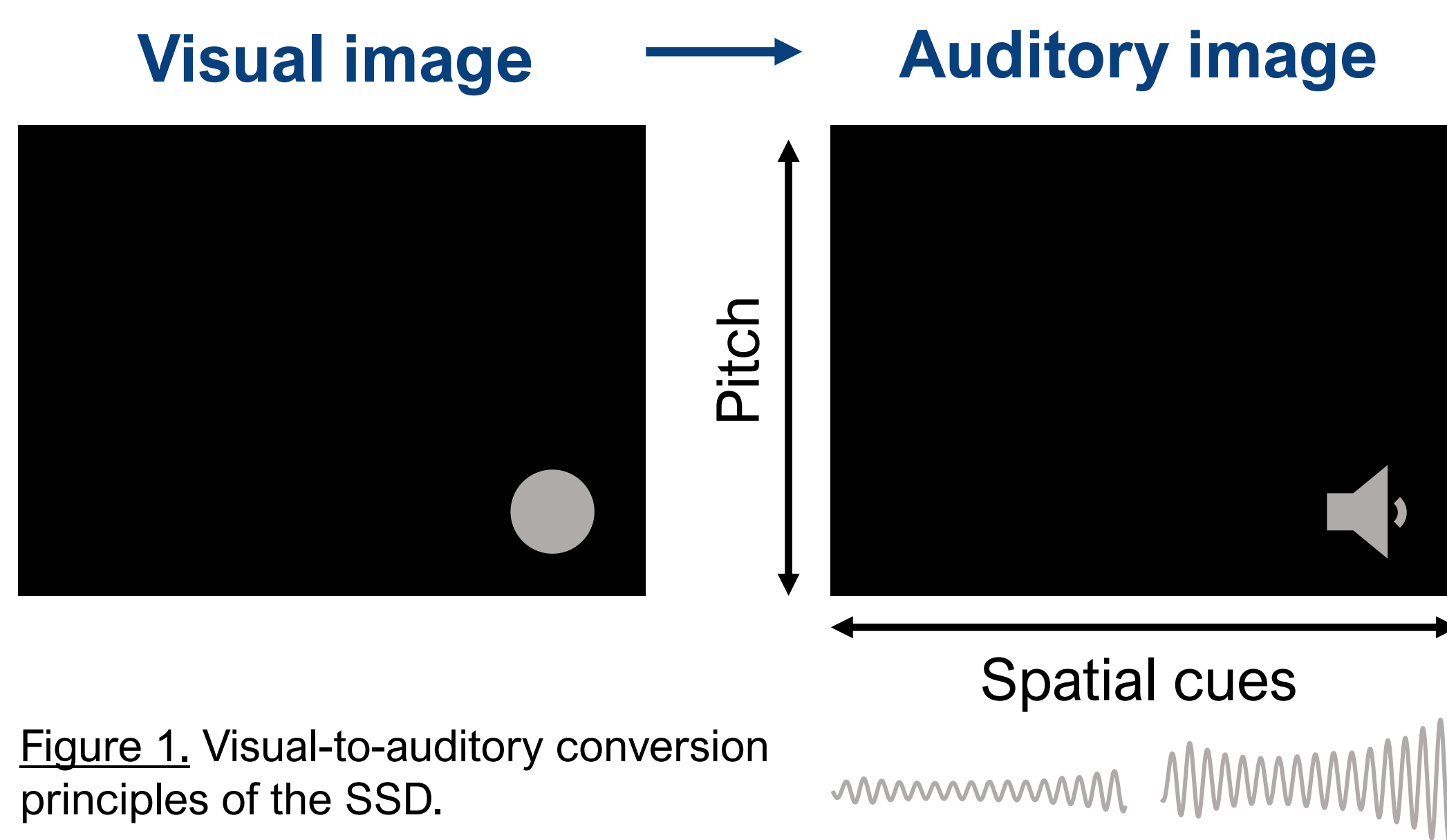


Figure 1. Visual-to-auditory conversion principles of the SSD.

- SSD users are able to focus their attention on relevant information while ignoring irrelevant environmental sounds (Buchs et al., 2019).
- Increasing the spatial separation between simulated auditory distractors and a simulated sound source improves localization performance (Kawashima et al., 2015).

- To what extent do distractors perceived with a visual-to-auditory SSD impair localization abilities?
- Does the spatial arrangement influence the performance?

## Procedure

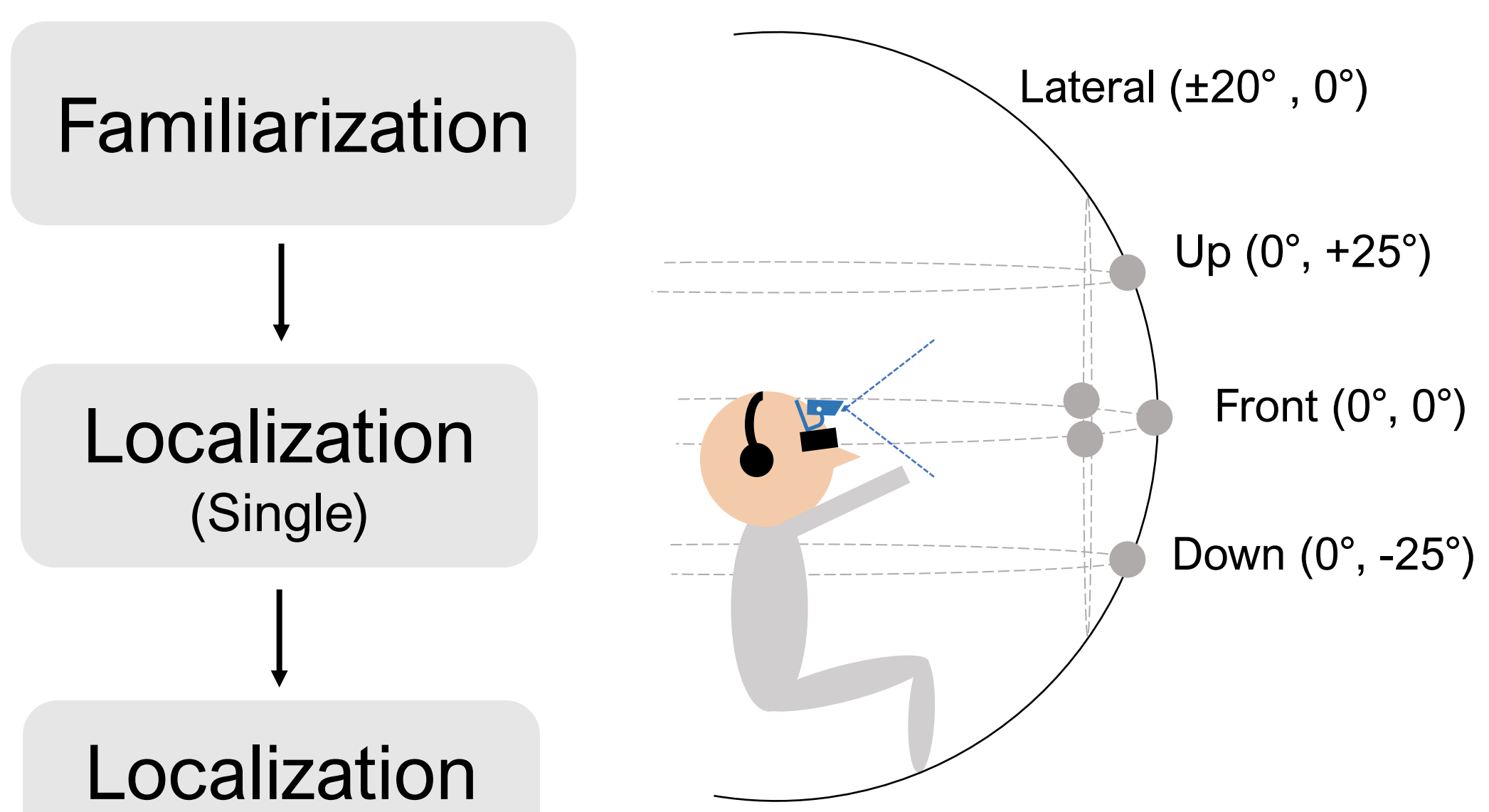


Figure 2. Experimental set-up and the locations of the target in the localization task.

## Localization task

- 19 blindfolded participants (age: M = 23.7, SD = 3.3) localized a target without (Single) and among distractors (Multiple) that were either spatially incongruent (I) or congruent in azimuth (A) or in elevation (E) with the target.

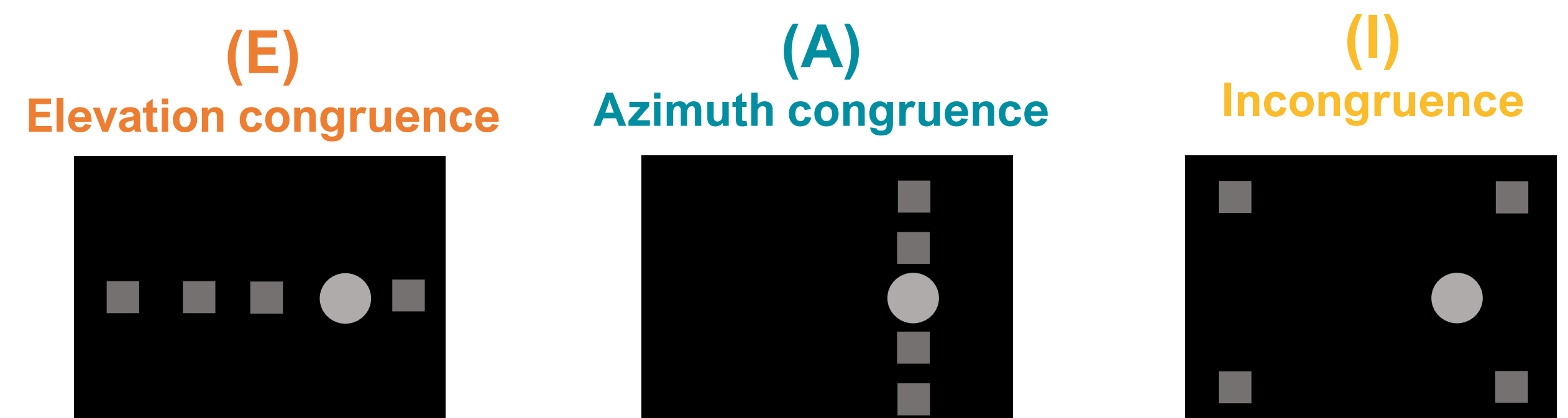
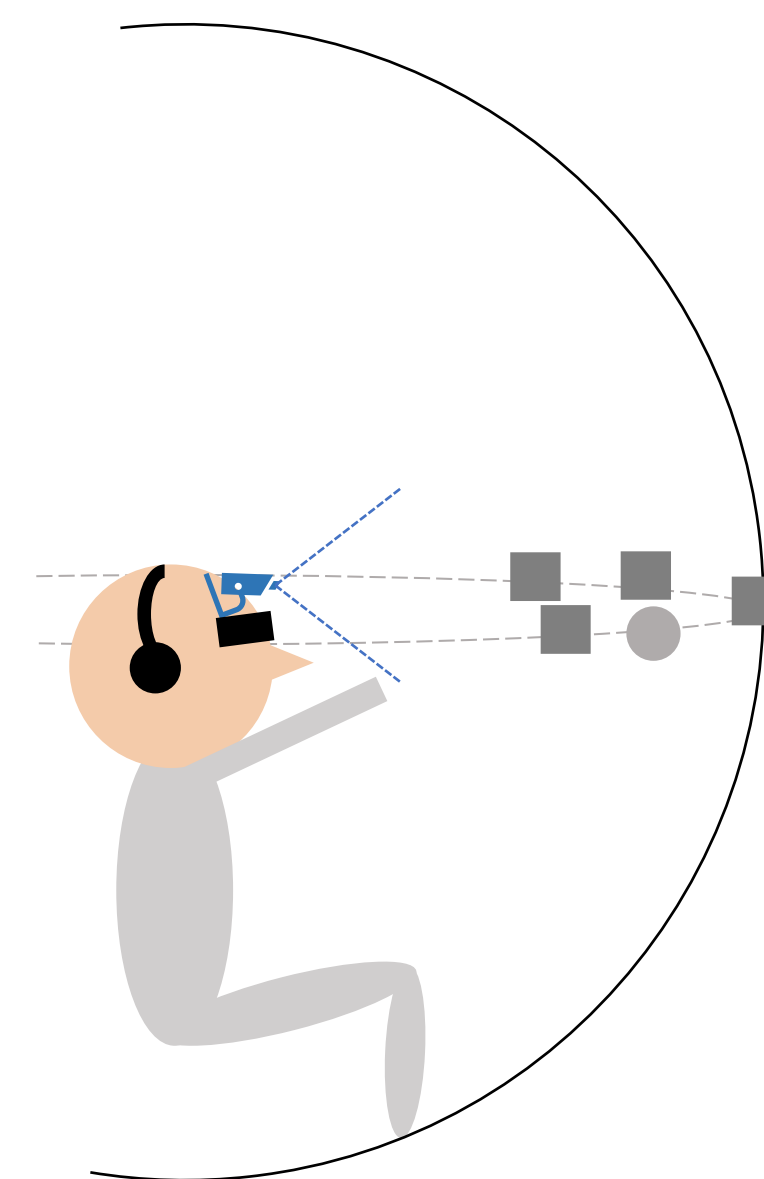
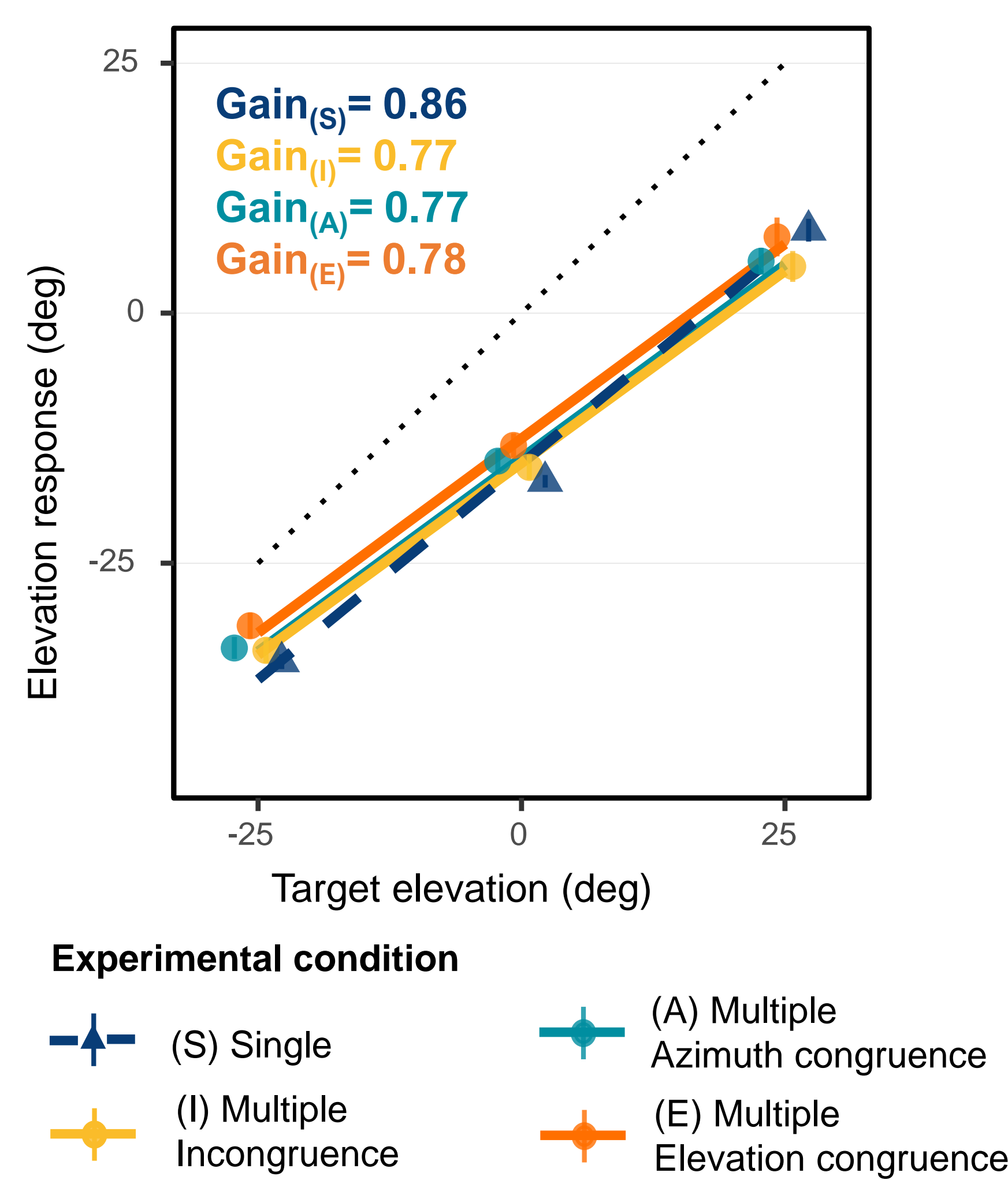


Figure 3. Example of the localization task in the Multiple condition with distractors that are spatially congruent in elevation. The position of the distractors and the target on the visual image is depicted in the 3 spatial congruence conditions.

## Elevation localization

- No significant effect of the presence of distractors [ $t(18) = 1.36, p = .19$ ], nor of the spatial congruence [all  $t(18) < 0.13$ , all  $p > .99$ ].
- Compression bias** with all gains lower than 1.0 [all  $t(18) > 8.42$ , all  $p < .0001$ ] except in the Single condition [ $t(18) = 1.62, p = .12$ ].



## Azimuth localization

- In average, a **lower azimuth gain in the Multiple condition** (all spatial congruence conditions pooled) than the Single condition [ $t(18) = 2.20, p = .041$ ].
- Significant effect of the spatial congruence** with no more overestimation of the laterality in the elevation congruence condition [all  $t(18) > 7.59, p < .0001$ ].

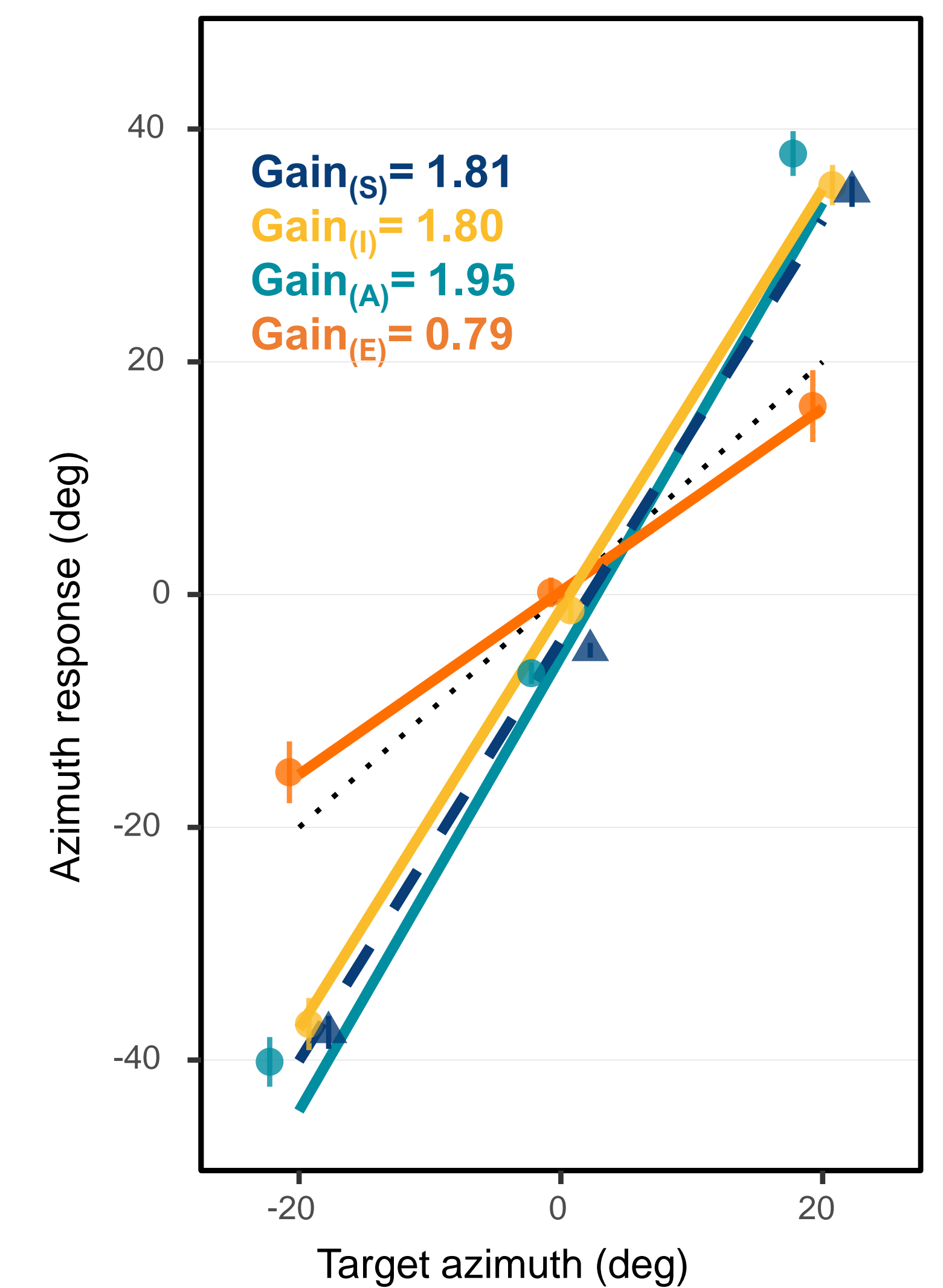


Figure 4. Mean elevation (left) and azimuth (right) response position as a function of the target position in the Single condition (dark blue) and in the Multiple conditions including spatial incongruence (yellow), congruence in azimuth (light blue) and congruence in elevation (orange). Error bars show standard error. Solid and dashed lines show the estimated trend from the Linear Mixed Model, while the dotted line shows the optimal trend (gain = 1.0).

## Discussion

- Azimuth localization abilities with the SSD (using spatial auditory cues) were modulated when the target was displayed among distractors with comparable regarding the spectral content (elevation congruence).
- Although an elevation compression bias was observed, elevation localization abilities with the SSD (using pitch modulation) were not modulated by the presence of distractors.

## References

Bordeau, C., Scalvini, F., Migniot, C., Dubois, J., & Ambard, M. (2023). Cross-modal correspondence enhances elevation localization in visual-to-auditory sensory substitution. *Frontiers in Psychology, 14*. doi: 10.3389/fpsyg.2023.1079998. Buchs, G., Heimler, B., & Amedi, A. (2019). The Effect of Irrelevant Environmental Noise on the Performance of Visual-to-Auditory Sensory Substitution Devices Used by Blind Adults. *Multisensory Research, 32*(2), 87-109. doi: 10.1163/22134808-20181327. Kawashima, T., & Sato, T. (2015). Perceptual limits in a simulated "Cocktail party". *Attention, perception & psychophysics, 77*(6), 2108-2120. doi: 10.3758/s13414-015-0910-9