Beware of tigers...

How does our visual system select and promote the relevant visual features (e.g., color, orientation...) such that search speed is maximized?


What is the underlying mechanism?

This model applies optimal top-down gains on bottom-up saliency maps such that SNR is maximized, thereby increasing search speed.

**Model**

- **Top-down bias**
  - Predictive map: Target-driven bias
  - Bottom-up salience: SNR
  - Search speed and accuracy

**Simulation Results**

<table>
<thead>
<tr>
<th>Task distribution</th>
<th>Observer’s belief</th>
<th>Optimal gains</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non priming / top-down guidance</td>
<td>19.7dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineral priming / top-down guidance</td>
<td>23.0dB</td>
<td></td>
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<tr>
<td>Prominence of target and distractor</td>
<td>7.4dB</td>
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<tr>
<td>High SNR leads to low reaction times and easy search (Wolfe et. al, '03).</td>
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**Psychophysics experiments**

Surprising prediction: It is sometimes optimal to boost a non-target feature. To test this prediction, we design the following psychophysics experiments.

- **Experimental design**: Set up the gains using T1 trials (search for SS among 50 items)
- **Test the gains by randomly inserting T2 trials (where the target must be reported among probes all orientations).**
- **Additional controls show a reversal in the trend of biasing when the distractor is reversed.**

**Discussion and conclusion**

1. Our theory can successfully account for a large body of existing visual search literature.
   - Bottom-up effects: Target-distractor discriminability, distractor heterogeneity, linear separability, pop-out.
   - Top-down effects: Role of priming, uncertainty, target enhancement, distractor suppression.

2. These results suggest that humans may modulate gains optimally during visual search.