Shifted Center-looking suggests flexible allocation of attention in multiple object tracking

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Allocation of Attentional Resources

How does the brain allocate its limited resources to multiple stimuli?

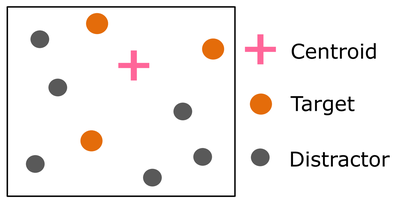
Fixed Resource Model: The brain has a set number of pointers. Each one is used to attend to one object.

Flexible Resource Model: The brain has a pool of resources that can be spread among objects in different proportions.

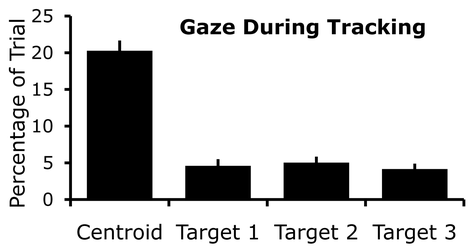
One way to address this question is to measure eye movements made during a Multiple Object Tracking (MOT) task.

Eye Movements during Tracking

Fehd & Seiffert (2008) found that, when tracking multiple objects, people often engage in center-looking. People look at the center of mass, or centroid, of the targets more often than any one target.



Gaze position during object tracking was analyzed by calculating the percentage of each trial that people spent looking within a specified distance from each region of interest.



People spend more time center-looking than target-looking.

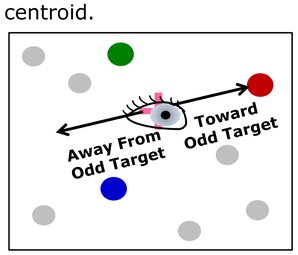
Center-looking could happen because gaze is pulled equally toward the equally attended targets.

Current Experiments

We attempted to vary the amount of resources each target demanded to see if gaze would remain at the centroid or shift.

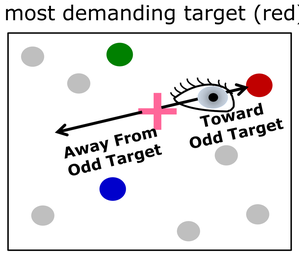
Fixed Resources

Resources can only be applied equally to each target so gaze should not shift from the centroid.



Flexible Resources

Resources can be applied unequally between targets, so gaze should shift toward the most demanding target (red).



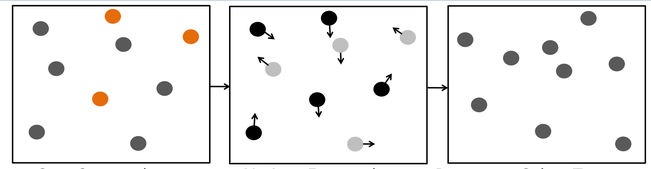
Experiment 1: Do low level differences between targets shift center-looking?

Method

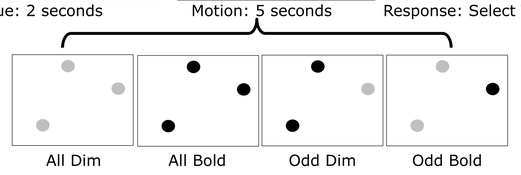
Varied Contrast

Contrast of Dim: 8%

Contrast of Bold: 99%



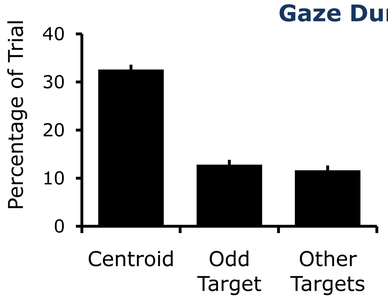
Each target could have one of two contrasts creating 4 conditions:

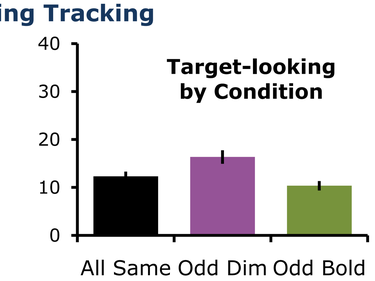


Results

Tracking accuracy was overall high (91%). It was higher when more of the targets were bold than dim ($t(14)= 2.864$, $p < .05$). However, the participants did not choose the odd target any more often than the other two targets when it was dim ($t < 1$, *ns*) or bold (t < 1, *ns*).

Gaze During Tracking

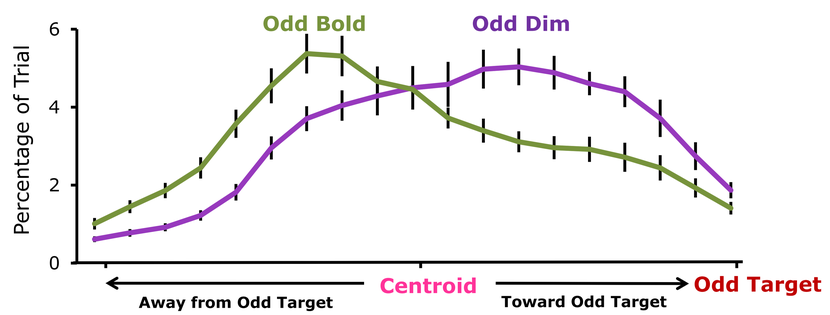




People looked at the centroid more often than the targets ($t(14) = 17.677$, $p < .001$).

People looked at the odd target more often when it was dim than when it was bold ($t(14) = 4.695$, $p < .001$).

Shifts in Gaze



Observers shifted gaze toward the odd target when it was dim but not when it was bold. Making a target hard to see makes center-looking shift toward it.

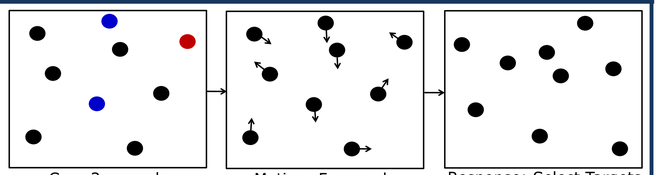
Gaze shifted toward the dim target.

Experiment 2: Do higher level differences between targets shift center-looking?

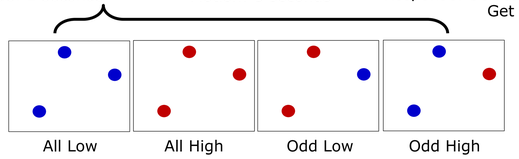
Method

Varied Point Value

- = 6-point target
- = 1-point target
- = 0-point distractor



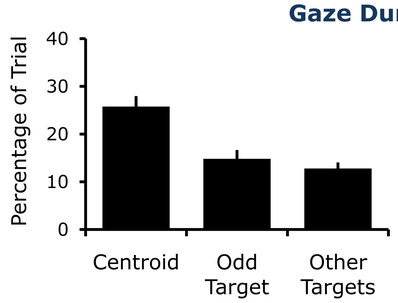
Each target could have one of two values creating 4 conditions:

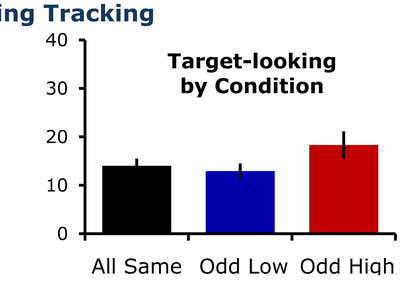


Results

Tracking accuracy was overall high (81%). Also, participants chose the odd target more often than the other targets when it was high value ($t(13)=3.641$, $p < .05$) but chose the odd target less than the other targets when it was low value ($t(13)=4.328$, $p < .05$).

Gaze During Tracking

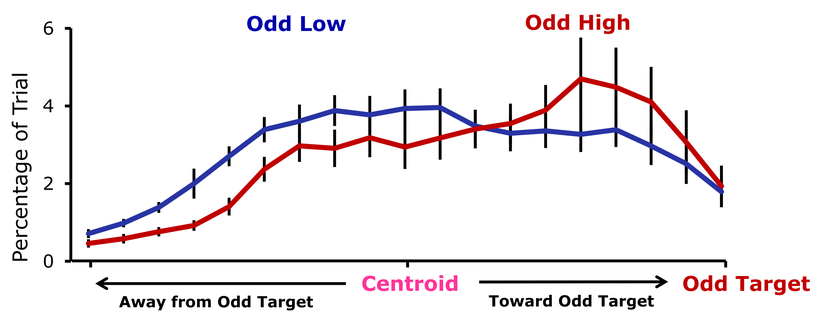




People looked at the centroid more often than the targets ($t(13)= 6.388$, $p < .001$).

People looked at the odd target equally often across conditions (Odd High – Odd Low: $t(13)= 1.722$, *ns*).

Shifts in Gaze



Observers seemed to shift their eyes toward the odd target when it had a high value but not when it had a low value.

Gaze shifted toward the high-value target.

Conclusions

When the odd target required more resources (e.g. Dim or High Value), gaze was shifted toward it. From this we conclude that subjects allocate resources to the targets in different proportions, lending support to the theory of flexible resources.

References

Fehd, H.M. & Seiffert, A. E. (2008). Eye movements during multiple object tracking: Where do participants look? *Cognition, 108,* 201-209.

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