Automatic Processes

• Fast
• Require no attentional resources
• Outside of consciousness
• Obligatory

Stroop Effect

Incongruent Congruent
GREEN BLUE
43.3 secs 41.0 secs (100 words)

Incongruent Congruent
GREEN BLUE
110.3 secs 63.3 secs (100 words)

Kahneman & Henik

• Fixate in the middle, name ink color in circle
• Fixate in the middle, name ink color in rectangle
• Attention Matters
  – Reading is not completely obligatory

Automatic Controlled

Automatic
• Without intention
• Not subject to introspection
• Few, if any, attentional resources
• Rapid (1 second or less)
• Inflexible

Controlled
• With intention
• Subject to introspection
• Uses most, if not all attentional resources
• Relatively slow (several seconds)
• Flexible

Memory Search Task (S&S)

Memory Set

Visual Array

A J
M F
Consistent Mapping

Memory Set: Consonant
Distractors: Numbers

Varied Mapping

Memory Set: Consonant or Number
Distractors: Consonant OR Number

Schneider & Shiffrin

- Consistent Mapping (diff cat. distr.)
  - Memory Set Size (no effect)
  - Distractor Set Size (no effect)
  - 80 ms/trial for 95% accuracy
- Varied Mapping (same cat. distr.)
  - Memory Set Size (more is harder)
  - Distractor Set Size (more is harder)
  - 400 ms/trial for 95% accuracy
- Letter/Number distinction automatic: fast and done in parallel

<table>
<thead>
<tr>
<th>Condition</th>
<th>Memory Set and Distractor Set</th>
<th>Processing</th>
<th>Effect of Increasing Memory or Distractor Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent mapping</td>
<td>Keys different because of one memory, the other is letters.</td>
<td>Difficult at the beginning, slowing down, becomes automatic processing after period.</td>
<td>No effect.</td>
</tr>
<tr>
<td>Varied mapping</td>
<td>Both are letters. A key is chosen in the memory set on one trial, and then switch to the converse set on next trial.</td>
<td>Controlled processing</td>
<td>Slower processing model, fewer decision, even for lower precision.</td>
</tr>
</tbody>
</table>
Problems w/S & S

- Redescription of data w/o explanation

Cheng

- Quantitative Effects
- Qualitative Effects
  - Restructuring

\[
\begin{align*}
2+2+2+2+2+2+2+2+2+2 &= 2 \times 10 = 20 \\
2+2 &= 4 \\
4+2 &= 6 \\
6+2 &= 8 \\
8+2 &= 10 \\
10+2 &= 12 \\
12+2 &= 14 \ldots \\
18+2 &= 20
\end{align*}
\]

Instance Theory of Automaticity (Logan)

- Each time stimulus encountered, traces stored in memory
- Practice
  - More info about stim and what to do w/it
- Practice
  - Rapid retrieval of info in response to stim

Instance Theory

- Race between memory & procedure
- 12+5=?
  - If solved before, remember “17”
  - If not, calculate
- Needle Analogy
  - When needles easy to find, search works
  - When needles hard to find, make a new needle

Explains Characteristics

- Fast
  - Retrieve old solutions
  - (Don’t compute anew)
- No Effect on Processing Capacity
  - Retrieval of overlearned material
- Unconscious
  - No processes intervene
Neisser; Simons

- Pick the white or black team
- Count the number of times their basketball is exchanged

Neisser; Simons

- Result:
  - over half the observers do not see the person in the gorilla suit
- Inattention blindness:
  - Failure to see objects in the center of gaze due to allocation of attentional resources elsewhere
- Instead of a complete, detailed world, we only see a small part of it
  - the part we are attending to!

Related Phenomena

<table>
<thead>
<tr>
<th>Change-blindness</th>
<th>Inattention-blindness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occurs when attention is broadly distributed over a visual scene</td>
<td>Requires focused attention on an engaging task</td>
</tr>
<tr>
<td>Can happen even when subject knows there will be a change</td>
<td>Does not happen when subject is aware that an anomalous event might occur</td>
</tr>
<tr>
<td>Reflects sparse nature of visual representation need for focal attention to perceive objects</td>
<td>Reflects role of top-down factors in perception need for focal attention to perceive objects</td>
</tr>
</tbody>
</table>

Research Questions

- Does conversing on a cell phone interfere with driving?
- What are the sources of the interference?
- How significant is the interference?

Why Do Cell Phones Cause Interference?

- From earlier studies, no interference from:
  - Radio broadcasts (audio input)
  - Books on tape & recorded conversations (audio/verbal input)
  - Simple shadowing (audio/verbal input, verbal output)
- Implies active engagement in conversation necessary
- Impairments from both hand-held and hands-free units
  - Implies central / cognitive locus
  - Inattention-blindness (Neisser, Simons)

Experiment 1a: Inattention-Blindness

- Test for evidence of cell-phone induced inattention blindness
  - High-fidelity driving simulator
  - Hands-free cell phone
  - Naturalistic conversation with confederate
  - Eye tracker
- Two phases to the study:
  - Phase 1: Single & dual-task driving
  - Phase 2: Recognition memory tests for objects encountered while driving
Experiment 1a: Summary

- 50% drop in recognition memory from single to dual-task, consistent with inattention blindness interpretation
- What about items more relevant to safe driving?
- Do drivers divert attention from processing items of low task relevance (e.g., billboards), but protect high task relevance items (e.g., pedestrians)?

Experiment 1b: Effects of Traffic Relevance

- Phase I: Single & dual-task driving
  - Interstate driving (with traffic)
  - Hands-free cell phone, naturalistic conversations
  - Unique items placed in single & dual-task scenarios
- Phase II: Surprise 2AFC recognition memory test
  - Single-task items (driving only)
  - Dual-task items (driving & phone)
  - Control items (not seen while driving)

Cell Phones: Summary

- Cell phone conversations create inattention blindness for traffic related events/scenes
- Cell phone drivers look but fail to see up to half of the information in the driving environment
- No evidence that cell phone drivers protect more traffic relevant information
- Attention plays a critical role in seeing and remembering information in dynamic naturalistic environments
Research Questions

- Does conversing on a cell phone interfere with driving?
- What are the sources of the interference?
  - Peripheral interference (dialing, holding the phone)
  - Attentional interference (cell phone conversation)
- How significant is the interference?

Selective Attention

- Visual attention needed for perception of objects (feature binding)
- Auditory attention needed for full processing of meaning
- Partial Selection Occurs Early
  - Not Simple Physical Filter
    - Attenuates unattended information
    - Amplifies attended information
- Sensitive to:
  - Past Experience
  - Context
  - Arousal
- Late selection can also occur but requires more central processing resources

Resource Allocation

- Difficulty of dual task performance depends on:
  - Task difficulty (multiple resources)
  - Task difficulty (engagement of central processing resources)
  - Practice
- Practice doing two tasks together
  - Learn optimal strategies for switching tasks
  - Maximize use of multiple resources
- Practice doing each task individually
  - Automate.
- Performance of multiple tasks is a complex process of:
  - Allocating limited resources
  - Using automated routines

Sensory Register/Sensory Store

- Sensory Receptors
- Sensory Register (a.k.a. sensory store)
  - Iconic memory (vis)
  - Echoic memory (aud)
- Sensory Trace

Function

- Maintain input as perceptual processes extract its meaning

Capacity of Iconic Memory

- How much info can people extract from brief presentations?
- Visual Report Technique
Capacity

- Visual Report Technique
- Whole Report
  - 3-6 (usually 4 or 5)
  - People Complained!
- Partial Report
  - \( \frac{3}{4} \)
  - \( 3 \times 3 = 9 \)

Duration of Iconic Memory

- How long does info stay in iconic memory?
- Visual Report Technique
- Vary time between offset of visual display and onset of partial report cue
- Time when partial report advantage no longer apparent is upper limit on duration

Duration of Iconic Memory

- Visual Report Technique
  - Array of Letters and Numbers
  - Partial Report
    - Tone indicates whether letters or numbers to be reported
    - No partial report advantage 😊

“Forgetting” in Sensory Register

- Decay
- Displacement (new info overwriting old)
- Vary color of visual field after display
  - 1 sec for bright display
  - 5 secs for dark display
- Follow one display by another

Sensory Register is Precategorical

- "Reading in a lightning storm." Haber
- Perceptual continuity
  - Saccades
    - 24-100 ms
    - No visual input taken in during this time
  - Phenomenological Experience
    - Continuous world

What is the sensory register for?
Auditory Sensory Register

- Echoic Memory
- Darwin, Turvey, & Crowder (1972)
- Partial Report
  - Advantage 2-4 secs

Modality Effect

- Items at end of list remembered better if list is presented in auditory modality
- Echoic memory has longer duration than iconic memory

Suffix Effect

- Present list of 9 TBR words
- 10th word “go”
  - Signals list is over
- Error rates higher for recall of words 7-9 w/suffix than w/o
- Speech-specific?

Sensory Register

- Capacity
  - Complete
- Accuracy
  - Veridical
- Duration
  - Iconic: 1 second
  - Echoic: 2-4 seconds
- Forgetting Mechanisms
  - Rapid Decay
  - Displacement by new information
- Pre-Categorical
  - Advantage for size, color, brightness cues
  - Not for “conceptual” cues, word vs. number