9.00 Lecture -- Attention

John Gabrieli
What is *attention*?

• “Everyone knows what attention is. It is the taking possession by the mind in clear and vivid form of one out of what seem several simultaneous objects or trains of thought... It implies withdrawal from some things in order to deal with others.”

  - William James, 1890
ATTENTION

- awareness/consciousness
- we often attend to more than we realize
- we often attend to less than we realize
ATTENTION & CONSCIOUSNESS

1. Attention as gatekeeper to perception and knowledge

2. Attention is very limited - one thing at a time
   (we miss a lot)

3. Unconscious/Unattended processes
   (do things we not notice influence us?)

4. Some external stimuli “capture” our attention - “bottom-up” processing

5. Some internal thoughts & goals direct our attention - “top-down” processing
Selective Visual Attention

Somewhere Among hidden the in most the spectacular Rocky Mountains cognitive near abilities Central City is Colorado the an ability old to miner select hid one a message box from of another. gold. We Although do several this hundred by people focusing have our looked attention for on it, certain they cues have such not as found type it or yet style.
Attention and Auditory Awareness

- Dichotic Listening/Shadowing Demo
SHADOWING & ATTENTION
(Cherry, 1953)

• left ear - shadowed message
• right ear - second message

What could be heard in unattended ear?
• if a voice is present
• voice changes from man to woman
• voice becomes a tone

What was not heard in unattended ear?
• content of message
• language of message
• change in language of message
• speech vs. nonsense backward speech
Paradox of cocktail party effect:

How can we notice something we do not attend to?
(MacKay, 1973)
• shadowed ear
  "The man approached the bank."
• other ear
  "money" or "river"
paraphrase
  "The man went to the savings and loan association"
  "The man went to the side of the river"

(Eich, 1984)
• shadowed ear
  essay
• other ear
  taxi fare (fair)

<table>
<thead>
<tr>
<th></th>
<th>Attended</th>
<th>Unattended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td>88%</td>
<td>12%</td>
</tr>
<tr>
<td>Spelling Bias</td>
<td>40%</td>
<td>41%</td>
</tr>
</tbody>
</table>
Paradox of cocktail party effect:

How can we notice something we do not attend to?

*some kinds of information are processed automatically/ without attention*
ATTENTION & CONSCIOUSNESS

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A Penny for Your Thoughts
Attention and Memory

• Less than half the participants thought the correct version of the penny was even a *plausible* answer.

• Without attention, learning is very hard, even with many, many exposures.
ATTENTION

• *controlled* or *top-down*
  conscious, effortful, selective, focused
  goal driven
  demands a lot of attention

• *automatic* or *bottom-up*
  unconscious, easy
  stimulus-driven
  demands little or no attention
## Stroop Effect

### Word Set #1

<table>
<thead>
<tr>
<th>RED</th>
<th>GREEN</th>
<th>BLUE</th>
<th>YELLOW</th>
<th>PINK</th>
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<tbody>
<tr>
<td>ORANGE</td>
<td>BLUE</td>
<td>GREEN</td>
<td>BLUE</td>
<td>WHITE</td>
</tr>
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<td>GREEN</td>
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<td>PINK</td>
<td>YELLOW</td>
<td>GREEN</td>
<td>BLUE</td>
<td>RED</td>
</tr>
</tbody>
</table>

Name the words – easy, automatic reading
Name the color of the PRINT – harder because of conflict between automatic reading process and controlled print naming.
HYPNOSIS & STROOP EFFECT

- Raz et al, 2008
- high & low hypnotizable subjects
- perform normally
- meaningless characters in a foreign language you do not know
- interference
  - low subjects - 104 msec, 121 msec (hyp)
  - high subjects - 157 msec, 5 msec (hyp)
High-Hypnosis Subjects

No Hypnosis Activation for Incongruent > Congruent

High-Hypnosis Subjects

Hypnosis Activation for Incongruent > Congruent

ATTENTION

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Visual Search

- *is there a red X in the display?*
Features & Conjunctions

- **Features** - defined by one dimension
  shape (X,O), color (black, red)

- **Conjunctions** - defined by co-occurrence of two dimensions
  \[
  \begin{array}{ccc}
  X & O & X \\
  X & O & X \\
  \end{array}
  \]
TWO KINDS OF VISUAL SEARCH

![Graph showing two lines: one for conjunction and one for feature. The red line represents conjunction, and the blue line represents feature. The x-axis is labeled SET SIZE, and the y-axis is labeled Reaction Time (msec). The graph shows an increase in reaction time with an increase in set size for both conjunction and feature search.]
TWO KINDS OF VISUAL SEARCH

<table>
<thead>
<tr>
<th>Preattentive</th>
<th>Attentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>features</td>
<td>conjunctions</td>
</tr>
<tr>
<td>parallel</td>
<td>serial</td>
</tr>
<tr>
<td>pop-out</td>
<td>no pop-out</td>
</tr>
<tr>
<td>flat slope</td>
<td>steep slope</td>
</tr>
</tbody>
</table>
ILLUSORY CONJUNCTIONS

Controlled attention binds features into coherent perceptions
Limits of Attention

• Attention is a very constrained resource.
  – Temporal constraints
Attentional Blink
Attentional Blink

Probability of getting T2 correct, given T1 correct

Frames (100 ms each)

Chance performance

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Limits of Attention

• Attention is a very constrained resource.
  – Temporal and spatial constraints
Multiple Object Tracking

How many targets can be accurately tracked

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Number of Objects Tracked after 30h of Action Video Game training

Number of Objects Tracked in Control Group (Tetris) (No Improvement)

Subliminal Perception

• Can non-attended stimuli still influence our actions?
KNOWING WITHOUT SEEING

SUBLIMINAL PERCEPTION
KNOWING WITHOUT SEEING
SUBLIMINAL PERCEPTION

(10 msec)

CHURCH

DOCTOR slower

XXXX

NURSE

DOCTOR faster

CHURCH

XXXX

DOCTOR slower

XXXX

NURSE

XXXX faster
DESIGN AND BEHAVIORAL RESULTS

fMRI
