Gazing at Rewards: Eye Movements as a Lens into Human and AI Decision-Making in Hybrid Visual Foraging

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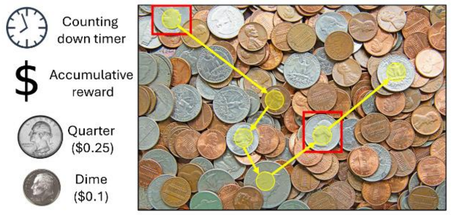
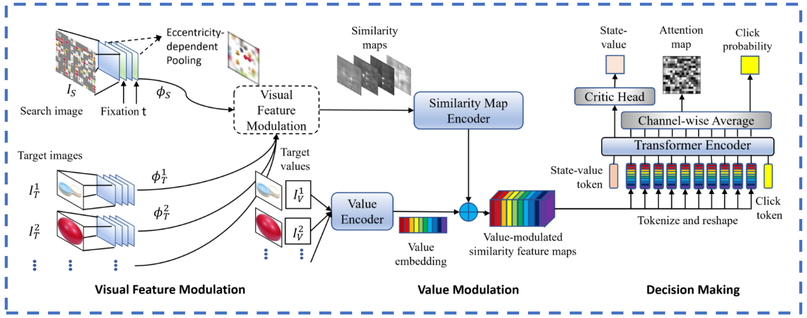
Introduction

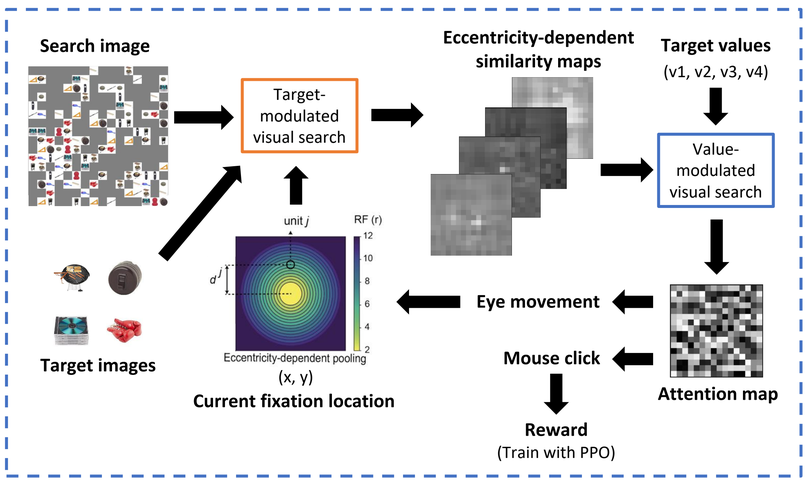
Hybrid visual foraging: Search for multiple instances of various target types stored in memory, where target values and prevalence can vary, and the exact number of target instances is often unknown.



Our observation: Humans can proficiently seek rewards when doing hybrid visual foraging with ***zero*** training, while current AI models struggle to generalize to unseen combinations of values and prevalence.

Visual Forager (VF)



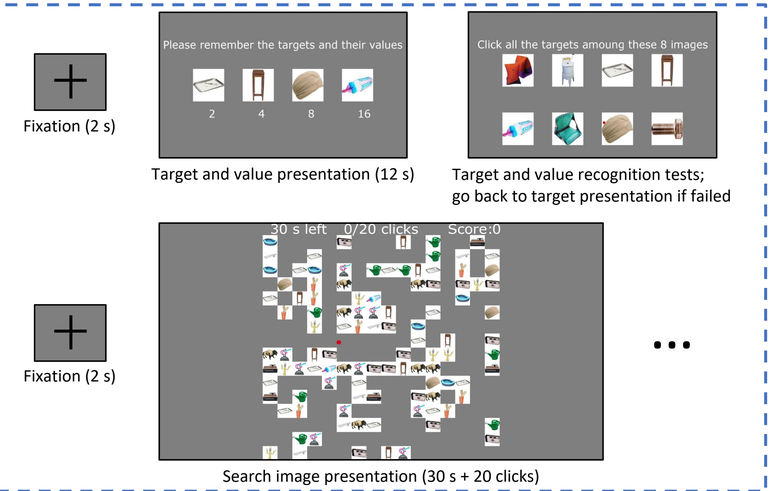


Task

Train (VF only):
- Uneven value, random prevalence

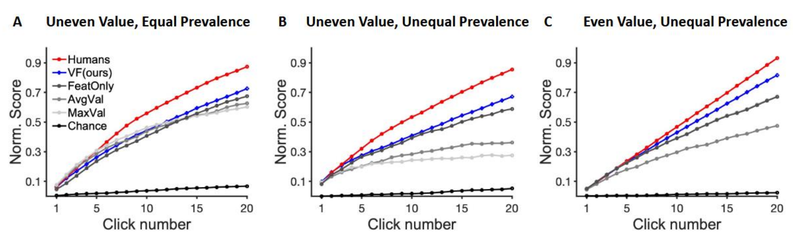
In domain (InD):
1. Uneven value, equal prevalence (UnValEqPre)
2. Uneven value, unequal prevalence (UnValUnPre)

Out of domain (OOD):
1. Even value, unequal prevalence (EqValUnPre)
2. Unseen target objects (UTargets)
3. Unseen value combinations (UValues)
4. Unseen total item numbers (UItemNum)
5. Unseen target set size (USetSize)



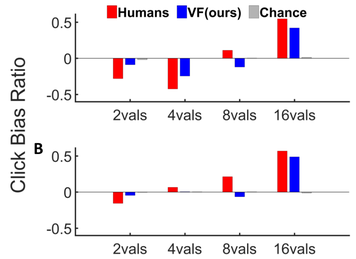
Results

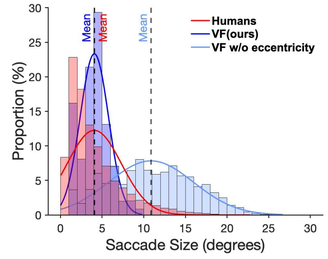
- Humans and VF are proficient foragers.
- VF outperform all the baseline models



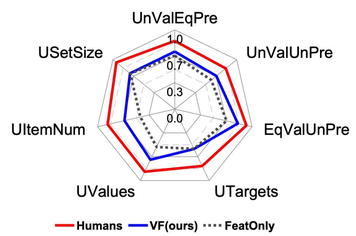
Results

- Both humans and VF show a tendency to prioritize high-valued targets initially, while selecting low-valued targets later and less frequently.
- VF approximates the saccade size distributions of humans, without training on human eye-tracking data.





- VF generalizes to OOD conditions
- Ablations reveal critical component designs



Ablations	UnVal EqPre	UnVal UnPre	EqVal UnPre
Behavior Clone	61.7	48.5	60.1
VF (2D-CNN)	**75.3**	63.7	70.0
Explicit Val. Emb.	69.2	56.7	61.8
W/o Augmentation	51.3	52.0	52.2
Full VF (ours)	72.6	**67.1**	**81.6**

Conclusion & Discussion

- ❑ Humans tend to over-exploit the most prevalent or high-valued target types encountering imbalance in target prevalence or values.
- ❑ Visual Forager with better generalization capability in hybrid visual foraging tasks.
- ❑ Visual Forager vs. Human Behavior.
- ❑ Cumulative rewards, foraging biases, & eye movements.

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