Escaping Attention:

Natural Scenes vs. Synthetic Stimuli

Li Fei-Fei

Collaborators:
Rufin VanRullen, Christof Koch, & Pietro Perona

California Institute of Technology, USA
Goal

Object recognition and its relation with visual attention.
Visual Search
Reaction Time

Conjunction of features

Single feature

Set Size
Dual Task
Feature Integration Theory

Master Map of Locations

Stimulus Pattern (Visual Scene)

Object Perception → Object Recognition

Attentional Spotlight

Feature Maps

Color → Orientation → Curvature → Motion → Depth
scrutiny

Attentional scrutiny

Tree

Preattentive Object File

RECOGNITION
150ms – A really fast signal...

Thorpe et al. 1996
A feed-forward mechanism?
Our question

How critical is attention in natural scene recognition?

How does this compare to other recognition tasks?
Peripheral categorization perf. (%) vs. Central discrimination perf. (%)

- Approximately 75%
- No interference
Peripheral categorization perf. (%) vs. Central discrimination perf. (%)

- Around 75% performance in both areas is depicted.
- The term "interference" is noted within the diagram, indicating a possible relationship between the two metrics.
Peripheral categorization perf. (%) vs. Central discrimination perf. (%)

- ~75
- ~75

Interference
Peripheral categorization perf. (%) vs. Central discrimination perf. (%)

- ~75
- No interference

50 ~ 75

Central discrimination perf. (%)
individual results

peripheral task performance (%)

central task performance (%)
Central

Peripheral

Time (ms)

0 100 200 300
Compare to seemingly simpler tasks
Compare to seemingly simpler tasks
Compare to seemingly simpler tasks
Compare to seemingly simpler tasks
Are animals special?
Reddy et al., 2002

Graphs showing the relationship between normalized gender task performance (Y-axis) and normalized letter task performance (X-axis). The graphs display data points indicating a negative correlation.

A. vs. B.
Is training essential?

**group I**
- Trained on animal categ.
- Tested on vehicle categ.

**group II**
- Tested on animal categ.
- Trained on vehicle categ.
Train on faces

Test on animals

Test on vehicles

normalized central performance (%)
Categorization without attention: Single Image vs. Double Images

![Graphs comparing single image to double images](image)
Double-Image performance: with vs. without attention

with attention

without attention

Visual Angle (in degree)

category perf. (%)
Parallel evidence for parallel processing

Rousselet et al. 2002
### Effect of “meaningful” category

<table>
<thead>
<tr>
<th>randomly rotated</th>
<th>fixed rotation</th>
<th>upright position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>fixed rotation</td>
<td>Upright position</td>
</tr>
<tr>
<td>Distractor</td>
<td>fixed rotation</td>
<td>Upright position</td>
</tr>
<tr>
<td>( \swarrow ) vs. ( \searrow )</td>
<td>( \swarrow ) vs. ( \nearrow )</td>
<td>( \mathcal{T} ) vs. ( \mathcal{L} )</td>
</tr>
<tr>
<td>(masked by ( \mathcal{O} ))</td>
<td>(masked by ( \mathcal{O} ))</td>
<td>(masked by ( \mathcal{O} ))</td>
</tr>
</tbody>
</table>
Effect of “meaningful” category

randomly rotated
Target vs. Distractor
(masked by )

fixed rotation
Target vs. Distractor
(masked by )

upright position
Target vs. Distractor
(masked by )
Take home messages

• Natural scene categorization escapes attention much “easier” than simpler synthetic stimuli.
• Seemingly “parallel” processing.
• “Meaningful” categories entail less attentional load.
Future Work

• two concurrent categorizations

• effect of top-down influence

• do subjects recognize animals or tigers?
Acknowledgment

• advisors: Christof Koch and Pietro Perona
• collaborator and mentor: Rufin VanRullen
• consultant: Jochen Braun
• sponsors: NSF, Paul and Daisy Soros Fellowship
