Chapter 4

Paying Attention

Two Types of Attention

- How does selective attention work?
  - How do we block out irrelevant information?
  - What can't we block out?
    - How much control do we have over our attention?
- When can we divide attention between two tasks?

Selective Listening

- Early Work : Selective Listening - Cherry
  - Cocktail Party Effect – How do we follow one conversation?
- *Shadowing*
  - *dichotic presentation*: different stimuli to right and left ears
  - Ss can shadow attended channel (ear)
  - report little from unattended channel
    - recognize speech vs music, male vs. female voice
    - hear one's own name sometimes or highly "meaningful" words
    - can't report meaning of message, English vs. jibberish that sounds like English

Selective Listening - Visual

- Video shows 2 teams of students playing ball. Ss had to signal when white team's ball changed hands & ignore black team.
- Student in gorilla costume walked through scene. No S noticed.

Broadbent's Filter Model

- Broadbent: Filter blocked everything except attended channel.
- First thought physical characteristics (ear, spatial location, voice) determined channel
- Couldn't account for intrusions from unattended channel, (one's name, cross- over study)
- Attention = inhibition of some processing + facilitation of other processing

Inattentional Blindness (Mack & Rock)

- Visual Perception is usually subjectively effortless. Subjectively doesn't seem to require attention or effort.
- Ss looked directly at *fixation point* on screen
  - then briefly shown plus signs (+) in which horizontal or vertical line was longer.
  - pattern mask (Why ???)
  - plus signs shown to left or right of fixation point

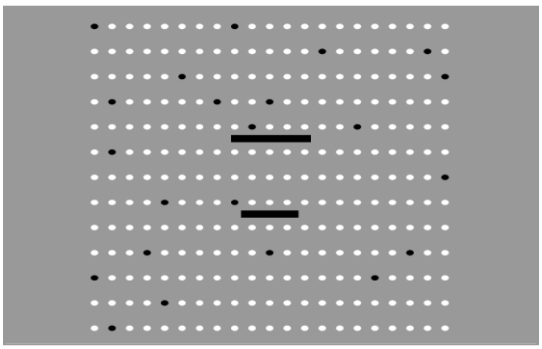
Inattentional Blindness - 2

- After several trials, fixation point replaced by triangle, rectangle or cross while + was shown.
  - Note: S looks at fixation point but attends to +
- 89% did not detect change in fixation point even though they were looking directly at it. Specific probe did not help.
- When asked to look for other targets that might appear, most Ss did notice.
- No *conscious* perception without attention.

Conscious & Unconscious Perception

- Ss shown computer screen with random pattern of black and white dots. Two lines, one longer than the other. Ss had to decide which line was longer. (Slide #9)
- After several trials, two lines of same length appeared, with black dots coming from ends of the lines. (Slide #10)
- Ss did not notice the dots made "arrowheads" at the ends of the lines.

A



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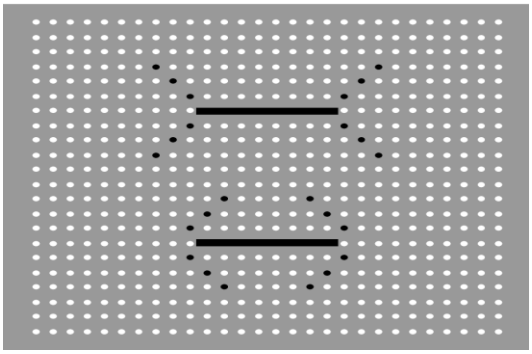
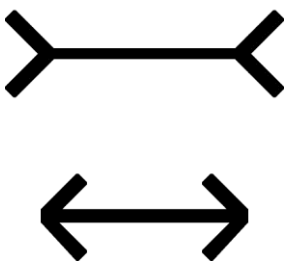


Conscious Perception - 2

- Ss could not choose the (arrowhead) pattern of black dots from a set of 4 patterns.
- Ss showed *Muller-Lyer* illusion: Line with arrowheads that diverge from end of line looks longer than line with arrowheads that converge on end of line. (Slide # 10)
- Ss did not **consciously** perceive arrowheads, but their perception was influenced by arrowheads.

C



Change Blindness

- Difficult to detect changes in a scene or differences between 2 scenes even when we are looking and attending.
- E.g. experiment in which objects changed when camera angle changed. Ss did not notice changes.
- Visual perception not automatic – effort needed to perceive and remember.
- → perception or retention of what is seen requires mental effort & resources

Selective Priming

- How explain inattentional blindness & change blindness?
- Expend *mental resources* to *prime* (prepare) some detectors . Not the same as repetition priming (bottom up). More like semantic priming (top down, effect of expectations, context etc.)
  - Allocation of "general resource" (general capacity?)
- Attention, expectation of stimulus, like 2nd type of priming. Expect some type of stimuli, get detectors ready to process unknown stimulus. Top Down.
- Kahneman (1973) referred to this input as "mental effort"

Early vs. Late Selection

- Broadbent's model → early selection
- Hearing one's name in unattended channel → late selection
- Evidence for both early & late selection
- Complex stimuli requires a lot of processing; no resources left for unattended stimuli → early selection
- Simple stimulus → can process other stimuli → late selection

Factory Analogy

- Factory has 200 workstations but only 50 workers.
- Different work stations do different jobs. Work stations organized in assembly lines.
- Each Assembly Line produces a different type of widget depending on the orders the factory has.
- Work stations = detectors
- Workers = attentional resources
- Limited number of skilled workers available = limited capacity = limited number of detectors.

Factory Analogy - 2

- Can't create new detectors quickly – takes time. Can't always hire trained workers, but can train existing or new workers to learn new jobs.
- Some work stations are semi-automatic (run by robots) = some detectors have low thresholds
- Expectations or mental effort (preparation of detectors) is like having some stations always have worjkers already assigned to stations before work begins because these stations are frequently used.

Factory Analogy - 3

- Without preparation, (no prior knowledge of what orders have to be filled), must assign workers to stations when orders come in.
- Repetition priming – lowering threshold (setting up robot so all it needs is a signal to start work)

Posner & Snyder: Two types of priming

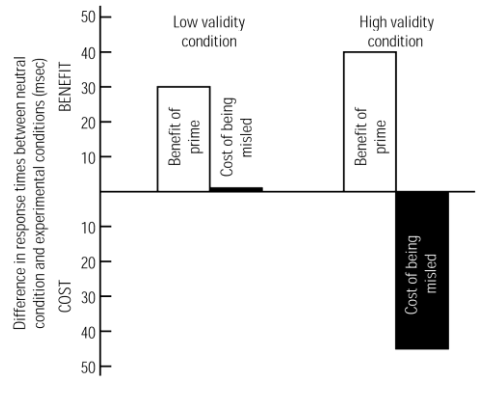
- Present two letters. Ss decide whether two letters are the same or different. AA → same, AB → different
- Warning signal before letters: neutral , helpful (primed condition – same letter) or misleading cue (different letter).
- Experiment repeated in two conditions: Ss expectations about validity of warning signal varied.
  - High Validity condition: warning stimulus helpful 80% of time
  - Low Validity condition: warning stimulus helpful 20% of trials.

	Type of trial	Typical sequence: Warning signal	Typical sequence: Test stimuli	Provides repetition priming?	Provides basis for expectation?
Low validity condition	Neutral	+	AA	No	No
	Primed	G	GG	Yes	No
	Misled	H	GG	No	No

	Type of trial	Typical sequence: Warning signal	Typical sequence: Test stimuli	Provides repetition priming?	Provides basis for expectation?
High validity condition	Neutral	+	AA	No	No
	Primed	G	GG	Yes	Prime leads to correct expectation
	Misled	H	GG	No	Prime leads to incorrect expectation

Posner & Snyder: Two types of priming - 3

- Low validity: Expect help from repetition priming, but cue not likely to be valid.
  - → Don't generate expectations → no interference from misleading cue.
- → small benefit from helpful cue (repetition).
- High validity: Two sources of help: Repetition priming & expectations.
- →Expect helpful cue to be very helpful, but misleading cue should produce a lot of interference (no repetition, expectation wrong).



Two Types of Priming – 5

Repetition priming – detector warm up

- Stimulus based; data driven or bottom-up effect
- Produces facilitation but not interference
- Develops rapidly in time
- Priming one detector has no effect on others; no cost

Two Types of Priming – 6

Priming based on expectations (preparedness)

- Expectation based; conceptually driven or top-down effect
- Develops more slowly in time
- Get different priming effects depending on interval between stimuli
- Costs in expectation priming → limited capacity

Chronometric Studies & Spatial Attention

- *Chronometric* = Greek: chron = time
  - *Meter* or *metr* = measurement
- *Chronometric studies* – measure time for mental events.
- Studies show people can pay attention to spatial locations but need time to prepare.
- Simple reaction time task
  - Neutral cue or informational cue (arrow) which could be helpful or misleading.
  - Neutral – 266 msec, Helpful Cue – 249 msec, Misleading Cue – 297 msec
    - Benefit from helpful cue, cost for misleading cue under high validity conditions
  - Effects not due to eye movements.

The Binding Problem

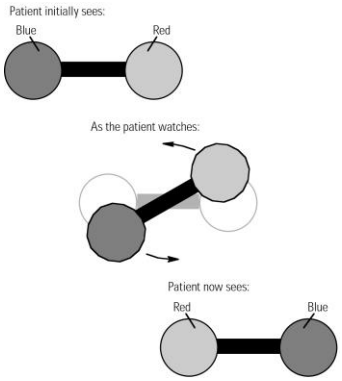
- Searchlight model of attention
  - Focus of beam wide or narrow
  - Movement of *attention* , not eye movements. Eye movements too slow.
- If attention focused on one object, detectors for that object or area of space are primed.

Searchlight Model of Attention

- Is attention space based or object based?
- *Unilateral neglect syndrome* – right parietal lobe damage
  - Patients ignore input from left side of body. E.g. eat food on only right side of plate, wash only right side of face, cross out letters on right half of page etc.
    - Suggests space-based deficit

Searchlight Model of Attention - 2

- 'Dumbell' experiment – show different objects in red and blue circles of dumbell. Red circle on the right.
- Patients responded better to targets in red circle in right visual field.
- Dumbell rotates 180° → Red circle is now on the left.
- Patients continue to respond to red circle, not objects in blue circle in right visual field.



Searchlight Model of Attention - 4

- If patient attends to only right half of space → should see object in blue circle.
- Patients report seeing only objects in red circle, now on left side.
- Initial bias to attend to right side
- One attention is captured, it continues to focus on attended object (red part of dumbell).

Searchlight Model of Attention - 5

- 3-part model of attention:
- Different areas of brain involved in 3 processes
  1) *Disengage* attention from current object
  2) *Move* attentional beam
  3) *Lock* attentional beam onto new object

Searchlight Model of Attention - 6

- Unilateral Neglect Syndrome
  - Ss have bias to attend to one side (left or right) of space.
  - Attention locks onto object in space.
  - UNS patients can't disengage attention from object.
- Attention both spatially defined and object defined.

Egly et al. (1994)

- Objects seen in rectangles to left or right of fixation.
- Target figure appeared in top or bottom of one of the rectangles & S responded upon detecting target
- Arrow cued location; misleading or accurate; hi-validity cue.
- Stimulus appeared in
  a) cued rectangle & cued location (top or bottom),
  b) cued rectangle & wrong location, or
  c) wrong rectangle

Egly et al. (1994) - 2

- Targets in 2 & 3 equal distance from cue → distance attention had to move not a factor.
- Space-based account predicts no difference between 2 & 3 because wrong location is cued.
- Object-based account predicts that 2 faster than 3 because correct rectangle is cued.

Egly et al. (1994) - 3

- Object-based account supported. Ss attended to the object in the location (rectangle).
- Attention is both space based & object based.
  - Ss attend to region of space (arrow & dumbell experiments) preparing for stimulus & then focus on object.
  - 'Gorilla' walking through the ball game
    → Ss attending to objects (white team) not space

Summary of Selective Attention

- Attention = inhibitory + facilitatory processes
- Facilitation includes
  - Priming relevant feature detectors (expect a particular pattern)
  - Priming detectors in limited spatial area
  - Priming object detectors
- 3 Steps: Disengage, Move, Lock
- Paying attention involves many processes & steps
  - Some processes have resource costs
- Can have early or late selection depending on conditions

Divided Attention

- Two hypotheses about divided attention
  - Limitation in general resources
    - two tasks combined require more total resources than are available
  - Limitation in task-specific resources
    - Two tasks compete for the same resources
    → should observe task-specific interference

Resource Specificity

- Allport, Antonis, & Reynolds – dual task
- Presented prose to be shadowed plus memory task
  - Memory items (1) auditory words, (2) visual words, or (3) pictures
  - Few errors on memory items when no shadowing task
  - Dual task condition: fewest auditory words recalled, visual words slightly better, pictures best
- Eliminated Broadbent's single-channel idea
- Suggest pictures & words use different resources, & auditory & visual words use some different resources & some common resources.

Resource Specificity - 2

- Some tasks which do not seem similar mutually interfere
- Driving: visual input, motor responses from hands & feet
- Talking on hands-free cell phone: speech input, speech response.
- Drivers using cell phones more likely to have accidents, ignore traffic signals, & are slower to hit the brakes.

Possible Task-general Resources

- Arousal level → available processing capacity
- Mental effort, mental energy
- Mental tools, e.g. planning resource
- Response Selector: mechanism for selecting and initiating a response, overt or mental
  - Can process only one response at a time
  - Important for timing of responses
  - Not needed for supervision of response execution

Possible Task-general Resources: Working Memory

- Central Executive Baddeley's model of working memory (see Ch. 1)
- Central Executive,
- Visuo-spatial sketch pad, rehearsal loop + phonological store
  - Sets goals & priorities, selects strategies, co-ordinates use of visual & phonological stores

Working Memory - 2

- Engle & Kane – most behaviour guided by habit & prior associations
- Executive control used when new response (other than habitual response) needed
  - Maintains desired goal (remember new response to be made)
  - Avoid distraction from incoming stimuli or internal thoughts
  - Inhibits habitual response

Working Memory - 3

- Kane et al. – Ss fixated on target, & instructed to move eyes towards cue stimulus. Consistent with habit.
- 2nd condition: Ss instructed to look away from cue. Inconsistent with habit
- No differences between high & low memory. capacity SS on first task.
- Ss with larger working memory capacity better on 2nd task than Ss with smaller working memories

Working Memory - 4

- Ss with high working memory capacity also better on many tasks requiring reasoning & problem solving, following complex directions, computer-language learning etc.
- Ss with good working memory have better reading comprehension

Working Memory: Neural Underpinnings

- Damage to prefrontal cortex (behind the eyes) → goal neglect, resolution between conflicting goals.
  - Patient understands what is required but fail to work towards assigned goals
  - Cingulate cortex (inside lateral fissure, above corpus callosum)
    - Involved in detection of conflict between goals (e.g. Stroop task)
    - Triggers activation in prefrontal cortex

General Resources: Working Memory - 4

- Tasks requiring Executive Control
  - can involve words, pictures, processing of spatial information etc.
    - Executive control function not specific to one sensory or response modality, or type of stimuli.

Practice

- With practice, a task requires less attention or mental effort
  - Executive control needed early in learning; with practice responses become habitual
  - With practice, people become better pattern detectors; can detect larger & more complex patterns
  - responses become associated into larger chunks → response selector needed less often

Practice - 2

- Learning complex task – coordinating many components
- E.g Driving: change gears, control speed, watch for pedestrians & cars likely to cut in front of you, change radio station, turn wipers on or off, look for road signs, etc.
- With practice, subtasks become easier & require less resources
- Some components may require retrieval of info from memory
  - E.g. Z test. Memorize critical z values
- When components mastered, can focus on higher-level aspects
  - Hockey: focus on strategies not keeping balance while skating
  - Music: focus on hitting notes correctly, timing, stress etc. or focus on interpretation, emotional expression

Controlled versus Automatic Processing

- Controlled processing – problem solving, novel task,
  - Many decisions being made on-line
  - Requires a lot of mental resources
- Automatic processing
  - Doer not making many decisions – once activity is initiated, very little effort required to keep it going.
  - People make habitual responses – follow normal route to work & forget to do errand
  - Skilled musicians, drivers, equipment operators

Stroop Demonstration

- On the next slide say the names of the print colours, not the words
  - Reading words is automatic in skilled readers. Must suppress word and say colour name.
  - Slower responses when names and colours inconsistent

Automatic Processing

- RED, BLUE, GREEN, YELLOW, PURPLE, GREEN, ORANGE, RED, YELLOW, BROWN, BLUE, ORANGE, RED, GREEN, BROWN, YELLOW, BLUE, RED, PURPLE, BLACK BLUE YELLOW, RED PURPLE BROWN ORANGE BLACK

Early vs. Late Selection

- Early selection: Attended input identified early & processed differently
- Late selection: All inputs processed to some extent, but 'unattended' inputs don't reach consciousness, or don't evoke response
- Evidence for both.

  → Muller-Lyer illusion – unattended input (dots) processes & created illusion

Early vs. Late Selection - 2

- Dichotic listening – if S probed for item in unattended message, memory decreases the greater the distance between probe & target.
- Electrical recordings of brain → attended inputs processed differently 70 msec after presentation.
  - In area V4 – neurons more responsive to attended inputs.

Limitations to Divided Attention

1) Task-specific resources

   - Allport, Antonis & Reynolds: better recall of pictures than auditory words & better recall of visual than auditory words when Ss do concurrent shadowing task.

2) Sufficient general resources – dissimilar tasks interfere → limited supply of 'mental energy' or processing capacity
   - response selector – only one response selected at a time
   - working memory & executive control – responses that are not automatic or habitual

3) Good channel segregation (dissimilar inputs and outputs)

4) Component tasks are simple or very well practiced