Towards a Better Understanding of Eye-Movement Strategies in Multiple Target Search

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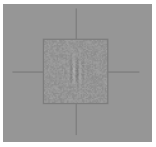
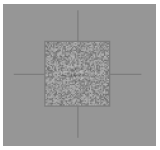
Research question: Where do people look when searching for multiple targets under time pressure?

At locations that look like targets, at locations about which they are uncertain, or somewhere else?

- Two heuristics are often applied:
  - Maximum A Posteriori (MAP): look at most clear targets *(e.g., Beutter, Eckstein, Stone, 2003; Najemnik, Geisler, 2005).*
  - Entropy: Look at most uncertain targets *(e.g., Lee & Yu, 2000; Legge, Klitz, Tjam, 1997; Renninger et al., 2007).*
- Entropy is efficient in situations with multiple targets and time pressure.
- When there are 6 locations, people tend to apply MAP strategies *(Verghese, 2012).*
- What happens when there are only 2 locations?
- What happens in 'critical trials':
  - One low noise location with clear target (MAP location).
  - One high noise location with or without target (Entropy location).



Target in low noise (MAP location)

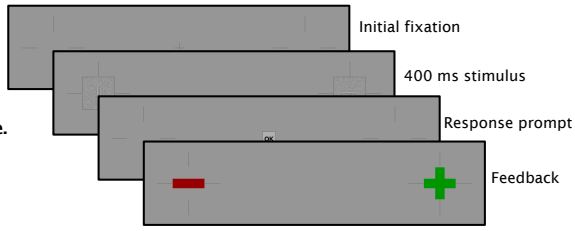


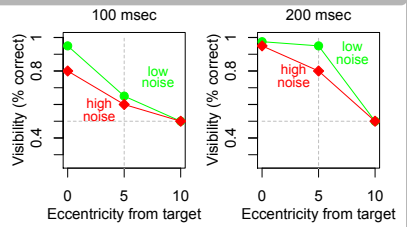
Distractor in high noise (Entropy location)

Method: Two-location target detection.

Experiment with stark contrast between Entropy and MAP prediction.

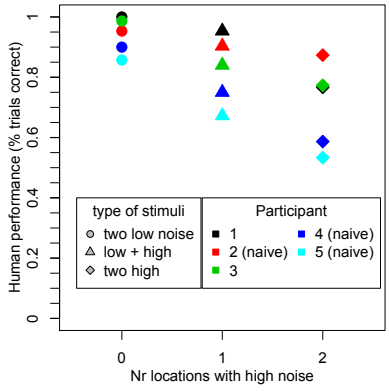
- Identify all targets (vertical gabors).
- Locations 5 deg eccentricity from center.
- Viewed under time pressure (400 ms).
- Target presence determined by prior (0.33, 0.50, 0.67).
- Targets are in low or high pixelated noise.
- Visibility depends on noise level, eccentricity, and viewing time.



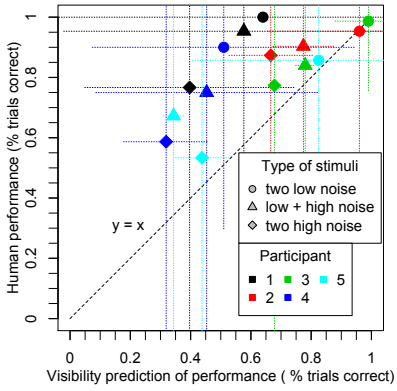


Results: Performance depends on stimuli and strategy.

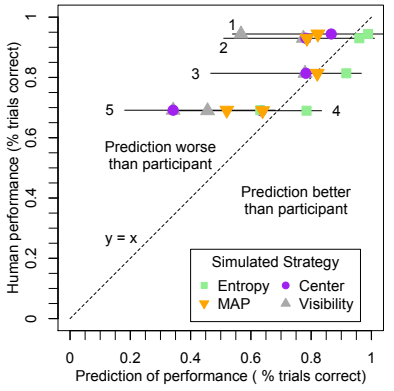
The most common strategy is to stay at center, followed by Entropy, then MAP.



Participants' performance declines when there are more high noise locations.



Participants perform better than a model based on their own visibility maps.



In critical trials: Participants can do even better by using Entropy strategy.

		Participant					
		Average	1	2	3	4	5
Saccade strategy	Center	80 %	53	99	100	55	93
	MAP	6 %	14	0	0	17	0
	Entropy	12 %	32	1	0	23	2
	Other	2 %	1	0	0	5	5

Participants mostly looked at center in critical trials.
For some participants (e.g., PP 2) this was a conscious strategy.

Saccades selected Entropy over MAP locations, but not consistently.

Conclusion: Participants use a variety of strategies.

Performance is good, but could be better and more efficient.

- Participants perform as good as, or better than predicted from their visibility functions.
- They do not show a strong preference for either MAP or Entropy.
- There are individual differences in performance and strategy.
- Participants seem to satisfice *(Simon, 1956)*, not optimize performance.

Acknowledgements

- Christian was supported by a Rachel C. Atkinson fellowship and Preeti was supported by R01 EY022394.