When to move on to the next raspberry bush?

Influence of target density and directives on cognitive visual search.

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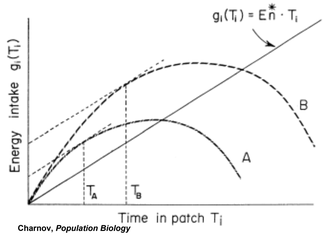
What is Optimal Foraging?

Real-world visual searches often contain a variable and **unknown number of targets**. Such searches present difficult meta-cognitive challenges, as searchers must decide **when to stop looking for additional targets**, resulting in high miss rates in multiple-target search.



Charnov, *Population Biology*

Fig 1. *The appropriate time to spend in each patch is found by constructing the highest line tangent to the curve and parallel to ray with slope En.*

Marginal Value Theorem (MVT; Charnov, 1976) predicts that observers will leave a patch when the **instantaneous yield** from that patch **drops below** the **average yield** from the entire field.

The need for a search strategy.

Drew T et al. Psychological Science

Fig 2. *83% of radiologists' failed to notice the gorilla in CT scan, while searching for cancerous nodules.*

we remain very interested in the discovery of targets (**Did the radiologist find the cancer?**),

but search termination rules are also important (**Did the radiologist miss the cancer because he quit too soon? Did the radiologist fall behind in his work because he spent too much time on each case?**
Is the MVT ingrained in us that it affects search behaviour and overides us when explicit instruction is give?

Adopted methodology.

30 participants were shown a single search scene (one image) and were told to search for the letter 's' amongst other letters. A blue circle appeared around identified targets to avoid them from interfering in further searches.

dwzwnctrhxarijknbiokaaqjwicmtchk
ebnziptcqeyydkwjtnfentpqmkhzibrv
ijtersdraefvhtchiwqakpmuempmcof
mathbbdnvcfqhbsfeljelzyyhawpicer
bpalfxofxbjtzrucmkthdxovsftohfyxu
uqywcowqpkvvdjnaqihbnsejsvkvb
mlsoblrmanhrpjakduxapjphqfwooe
zwywndkyhkdunpbfrfwucyvhvbvfbu
qneuvpmcivsuqwhouomjnaxfownvt
pxjubcojnvvvltfyzfeowfnmpixivbkln
vtxxcoujtbzopdhjeyeibyrrcbztmyqu
edpywifrnybpqhnauxyehvlbrsyrdcu
pdnwzvrvemafplidhzmadwbvtjlrylwt
vevkpzrlinymqvzvinnaypvndcrhmjd
wfocakwy xtwwvyrqkzynlxkomvqea

Fig 3. *The participants were asked to search for the letter s amongst all the letters pres*

The participants had to go through six search scenes (with 3 levels of target densities) individually one after the other finding as many targets possible within two minutes. Stimuli were presented on laptops with a 15-in screen and were programmed in Python using PsychoPy software.

Does our search behaviour change with variation in target density?

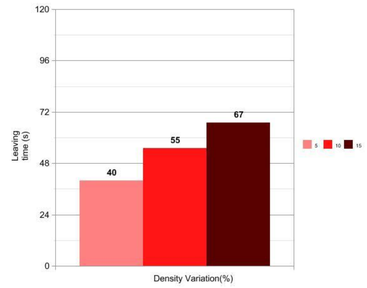


Fig 4. *As expected from the MVT people follow the opimal foraging model and linger on to a search scene for more time when the target density is more*

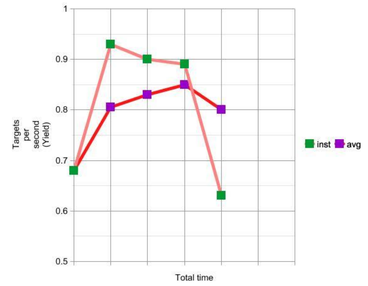


Fig 5. *The participants left the current search area after the instantaneous yield dropped below the average yield..*

What happens when directed to search exhaustively?

Participants were now told that they were supposed to select all targets in a search scene before moving on to the next search scene. Any unmarked targets would result in a penalty of 0.5 points.

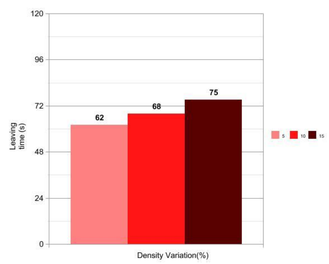


Fig 6. *When participants are directed to find all targets the leaving time increases, also the time difference between densities decreases appreciably.*

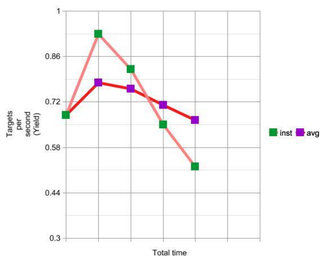


Fig 7. *Participants persisted with the search scene even after the instantaneous rate dropped below the average rate. But for not long.*

- As expected this resulted in **increase hit rate --- 68% to 83%**
- it is worth noting that this movement was not terribly dramatic; at least, not if one is thinking about "exhaustive" search in terms of finding every sign of disease or every threat to security.

Of course, this experiment does not tell us what radiologists or intelligence analysts might do, given instructions to "find everything." The results do tell us that, while they do respond to instruction, observers do not trivially switch to a truly exhaustive search mode.

Conclusion

- People do tend to search optimally in accordance to the Optimal foraging theorem. This is consistent with variation in target density.
- When explicitly directed to find all targets before proceeding to the next search scene people tend to move away for the optimal model but still miss quite a few targets.
- It might be the case that we have evolutionarily adopted the foraging model and apply it to other tasks such as visual search and search in our memory.

References

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