Variance in Localization of Click Sounds with a Preceding Distractor

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Goal

Investigate how **multiple sound sources** influence **variance** of sound localization in complex listening task

Introduction

Horizontal auditory localization

- Binaural ITD and ILD cues

Localization performance:

- JND / MAA

Perrott, D. R., & Saberi, K. (1990). Minimum audible angle thresholds for sources varying in both elevation and azimuth. *Journal of the Acoustical Society of America*, *87*, 1728–1731.

- Percent correct – psychometric function

Kashino, M., & Nishida, S. (1998). Adaptation in the processing of interaural time differences revealed by the auditory localization aftereffect. *The Journal of the Acoustical Society of America*, *103*(6), 3597. doi:10.1121/1.423064

- Unsigned localization error – RMS and correlation coefficient

Good, M. D., & Gilkey, R. H. H. (1996). Sound localization in noise: the effect of signal-to-noise ratio. *The Journal of the Acoustical Society of America*, *99*(2), 1108–17.

- Localization gain, offset, residual error

Razavi, B., O'Neill, W. E., & Paige, G. D. (2007). Auditory Spatial Perception Dynamically Realigns with Changing Eye Position. *Journal of Neuroscience*, *27*, 10249–10258.

- Signed localization error – Bias
- **Variance**

Kopčo, N., Best, V., & Shinn-Cunningham, B. G. (2007). Sound localization with a preceding distractor. *The Journal of the Acoustical Society of America*, *121*(1), 420.

- other

Sound localization in complex environments

Complex percept is a result of

- Peripheral (low-level) and central (higher-level) interactions of auditory processing

Kopčo et al. (2007) was trying to fill the gap between the effects on:

Kopčo, N., Best, V., & Shinn-Cunningham, B. G. (2007). Sound localization with a preceding distractor. *The Journal of the Acoustical Society of America*, *121*(1), 420.

- **Short-time scales** (2-50+ ms)

Echo suppression in the Precedence effect and the Precedence-built-up

Litovsky, R. Y., Colburn, H. S., Yost, W. A., & Guzman, S. J. (1999). The precedence effect. *Journal of the Acoustical Society of America*, *106*(4), 1633–1654.

Clifton, R. K., & Freyman, R. L. (1997). The precedence effect: Beyond echo suppression. In R. Gilkey & T. Anderson (Eds.), *Binaural and spatial hearing in real and virtual environments* (pp. 334–362).

- **Longer-time scales** (up to 150 ms)

MAA depends on SOA

Perrott, D. R. R., & Pacheco, S. (1989). Minimum audible angle thresholds for broadband noise as a function of the delay between the onset of the lead and lag signals. *The Journal of the Acoustical Society of America*, *85*(6), 2669–72.

Strybel, T. Z., & Fujimoto, K. (2000). Minimum audible angles in the horizontal and vertical planes: Effects of stimulus onset asynchrony and burst duration. *Journal of the Acoustical Society of America*, *108*(6), 3092–3095.

Previous study Kopčo et al. (2007)

Target preceded by distractor (D-T click pair)

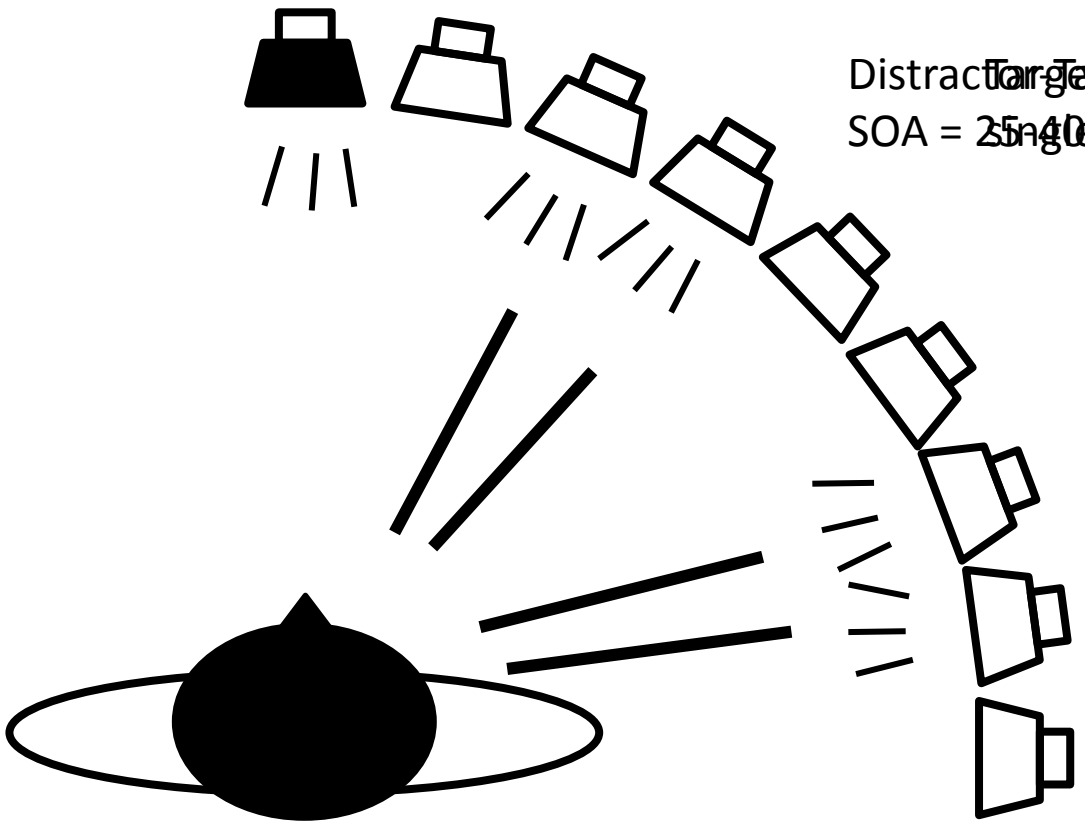
- biases in responses
- variance increased

Target only (T-only)

- biases in responses due to context
- variance not analyzed

Current study => examine variance

Example experimental run:



Kopčo et al. (2007)

Candidate effects

Precedence effect and precedence built-up

- Increase of variance

Perceptual streaming

- Increase of variance when T and D are one stream
- Decrease of variance when T and D are in separate streams

Contextual effects (short-term adaptation)

- Previous change of AO neural representation persists
  - Decrease, Increase, No change

Perceptual anchor – relative cues

- Decrease of variance because of additional cues

Methods

Experimental manipulations

- frontal distractor
- SOA fixed during run (25ms, 100ms, 400ms)
- Percent of Distractor-Target click pairs (50% ,75%) in one exp. run

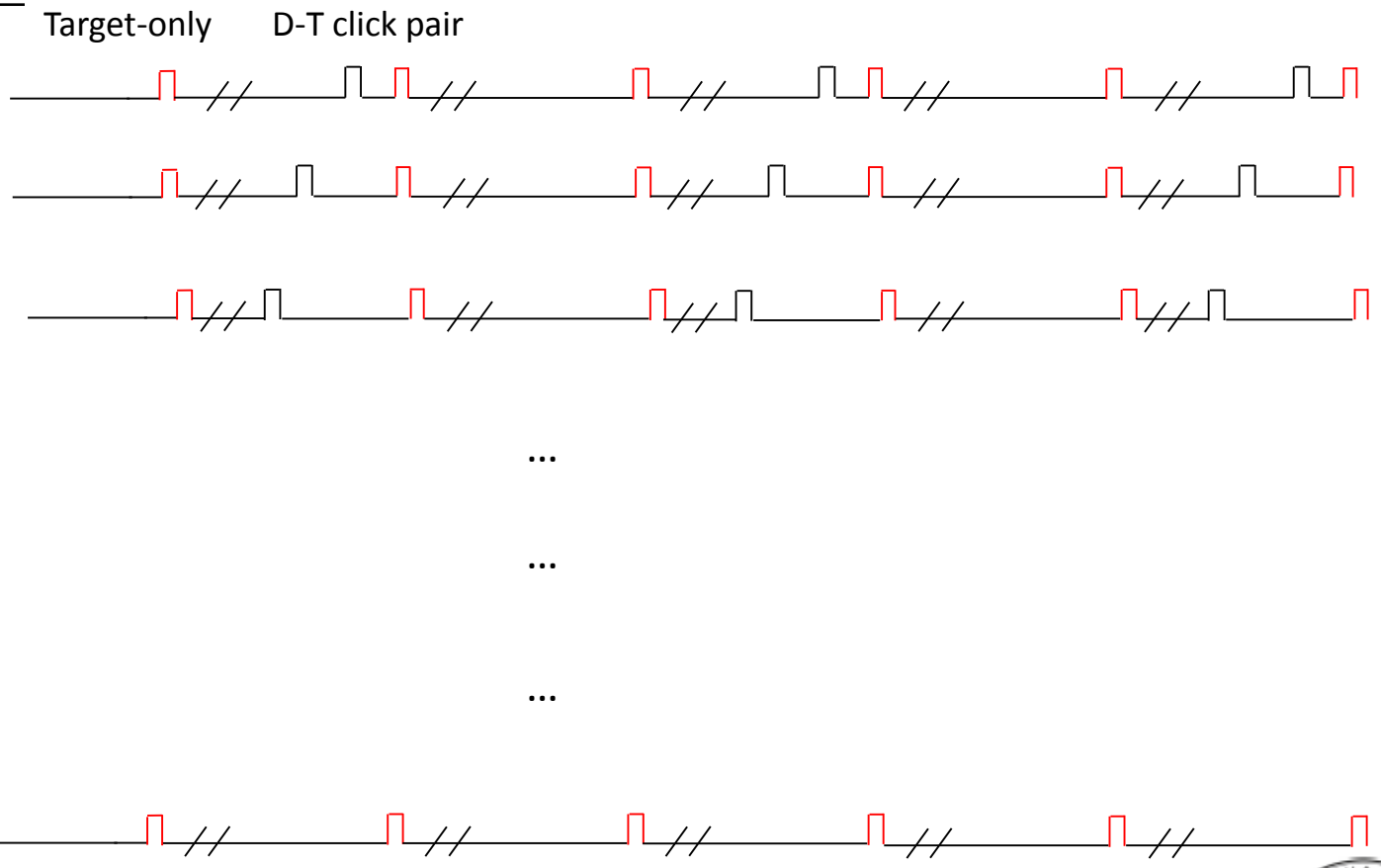
=> **6 conditions + baseline**

Measures of localization variance

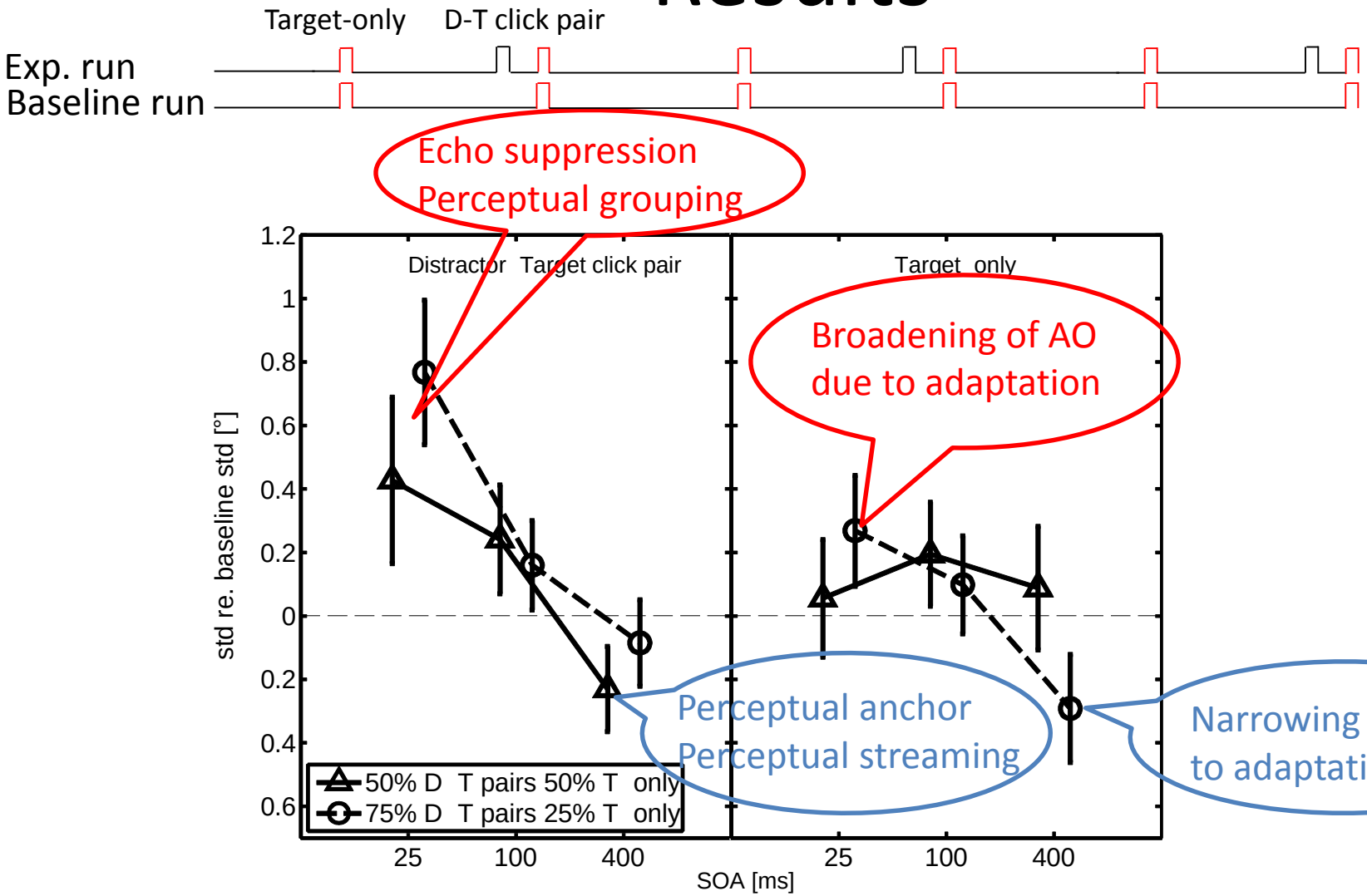
- Standard deviations of responses in trials with
  - Distractor-Target click pairs
  - Target-only (single clicks)

Methods

SOA [ms]	D-T pairs [%]
25	50
100	50
400	50
25	75
100	75
400	75
Baseline	



Results


Target-only
D-T click pair
Exp. run
Baseline run
Echo suppression
Perceptual grouping
Distractor Target click pair
Target only
Broadening of AO
due to adaptation
std re. baseline std [°]
1.2
1
0.8
0.6
0.4
0.2
0
0.2
0.4
0.6
50% D T pairs 50% T only
75% D T pairs 25% T only
Perceptual anchor
Perceptual streaming
Narrowing of AO due
to adaptation
25
100
400
SOA [ms]

Conclusion

Previous results replicated

- Variance is **increased** due to immediately preceding sound at short SOA

=> **distractor**

New observations

- Variance **decreased** due to immediately preceding sound at longer SOA

=> **anchor**

- Perceptual properties of Auditory object are being adapted,
- but only when statistically strong reinforcement is present

Consequences

- **both peripheral and more central neural factors** contribute to AO formation in complex environment
- Both are subject to adaptation which may act on higher neural processing stage

Collaborators

Norbert Kopčo (left)

- PhD advisor

Beáta Tomoriová (middle)

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Európska únia
Európsky sociálny fond

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