Effects of Automatic Attentional Orienting and Cue-Target Similarity on Auditory Spatial Discrimination

Yeganeh Modaresnia, René Šebeňa, Udbhav Singhal, Norbert Kopčo

P J. Šafárik University in Košice



Conversation

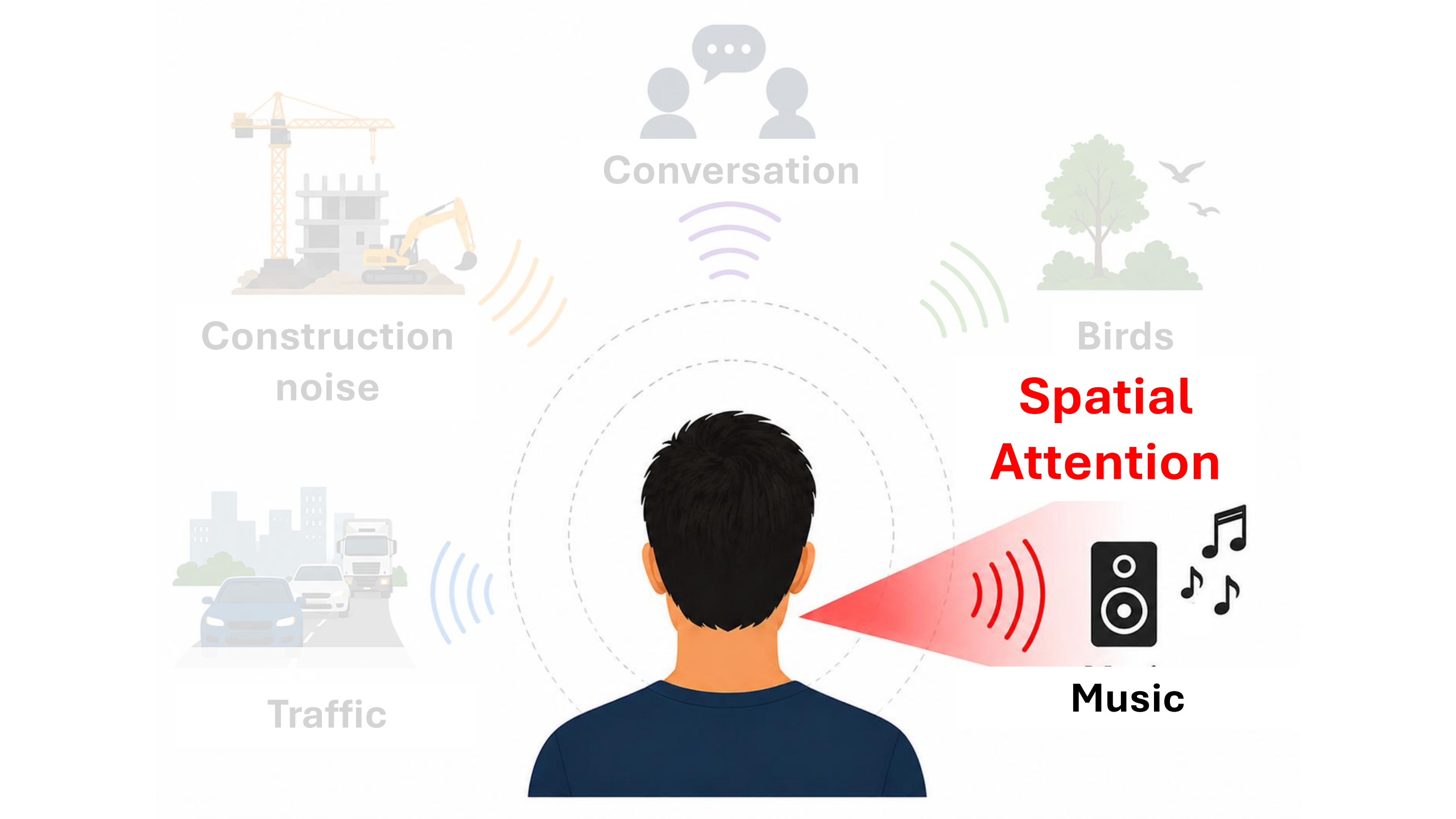
Construction noise

Birds

Spatial Hearing

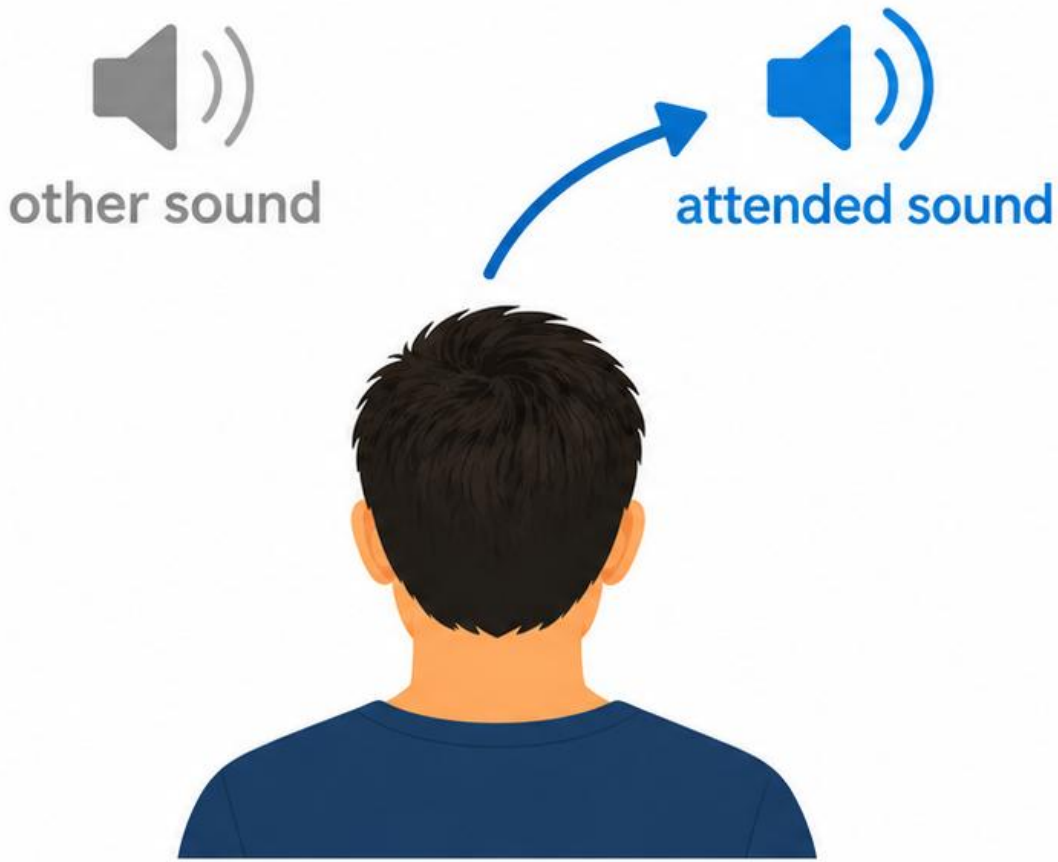
Traffic

Music


Conversation
Construction noise
Birds
Spatial Attention
Traffic
Music

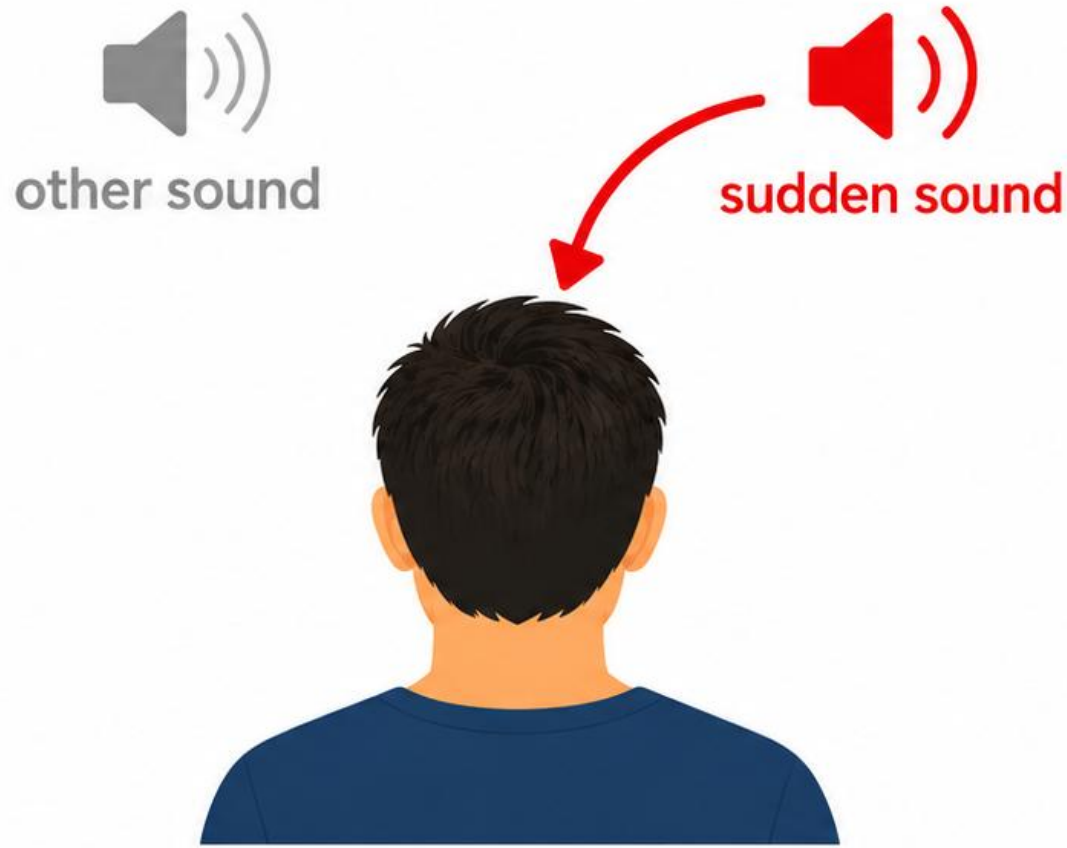
Endogenous attention

Voluntary, goal-driven

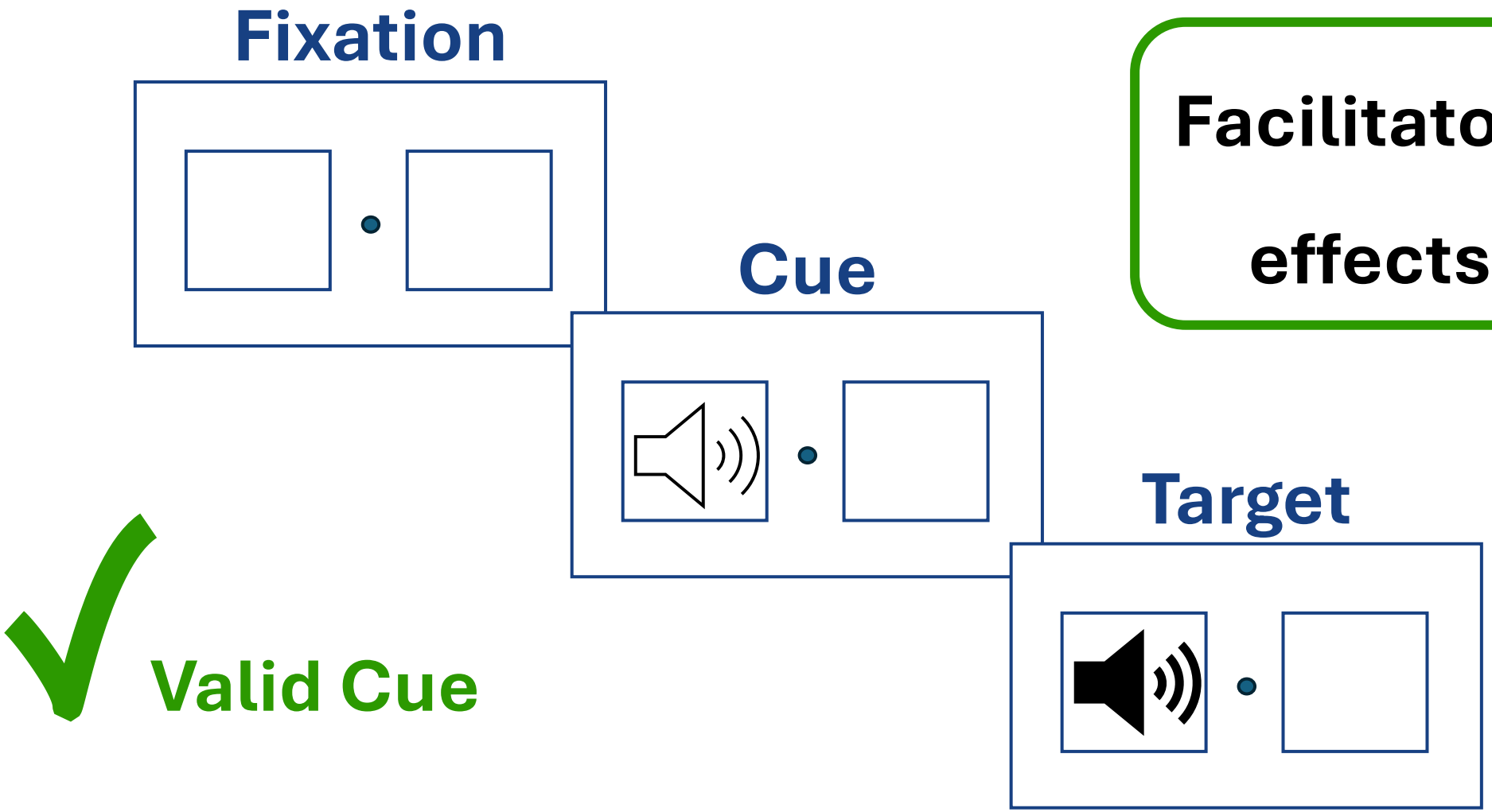


Exogenous attention

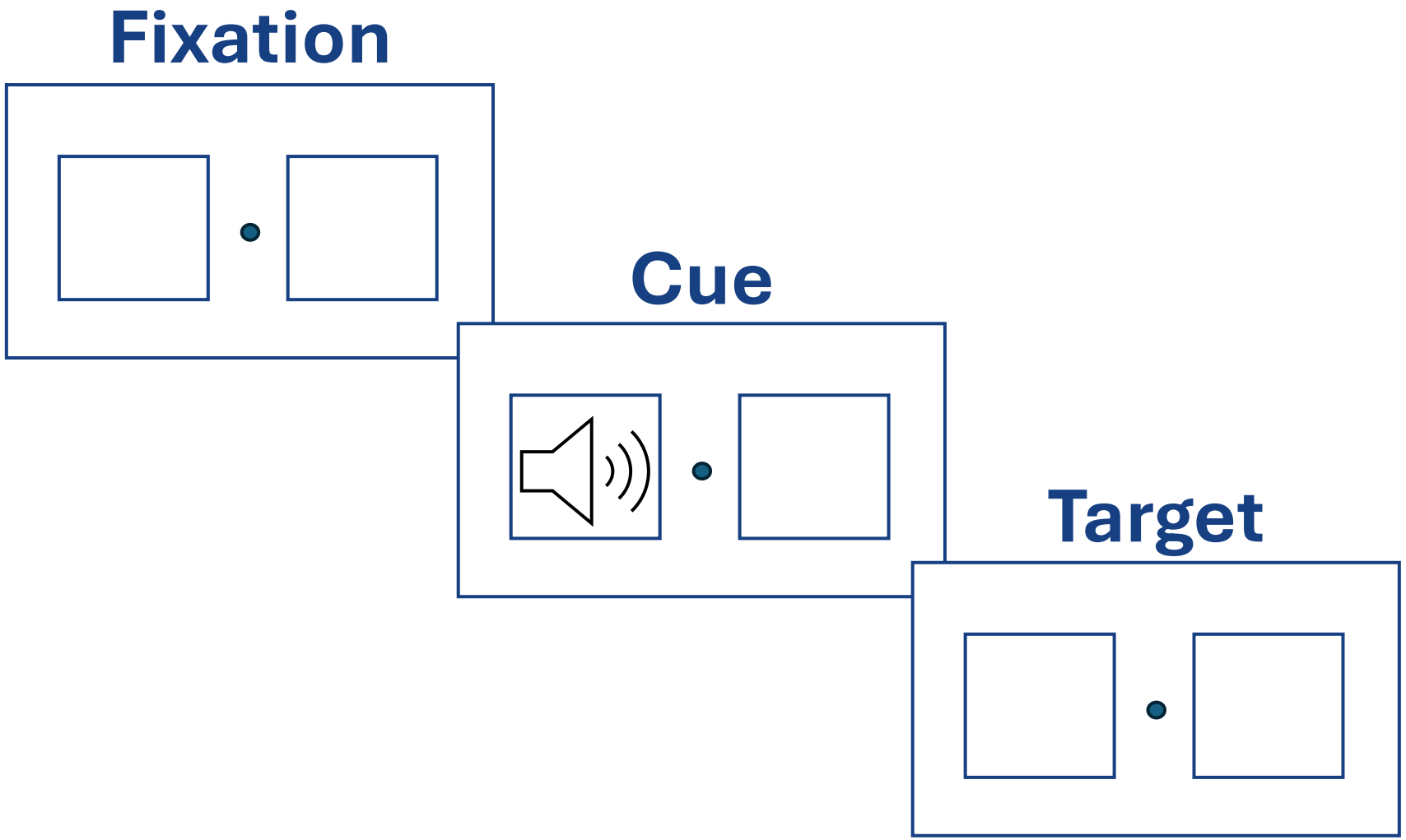
Automatic, stimulus-driven



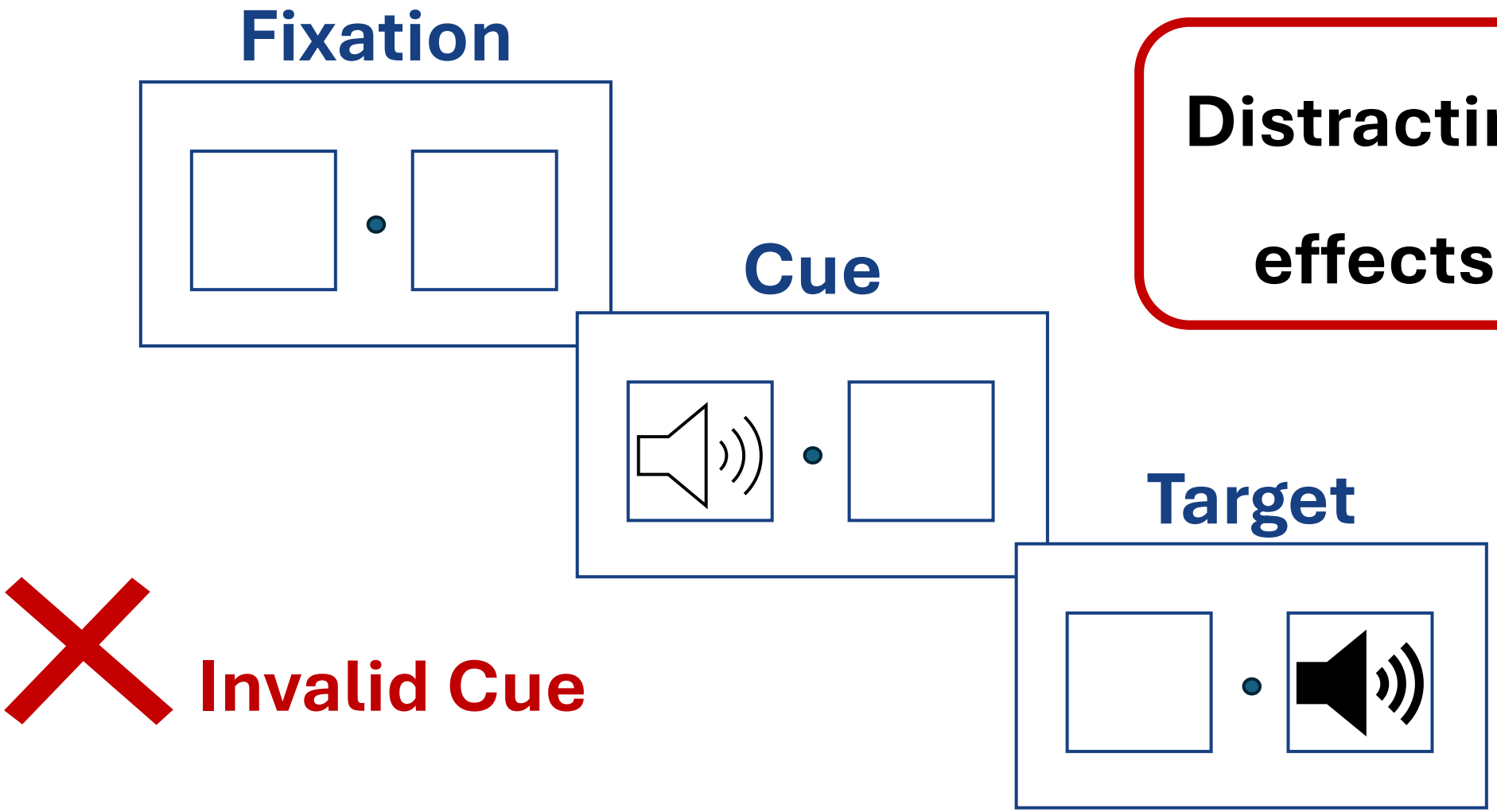
Spatial Cueing



Spatial Cueing



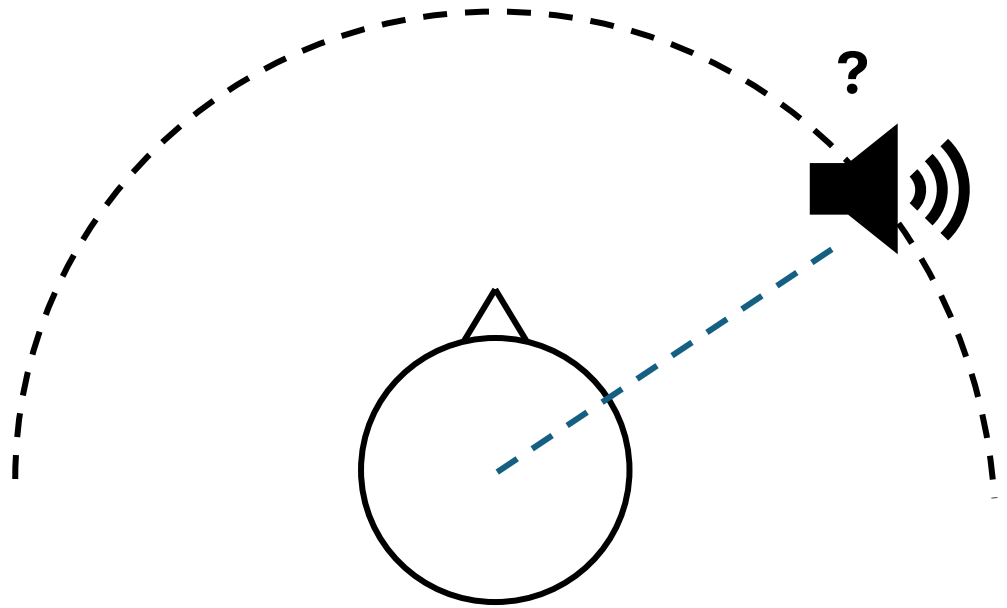
Spatial Cueing



Measuring Spatial Perception

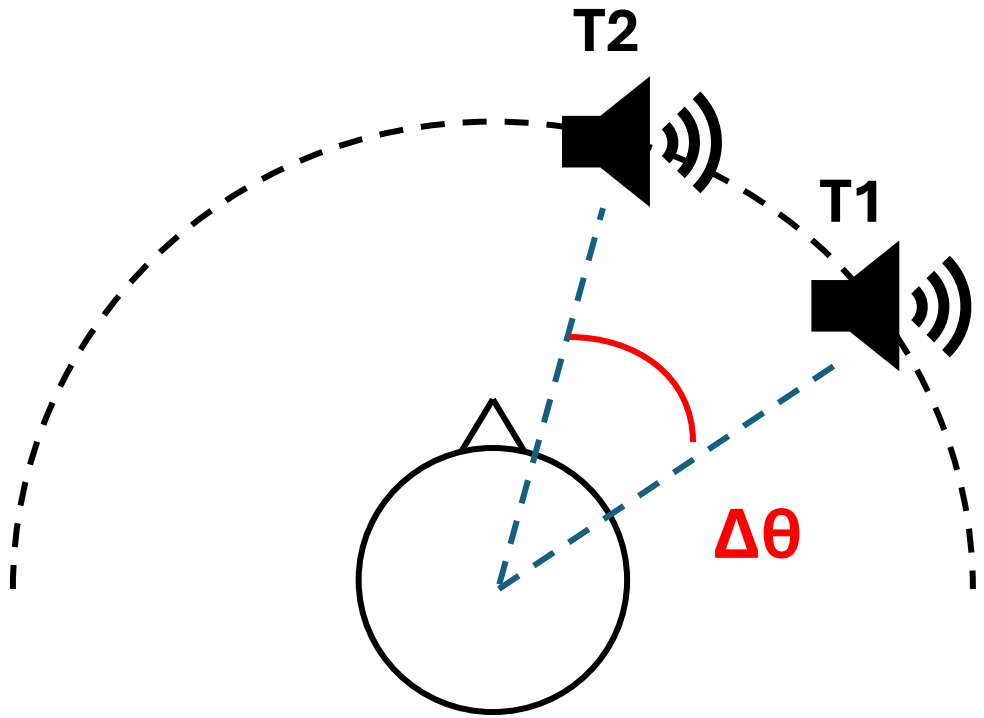
Localization

Where is the sound?



Discrimination

Task used in our study



Method

Participants: Normal-hearing young adults (n=11)

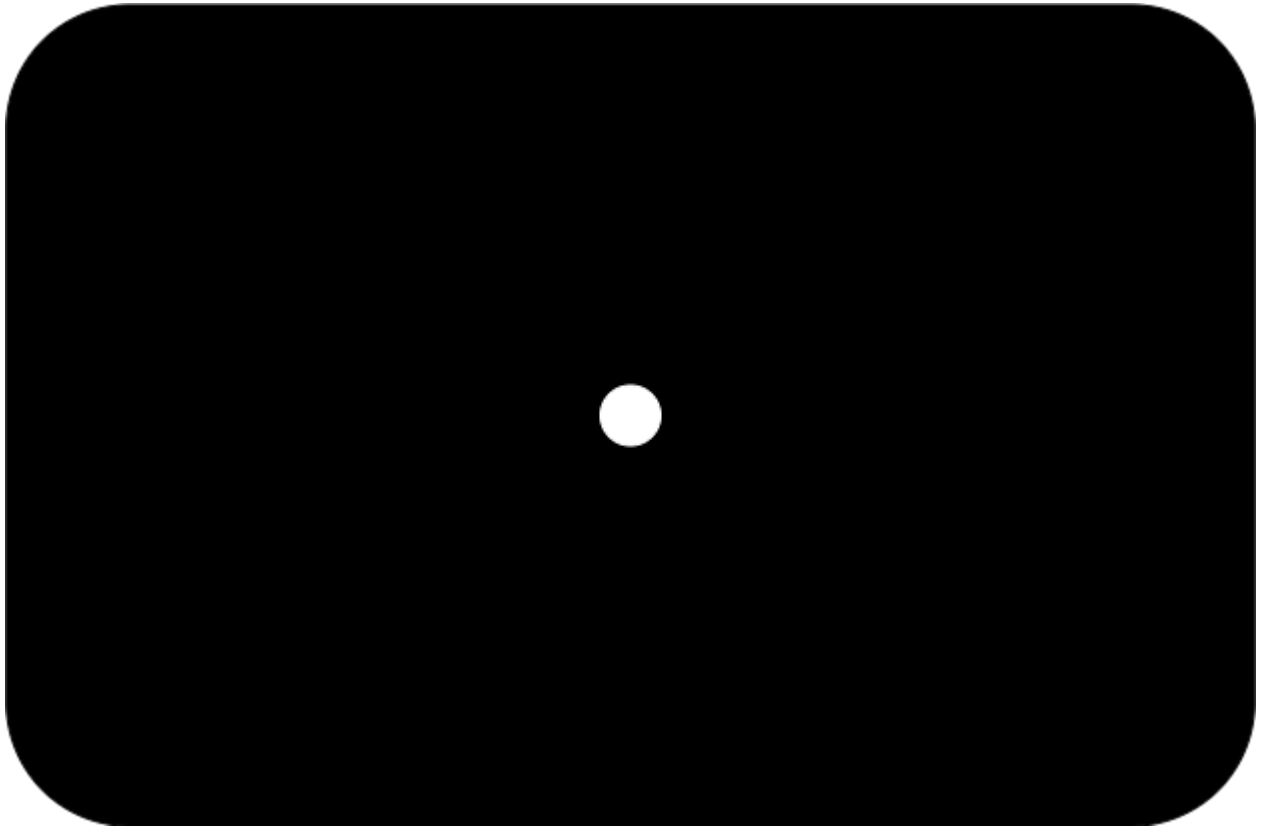
Setup: Virtual auditory environment using anechoic HRTFs

Locations:

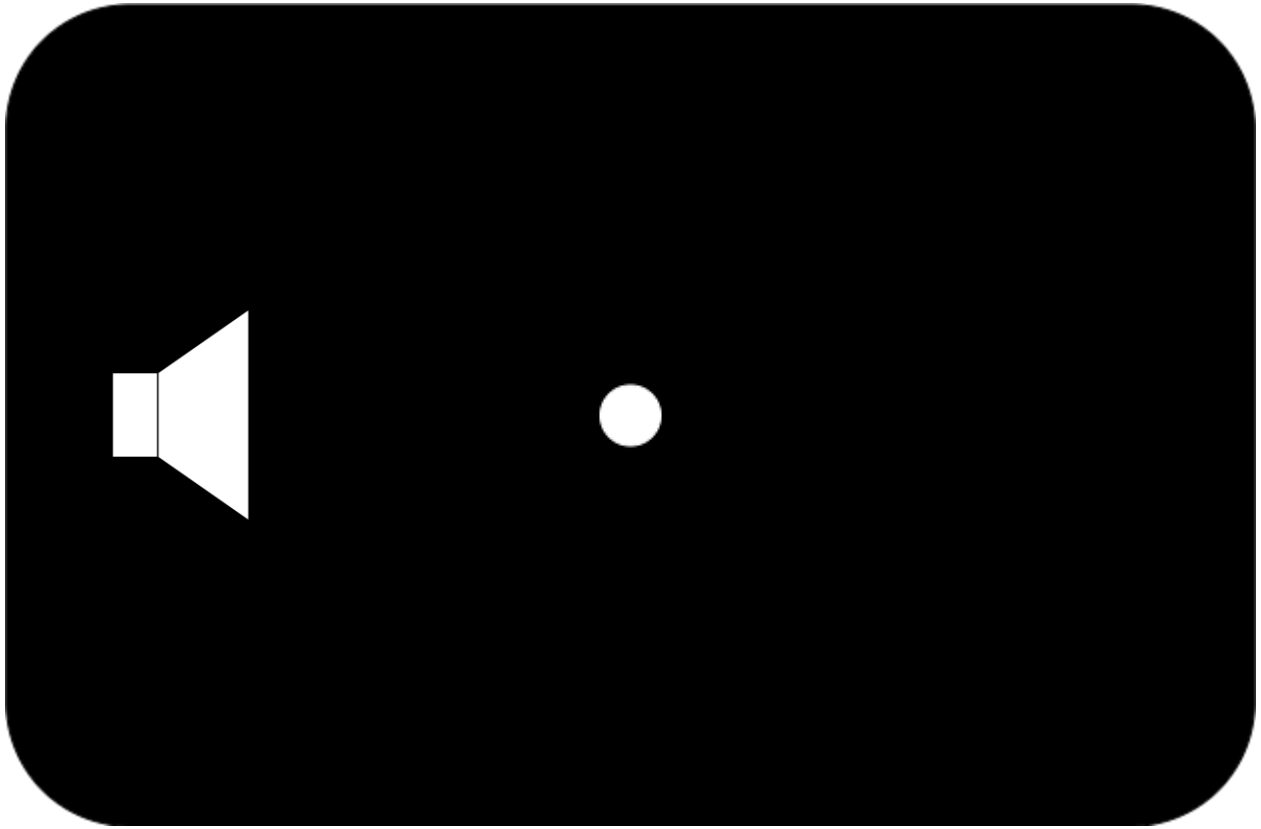
T1 at −25°, 0° or +25°

T2 shifted ±4.2° (central) or ±8.4° (lateral)

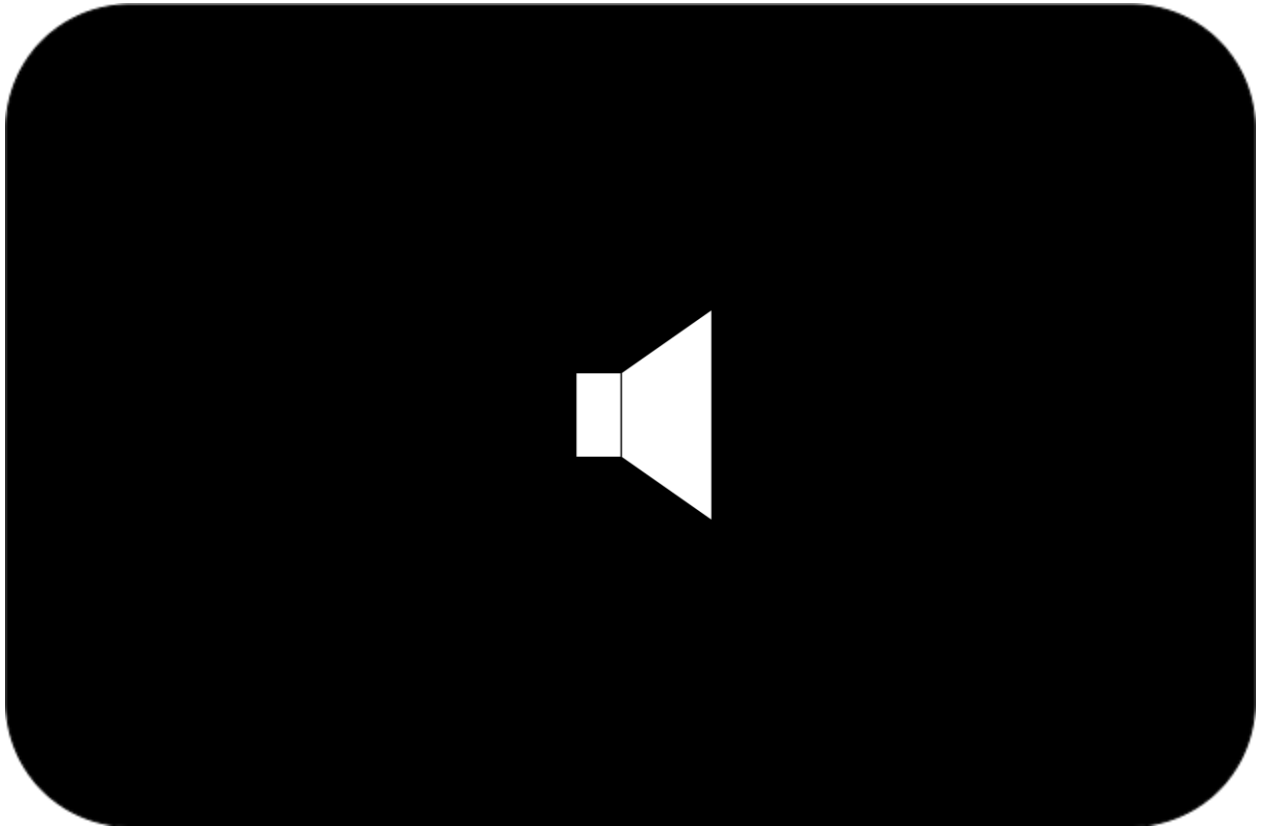
Fixation point



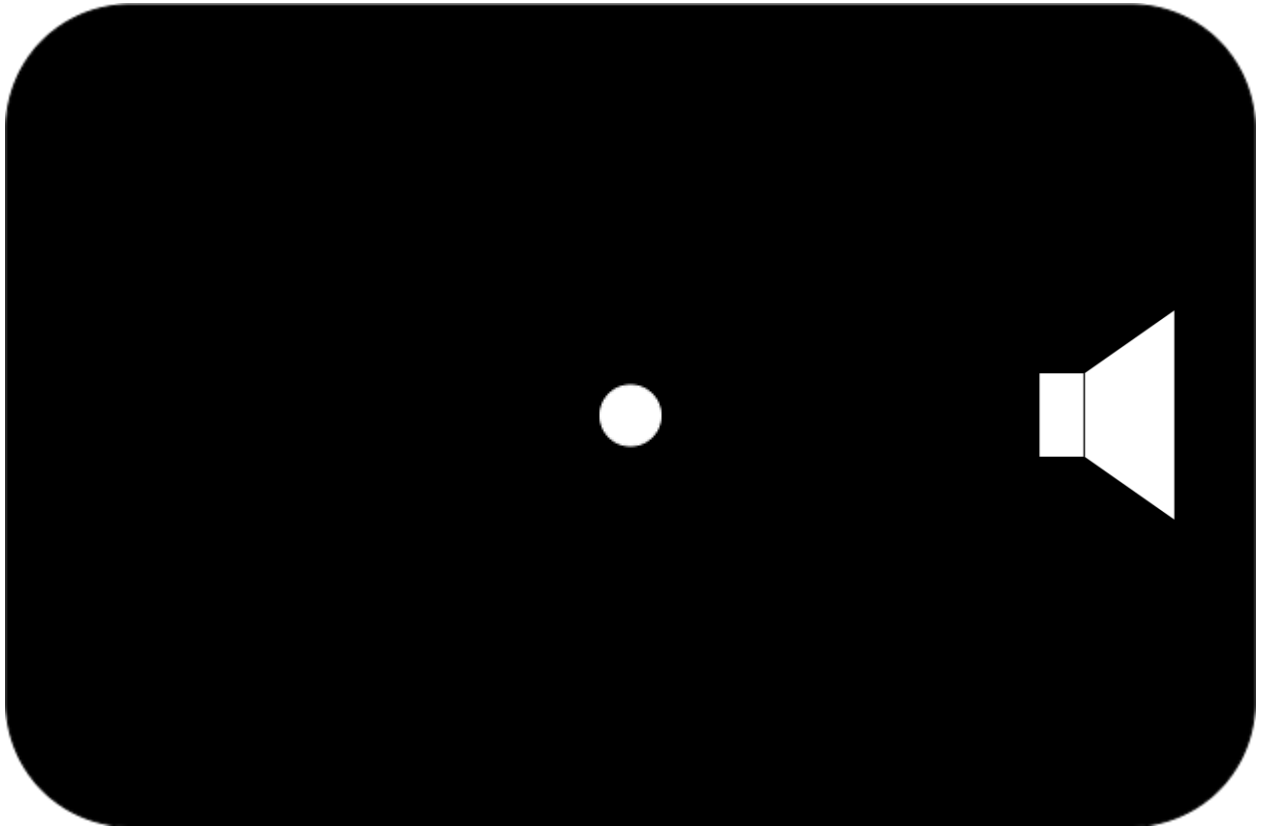
Target / cue location: LEFT



Target / cue location: CENTER

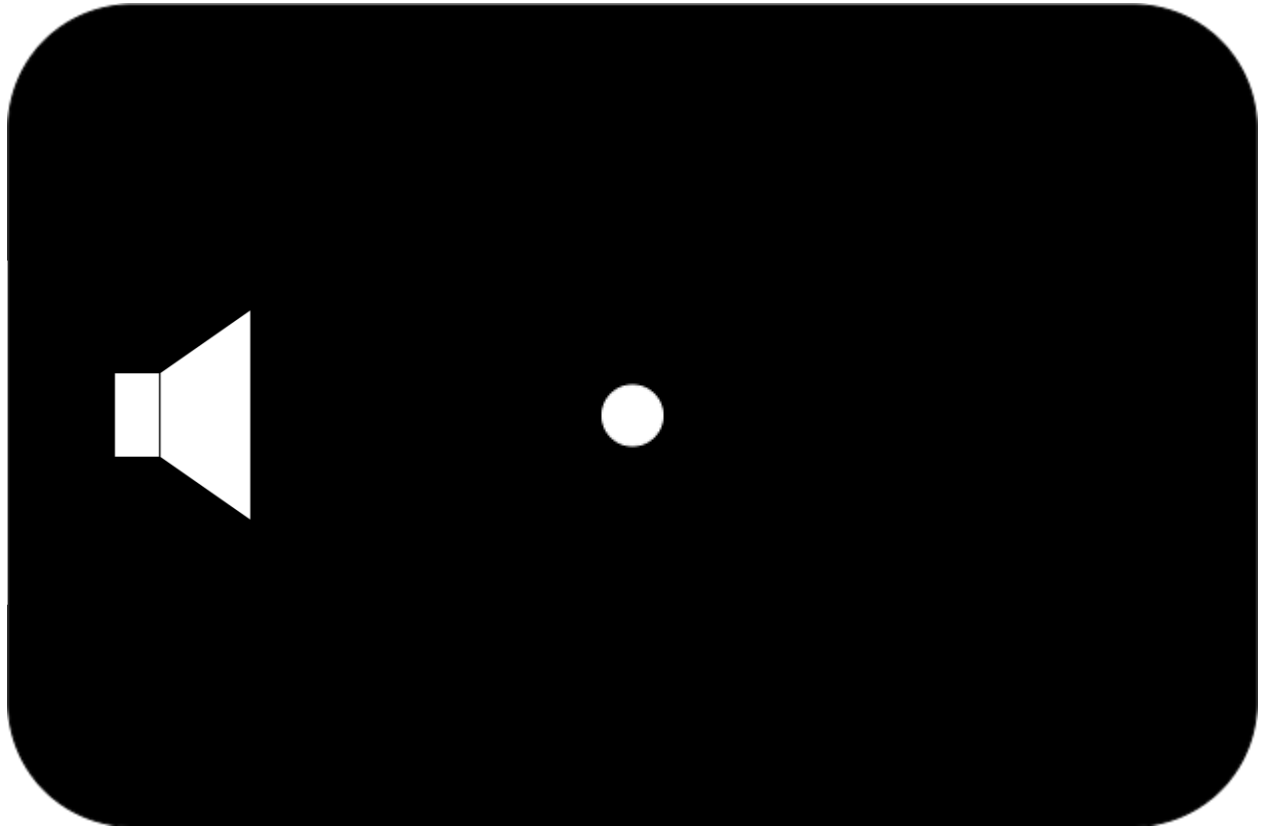


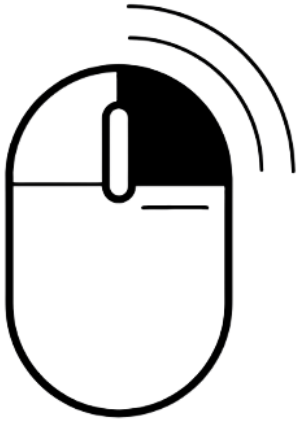
Target / cue location: RIGHT



Task : Did the sound move to the right or to the left?

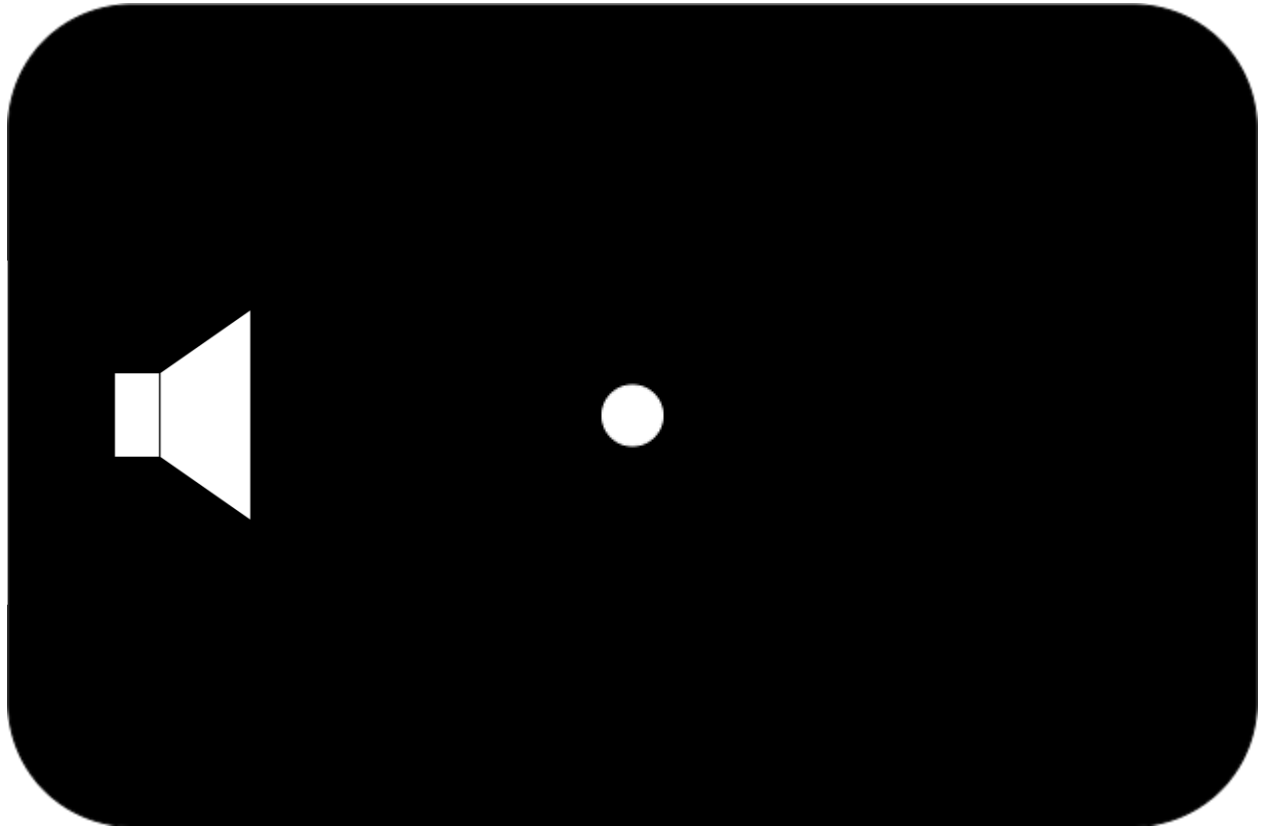
Task

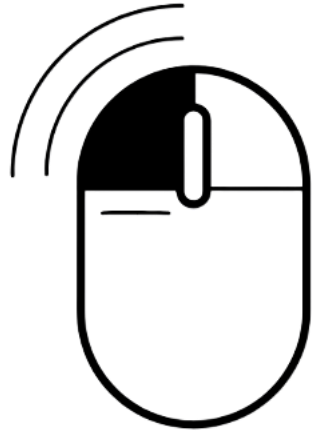




Right click if the sound moves the right

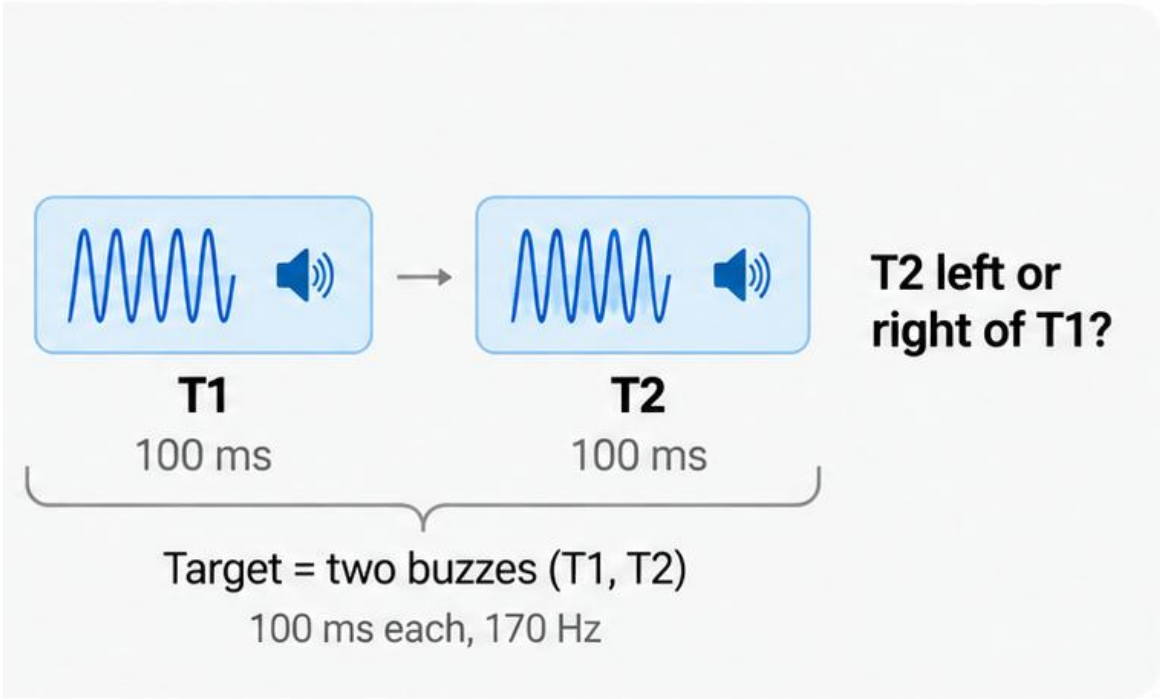
Task



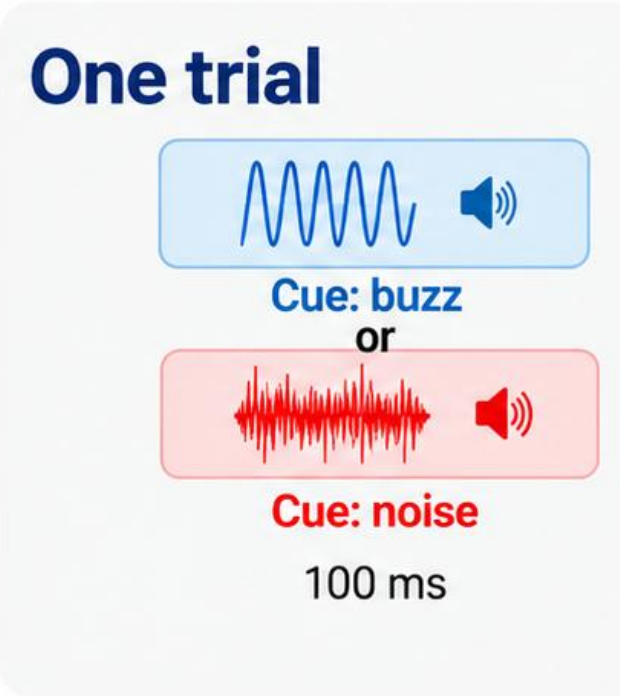


Left click if the sound moves the left

Stimuli

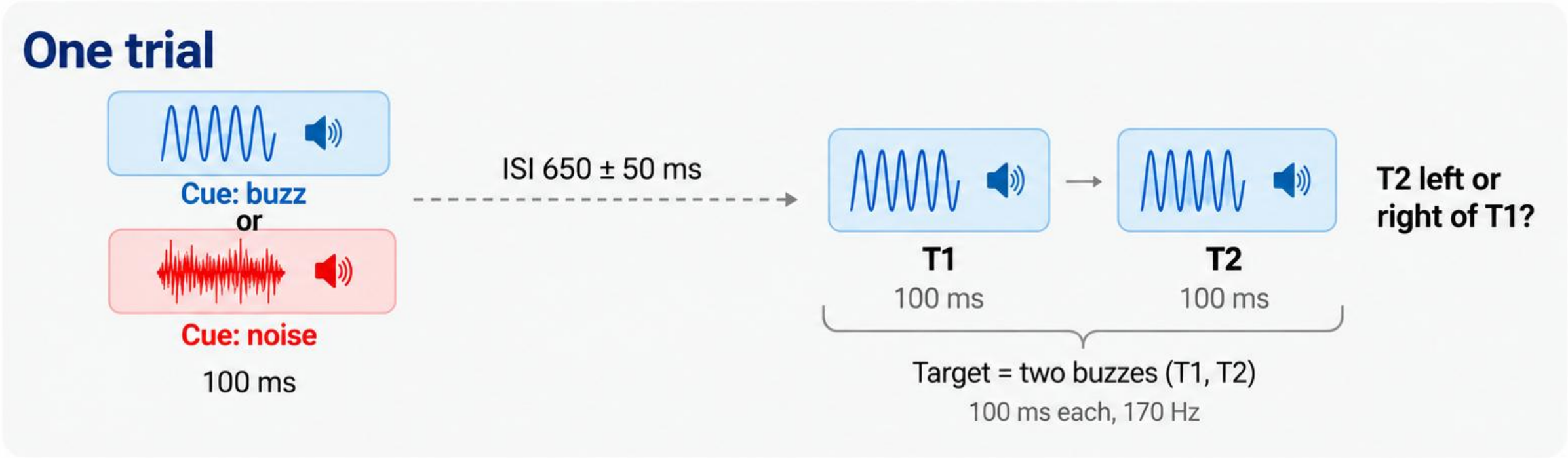

T1
100 ms
T2
100 ms
T2 left or right of T1?
Target = two buzzes (T1, T2)
100 ms each, 170 Hz

Stimuli



- with equal probability

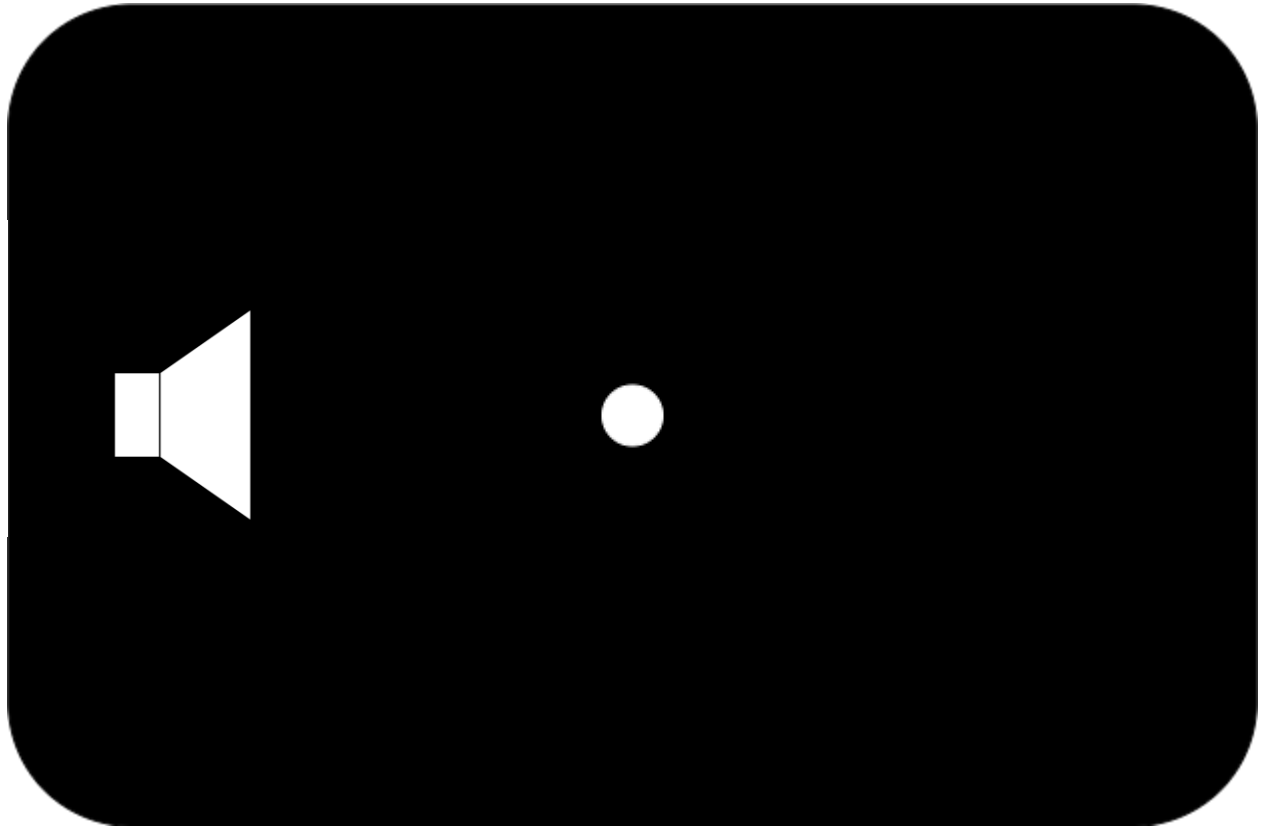
Stimuli



- with equal probability
- Random offset

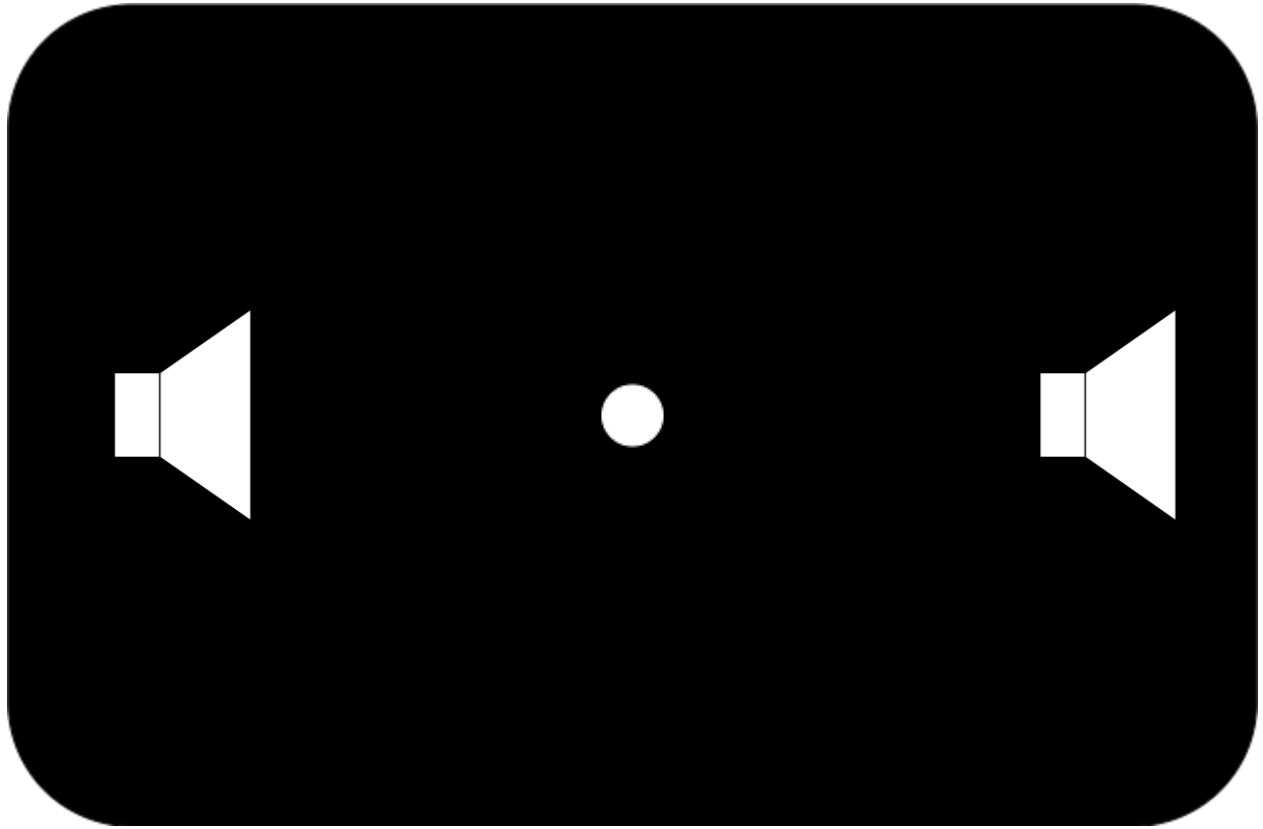
Valid trial example

Target



Invalid trial example

Target



Previous Findings

Auditory exogenous spatial attention remains understudied, with mixed findings on how it influences spatial perception

Cueing

- Can improve reaction times (Spence & Driver, 1994)
- Small improvements (Sach et al., 2000)
- Location-specific improvements (Maier et al., 2009)
- No improvement (Kopčo et al., 2001)

Yet understanding involuntary attentional orienting is increasingly relevant in information-rich environments.

Motivation

Maddox et al. (2014)

- Suggested auditory cueing effects may reflect eye position.

Šebeňa et al. (2026)

- Eyes fixated at a neutral location
- Cueing effects remained.

[1] Maddox RK, Pospisil DA, Stecker GC, Lee AK. Directing eye gaze enhances auditory spatial cue discrimination. Curr Biol.

[2] Šebeňa R, Ahveninen J, Best V, Shinn-Cunningham B, Kopčo N. Modality-dependent bottom-up attention and eye gaze direction affect auditory spatial discrimination. Atten Percept Psychophys.

Current Study

Behavioral Experiment

- Performed based on Šebeňa et al.

Motivation

Šebeňa et al. (2026): valid cue → better discrimination; invalid cue → worse discrimination and biased responses

Open Question

Were **these effects** truly attentional, or partly driven by cue-target similarity?



Current Study

Behavioral Experiment

- Performed based on Šebeňa et al.
- Examined whether **cue-target similarity** affects performance

Hypothesis:

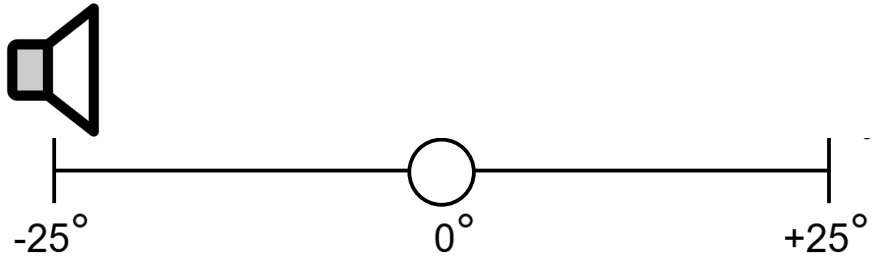
Effects of cueing will be **reduced** when the cue-target are dissimilar

- Tested whether fixation modulates the cueing effect

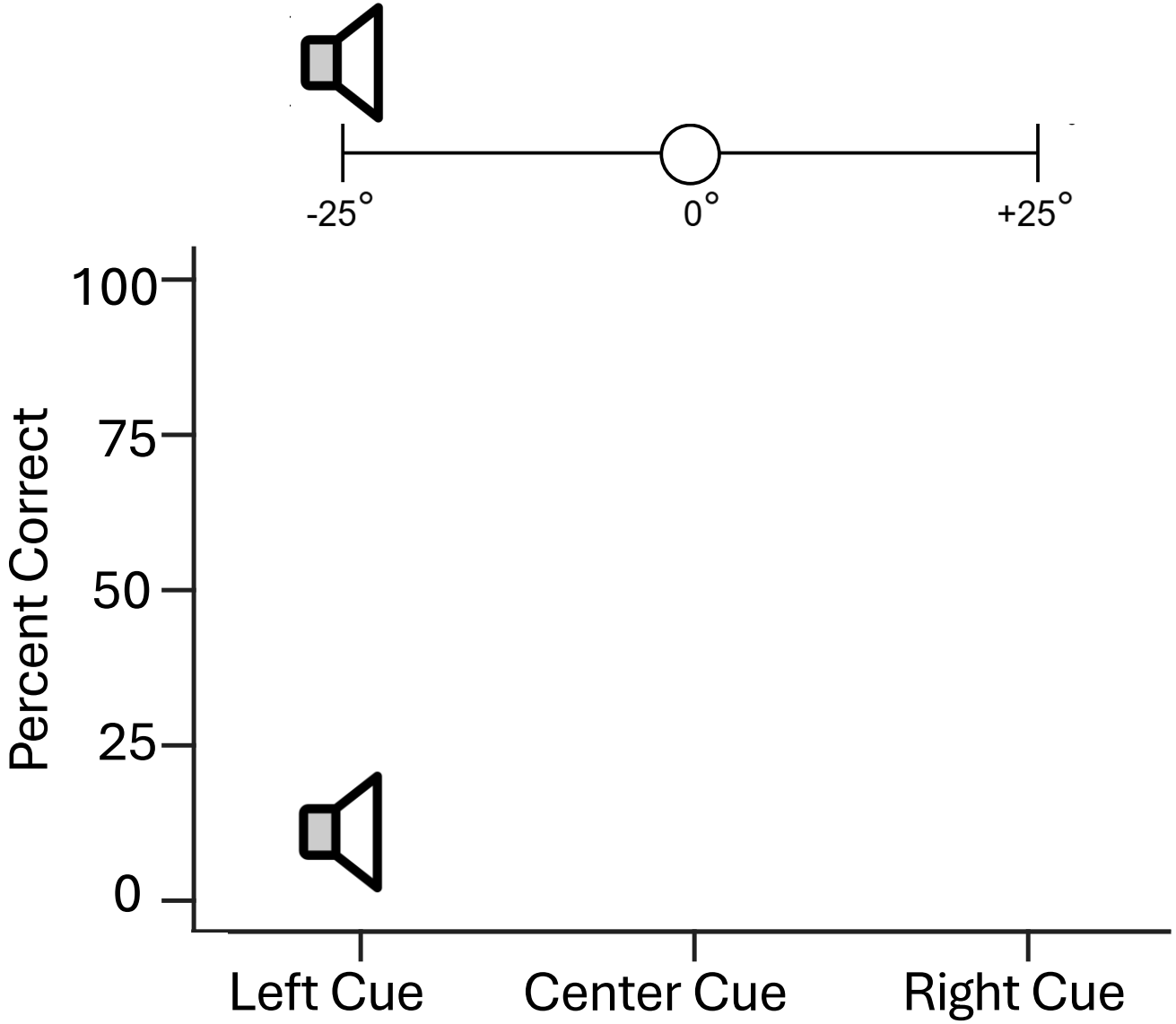
Results: Percent Correct

Percent Correct: Target left

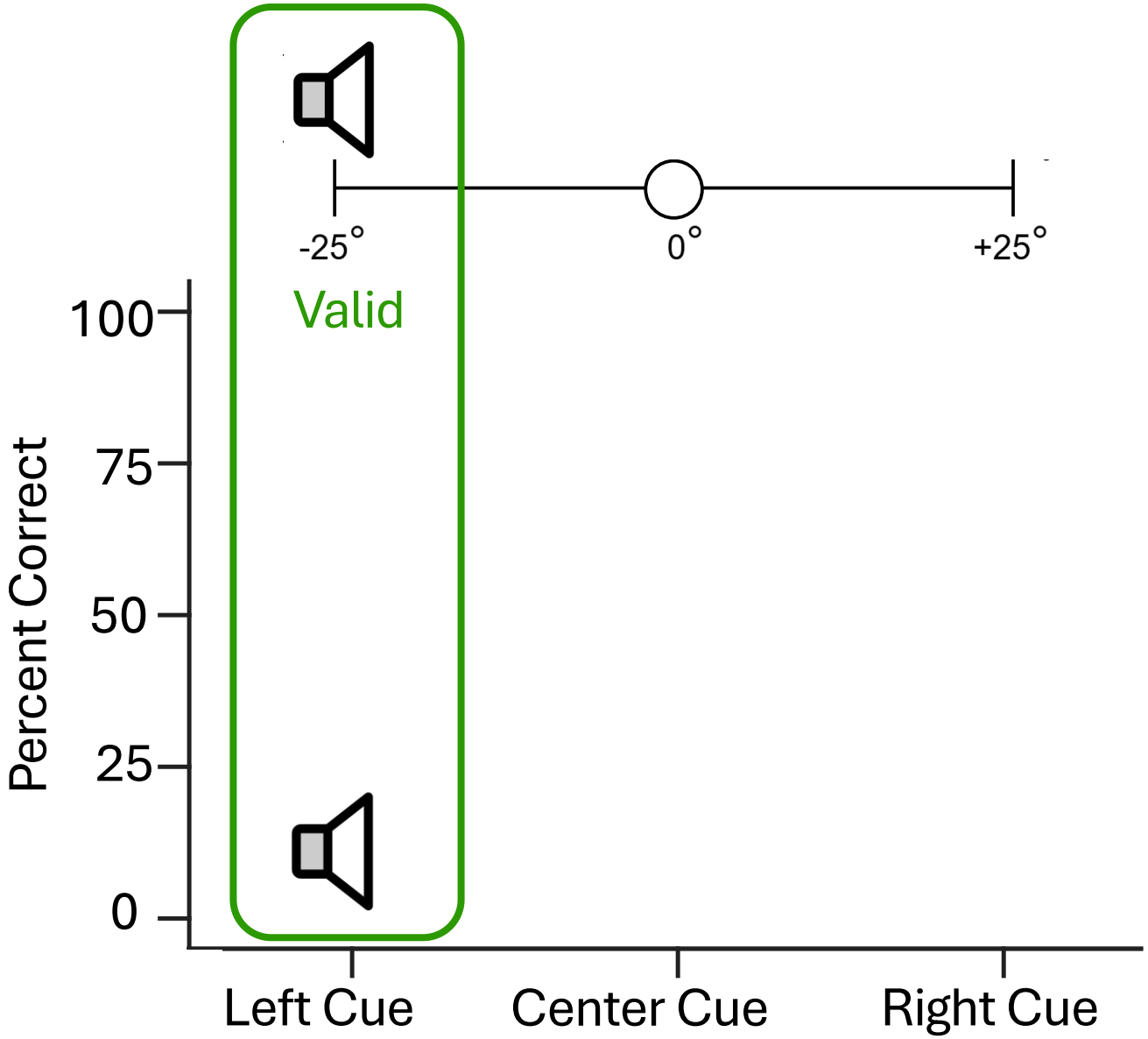
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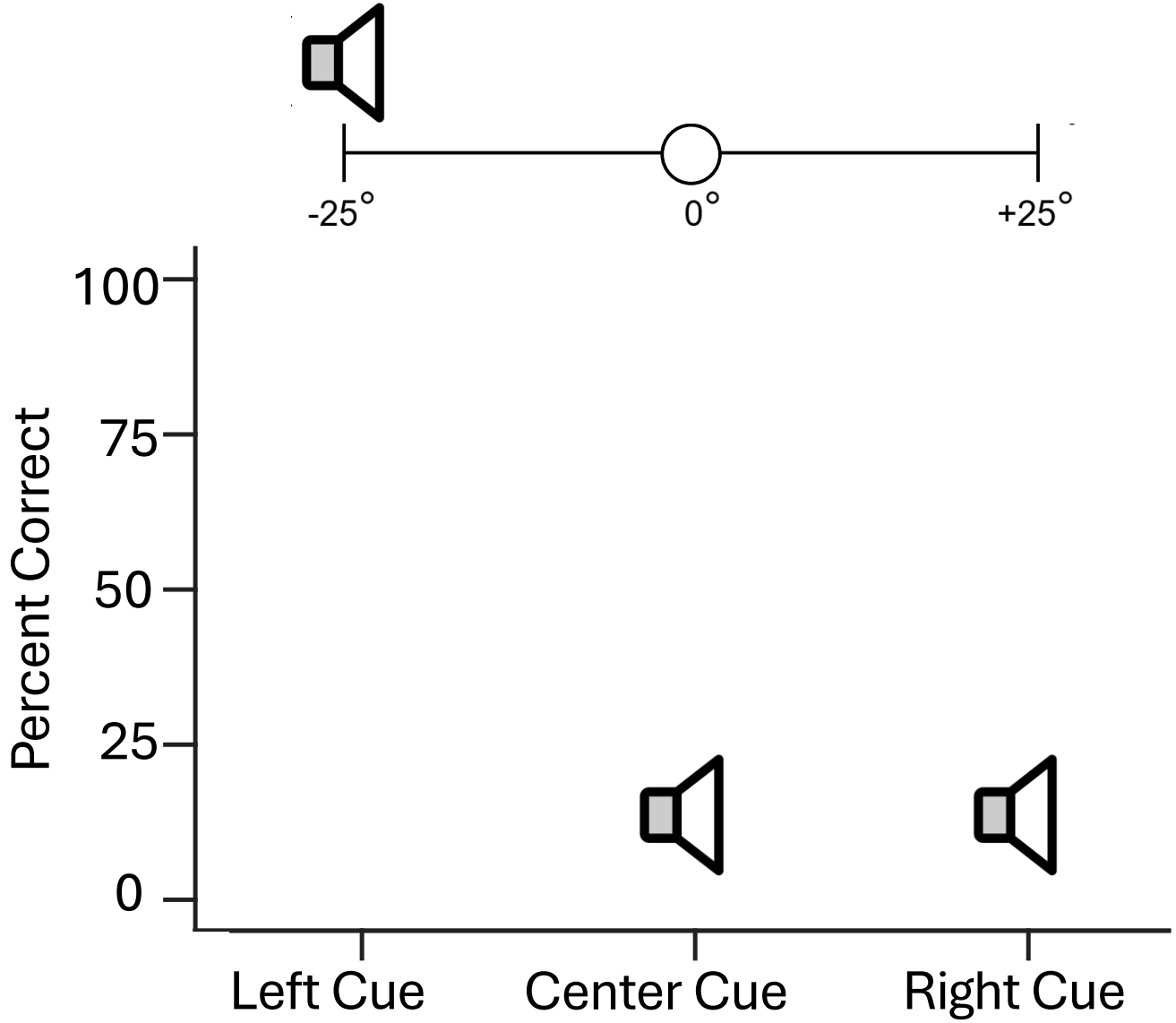
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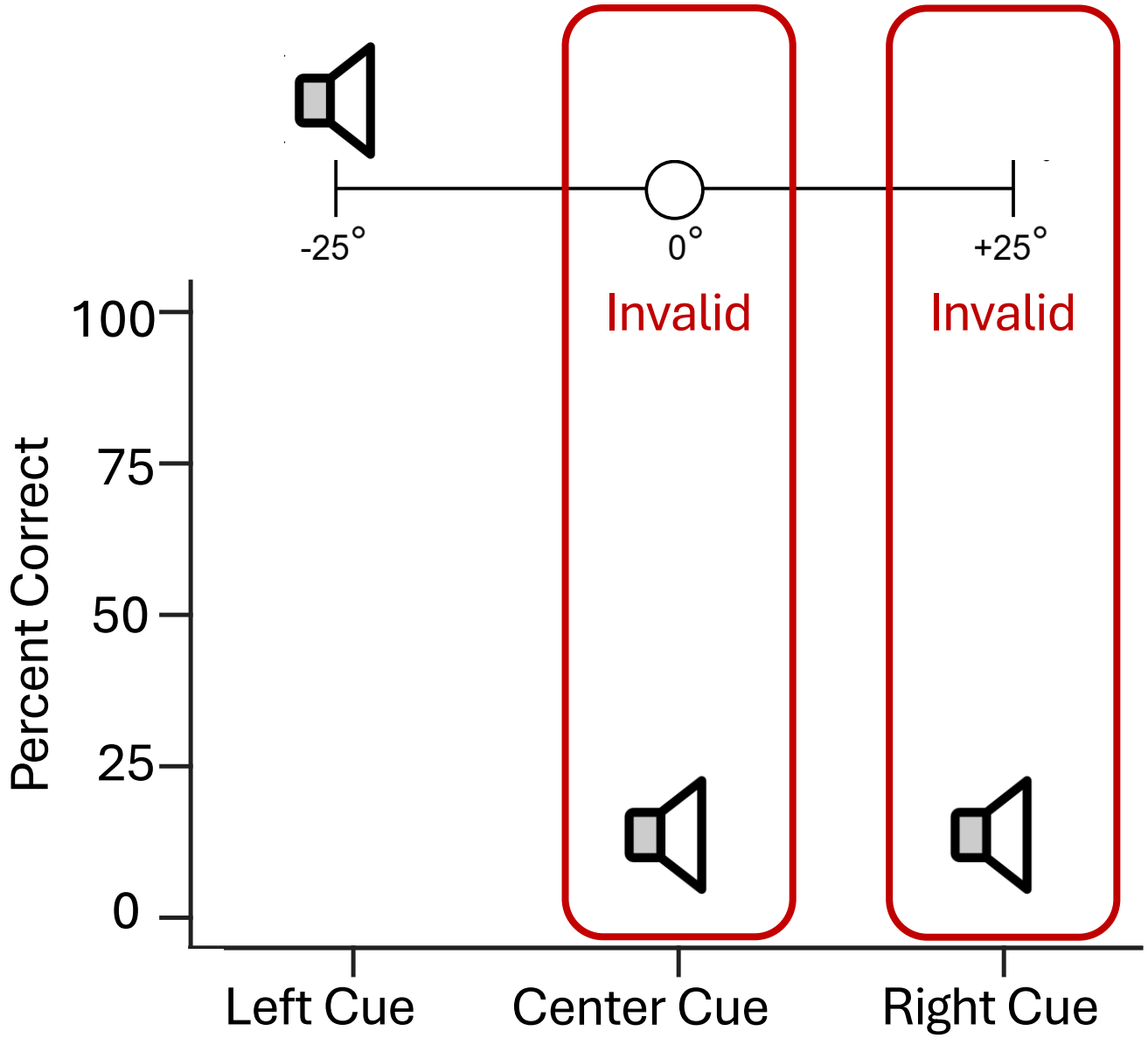
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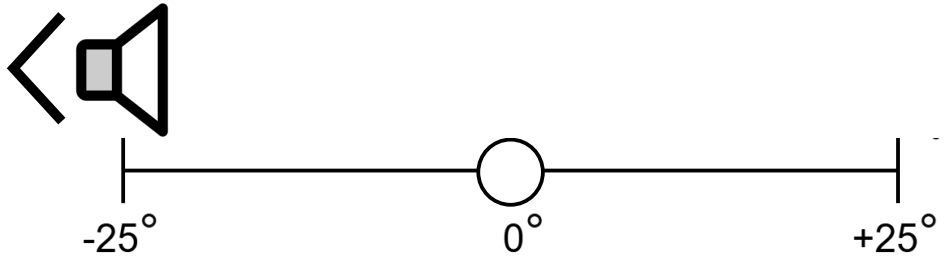
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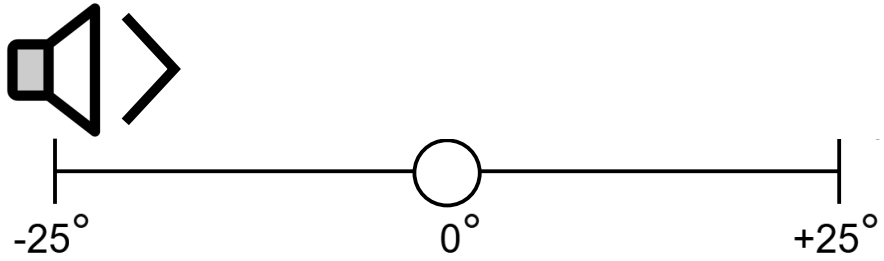


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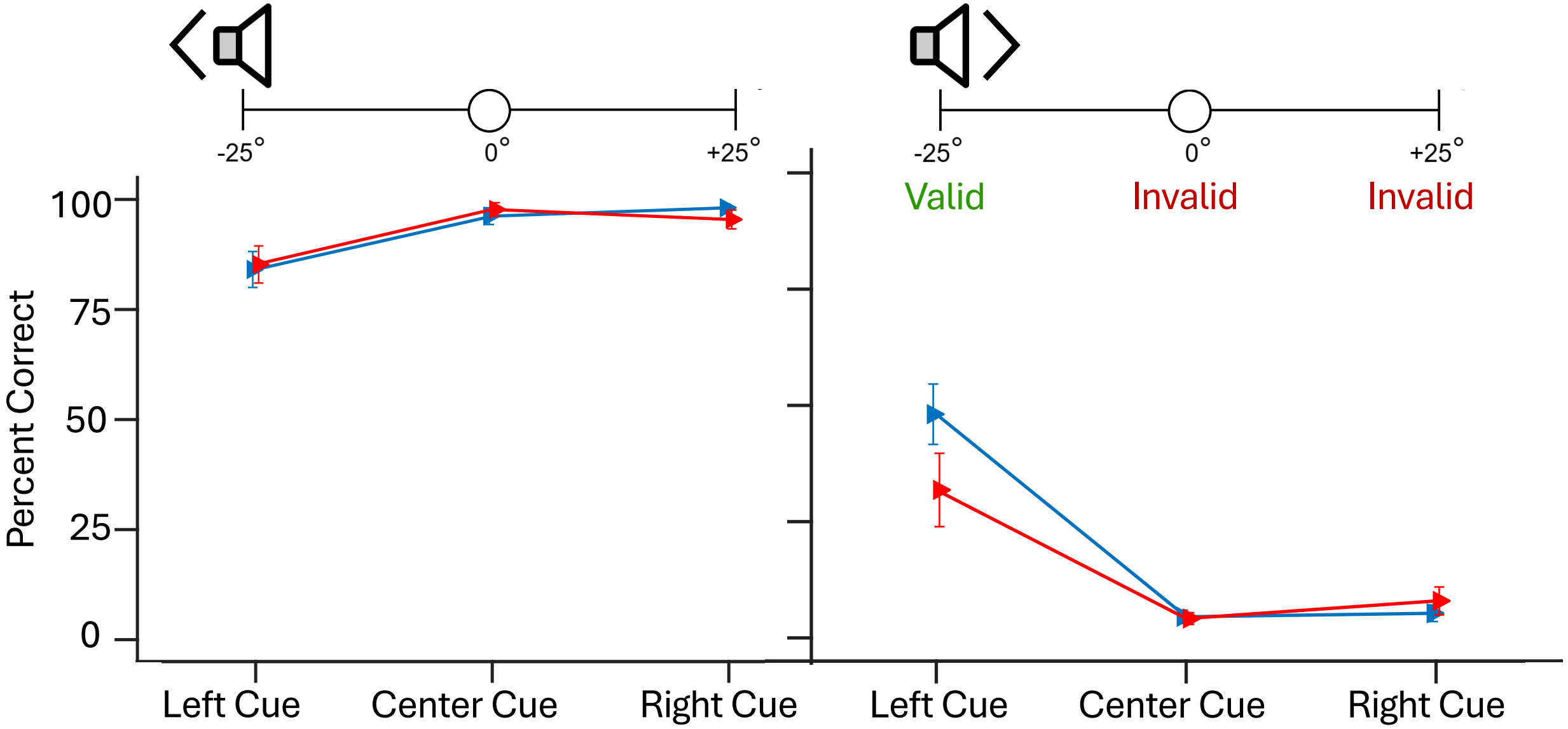


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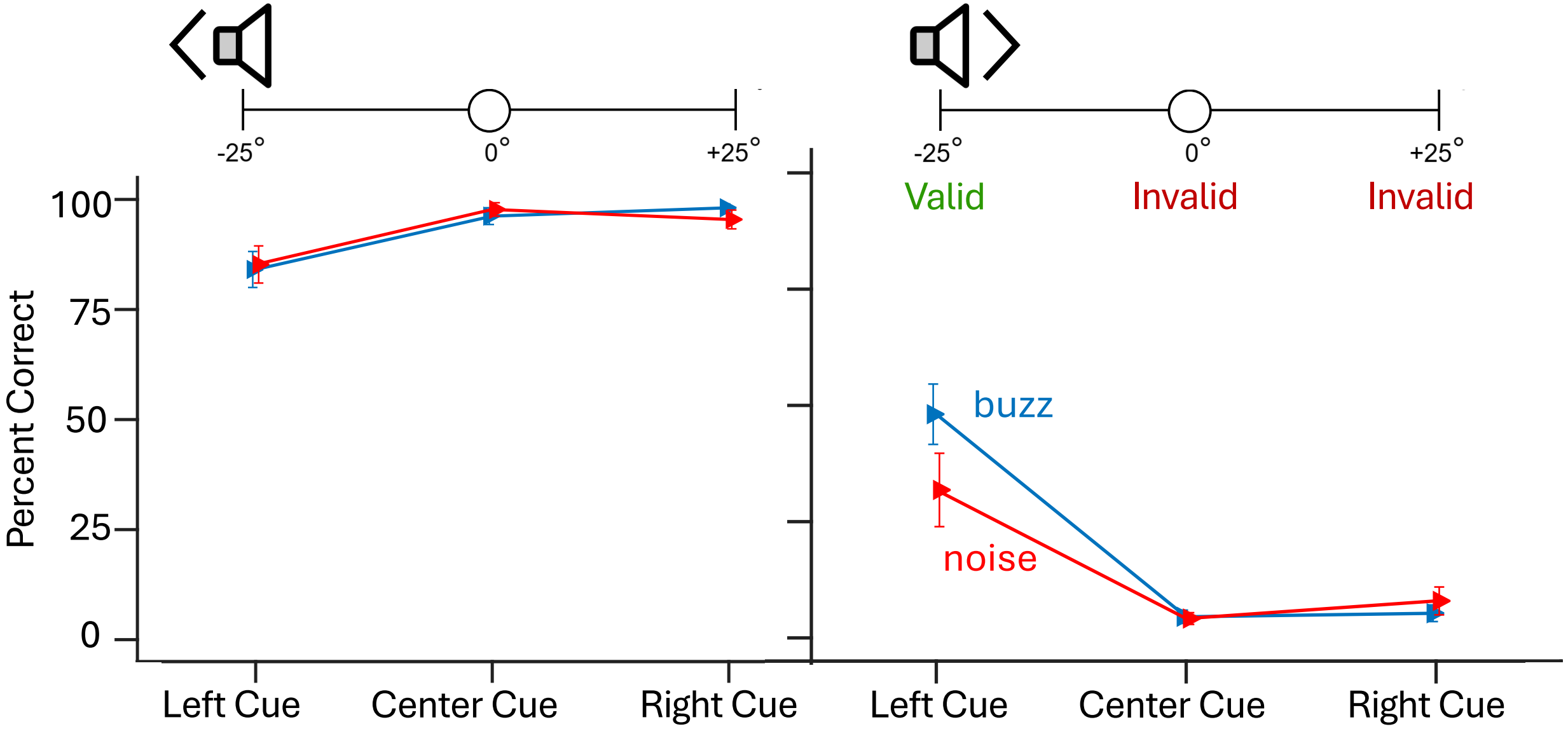




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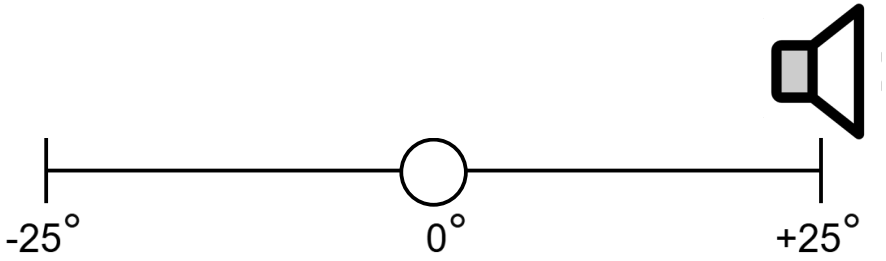


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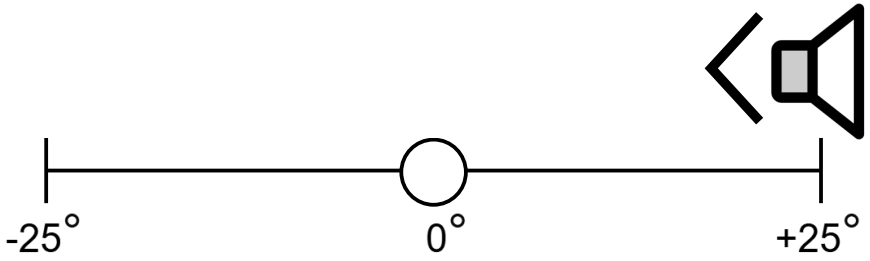


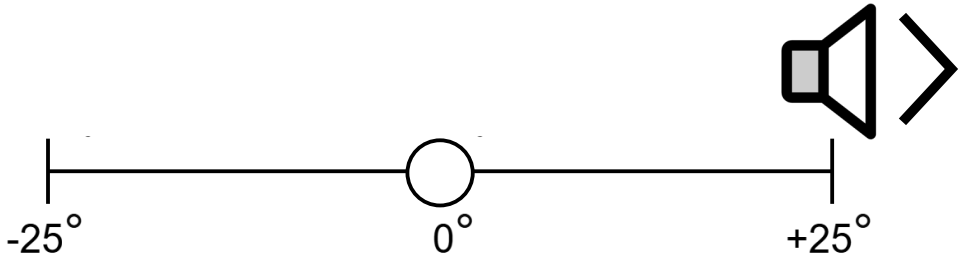
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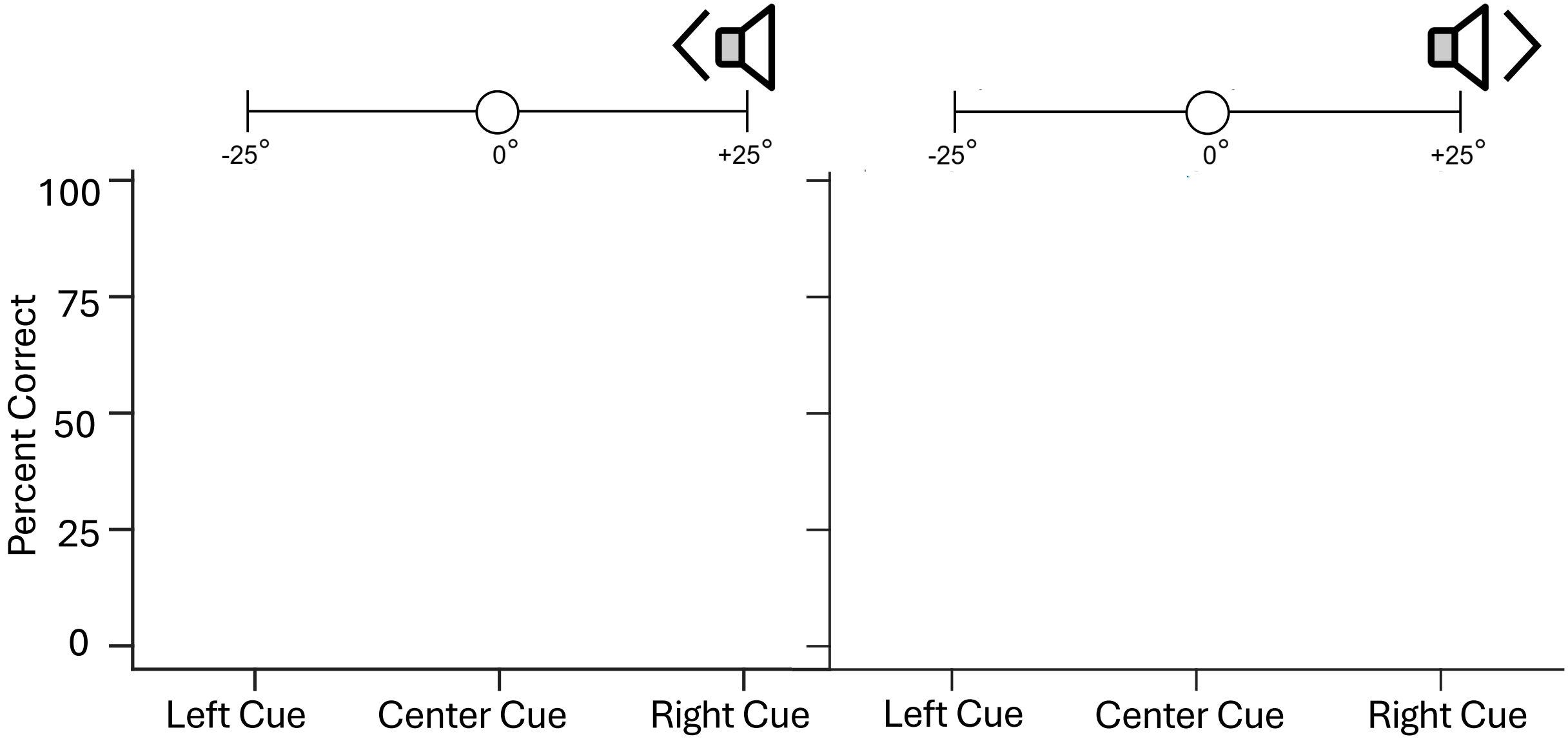


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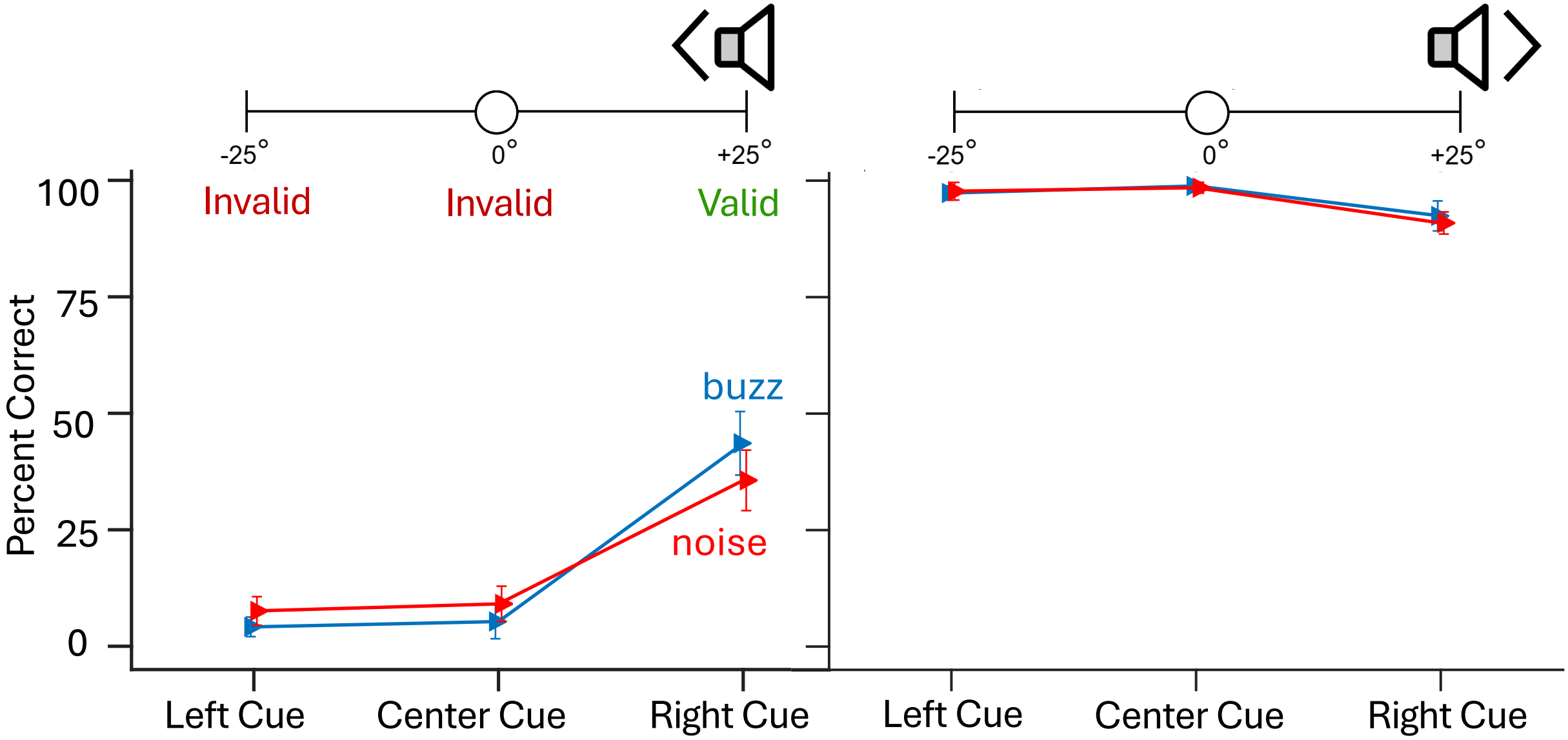




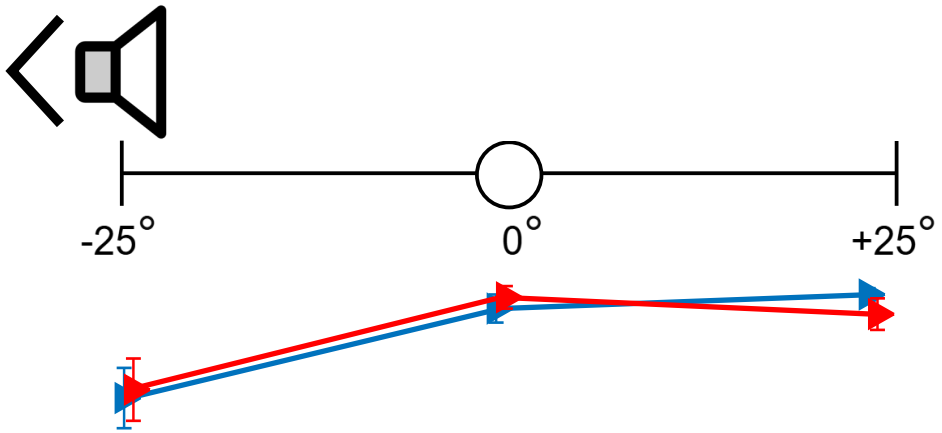
Percent Correct: Target right



Percent Correct: Target right



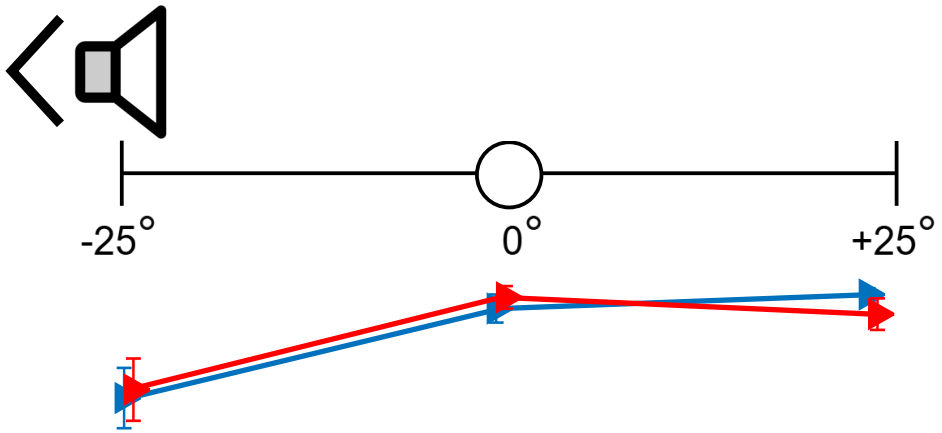
Lateral Target

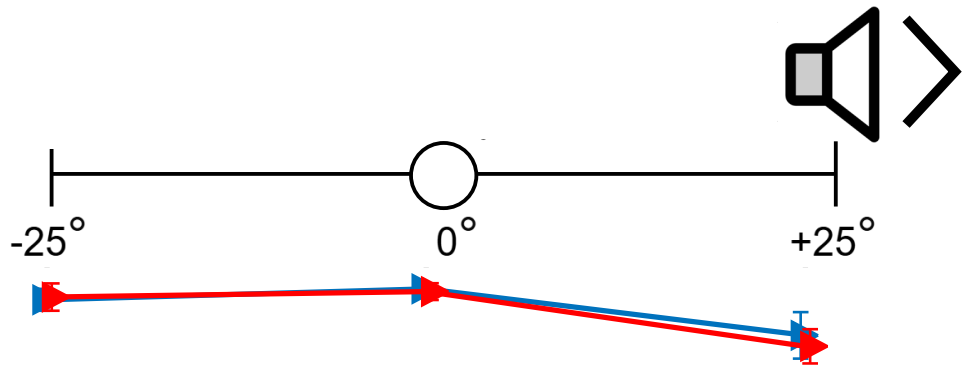


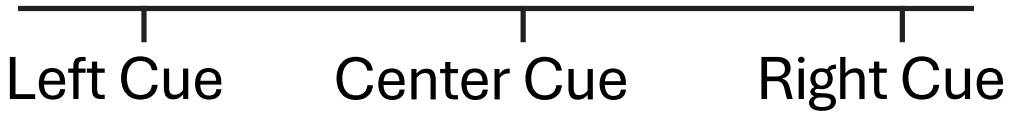
Left Cue Center Cue Right Cue

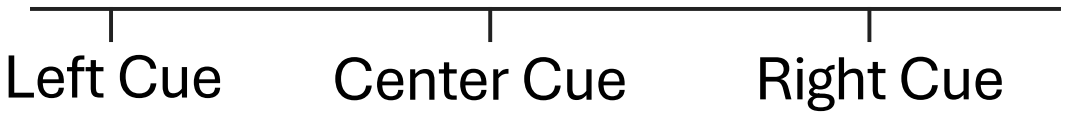
Left Cue Center Cue Right Cue

Lateral Target

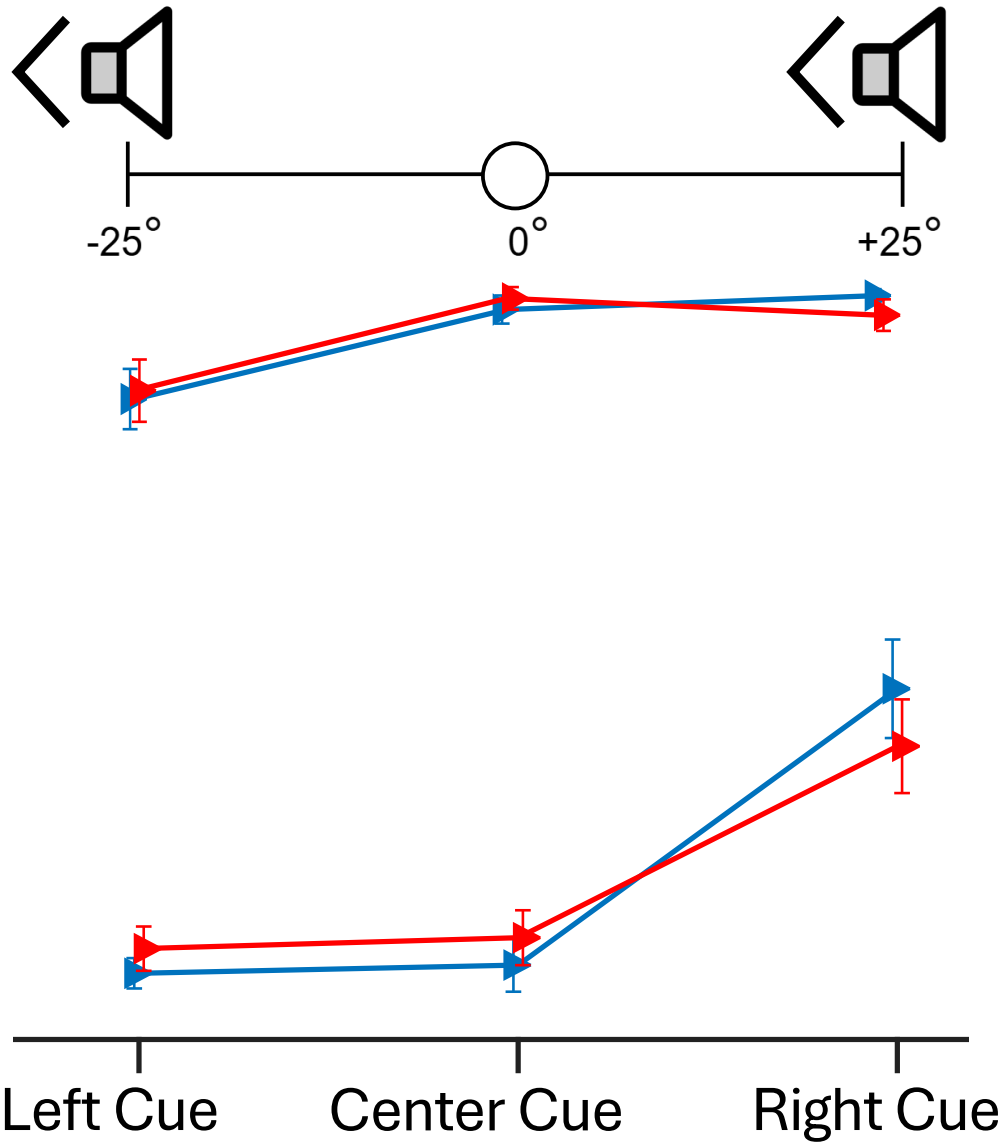


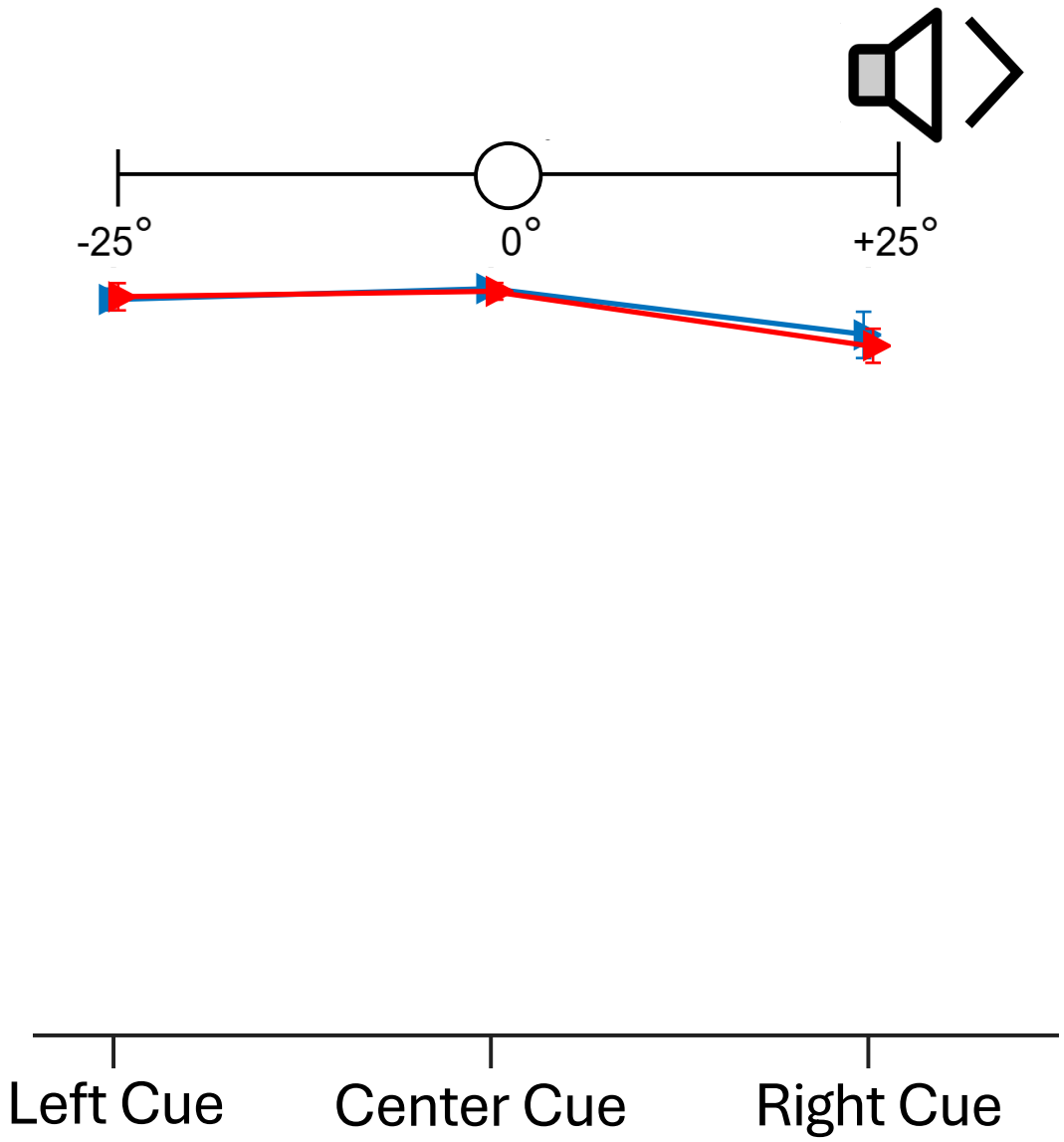




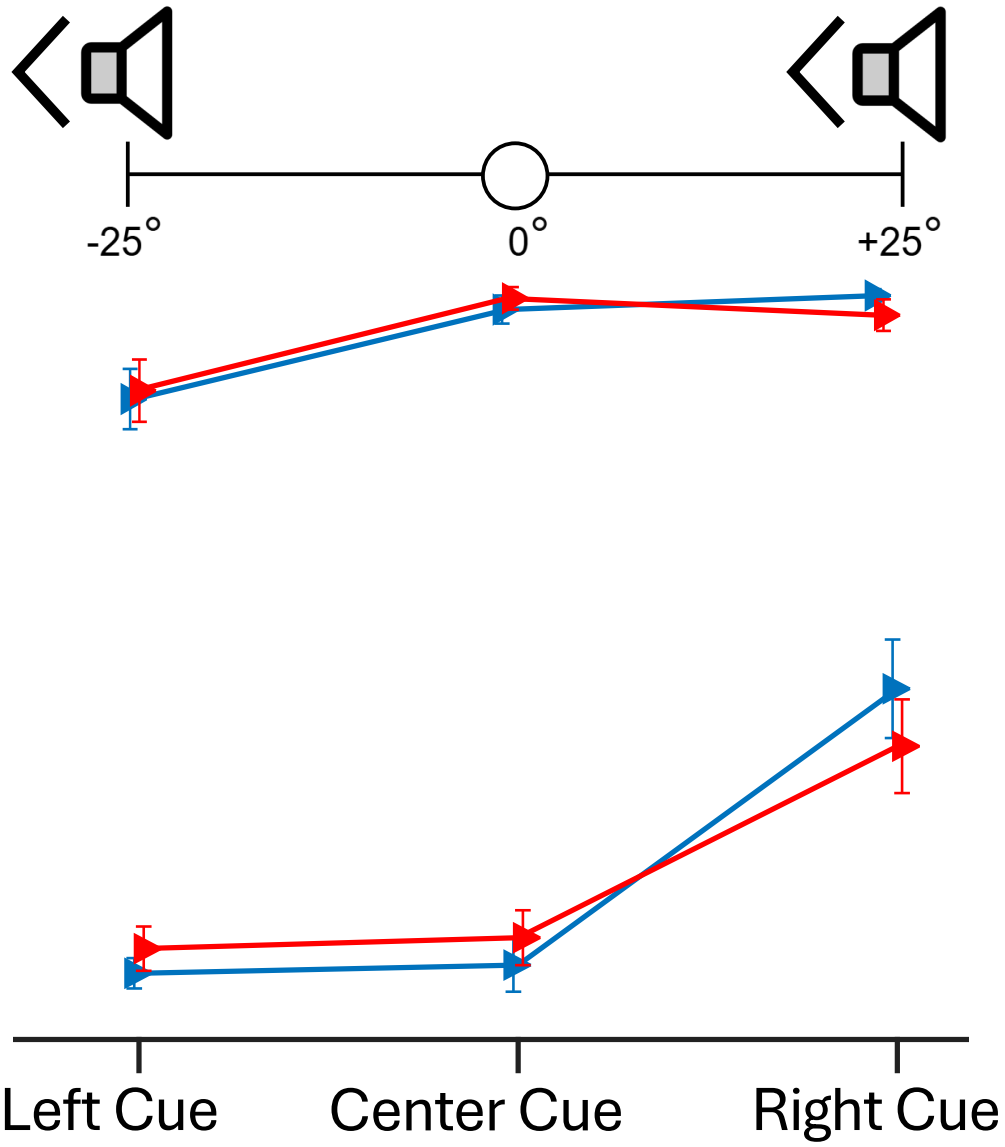


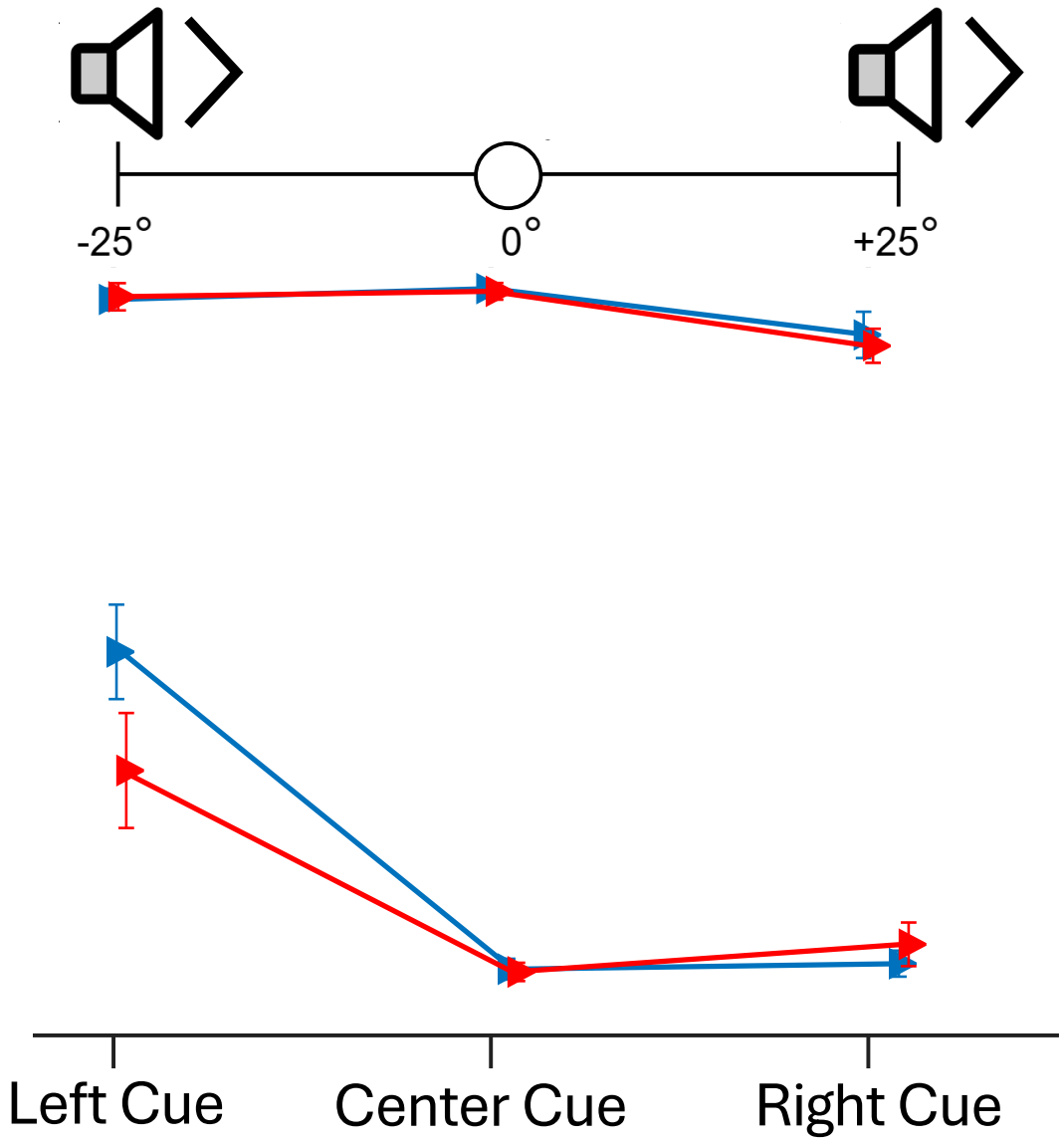
Lateral Target





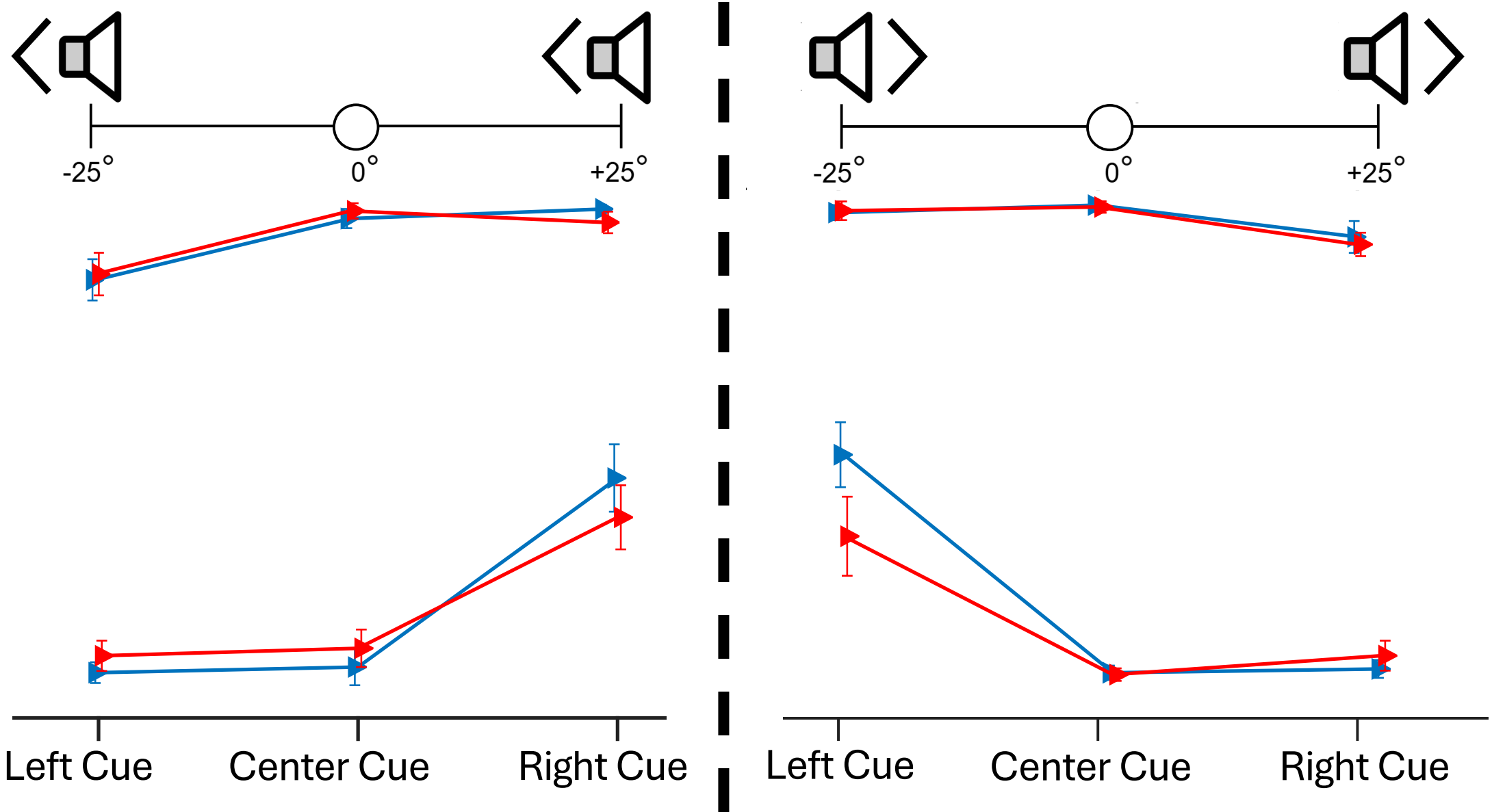
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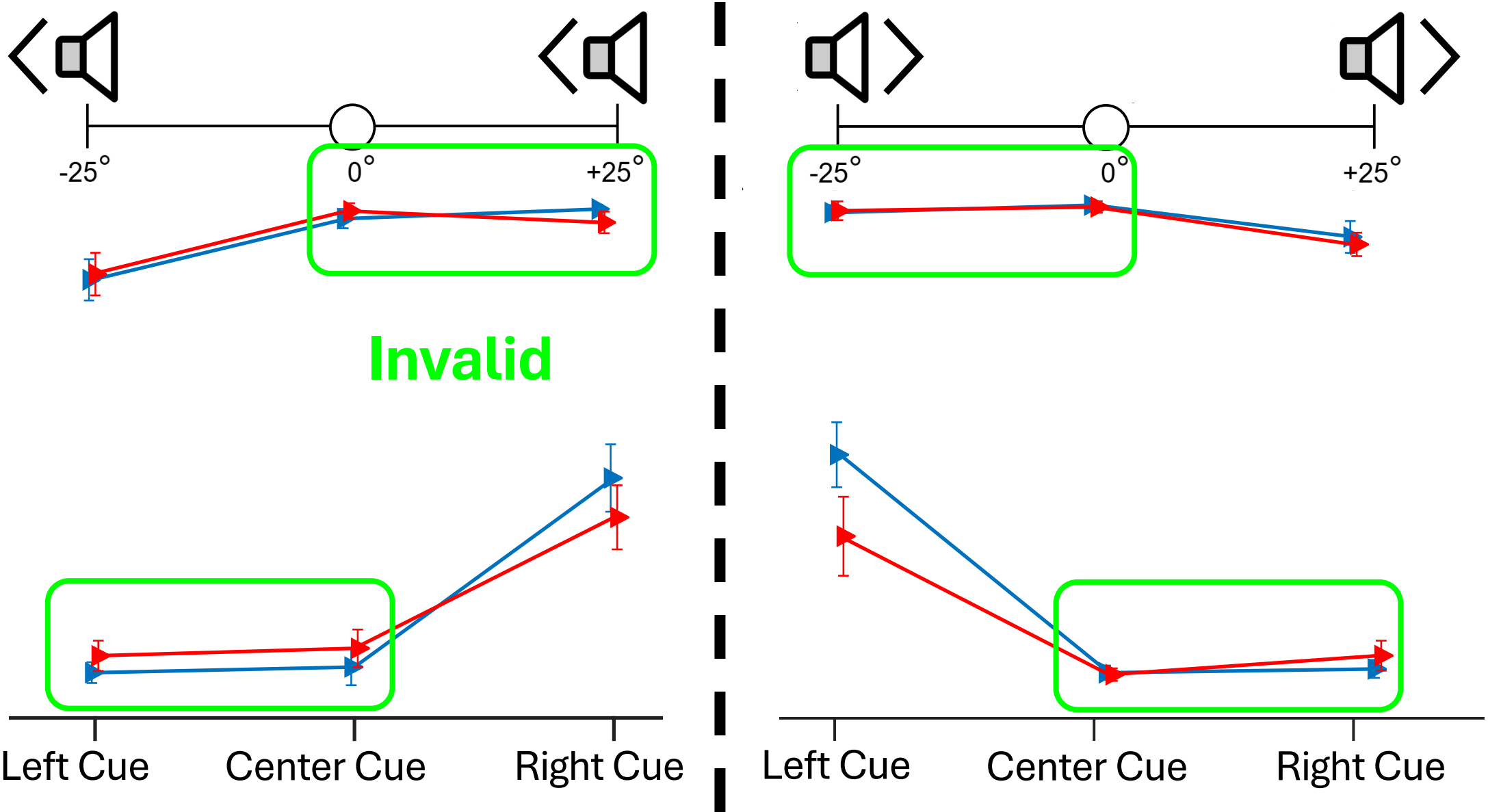
Lateral Target

Mirror



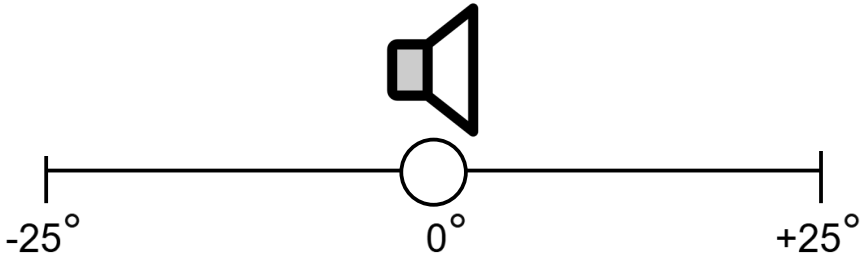
Lateral Target

Mirror

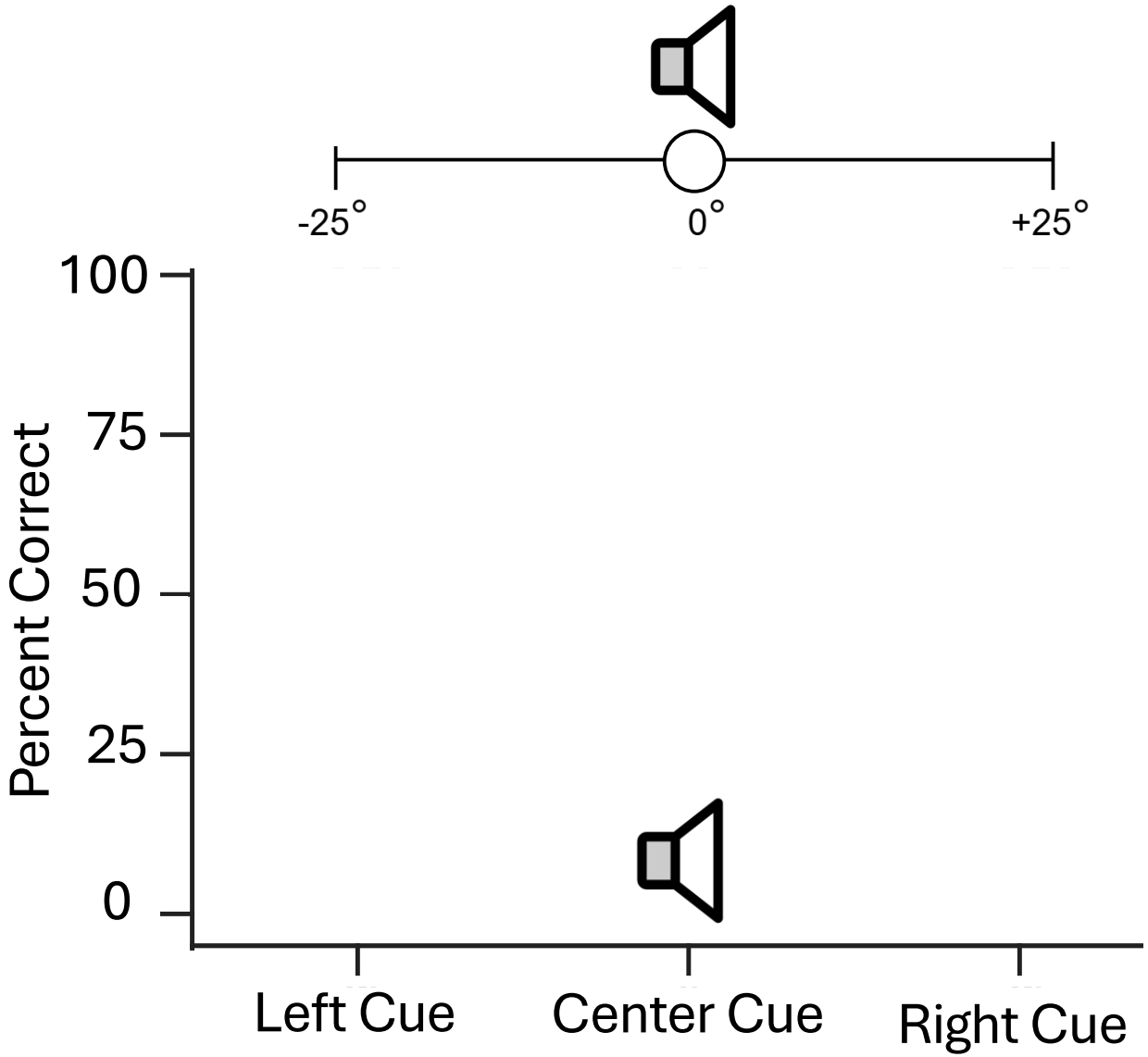


Percent Correct: Target center

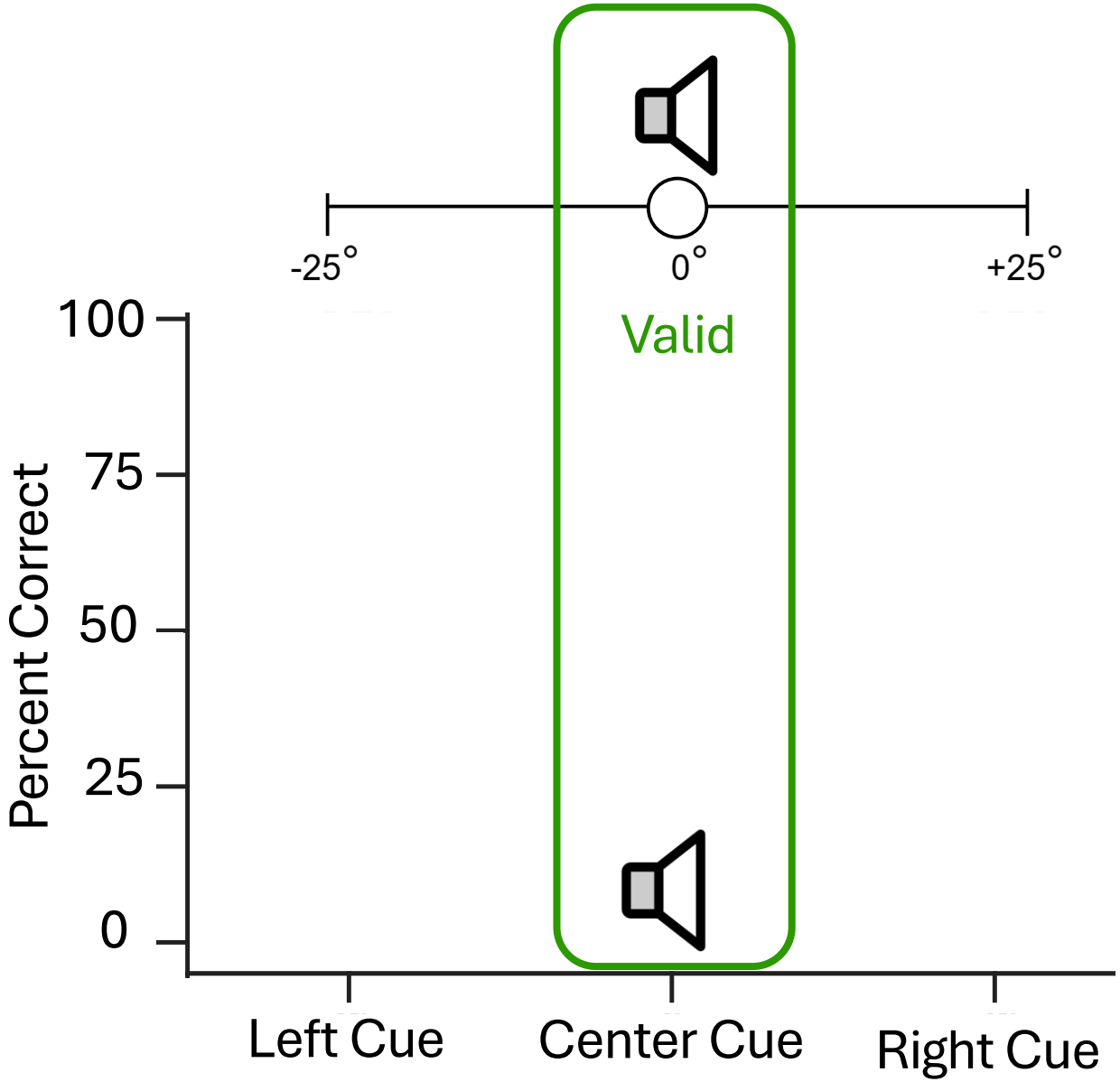
Percent Correct: Target center



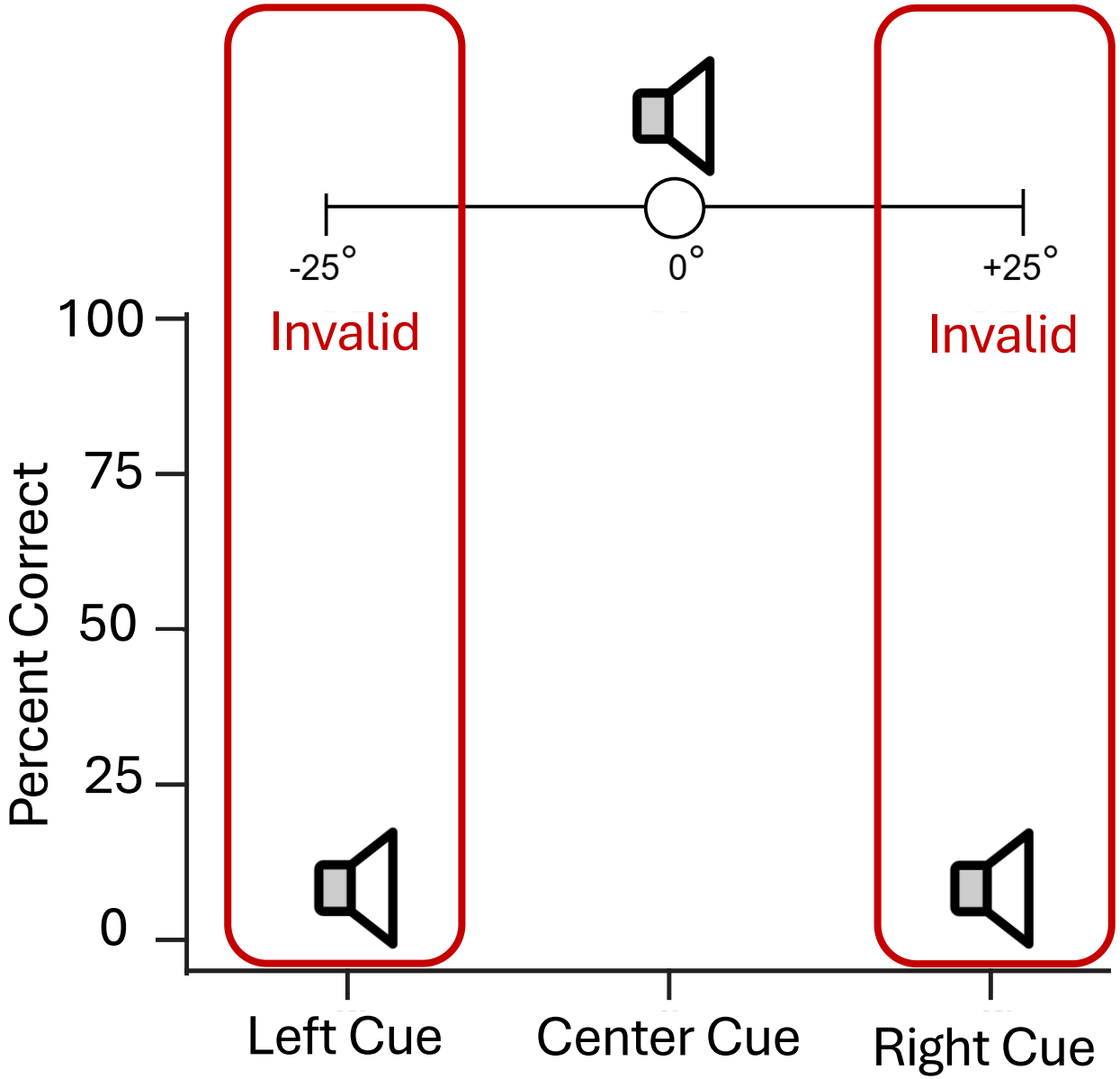
Percent Correct: Target center



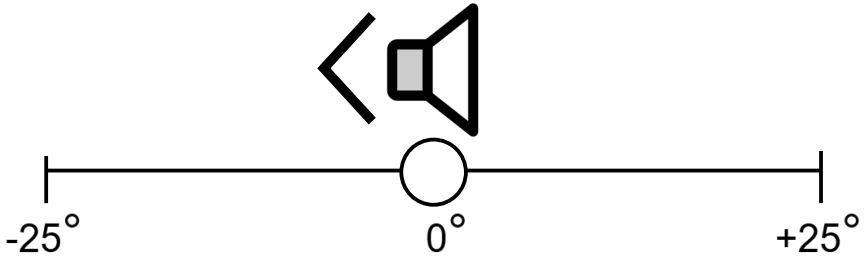
Percent Correct: Target center

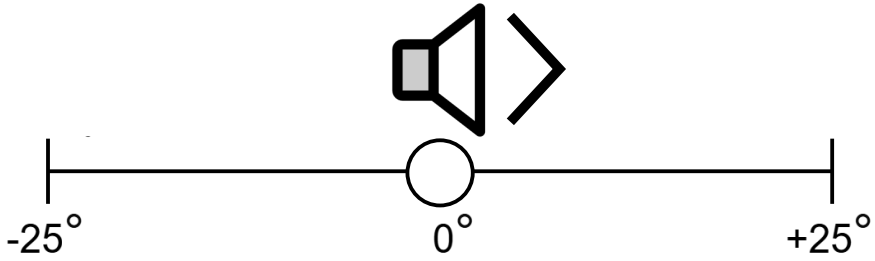


Percent Correct: Target center

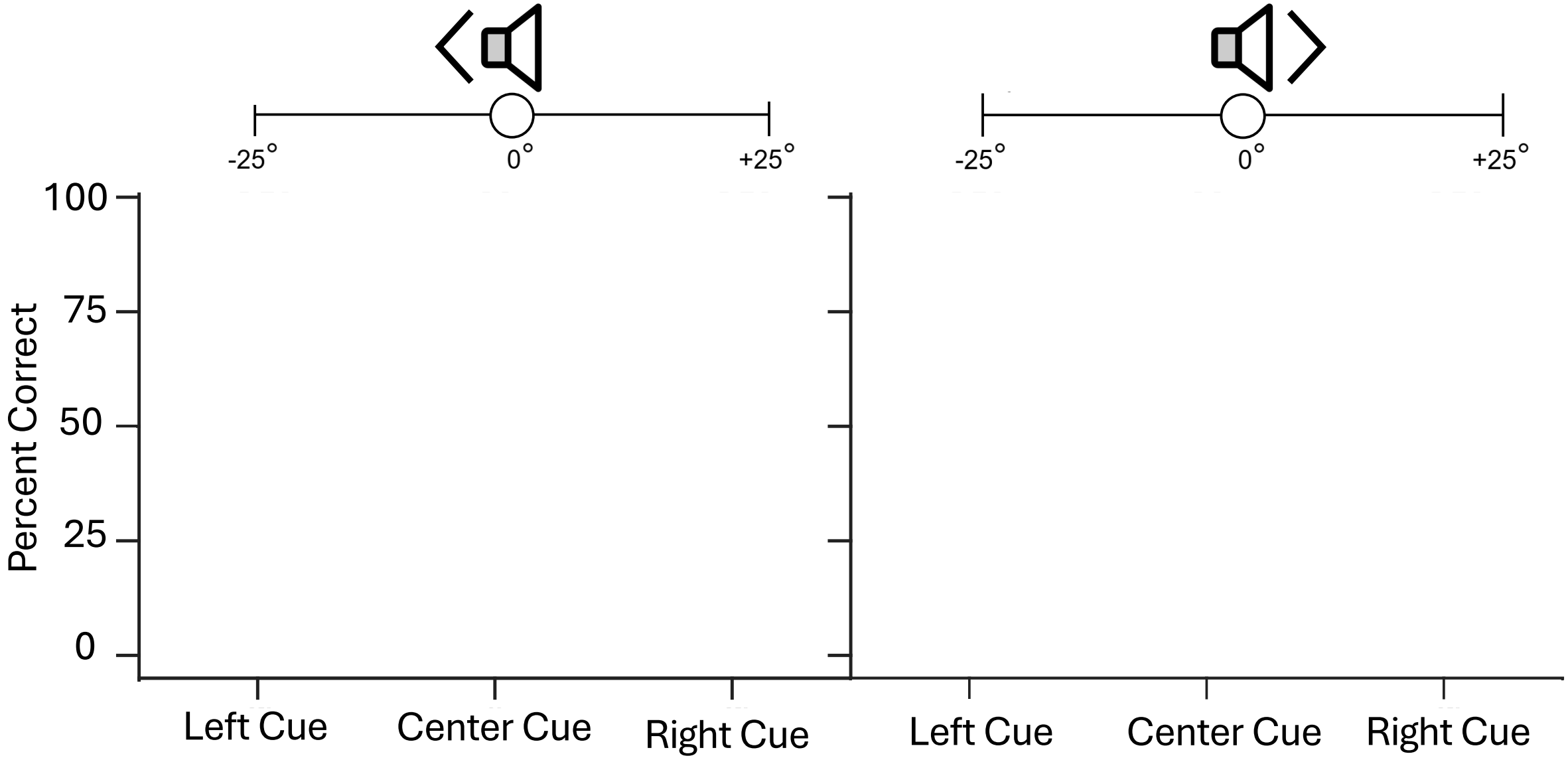


Percent Correct: Target center

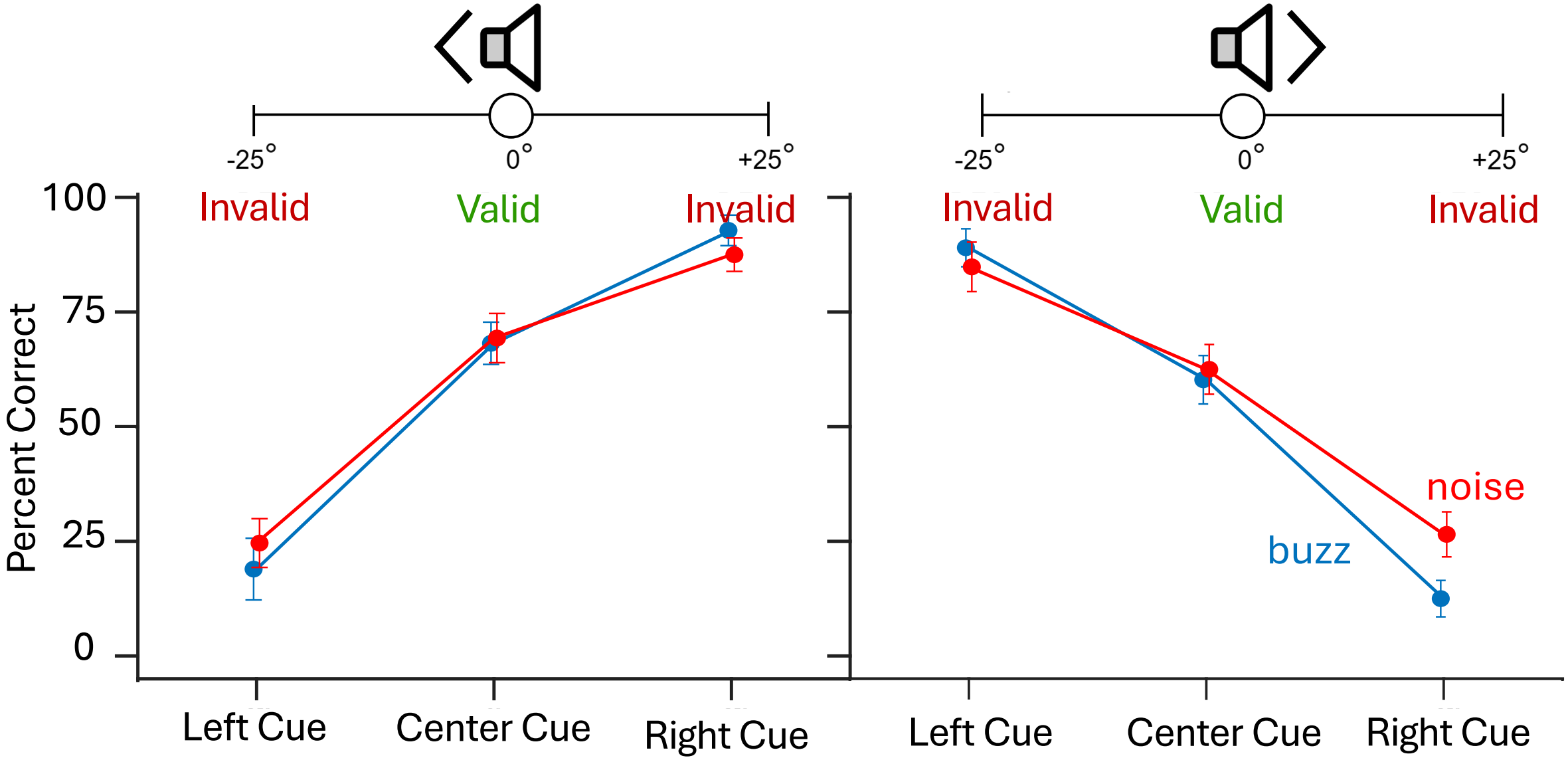




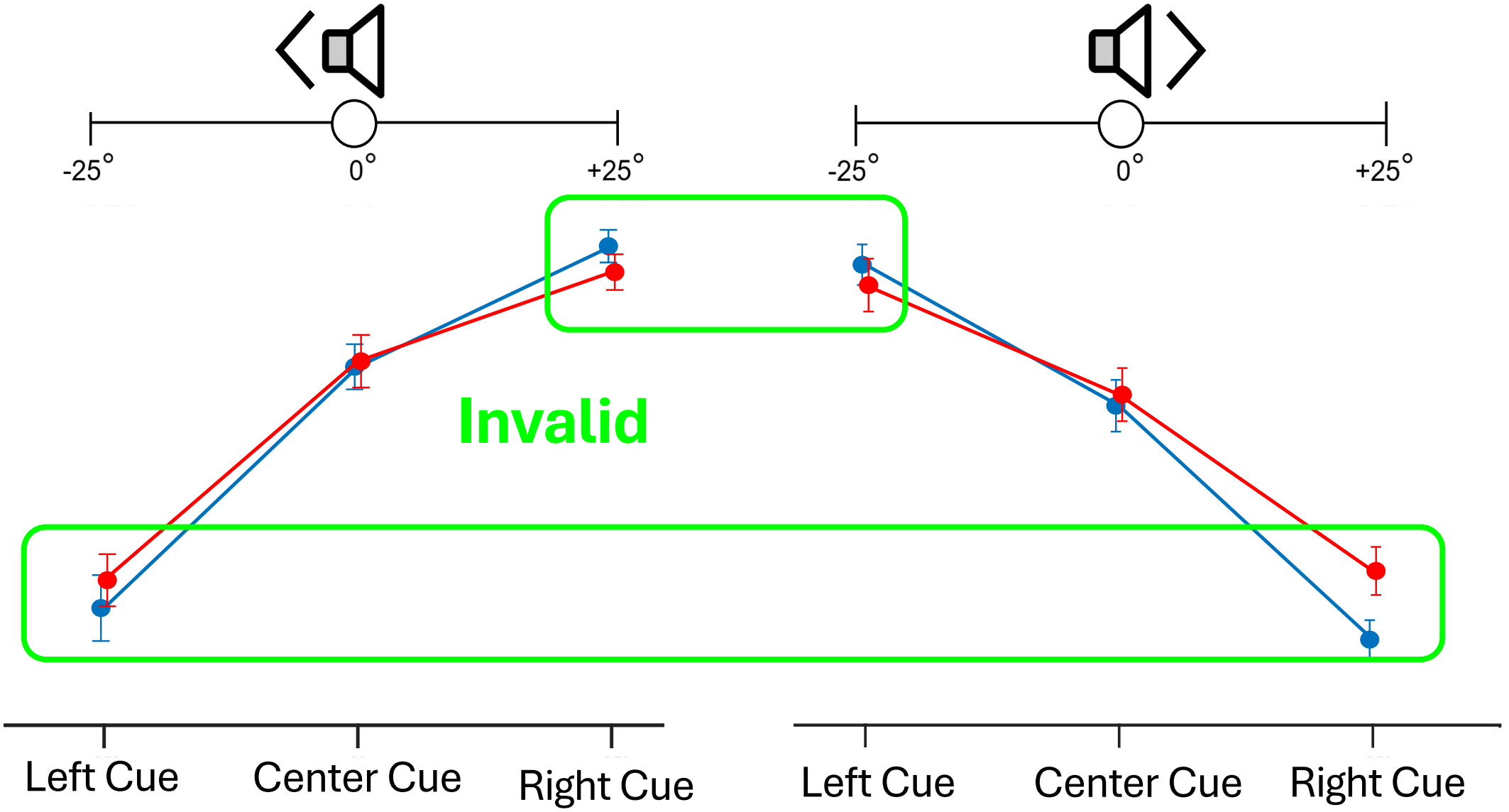
Percent Correct: Target center



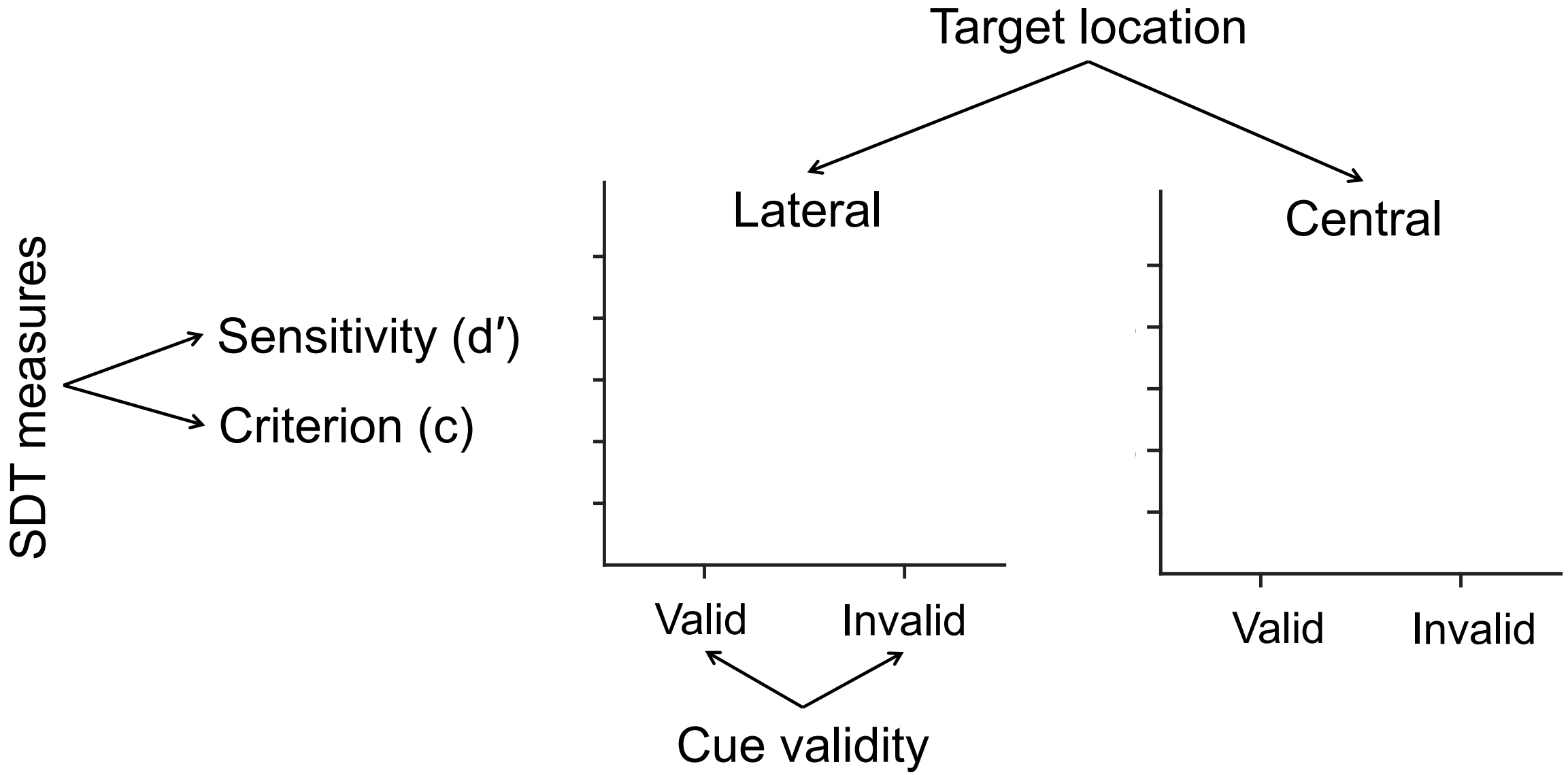
Percent Correct: Target center



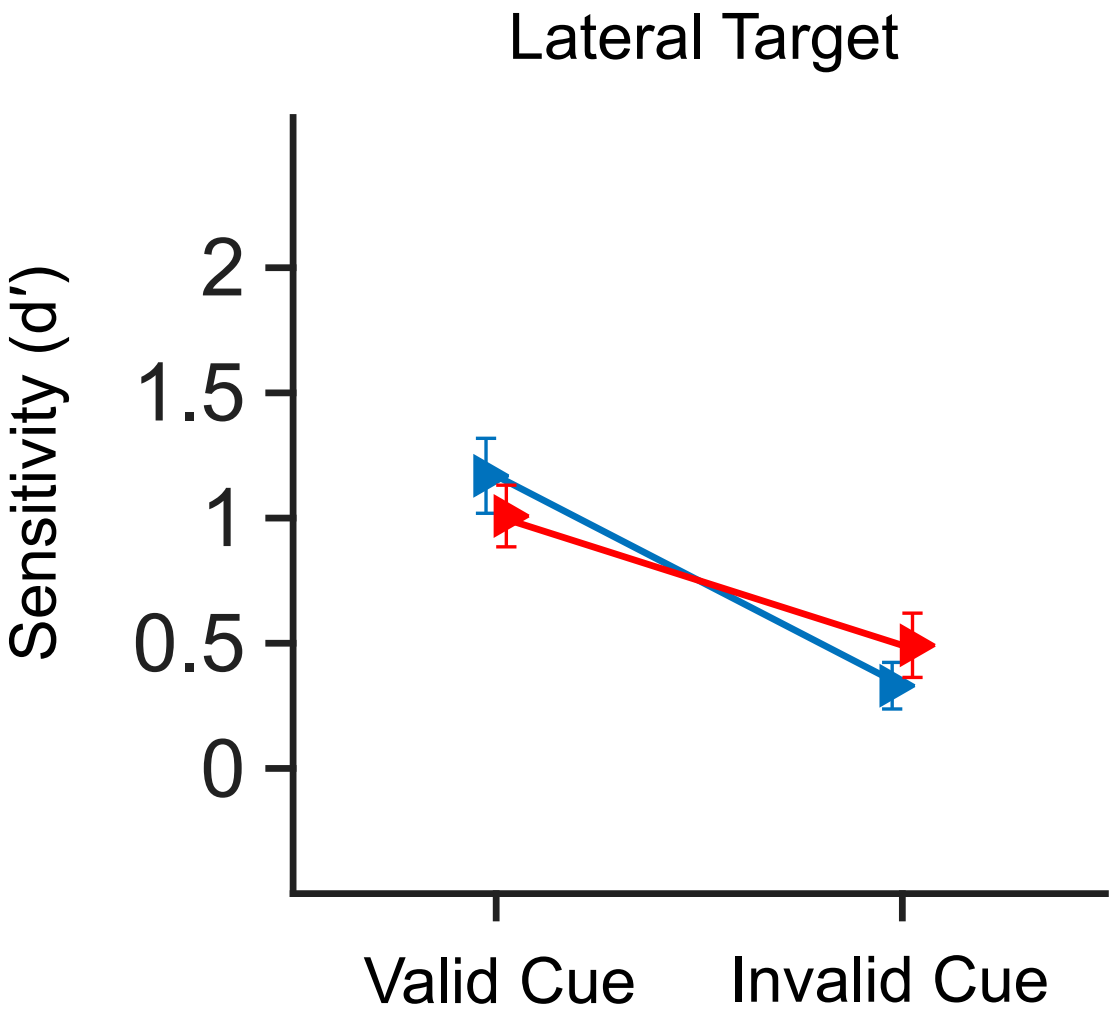
Central Target

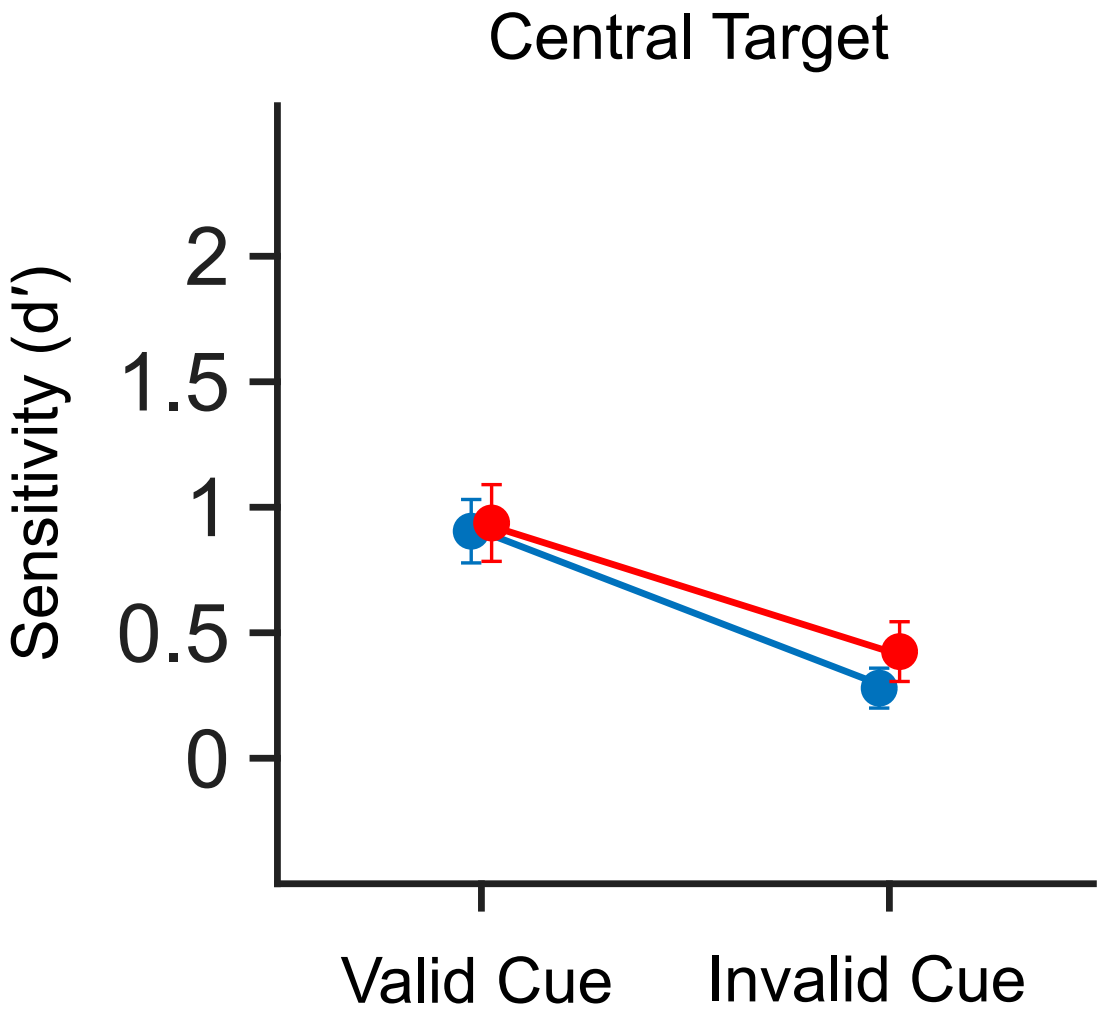


Signal Detection Theory

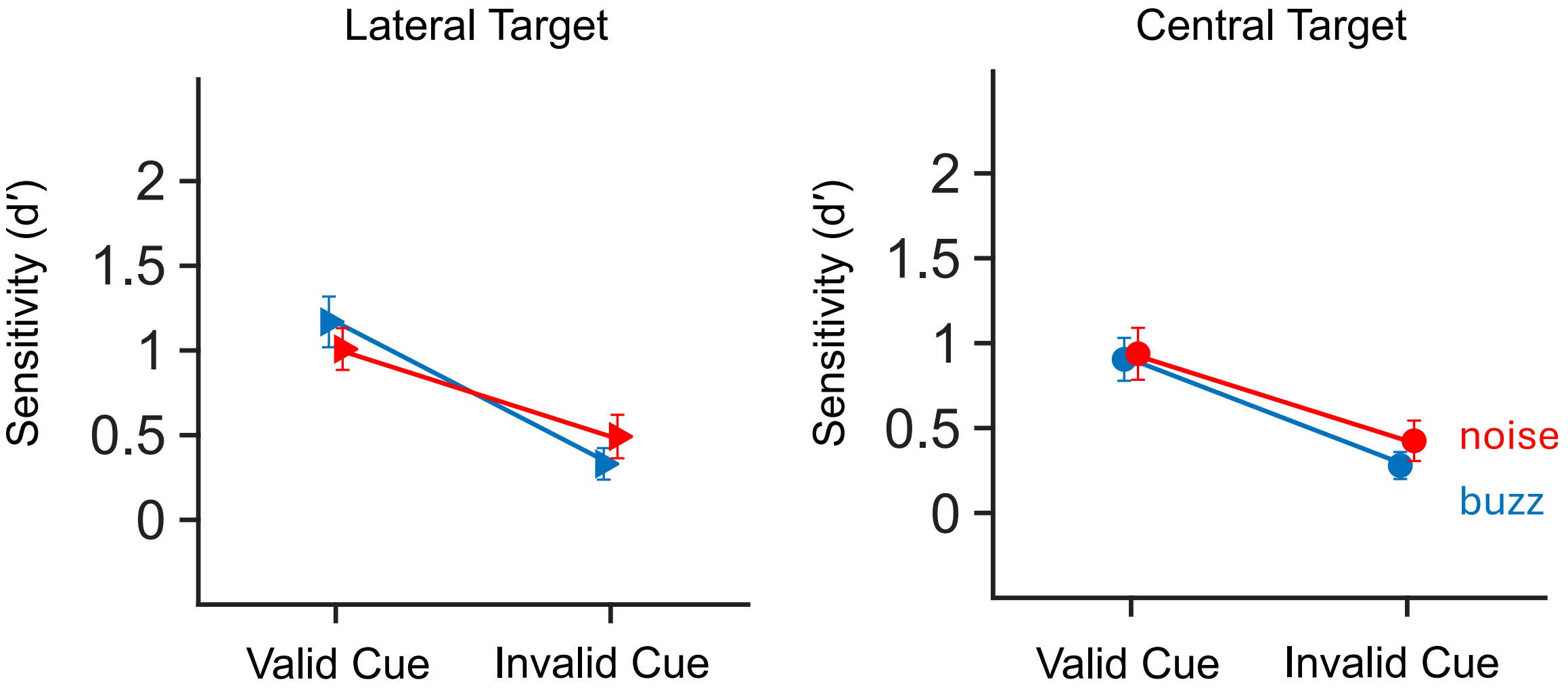


Sensitivity (d') Result

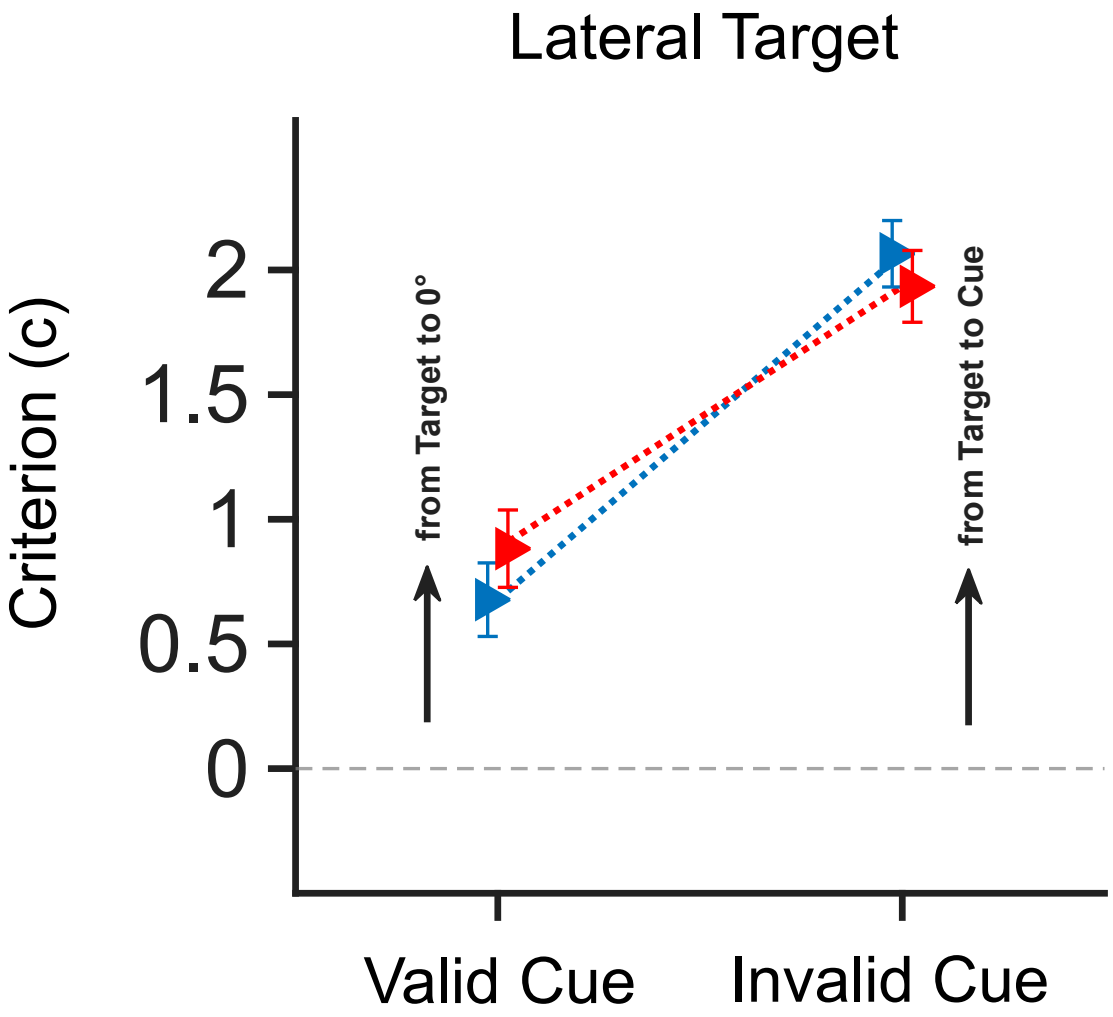


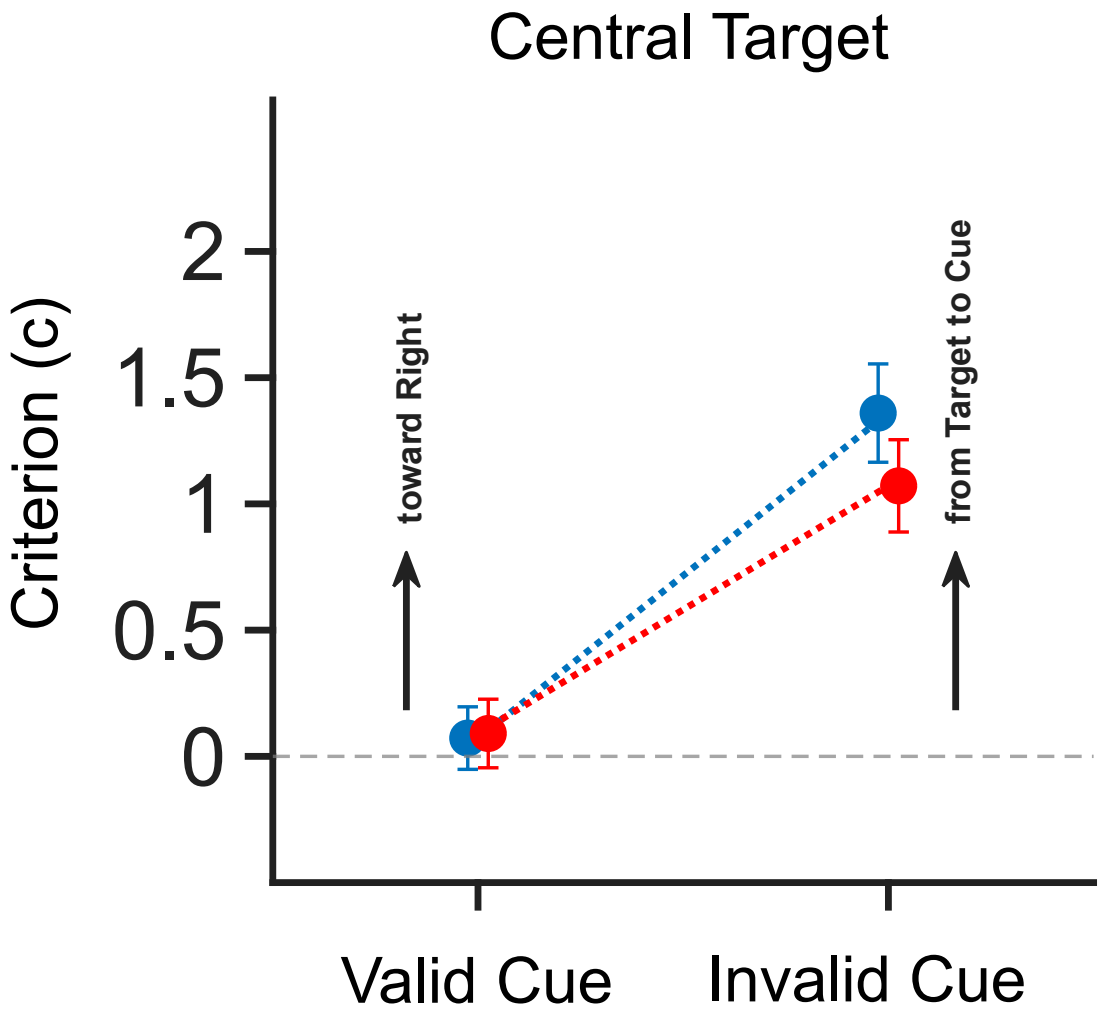


Sensitivity (d') Result

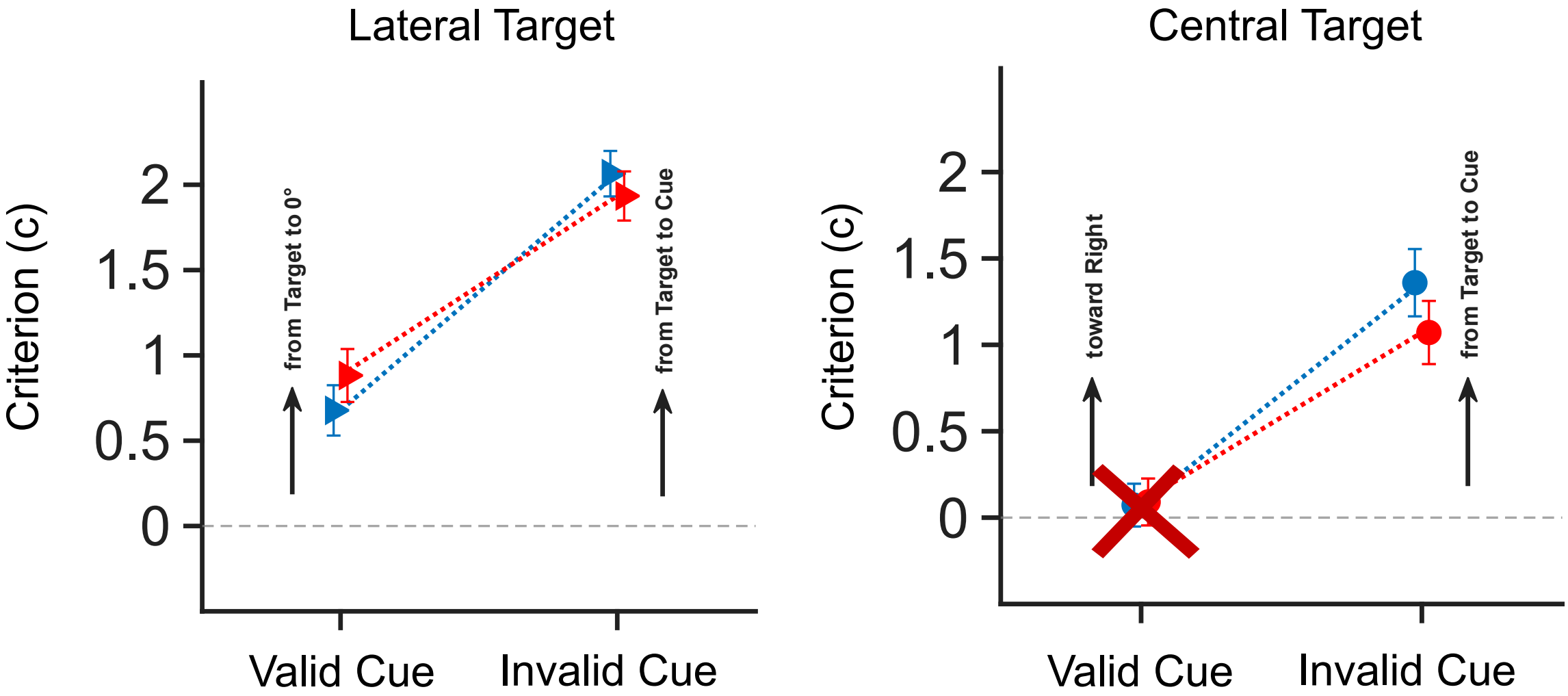


Criterion (c) Result

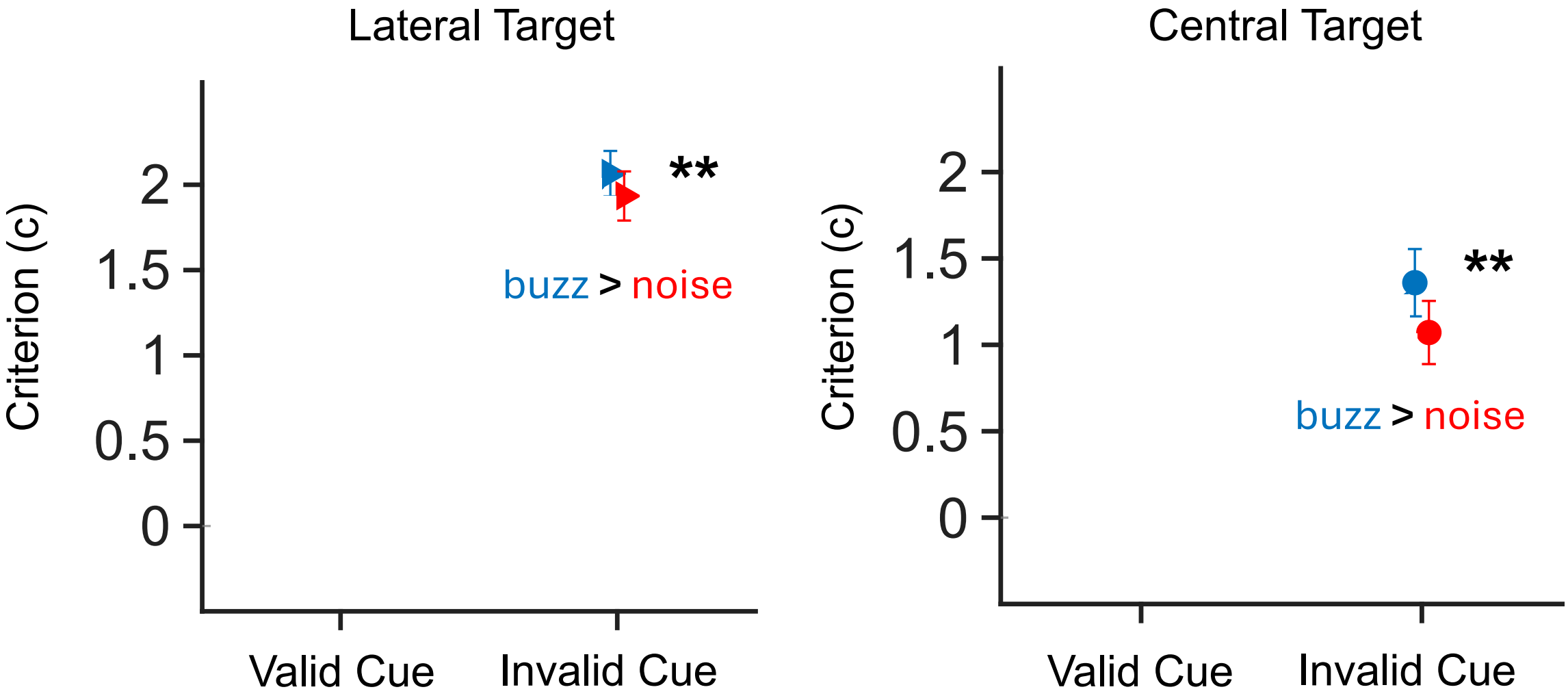




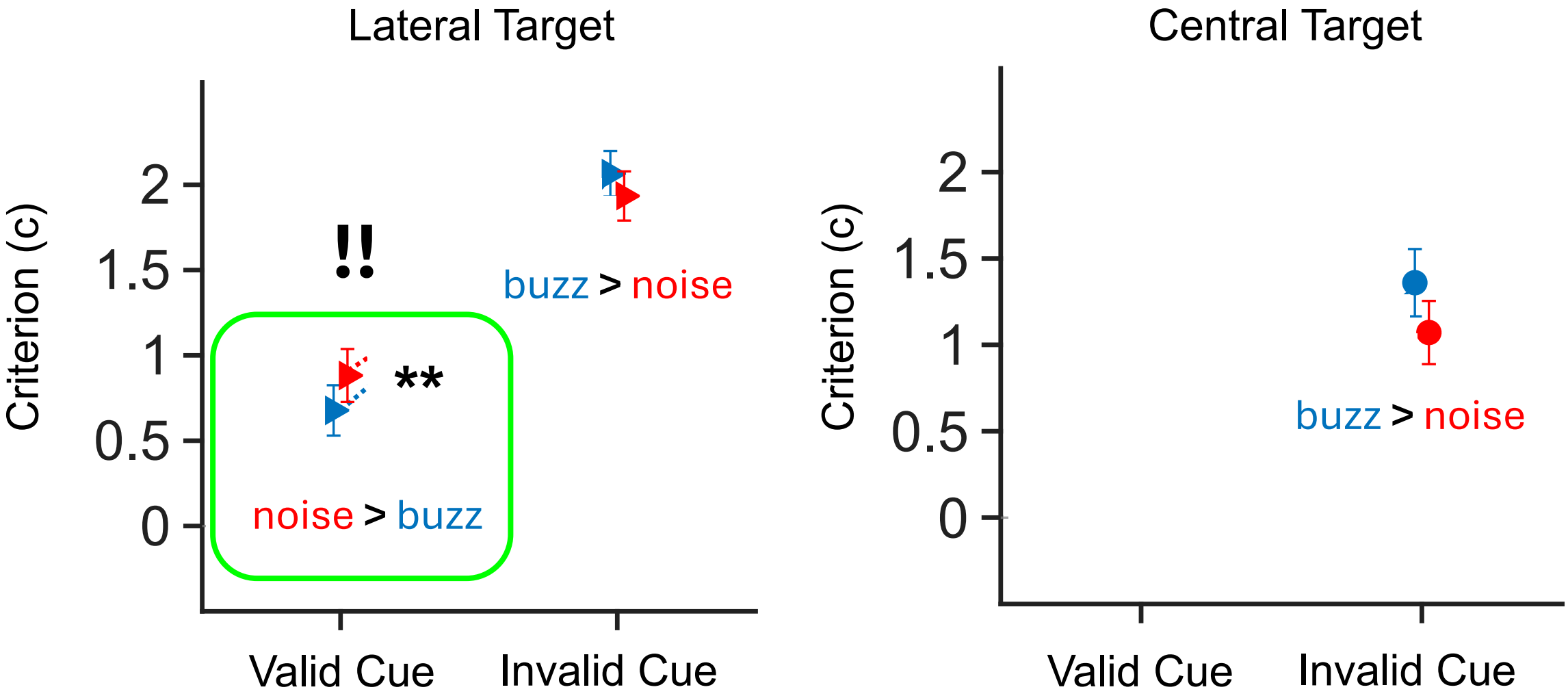
Criterion (c) Result



Criterion (c) Result



Criterion (c) Result



Take-home

A task-irrelevant cue changes both **sensitivity** and **response bias**, but only **bias** depends on **cue-target similarity**

	Sensitivity (d')	Response bias (c)
valid vs invalid	✓ Valid > invalid	✓ Biases induced
buzz vs noise	✗ No effect	✓ Depends on cue identity
Likely process	Attentional orienting	Other processes, e.g. flanker-like interference from cue→target motion

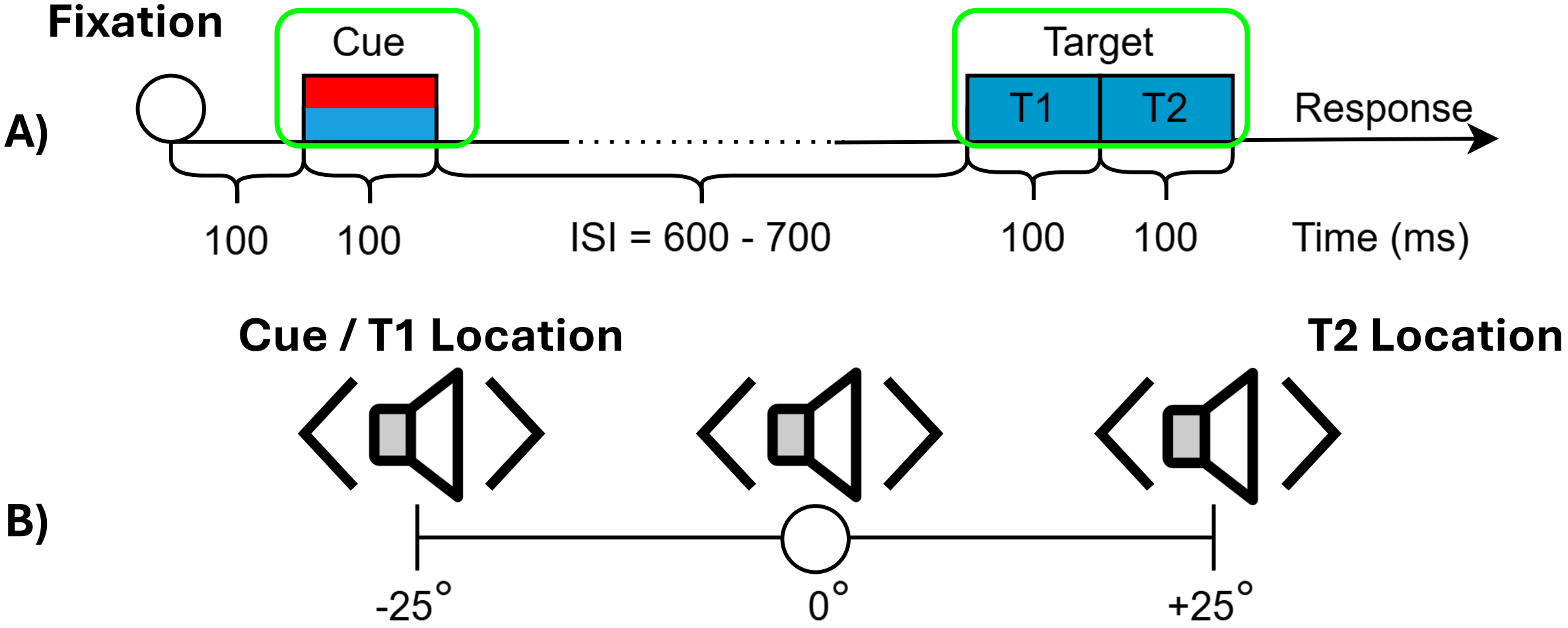
Next: EEG to test whether these two effects have separate neural signatures

Thank you

Any Questions?

Yeganeh.Modaresnia@student.upjs.sk

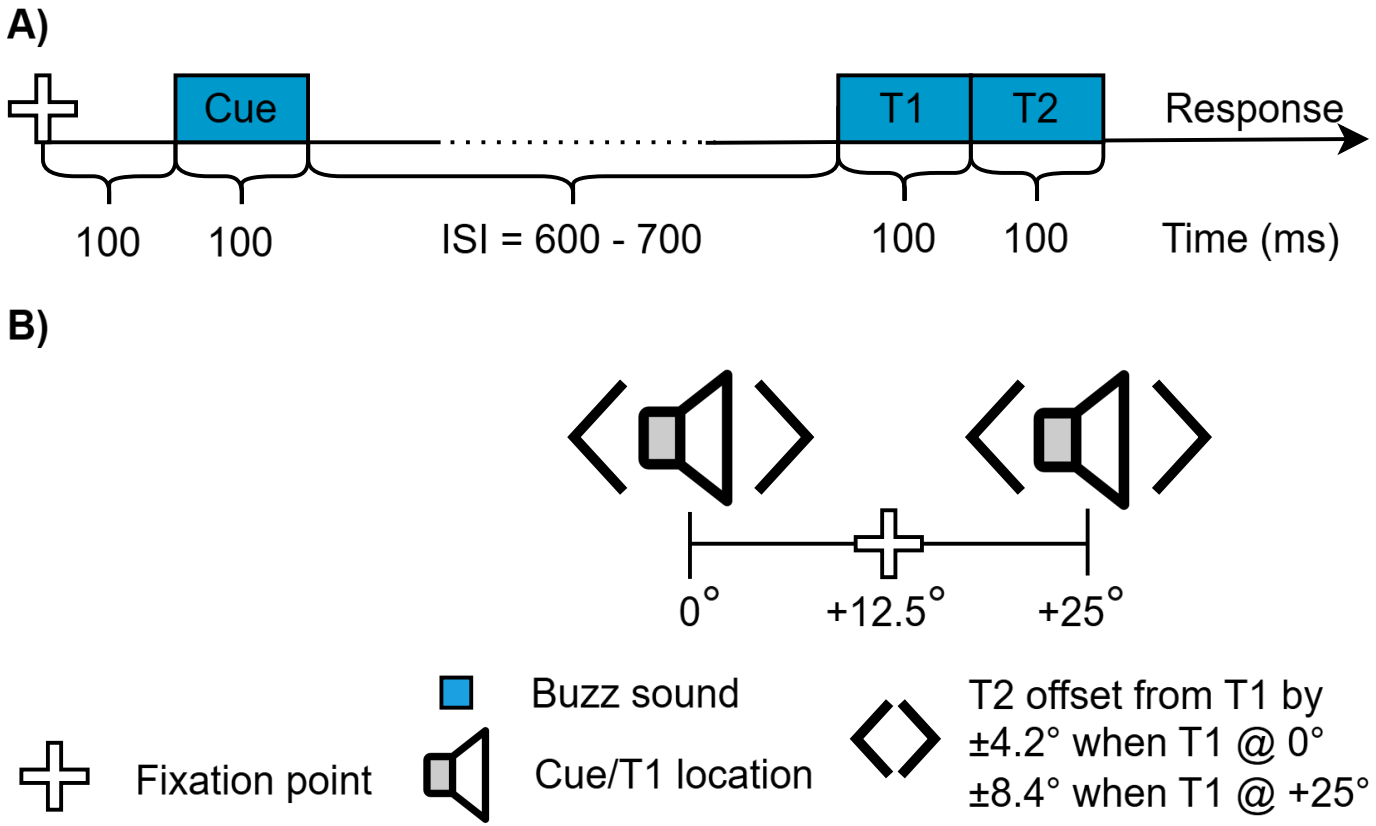
Setup



A) Temporal setup and B) Spatial setup

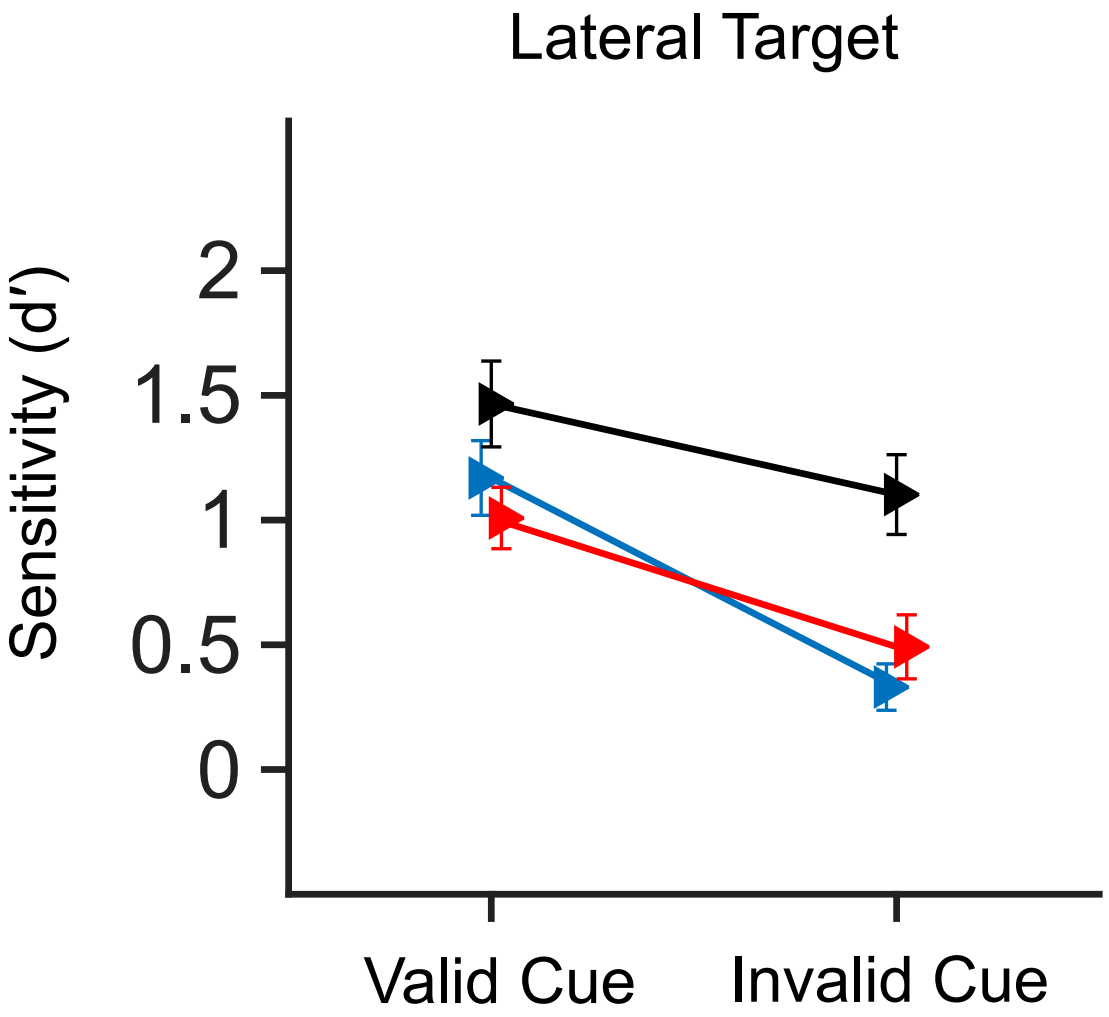
T2 location, offset from T1 by
±4.2° when T1 @ 0°
±8.4° when T1 @ ±25°

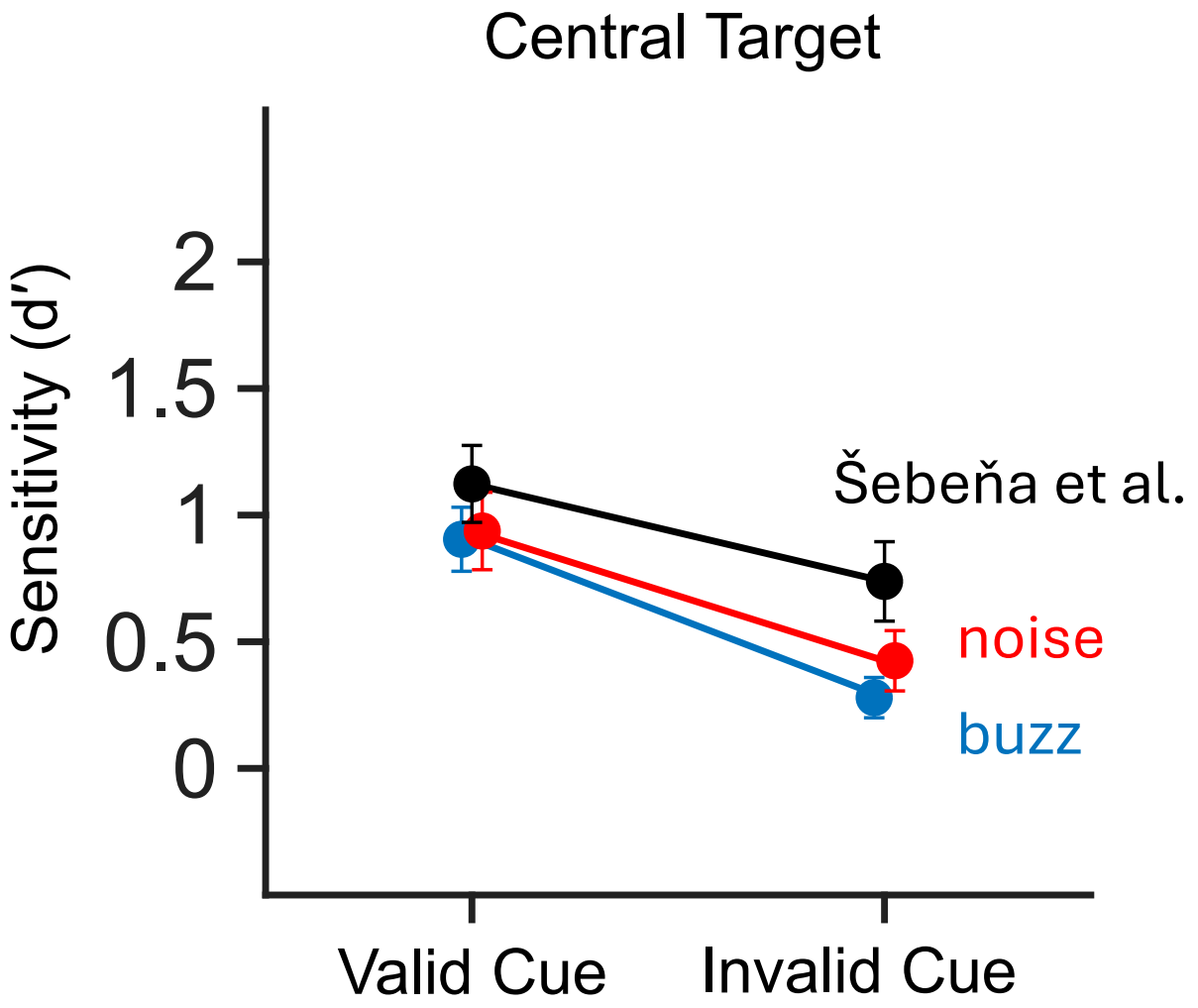
Setup (Šebeňa et al.)



A) Temporal setup and B) Spatial setup

Sensitivity (d') Result





Criterion (c) Result

