Using mouse tracking to study visual search

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Motivation

- Multiple motor plans are prepared in parallel and continuously feed into the motor system to generate action (Song and Nakayama, 2006, 2008)

- Neural correlates of decision making are found in motor cortex (Cisek and Kalaska, 2005)

=> Motion data allows us to infer cognitive processes

Attention in motor control

- Wolfes guided search: In a preattentive stage some guiding features are processed in parallel and attention selects targets in a second stage

- Color and orientation are guiding features
- Task-irrelevant, salient singleton features influenced search efficiency (Proulx, 2007)

- Looming motion can capture attention and change hand trajectories even though it is task irrelevant.

Target selection in motor control

- pointing trajectories are biased according to the spatial distribution of potential target locations (Gallivan & Chapman, 2014; Chapman et al., 2010)

- shorter planning intervals lead to movements into a default direction between the potential targets

  If not task relevant items draw attention do they have a similar effect as a potential target?
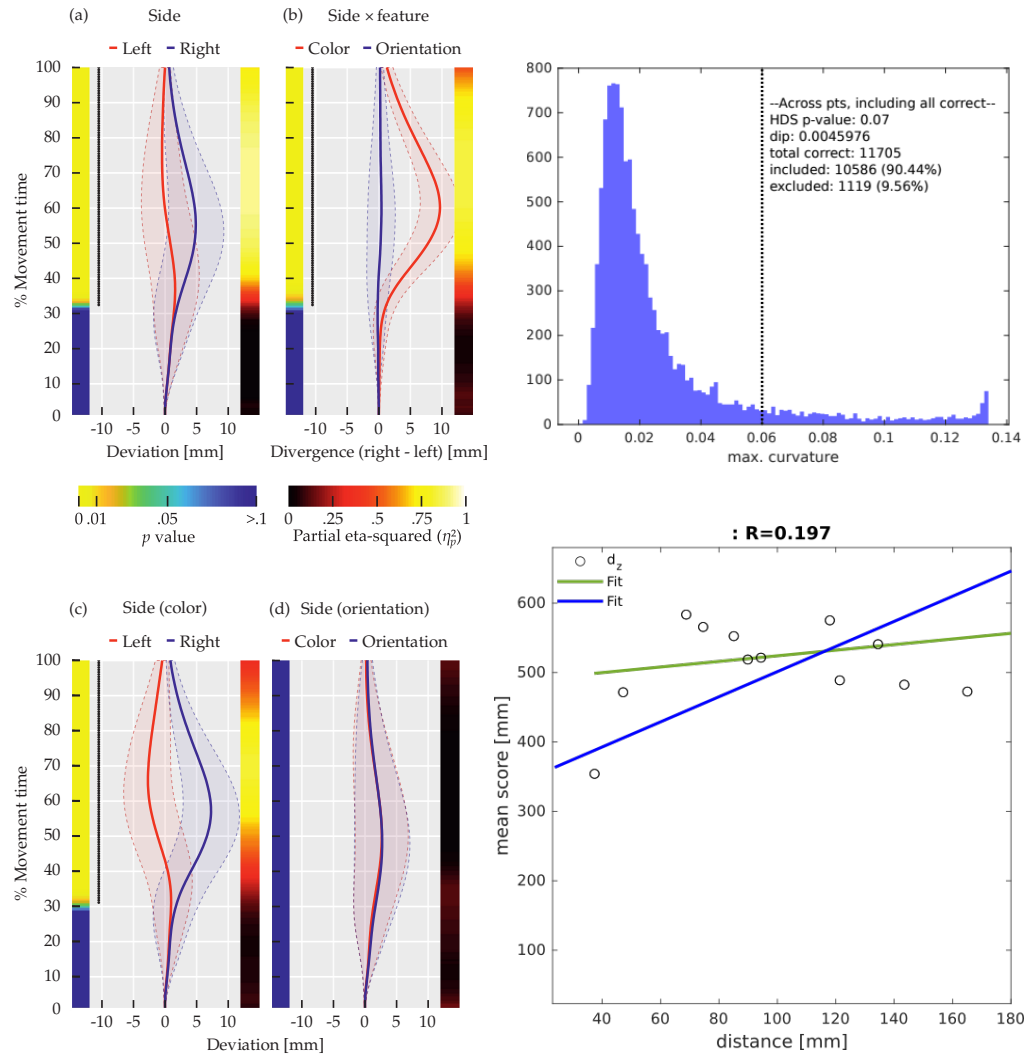
Methods I

Conditions:
1) Distractor shares target Color
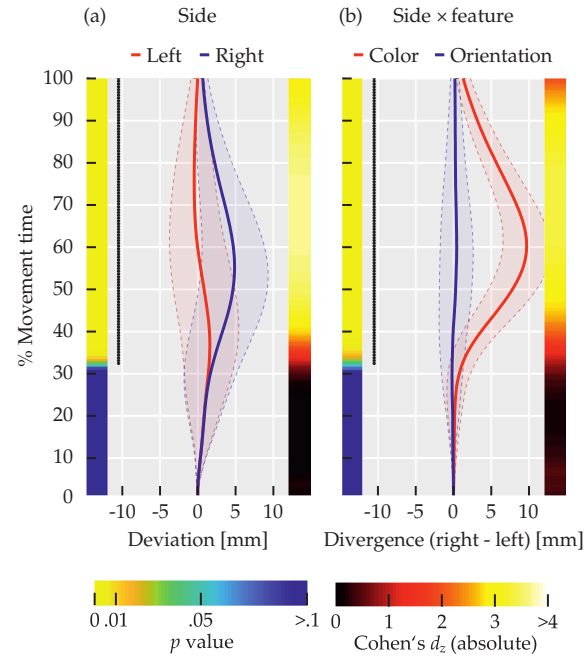2) Distractor shares target orientation
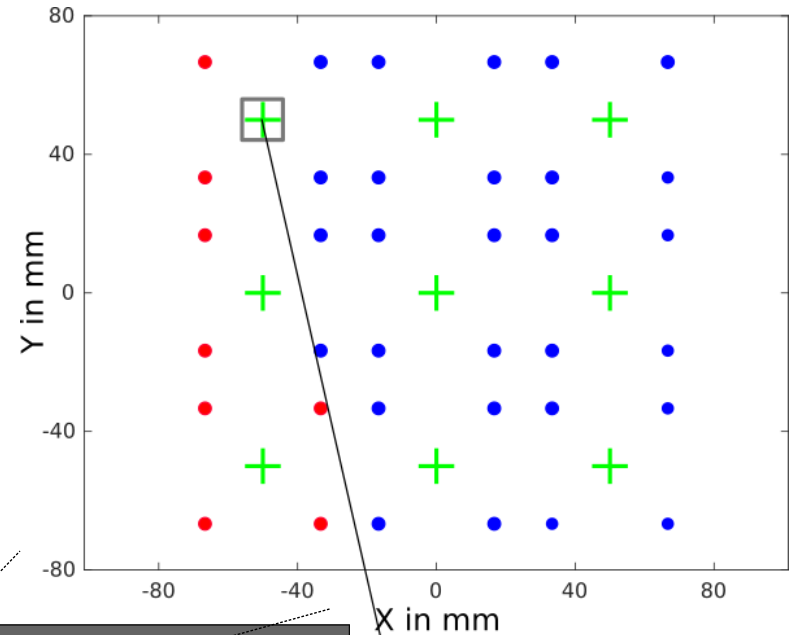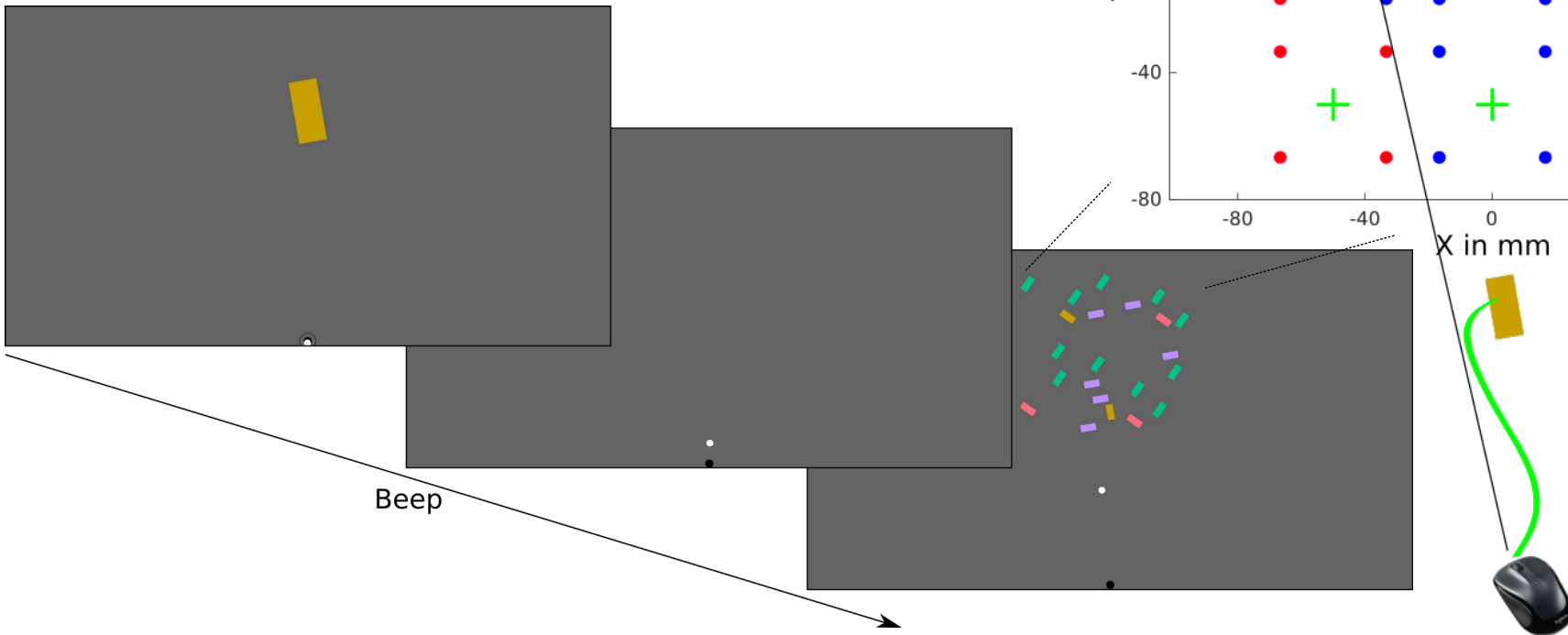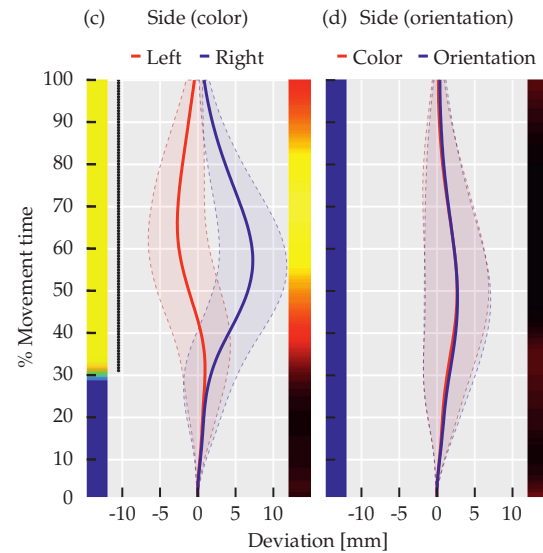
Results I

Mean trajectories

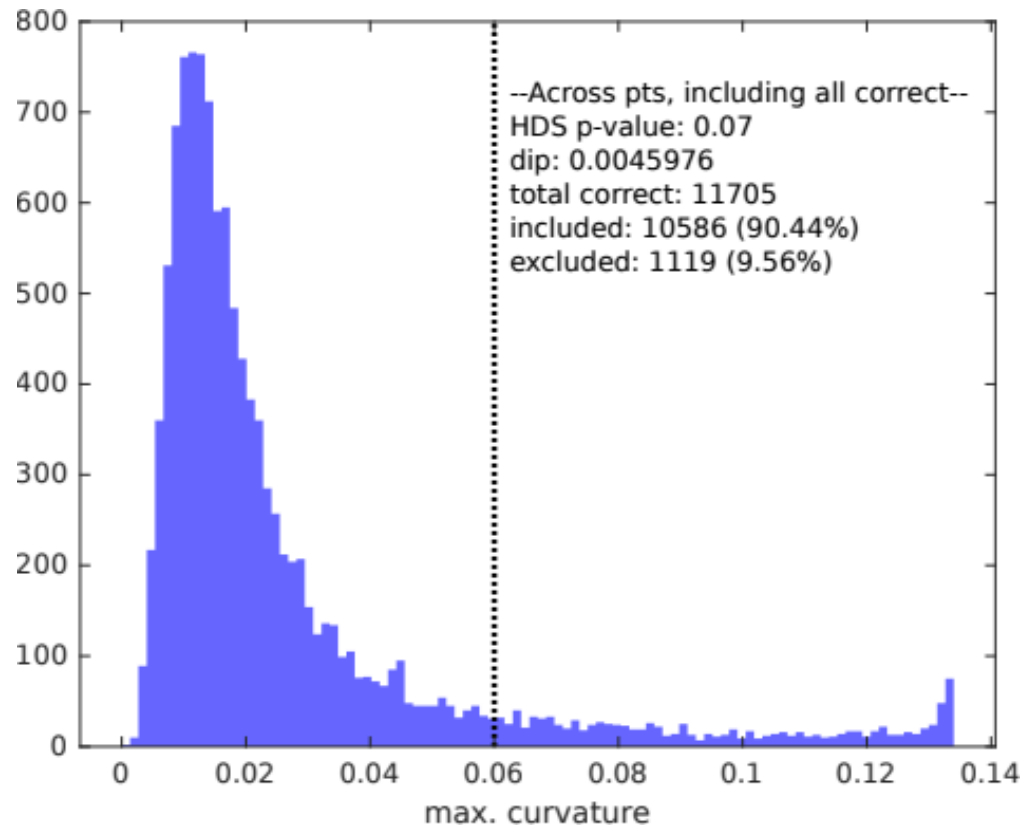Distractor effect over all conditions

Feature Effect

Distractor effect in color

No effect in orientation

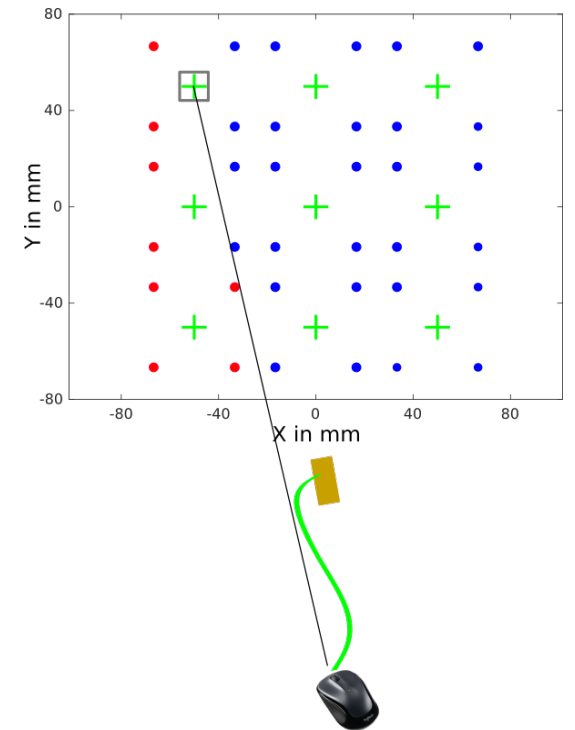# Bimodality

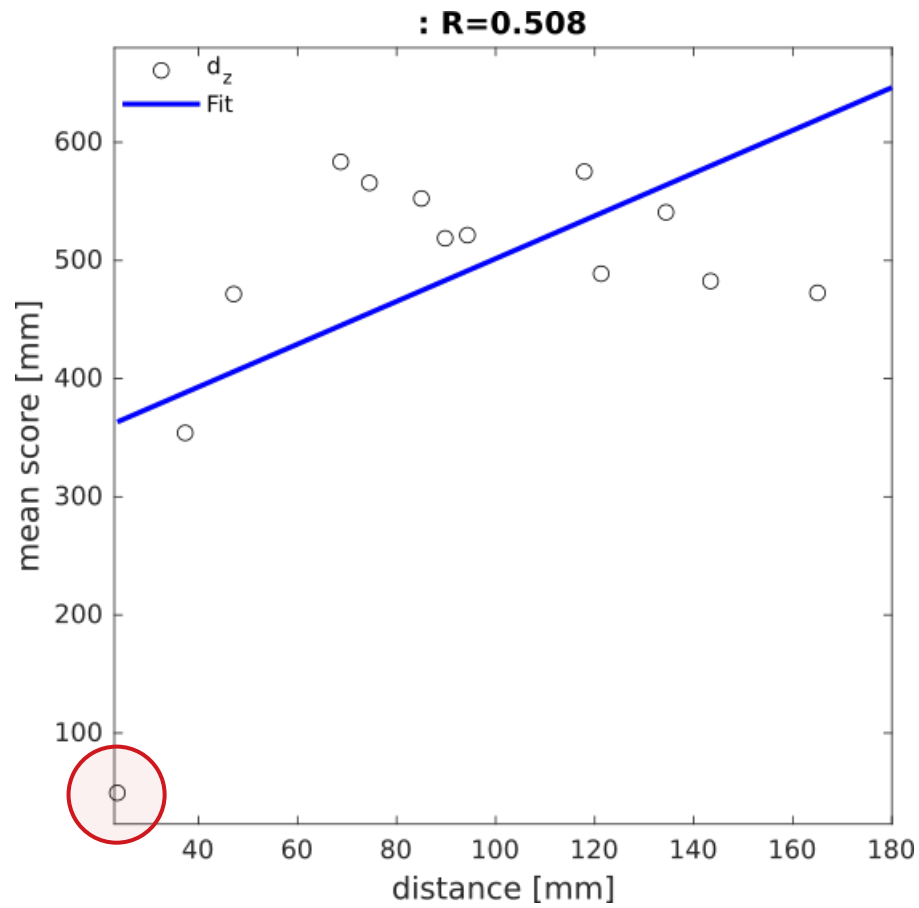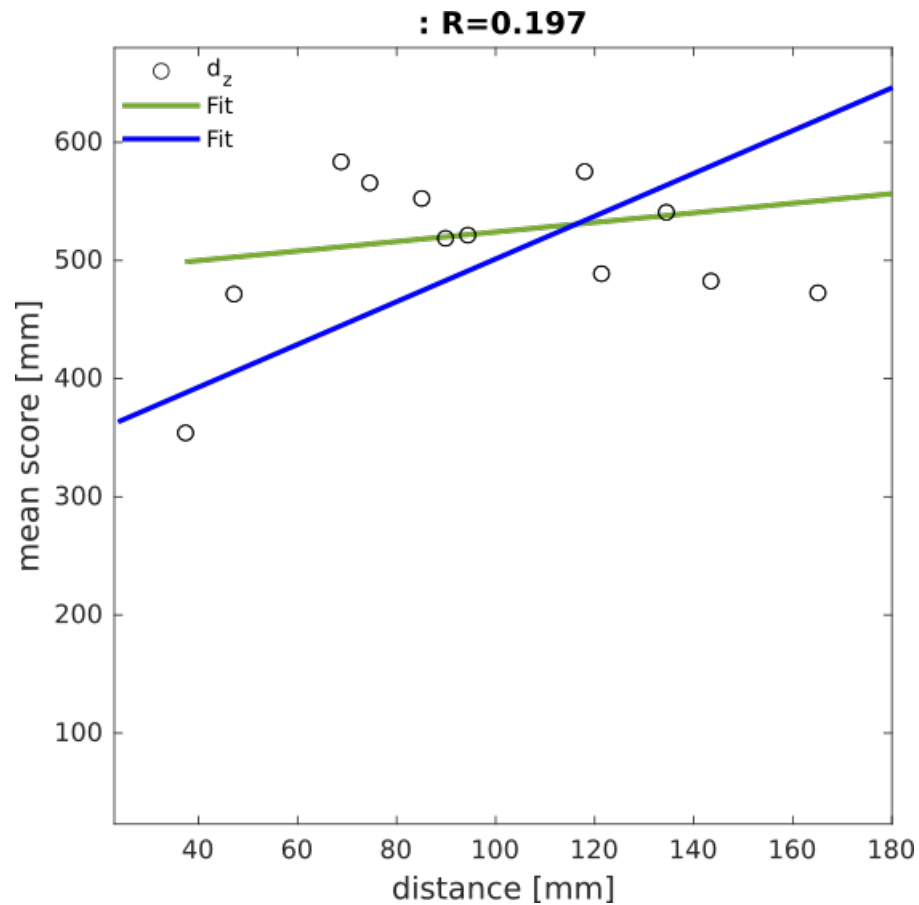We calculated the curvature of the individual trajectories to test for bimodality

--Across pts, including all correct--
HDS p-value: 0.07
dip: 0.0045976
total correct: 11705
included: 10586 (90.44%)
excluded: 1119 (9.56%)

=> The trajectories belong to one population

Distractor effect

Distractor effect

=> The distractor effect is stable over distance

Results II

- A distractor with the same Color as the target attracts the mouse trajectory

- This attraction effect is not there for shared Orientation

- The attraction effect is independent of the distance from the target

Attention in motor control

overt search

- a series of eye movements made to bring complex items onto the fovea
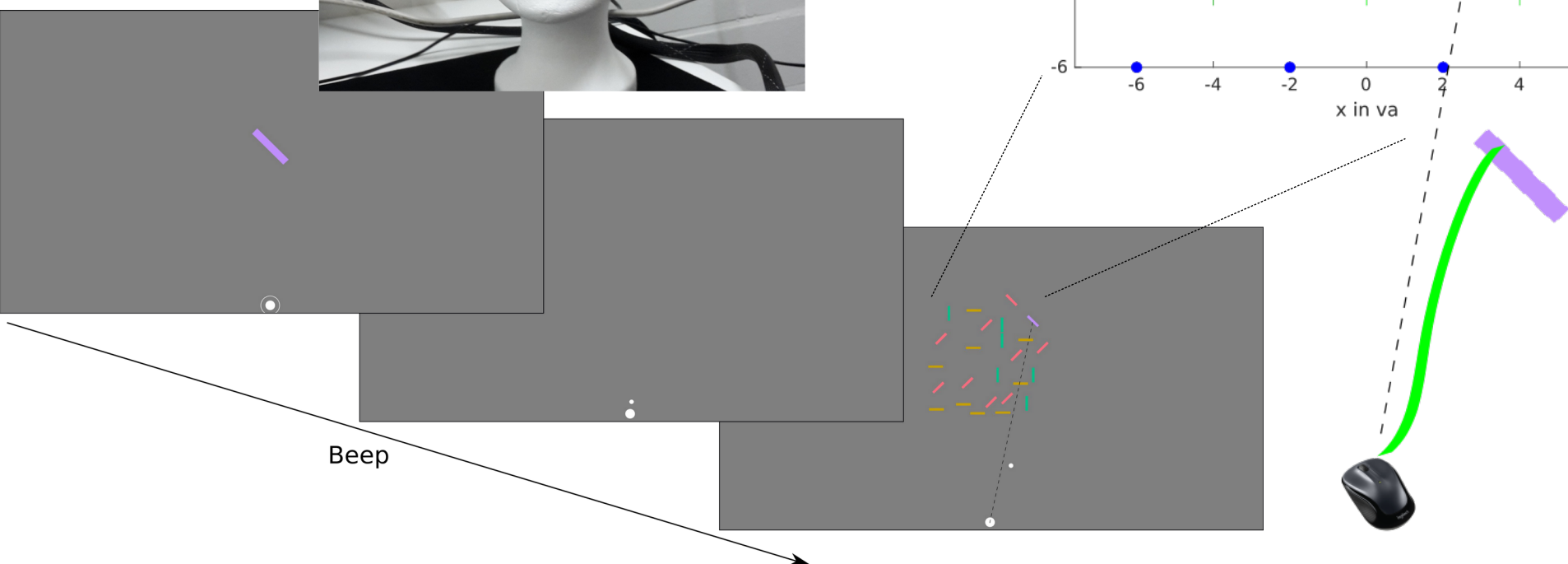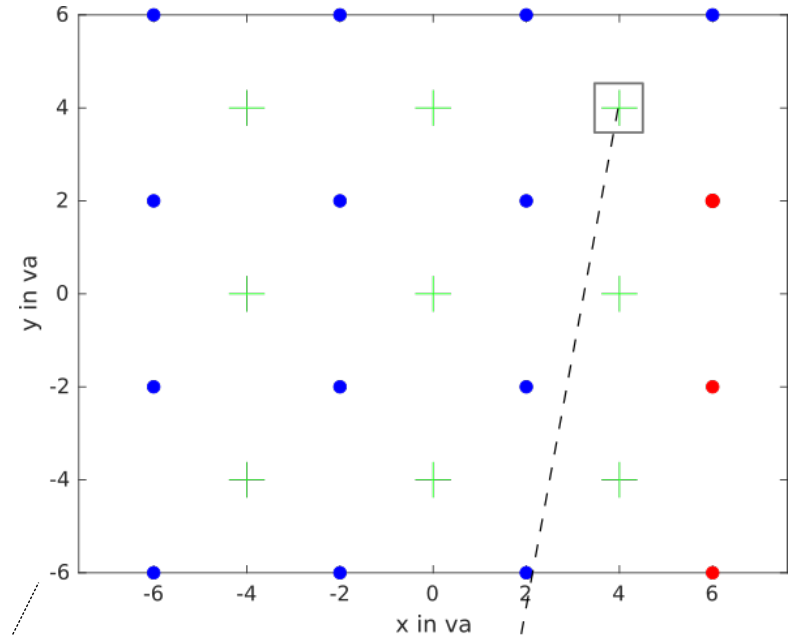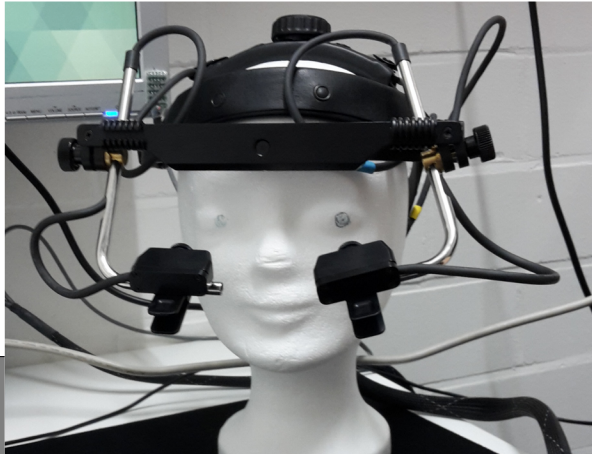
covert search

- if the items are large enough to be identified without fixation

- VS can be performed while focusing a single point

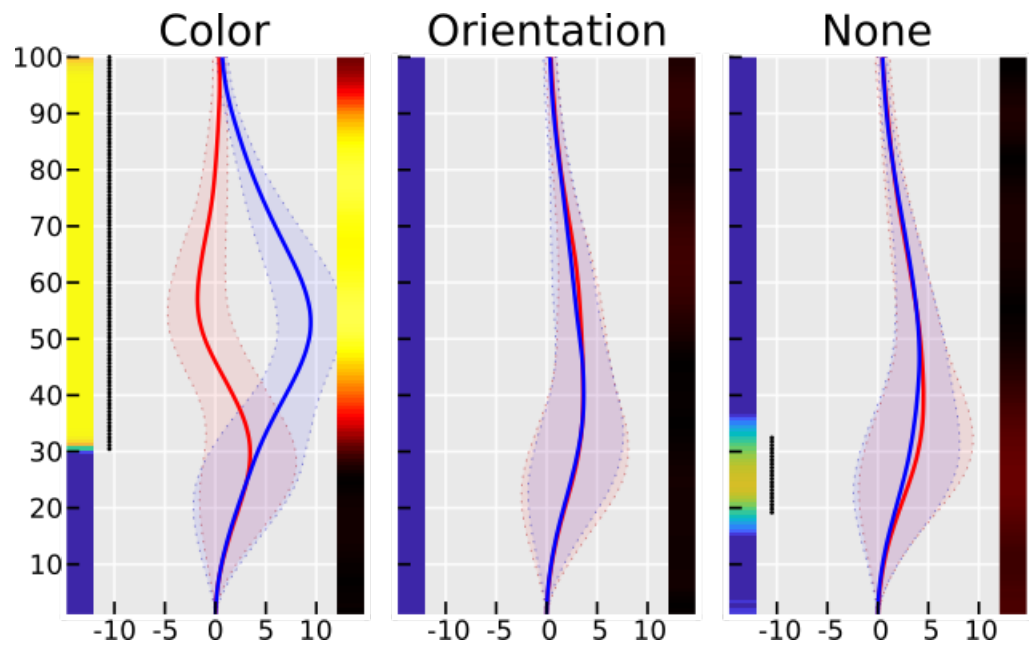- covert attentional shifts are inferred rather than directly observed
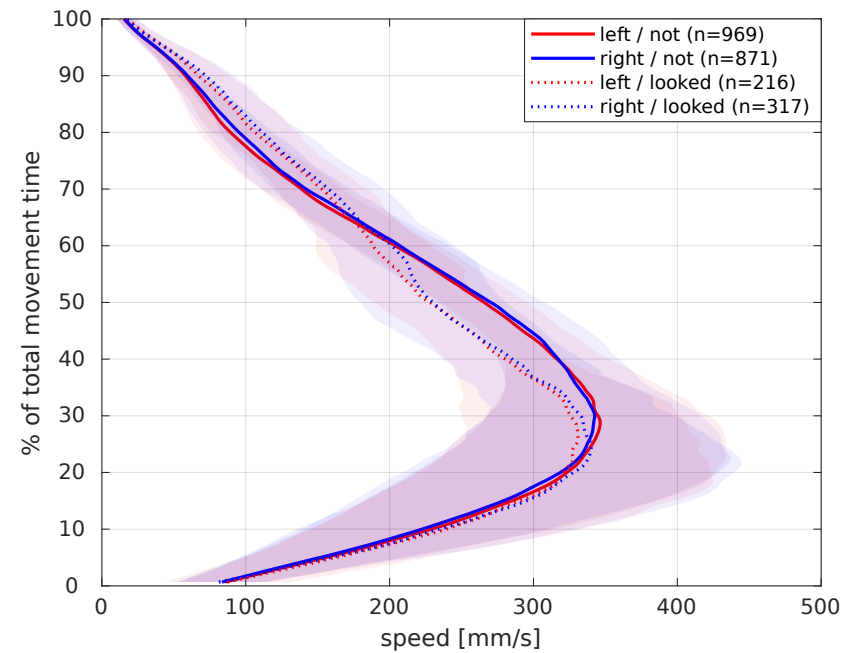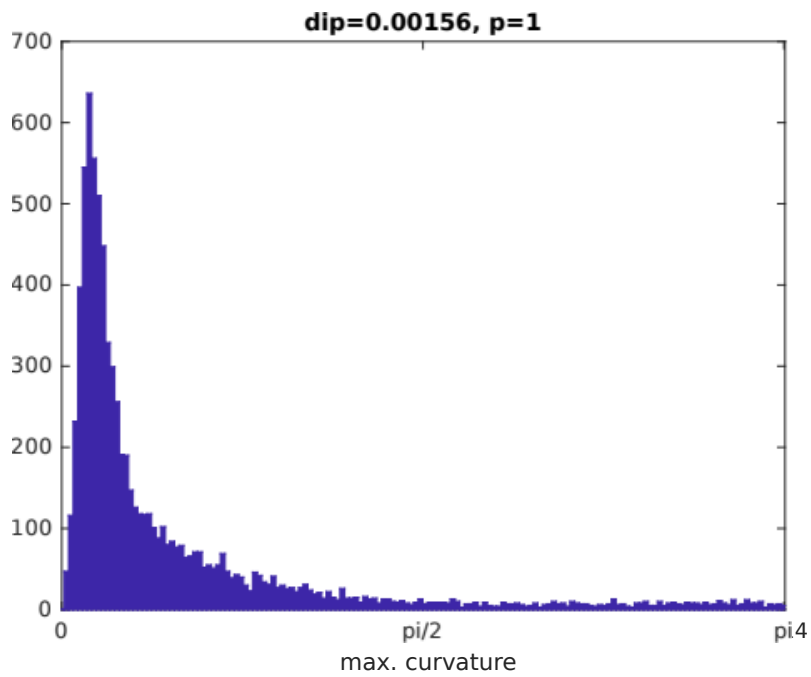
Methods II

Conditions:
1) Distractor shares target Color
2) Distractor shares target orientation
3) Distractor shares no target feature

Beep

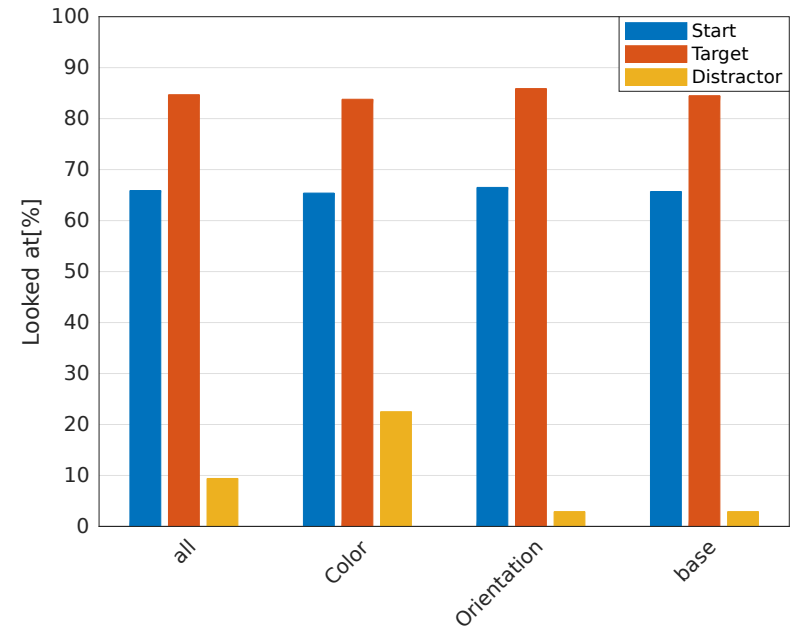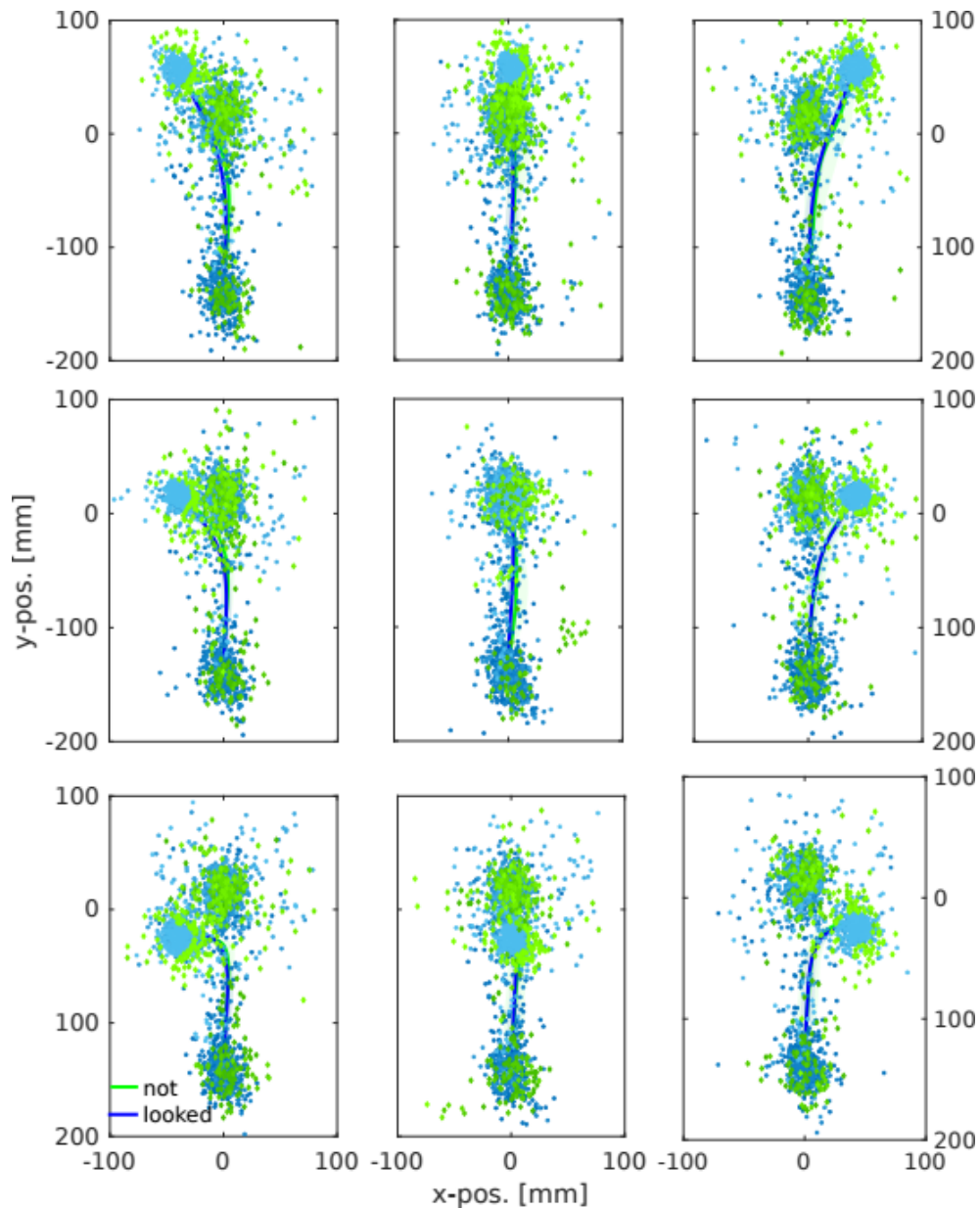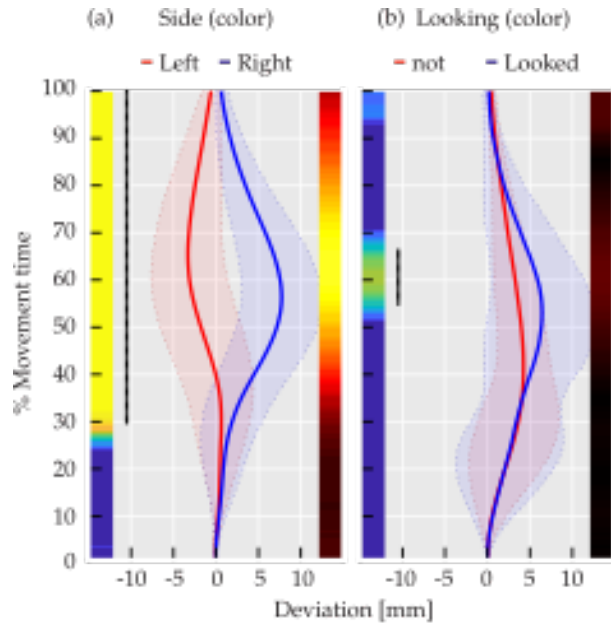# Results II

Bimodality

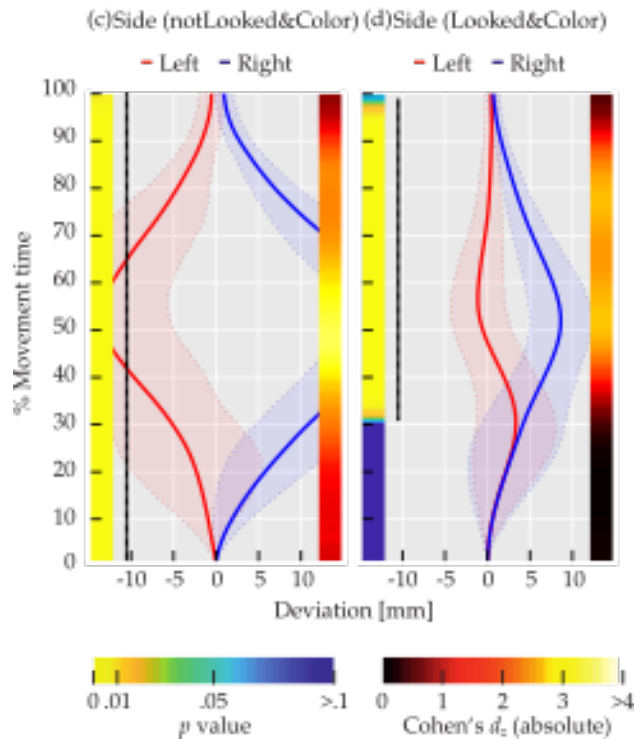=> The trajectories also belong to one population

=> Fixations are made at points of interest – but the distractor was rarely fixated

Distractor effect in color

No Looking effect in color

Distractor effect in color & notLooked

Distractor effect in color & Looked

(a) Side (color)
— Left — Right

(b) Looking (color)
— not — Looked

% Movement time

Deviation [mm]

(c)Side (notLooked&Color) (d)Side (Looked&Color)
— Left — Right   — Left — Right

% Movement time

Deviation [mm]

0.01   .05   >.1
p value

0   1   2   3   >4
Cohen's d_z (absolute)

Conclusion

- We found an attraction effect in mouse trajectories to a task irrelevant item, but only for the feature color

- The effect is likely absent for orientation because Color dominates as a feature [Alexander, R., & Zelinsky, G. (2014)]

- Attraction to the distractor even if it is not fixated show that covert attention shifts in visual search create deviations in human movement

- Not task relevant items attract mouse trajectories in visual search

Thank you for your attention!
Questions?