ATTENTION!
(Specifically Divided and Selective Attention)
Chapter 4

Learning Objective Topics

- Selective Attention
  - Visual Tasks
  - Auditory Tasks
  - Early vs. Late Selection Models
  - Visual Search
- Divided Attention
- Attention Blindness
Controlled attention

- Deliberate, voluntary allocation of attention

- Selective attention: attend to one source, ignore other sources
  - Attention metaphor: filter

- Question we will focus on: What influences our ability to ignore irrelevant stimuli?

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Selective attention: Visual tasks

- Flanker compatibility task
- Attend to center of display, ignore sides (“flankers”)
- Instruction: say if target is present or not
  - [http://cognitivefun.net/test/6](http://cognitivefun.net/test/6)

- Press one key if A or B is in the center
- Press Another if C or D is in the center

<table>
<thead>
<tr>
<th>STIMULUS</th>
<th>FLANKERS</th>
<th>TYPICAL RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) B A B</td>
<td>Compatible</td>
<td>Fastest response to target</td>
</tr>
<tr>
<td>(b) C A C</td>
<td>Incompatible</td>
<td>Slowest response to target</td>
</tr>
<tr>
<td>(c) X A X</td>
<td>Neutral</td>
<td>Intermediate response to target</td>
</tr>
</tbody>
</table>

(target)
Participants are influenced by flankers even if told to ignore them
But only up to a certain point

Press one key when the target is N, one key when the target is X
For which one is the flanker more distracting?
Flanker

- Incompatible – slows response for low load
- No effect on high load
- Why does this happen?

Video-Game Experts

- Tested using flanker compatibility task
- Low load: experts’ performance is similar to non-experts
- High load: experts still had enough resources left to process distractors
  - They had slower reaction times in the incompatible condition even under the high load condition
- What does this suggest about playing video games?
Selective attention: Visual tasks

• Stroop task
  • Dual-component stimuli (color and word)
  • Instruction: say color of ink
  • Why was the classic Stroop often harder than your Stroops?
• From the Flanker and Stroop tasks:
  • What influences our ability to ignore task irrelevant stimuli?
• Real life examples: When does an automatic task interfere with intended processing?

Selective attention: Visual tasks

• Simon effect
  • Right button – red light
  • Left button – green light
  • Ignore location
  • Hypothesis? Will you be faster if red button appears on left or right?
Simon Applications

- Design of Aircraft cockpits
- Industrial/Organizational Psychology

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Selective attention: Auditory tasks

• Dichotic listening
  • 2 auditory messages: 1 in each ear
  • Task: to attend to 1 ear

• Shadowing task
  • Dichotic listening
  • Task: repeat content of 1 ear

Let’s try it!

• Volunteer to be the listener
  • Shadow what you hear in the right ear
• Two readers
Cocktail Party Effect

- Processing of sound in noisy environments
  - Auditory regions of the brainstem – inferior colliculus
  - Inputs from cortex - amplify relevant information in the sound signal while inhibiting irrelevant information
- Evidence from bats and birds


What do you know about the disorder (formerly known as?) dyslexia?
Cocktail Party Effect & Dyslexia

Chandrasekaran et al., 2009:
- Measure brainstem activity
- Non-Dyslexic Children: Watched video while the syllable “da” was played
  - Syllable was either in a repetitive or unpredictable pattern
  - Repetitive syllable: more brainstem activity
  - Filter out repeated syllable and attended to video
- Dyslexic children
  - No increased brainstem for repetitive
  - Have trouble filtering out background cues
  - Trouble focusing in class
- Music training may help!

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Early selection findings

• Cherry (1953) dichotic listening findings
  • Don’t notice language or content of 2nd message
  • Do notice gender of 2nd message

Early selection findings

Broadbent (1958)
• “Split scan” method: Hear 3 pairs of digits simultaneously in right/left ear
  • After all three pairs are spoken:
    • Recall items in any order or in pairs
Early selection findings

Broadbent (1958)

- Results A: Report any order
  - Participants chose to recall digits from one ear then other – 65% accurate
- Results B: Report in pairs
  - Forced to switch – 20% accurate

Broadbent’s Filter Model of Attention

- Bottleneck model: restricts info available
  - Which part would be the bottle neck part?
- Filter selects info based on physical characteristics
- Early selection theory
How does this relate to the early selection theory?

Broadbent (1958)
- Messages are first selected based on physical characteristics (filter)

Evidence against Broadbent’s model
- Moray (1959)
  - Method:
    - Shadow 1 ear
    - Name said in unattended message
  - Results/Conclusion:
    - 1/3 hear name = “Cocktail party effect”
    - Name not filtered so analysis of unattended message goes beyond physical characteristics
Dear Aunt Jane Experiment (Gray & Weddeburn, 1960)

Method:
Shadow 1 ear: “dear 7 Jane” vs. “9 Aunt 6”

Results:
Ss report hearing in shadowed ear “dear Aunt Jane”

Treisman (1960)

- Complete message switches to “unattended” ear
- Treisman (1960) results:
  - Attention can switch with message meaning
  - Unattended message “reduced”
Broadbent’s Model Could Not Explain

- Participant’s name gets through
  - Cocktail party phenomenon
- Participants can shadow meaningful messages that switch from one ear to another
  - Dear Aunt Jane (Gray & Weddeburn, 1960)
- Effects of practice on detecting information in unattended ear
  - You can be trained to detect in unattended ear based on the meaning of the message

Treisman’s Attenuation Theory

- Analysis beyond sensory information
- If important, boosted above threshold
- If unimportant, value is weakened (“attenuated”)
Treisman's attenuation theory

- 2-stage process:
  - Attenuator: Analyzes physical characteristics and possibly meaning
    - Only uses what is necessary
  - Dictionary unit: Decide if reached threshold for output
  - Early selection theory (b/c filter early in processing)

Early vs. Late Selection

- Early Selection Models:
  - the locus of selection is at early stages of processing
  - unattended stimuli are not fully processed
- Late Selection Models:
  - attention operates only after stimuli have been fully processed.
Norman’s Pertinence Model

- Selection based on
  - Sensory information AND
  - Pertinence
  - Highest combination gets attention
- Continuous process
- Late selection theory

MacKay (1973)

- Method
  - Ambiguous sentence in attended ear – one word at a time
    - "They were throwing rocks at the bank."
  - Unattended ear – word related to one meaning (bias word)
  - Asked which test sentence closest in meaning
- Result
  - Bias word influences sentence meaning
- Conclusion
  - Unconscious processing of unattended information
  - Support for late selection
Early vs. Late selection

• How much is processed before selected?

• Early: filter at physical (sensory) analysis (fig a)
• Late: filter at/after semantic analysis (fig b)

Effect of Load on Selective Attention

• Perceptual Load Theory:
  • High-load experiments support early selection
    • Example: Treisman’s half of messages in each ear
  • Low-load experiments support late selection
    • Example: MacKay’s bank/bank study
    • Why is this low load??

• This theory is currently challenged too!
  • http://www.frontiersin.org/cognition/researchtopics/early_and_late_selection_effec/977#sthash.APNiaiBW.dpuf
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Stimulus for Neisser’s (1964) visual search experiment

Where is the letter Z?
Which takes longer? Why?
Feature Search
- Allows participants to respond quickly regardless of number of distractors
- Pop-out effect
- Aka Parallel Search
Conjunctive Search

- Participants must study each item individually until the target is identified.
- Hypothesis: Search time should increase with the number of distractors
- AKA serial search

What search method is used to identify the blue-yellow-red molecule in the pictures below?
Feature Perception

- How do we perceive features as part of the same object?
- Red, Ball, Rolling

Anne Treisman’s Feature Integration Theory

- How are Treisman’s two stages shown in the visual search findings?

Http://psych.princeton.edu/psychology/research/treisman/index.php
Selective attention

- When does selective attention occur?
- Is it different for:
  - Auditory vs. visual selective attention
  - Type of task
  - Memory load
  - Automatic or Controlled Processes

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Divided attention

• TRY to split attentional resources between 2 sources
  • Dual-task methodology
• Real-world examples?
• Today we will discuss: How are you capable of doing more than 1 thing at the same time?
  • 1 or more of the tasks requires fewer resources
  • Automatic processing: require little or no conscious attention

Divided attention: Tyler et al (1979)

• Question:
  • Can attention be split?
• Method:
  • 1) Anagram task (easy or hard)
  • 2) RT to tone
• Results:

• Conclusions:
  • Difficult tasks uses more resources leaving less for 2nd task, causing decrease in performance
  • Competition for limited attentional resources
Divided Attention

• How did it feel when you were learning to drive? Move from "controlled" to "automatic"?

• Schneider & Shiffrin (1977): How does processing become automatic?

• Putting on a coat

Schneider & Shiffrin (1977)

• Question:
  • How does processing become automatic?

• Task:
  • Dual task: hold info in memory; search for target among distractors
  • Stimuli: #s or letters
  • Measure: RT and accuracy
You will see grids of letters which may or may not have the target in them. Your task is to say if the following target is in the grids:

\[
\begin{array}{cc}
3 \\
\end{array}
\]

A   F

M   G
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
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<tbody>
<tr>
<td>G</td>
<td>W</td>
</tr>
<tr>
<td>V</td>
<td>B</td>
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</table>
Schneider & Shiffrin (1977)

- Was it there?
- What is the attention divided between here?

- Improvement in performance with practice in Schneider and Shiffrin's consistent mapping condition. The arrow indicates the point at which participants reported that the task had become automatic.
Developing automaticity
Spelke, Hirst, & Neisser (1976); Hirst, et al. (1980)

- Dual-task
  - Read stories silently
  - Copy irrelevant words being dictated
- Results
  - Week 1: handwriting illegible, reading slow
  - Week 6: better reading comprehension, poor recall of dictated words
  - Week 17: Can copy complete sentences while reading, with understanding of both
- Conclusion
  - Practice can automatize particular task or how tasks function simultaneously
  - But, alters ability only for those particular tasks!

Automatization

- How do processes become automatic?
  - More efficient through practice
  - Effortful steps $\rightarrow$ integrated into single operation

- Is automatization always good?
Driving and Attention

- What aspects of driving still remain “controlled” and why?
- What tasks or activities interfere more with driving ability and when?

Disadvantages of automaticity
Barshi & Healy (1993): proofreading

Task: Scan pages of multiplication problems w/ same mistakes repeated; find errors

Fixed order: problems in same order on each page
- encouraged automatic processing

Varied order: problems in different order on each page

- Hard to undo automatic behaviors
- Real world examples?
Results: When the person was talking on the cell phone, they (a) missed more red lights, and (b) took longer to apply the brakes.

Driving and Attention

• How do the cell phone studies in the text relate to your own driving behaviors?
• What experiences do you have with driving that might provide insights about attentional processes?
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Instructions

• You will see 2 teams of players – one wearing white t-shirts and one wearing black t-shirts. Try to count the total number of times the team wearing white passes the ball.

• http://www.youtube.com/watch?v=Ahg6qngoay4
Simons & Chabris (1999)

- **Question**
  - Does perception depend on attention?

- **Method**
  - 75s film with surprising event
  - Ss asked if noticed anything unusual

- **Results**
  - 46% fail to report event
  - Selectively attending to white not to black objects

- **Conclusion**
  - “Inattentinal blindness”
  - Conscious perception depends on attention

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Simons & Chabris (1999)

“Gorillas in our midst: Sustained inattentional blindness for dynamic events”

<table>
<thead>
<tr>
<th></th>
<th>Easy Task</th>
<th>Hard Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Umbrella</td>
<td>58%</td>
<td>33%</td>
</tr>
<tr>
<td>Black Umbrella</td>
<td>92%</td>
<td>42%</td>
</tr>
<tr>
<td>Trans-Gorilla</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Opaque</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Umbrella</td>
<td>100%</td>
<td>83%</td>
</tr>
<tr>
<td>Black Umbrella</td>
<td>58%</td>
<td>58%</td>
</tr>
<tr>
<td>Trans-Gorilla</td>
<td>42%</td>
<td>48%</td>
</tr>
</tbody>
</table>

- Results: % notice unexpected event
- Easy: count passes
- Hard: count air vs bounce passes
- Color: team attended to
Change Blindness

• http://www.youtube.com/watch?v=Qb-gT6vDrmU

Change Blindness and Inattentional Blindness

• Attention: necessary but not sufficient to detect change
  • Sometimes we don’t store details even though we attend to them

• Are we just not efficient and accurate processors of (visual) information?
  • If you tracked every detail, your system would be overwhelmed
  • Instead visual system gets gist and you ignore the details

• What future studies could be conducted?
• What are the applications of this research?
Links

• D. Simons webpage
  • http://viscoq.beckman.uiuc.edu/djs_lab/

• D. Levin webpage
  • http://www.vanderbilt.edu/psychhumdev/levin/labpage/VisualCognitionLab.html

• Demos
  • http://www.simonslab.com/videos.html