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# Towards developing a discrimination task that induces reweighting of binaural localization cues

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# Background

- Adaptation to altered sound localization cues:
  - Establishment of a new spatial map of the altered cues (e.g., Trapeau & Schönwiesner, 2015)
  - Stronger relative weighting of unaltered compared to altered cues, referred to as reweighting (e.g., Kumpik, Kacelnik, & King, 2010)
- Recent study: Reweighting of the two binaural cues (ITD and ILD) can be achieved with a localization training in virtual reality (VR).
- We now seek to develop a simpler training method to make the training more accessible for a wide range of listeners.

## Methods

- Series of pilot experiments
- 3 days of training
- 2-AFC staircase procedure for left/right discrimination
- Stimuli:
  - 500-ms narrow-band white noise bursts (one octave bandwidth, geometrically centered at 2.8 kHz)
  - Various combinations of spatially inconsistent ITD and ILD
  - Overall level roved by  $\pm 2.5$  dB
- Feedback (correct/incorrect) always followed the ILD location

## Pilot 1 - Methods

- *Pre-/Posttest:* Virtual reality (VR) localization task
- *Training:*
  - 2 groups (absolute vs. relative discrimination)
  - 3 disparities between ITD and ILD location (25.2°, 18° and 10.8°), chosen randomly
  - 2-down-1-up adaptive procedure
  - Staircase adapted separately for each cue disparity
  - ca. 20 min of training per day
- N = 16 (8 per group)

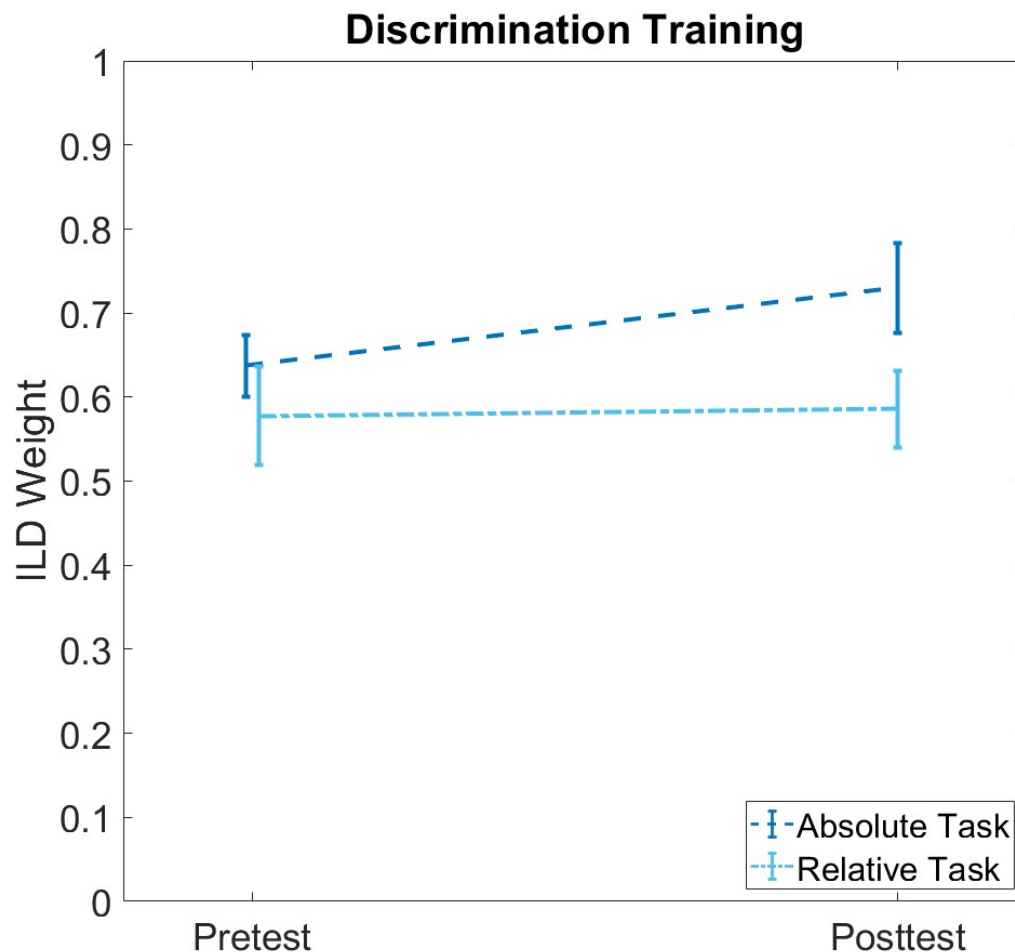
# Pilot 1 - Methods

	Absolute Task	Relative Task	
		Reference	Target
<b>ILD location</b>	Starting at $\pm 30.6^\circ$ ; 3.6° closer to center with each staircase adaptation	Randomly chosen between $\pm 30.6^\circ$ (3.6° spacing)	Shifted from reference location by $\pm 32.4^\circ$ (start); 3.6° closer to reference with each staircase adaptation
<b>ITD location</b>	Shifted from ILD location towards center by chosen cue disparity	Same as ILD location	Shifted from target ILD location towards reference by chosen cue disparity

# Pilot 1 - Results

- ILD weight: Slope of a linear regression (x: cue disparity; y: lateralization bias)
- Trend for increasing ILD weights in absolute task group ( $p = .069$ ), no change for relative task group

*Note: 2 (absolute group) + 3 (relative group) participants were excluded due to poor performance in the VR task*



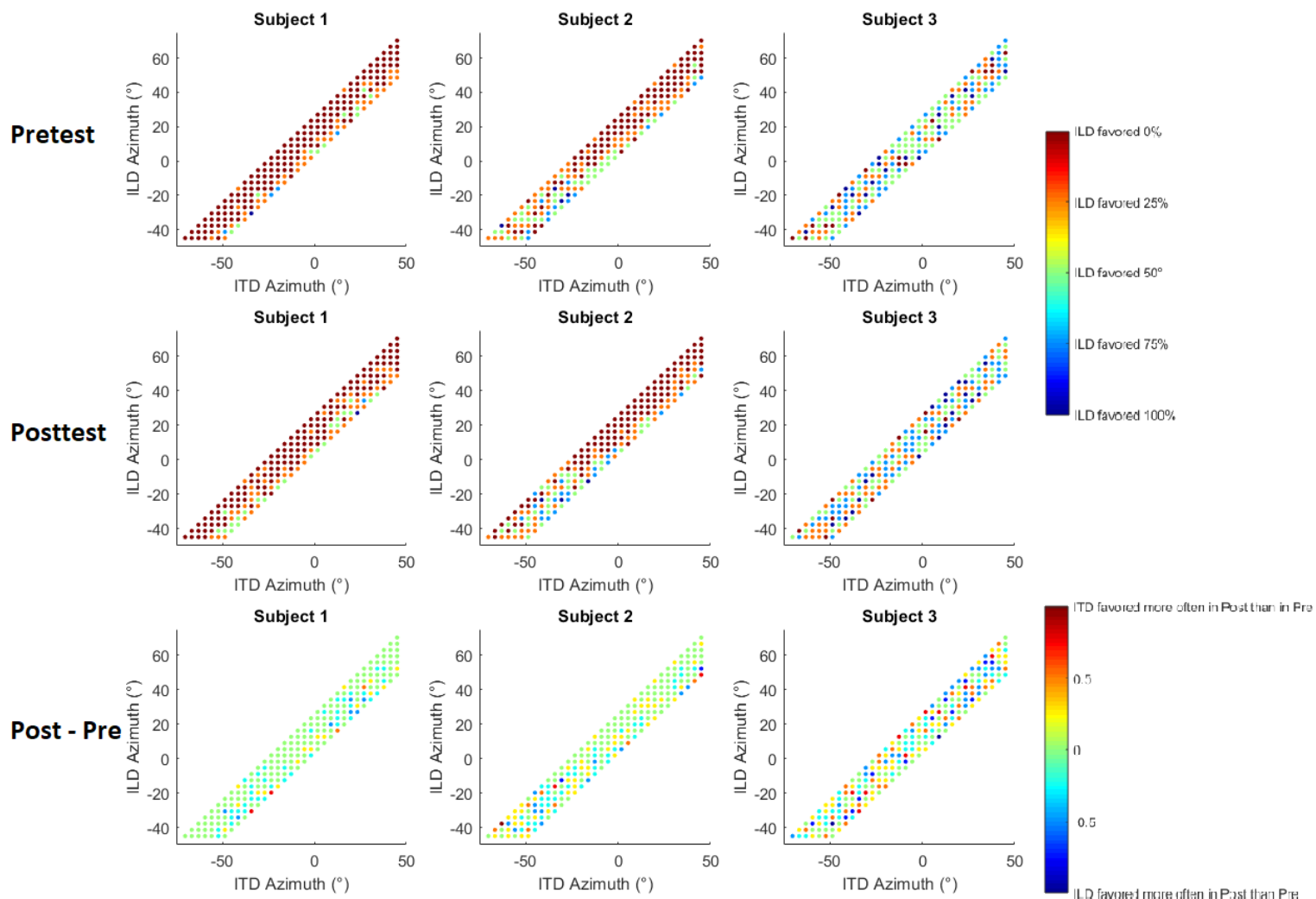
## Pilot 2 - Methods

### Modifications to Pilot 1:

- *Pre-/Posttest:*
  - Relative discrimination task using two consecutive stimuli for which ITD and ILD azimuth are switched
  - Using the same ITD/ILD combinations as in VR task
- *Training:*
  - Only absolute discrimination training
  - 3-down-1-up adaptive procedure
  - 600 trials per day
- $N = 3$

# Pilot 2 - Results

- No change between pre-/posttest
- Subject 3 seems to respond randomly





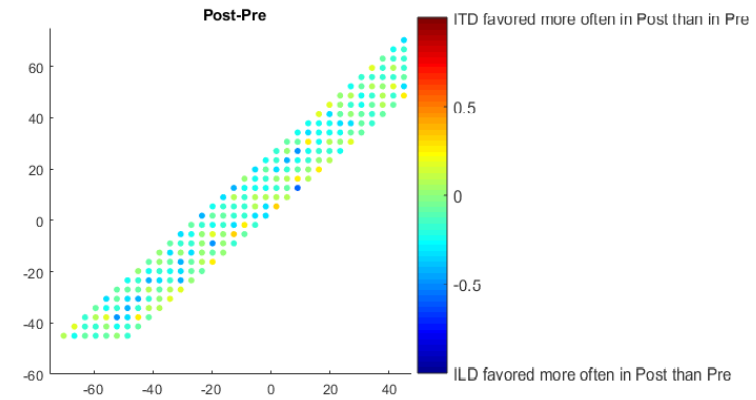
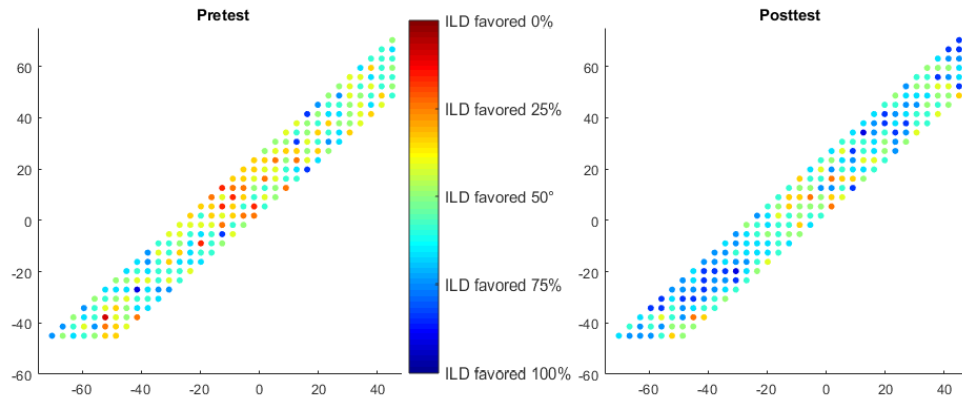
## Pilot 3 - Methods

### Modifications to Pilot 2:

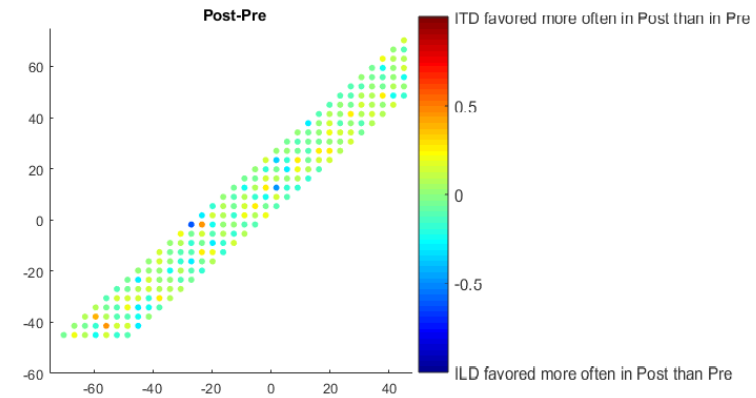
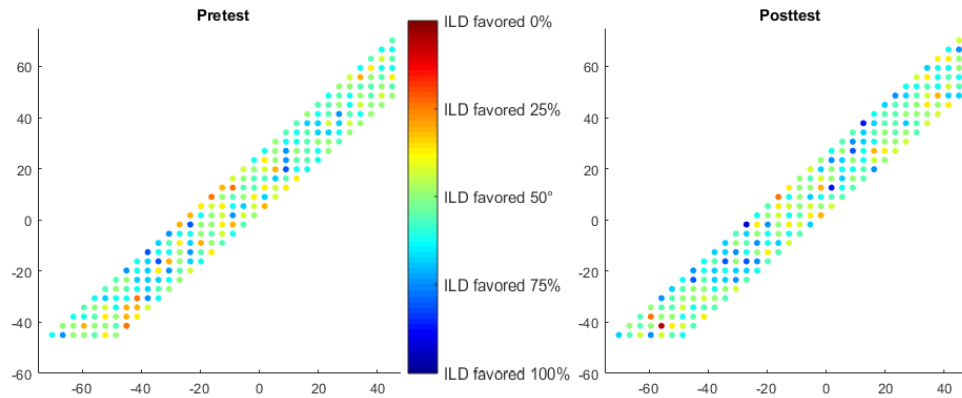
- Training with consistent items before the pretest (including feedback)
- *Pre-/posttest*: Some consistent items added
- *Training*:
  - Relative discrimination task
  - Repetition of incorrect trials with correct response shown on screen
  - Cue disparities used: 25.2°, 21.6°, 18°
  - 2-down-1-up adaptive procedure
  - 500 trials per day
- $N = 7$

# Pilot 3 - Results

Participants who  
reached 75%  
correct on  
consistent items  
(n = 3)



Participants who  
did not reach  
75% correct on  
consistent items  
(n = 4)



- Significant effect of *time* ( $p = .028, \eta_p^2 = .581$ )
- Highly significant *time* x *group* interaction ( $p = .009, \eta_p^2 = .776$ )

## Conclusion

- Why did the final pilot experiment work best?
  - Participants who performed poorly with the consistent items could be excluded
  - Pre-/posttest and training task were the same
    - No transfer between different tasks was needed
    - Pre-/posttest task practiced sufficiently
  - Possibility for bottom-up multisensory integration
- Even though it depends on the specific parameters, binaural cue reweighting seems to be achievable by using a left/right discrimination task
- Full study (possibly with gamified version) will follow