Action & Masking

Learning Objective Topics

- Action
  - What/Where Pathway
  - Dissociations
  - Mirror Neurons
- Masking
  - Masking theories
  - Masking and Automatic Perception of Emotion
How do we coordinate our visual perceptive processes with movement?

Perception (What) and Action (Where): Ungerleider & Mishkin (1982)

- What stream: identifying an object
- Where stream: identifying the object’s location
Dissociations

- Why?
  - You are trying to understand a complex system in the brain
  - The brain is filled with networks
  - You want to know if an area of the brain is involved in a certain process

- How?
  - Study brain damage
  - Use logic to determine the function of different areas

Single Dissociation

- A brain lesion disrupts one thing but not another
  - Factor X Disrupts Task 1 but not Task 2

- Question it could answer: is this brain area necessary for this process?
Kitchen Appliance Example

- Kitchen knife
  - Suffered damage to the edge of the knife
  - (What actually happened is its serrated edge was rubbed smooth)

<table>
<thead>
<tr>
<th></th>
<th>Cut Steak</th>
<th>Cut Butter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knife (Edge Damage)</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

1. What can we conclude about the purpose of the edge of a knife?
2. Is the edge of the knife involved in both processes?

Single Dissociation Example

<table>
<thead>
<tr>
<th></th>
<th>Identify Objects (what)?</th>
<th>Identify Locations (where)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monkey A (Temporal Lobe Damage)</td>
<td>No</td>
<td>Yes</td>
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Conclusion:
- The temporal lobe is necessary for identifying objects
- But could the temporal lobe still be involved in both processes?
Single Dissociation Example

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Why is this not the whole story?

- Possible that the two tasks use the same neural resources
  - BUT identifying objects is just harder, so it uses more brain power

Double Dissociation

- Two lesions effect two different things
- You do one thing (Factor X) and it effects the first variable (Task 1) and not the second (Task 2)
- You do another thing (Factor Y) and it effects second variable (Task 2) and not the first (Task 1)
- Question it could answer: Are these two brain areas involved in separate processes?
Blender Example

A: Damage to motor: can’t grind walnuts
B: Crack in pitcher: can’t make milkshakes
A: Warped pitcher: can’t grind walnuts

Blender Example: Double Dissociation

<table>
<thead>
<tr>
<th></th>
<th>Grind Walnuts?</th>
<th>Make Milkshakes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blender A</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Blender B</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

• What conclusions could we make?

• Should the motor be the walnut region and the pitcher be the milkshake region?
Caption: The two types of discrimination tasks used by Ungerleider and Mishkin. (a) Object discrimination: Pick the correct shape. Lesioning the temporal lobe (purple shaded area) makes this task difficult. (b) Landmark discrimination: Pick the food well closer to the cylinder. Lesioning the parietal lobe makes this task difficult. (From Mishkin, Ungerleider, & Macko, 1983.)

Double Dissociation Example

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</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Monkey B</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>(Parietal Lobe Damage)</td>
<td></td>
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</tbody>
</table>

Conclusion:
- Identifying objects and identifying locations are two separate processes
- Make up two separate neural networks
Double Dissociation Example

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Why should we be cautious about the what and where pathway label?

Is there only one way to damage any brain region?

- No!
Perception and Action

- Patient D.F. – damage to the temporal lobe
  - Cannot match the orientation of a slot by turning the envelope (match orientation)
  - Can put it into the slot once started moving the envelope (vision/action coordination)

Perception and Action

- Parietal damage
  - Cannot coordination vision & action
  - Can match orientation

- Draw the chart to determine if it is a double dissociation.
- What should we be cautious about?
- What can we conclude?
- Perception/What Pathway
- Action/Where Pathway

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  - Mirror Neurons

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Mirror Neurons

- Neurons that respond the same way when actually performing an act and when observing someone else perform the act
- Located in the premotor cortex

Rizzolatti et al. 1996

- Ventral premotor cortex (area F5) of the macaque monkey
Rizzolatti et al. 1996

- Neuron fires when monkey grasps food
- AND when experimenter grasps food

What else could be happening?
How could we test this?
Parietal Mirror Neurons

- Do you remember the parietal role in movement?

Brain Mechanisms of Movement

- **Posterior parietal cortex** respond to visual or somatosensory stimuli, current or future movements.
  - Damage to this area causes difficulty coordinating visual stimuli with movement.
Auditory Mirror Neurons

- Fire when performing an action and when HEAR a sound from that action!

Pianists, but not nonmusicians, activated some of the same regions that were active while playing the piano keyboard.

Perception of Action: Mirror Neurons

- Mirror neurons and action:
  - [http://www.youtube.com/watch?v=lqG4G5Z02YQ](http://www.youtube.com/watch?v=lqG4G5Z02YQ)

- Autism:
  - [http://www.youtube.com/watch?v=_8WV1zAh9zU](http://www.youtube.com/watch?v=_8WV1zAh9zU)
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Masking

- A brief display that is clearly visible when shown alone
- Rendered invisible by the subsequent presentation of a second visual stimulus.
- Perception + Attention = Masking
Masking

- How does mask interfere with perception of target?
- *Mask Form:*
  - Pattern mask
    - Occupies same space as target
  - Metacontrast mask
    - Similar contours of target but doesn't overlap space
  - 4 dot mask
    - Non-similar shape to target

Masking demos

- Identify the shape
Simplified Pattern Mask Demo

Why might this have happened?

- SOA = stimulus onset asynchrony
  - -300 (mask before target)
  - +300 (target before mask)
- Temporal dimension
  - Forward masking
  - Backward masking
- If mask comes right before or right after – less likely to identify it

Theories of masking

- Breitmeyer (1984)
  - Pattern mask
  - Finding: worst @ SOA=0ms; ok @ +/- 100ms
  - Theory/conclusion:
    - We perceive them as part of the same pattern
    - Our visual system doesn’t pick up on the timing
    - Mix up signal (the target) with noise (the mask)
    - Integration effect
Metacontrast masking

- Backward masking
  - Target (30ms) then mask (30ms)
- Greatest at SOA of 50-100ms

**Simplified Metacontrast Mask Demo**
Why might this have happened?

Theories of masking

- Weisstein, et al. (1975)
  - Metacontrast mask
  - Finding: U-shaped effect (worst @ SOA=\sim80\text{ms})
  - Theory:
    - Fast signal = on/off; slow signal = object processing (e.g. ID shape)
    - Fast signal of mask turning on interrupts slow object ID signal of target
  - Conclusion: Early visual interruption process
    - We start to process the first target, but it's interrupted by the second
Two-channel theory
“ Interruption masking”

- Onset of each stimulus (target and mask) initiates activity in two channels
- One signal fast-acting, but short-lived
  - Signals stimulus onset and offset
- Other slow-acting, but longer lasting
  - Signals info regarding stimulus shape/color
- Metacontrast masking effect
  - Fast-acting signal in response to mask inhibit slow-acting signal generated by earlier target
- Will a 4-dot mask have same effect?

Theories of masking

- Enns & DiLollo (1997)
  - 4-dot mask: masking occurs if conditions are met
  - More of a focus on the process of attention

- http://www.sfu.ca/~enzo/
• Task: Report target highlighted by 4 dots
• IV: set-size

• Masking only occurs if:
  • Multiple objects
  • Target not distinct
  • No spatial cue before target

Enns & DiLollo (1997)

• Comparison of previous vs. current pattern
  • Searches for match between perceptual code and sensory code
  • If mask continues: there is “mismatch”
  • If many targets, will loose target signal

• Object substitution theory: Mask doesn’t just interrupt processing, it is new focus of object recognition
• Effect of attention mechanism
Theories of masking

- Breitmeyer (1984)
  - Pattern mask: monotonic effect (strongest SOA=0ms)
  - Integration effect: target and mask = single stimulus
- Weisstein, et al. (1975)
  - Metacontrast mask: U-shaped effect (strongest SOA=80ms)
  - Interrupt early visual processing
- Enns & Di Lollo (1997)
  - Object-substitution mask: effect depends on condition
  - Attentional process – mask becomes new focus of attention (object substitution)

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Emotion Perception Demonstration

- Task: say what the facial expression is.
- I will mask it with a neutral face.
- Various SOA (stimulus onset asynchrony)
Can attention be captured by emotion without conscious awareness?
Dimberg et al. 2000

Facial Contraction of muscles – despite unaware!

Zygomatic Major: Smile

Corrugator supercili: angry face

Amygdala activation by subliminally presented fearful eye-whites

Whalen et al. (2005) Science 372 :