



Cognitive Psychology

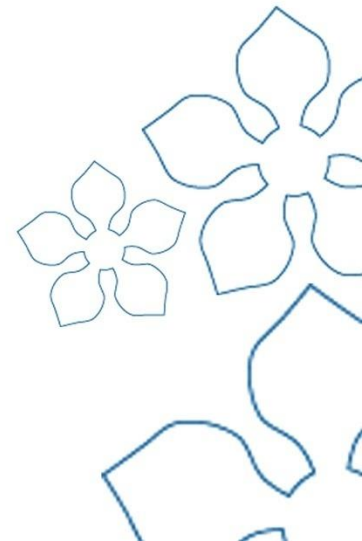
M5X00908 Brain, Behaviour, and Cognition (BBC)

Lecture 4: Attention

Dr Kate Williams



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Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David



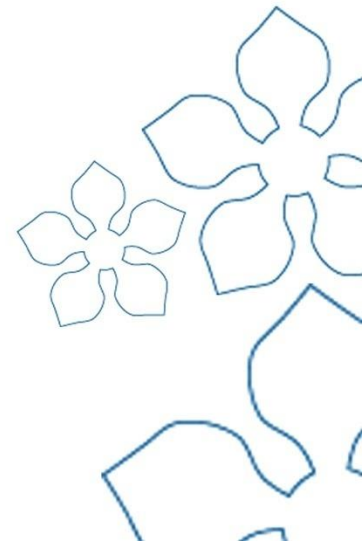


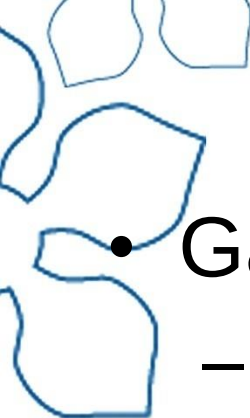
Essential Reading!

- Eysenck, M. W., & Keane, M. T.
Cognitive psychology: Chapter 5

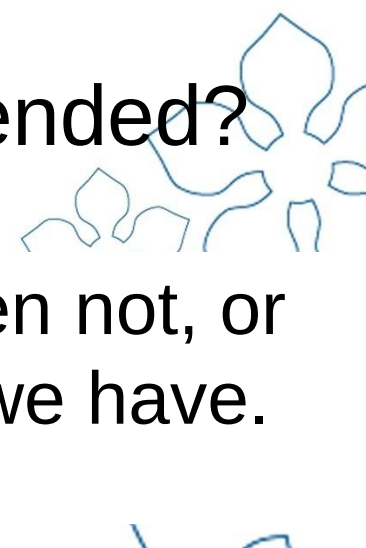


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What is Attention?

- Gatekeeper to perception & knowledge.
 - Mechanism for continued cognitive processing.
 - But, it is a limited capacity information processing system.
 - Why? So, many sensations coming from the world, we cannot process them all.
 - How do we know what has been attended?
 - Can think we have attend to something when not, or
 - Do not think we've attending to something we have.
- 

What is attention?...

“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).

“The sustained concentration on a specific stimulus, sensation, idea, thought, or activity.” Coleman (2001).

Why do we need attention?



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Distinctions of Attention

- “Active” vs. “Passive” (William James)
 - Active: controlled by top-down processes and guided by our goals and expectations.
 - Passive: controlled in a bottom-up way by external stimuli.
- Focused (Selective) vs. Divided (multitasking)
 - Research on focused attention examines how we select to attend, the nature of the selection process, and what happens to unattended stimuli.
 - Research on divided attention tell us the processing limits, the mechanisms of attention, & capacity of attention.
- Internal vs. External
 - Internal: select & maintain internally generated information
 - External: selecting sensory information

ATTENTION

Processes 1
input

Focused

Processes all
inputs

Divided

Auditory
(Shadowing)

Visual
(Spotlight/Zoom
-lens)

Task
Similarity &
Difficulty

Automaticity
(Practice effects)



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Focused/Selective Attention

Exploring how some information is registered and other information is rejected.

Studied by presenting two or more messages at the same time; instructed to only focus on one.

- Shadowing – one message fed into left ear, one into right ear; participant repeats one message.
- Provides information about how we selectively attend to certain stimuli.



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The Cocktail Party Effect

- Cherry (1953): Play different messages to each ear
- Left ear: shadow message, Right ear: unattended message
- What can you hear in the unattended ear?
 - If there is a voice (or not)
 - If it's a man or a woman
 - If the voice changes to a tone
- What do you miss in the unattended ear?
 - Content
 - Language
 - Change in language
 - Nonsense speech
- Conclusion: unattended semantic auditory information does not seem to be processed.

Physical info retained

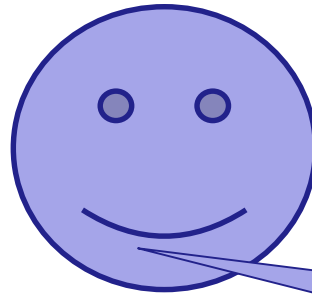
Semantic info lost

Modified version using numbers reveal most people choose to report digits by ear rather than by pair.

(a) ear-by-ear order of report

Right ear

7-9-5



Left ear

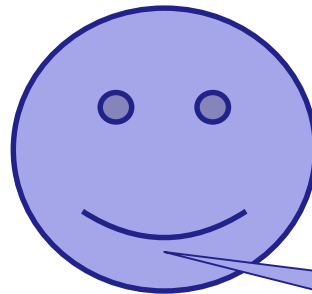
2-6-1

795 261

(b) Pair-by-pair order of report

Right ear

7-9-5



Left ear

2-6-1

72 96 51



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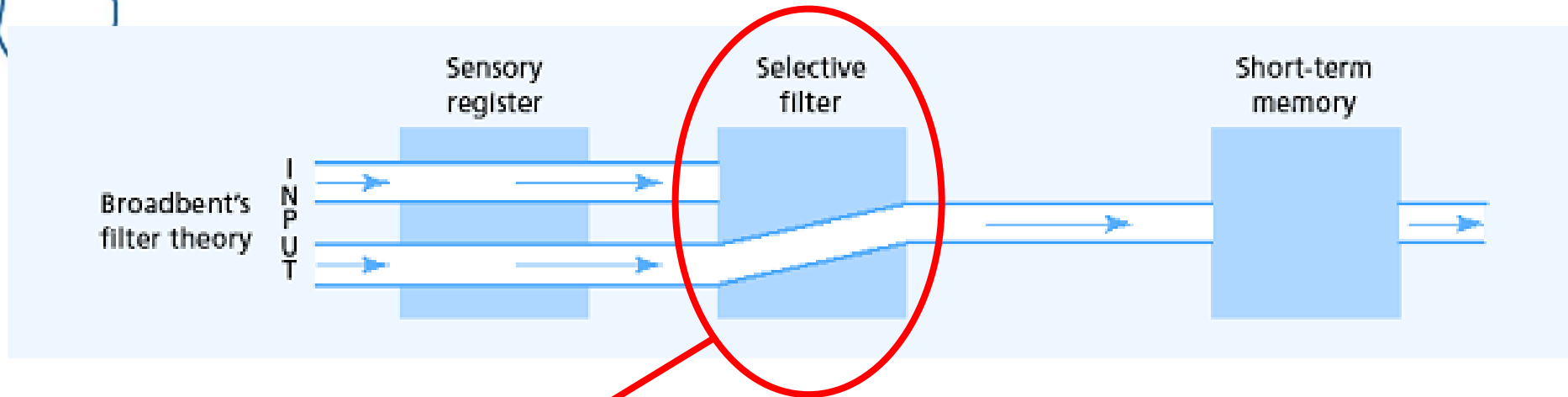
Broadbent (1958): Dichotic Listening task

Models of Focused Attention

- Single channel Models:
 - Single channel models are interested in selective attention processes and see attention as *serial processing...*
 - Some models of attention: “bottleneck models” believe we filter out information at a very early stage, before it reaches STM.
 - This filter allows some information to pass, whilst other information is discarded.

Models of Attention (Auditory)

Broadbent's (1958) Filter Model



Filters out competing stimuli before it reaches short-term memory.

This is known as an
'Early Selection'
Theory of Attention



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Diagram adapted from web resources supplied by Psychology Press, publishers of Eysenck & Keane (2010)

Issues with Filter Model

Meaning of unattended stimuli sometimes processed.

- Difference in expertise (Underwood, 1974).
 - only 8% of digits from non-shadowed message detected by naïve Ps, while 67% detected by experienced Ps.
 - Why?: naïve Ps use all their processing resources on the shadow message due to their lack of experience.
- Similarity of messages (Allport, et al., 1972).
 - Memory for words was poor when shadowing of auditory presented words was combined with auditory presented words but better when shadowing was combined with picture presentation.
 - If 2 inputs are dissimilar they can both be processed more fully than Broadbent originally proposed

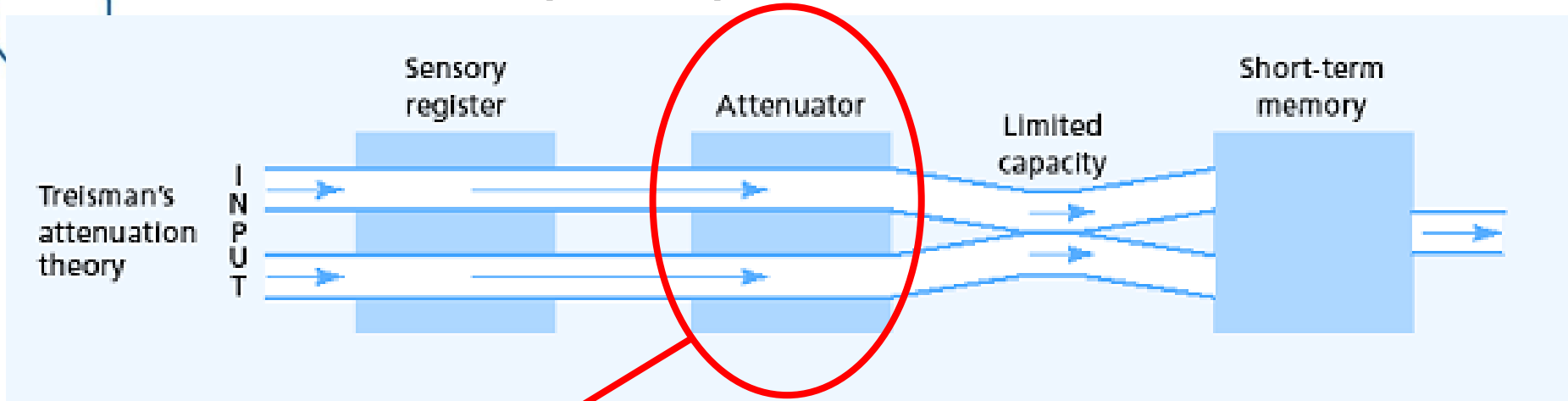
Issues with Filter Model

Meaning of unattended stimuli sometimes processed

- Conscious awareness (Von Wright, et al., 1975).
 - When a word previously associated with an electric shock was presented on the non-attended list of words, there was a physiological reaction (galvanic skin response).
 - Conclusion: unattended information could be processed even if the participant is not consciously aware of it.
- Name of P presented (Moray, 1959).
 - But dependant on individual WM capacity (Conway, Cowan, & Bunting, 2001; Colflesh & Conway, 2007).
- Combination of word and digit dichotic listening task (Gray & Wedderburn, 1960).
 - “Who 6 there” and “4 goes 1” shadowed correctly.

Models of Attention (Auditory)

Treisman's (1964) Attenuation Model



Non-attended information not completely filtered out but only surface processed. Able to “breakthrough” for deeper processing if task relevant.



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Evidence for Attenuator Model

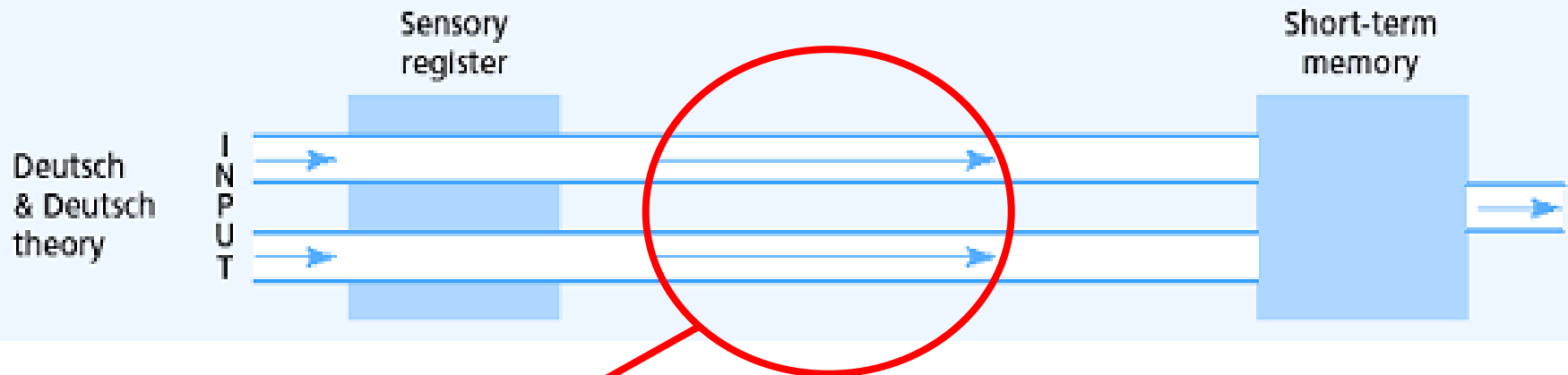
- Bentin et al. (1995): Ps asked to attend to words presented to only either left or right ear.
 - Unattended words received semantic processing
 - But this was less than for the attended words.
- Processing of unattended message enhanced if words have significance to the listener
 - Li et al. (2011): processing of weight related words interfered with shadowing in women dissatisfied with their weight.



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Models of Attention (Auditory)

Deutsch and Deutsch (1963)



No filtering out competing stimuli before processing. Filtering occurs after assessing which stimulus is the most relevant i.e. **late selection**



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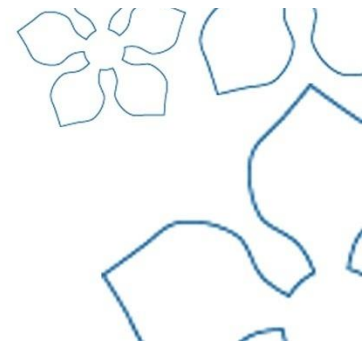
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Issues with Deutsch & Deutsch Model

- Treisman & Riley (1969):
 - Ps shadow 1 of 2 messages but told to stop when they hear a target item in either of the messages.
 - According to Deutsch & Deutsch model all stimuli is analysed completely, so detection rates of target word in both messages should be similar.
 - However, significantly more target words were detected in the shadowed message.
 - Suggests not all info is completely processed.

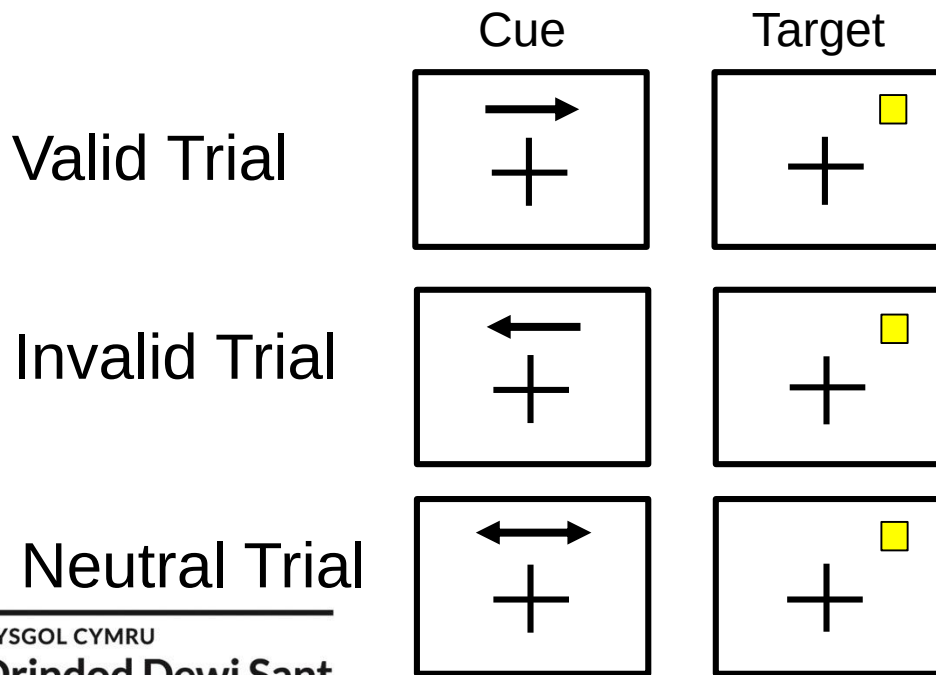


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Attention in Visual Processing

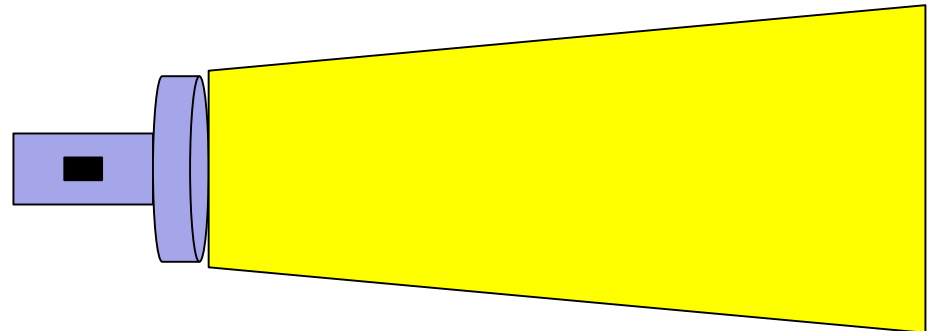
- Two major systems of visual attention
 - Endogenous: controlled by intentions & expectations
 - Exogenous: automatically shifts attention
- Examined by Posner's (1980) - Cueing Paradigm



Or outline of box would light up



- Posner: focused visual attention = spotlight, visual attention illuminates a small part of visual space.
- Info under spotlight is processed further but info outside spotlight does not receive much processing.
- Eriksen & St.James (1986): developed the spotlight notion in their Zoom lens model.
 - We can adjust area of focal attention by increasing or decreasing it in same way as zoom lens works on a camera
- However: Multiple Spotlights theory now dominates:
 - Visual attention is far more flexible: we can show split attention.
 - Awh & Pashler (2000)
 - Morawetz et al. (2007)



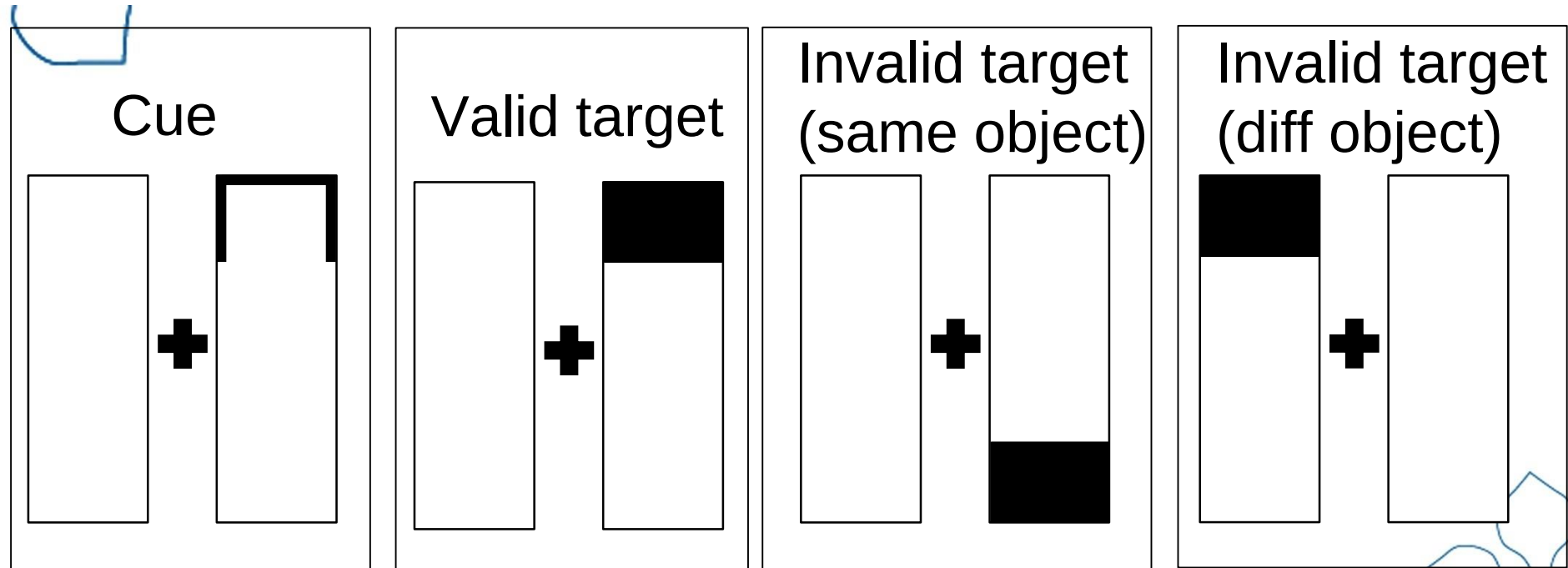


What does vision select?

- Locations
 - O'Craven et al. (1999): fMRI revealed that non-task-related pictures (face/house) that were superimposed in the location of task-related (2 oval shapes) pictures were also attended.
- Objects
 - Neisser & Becklen (1975): Gorilla experiment
 - Patients with unilateral visual neglect ignore one half of the visual field, when asked to draw an array of objects they draw one half of all the objects in the array as opposed to drawing whole objects from only one half of the array.
- Location and objects
 - Eagly et al. (1994).....

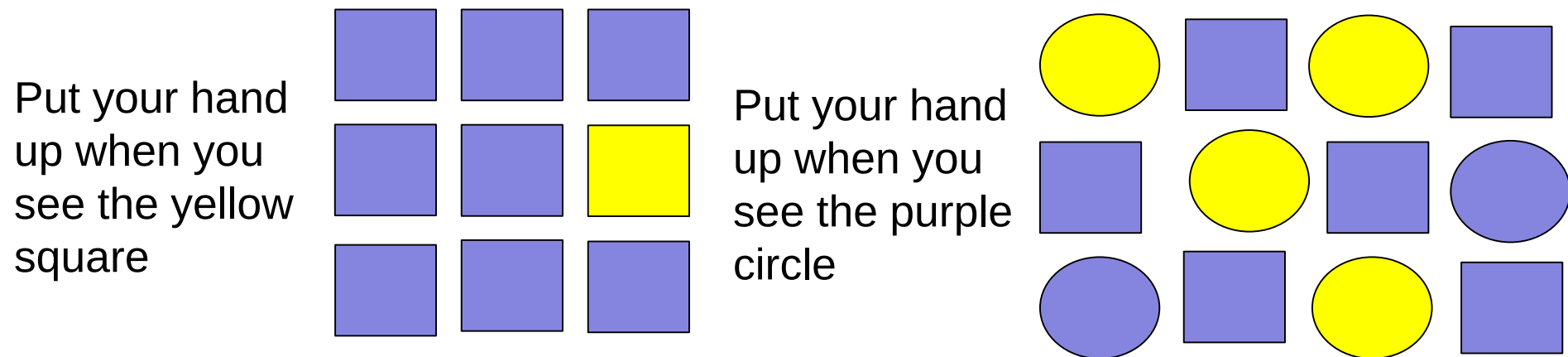
Eagly, Driver, and Rafal (1994)

- Ps required to respond as quickly as possible to a target that would appear in one location in one of the rectangles.



- Target detection slower on invalid trials compared to valid trials
- But, faster on invalid trials when the cue was in the same object rather than a different object.
- Suggests attention is also partially object-based.

- The study by Eagly et al. (1994) shows what happens when an external stimuli guides attention.
- But what about actively looking for something?
- We engage in **Visual Search**
- To test this in the lab, Ps are required to search for a target among an array of distractors.



- If the target differs from distractors on 2 dimensions (e.g., shape and colour) it takes longer to find that target than if it only differed on one dimension (e.g., colour).



Feature Integration Theory (FIT):

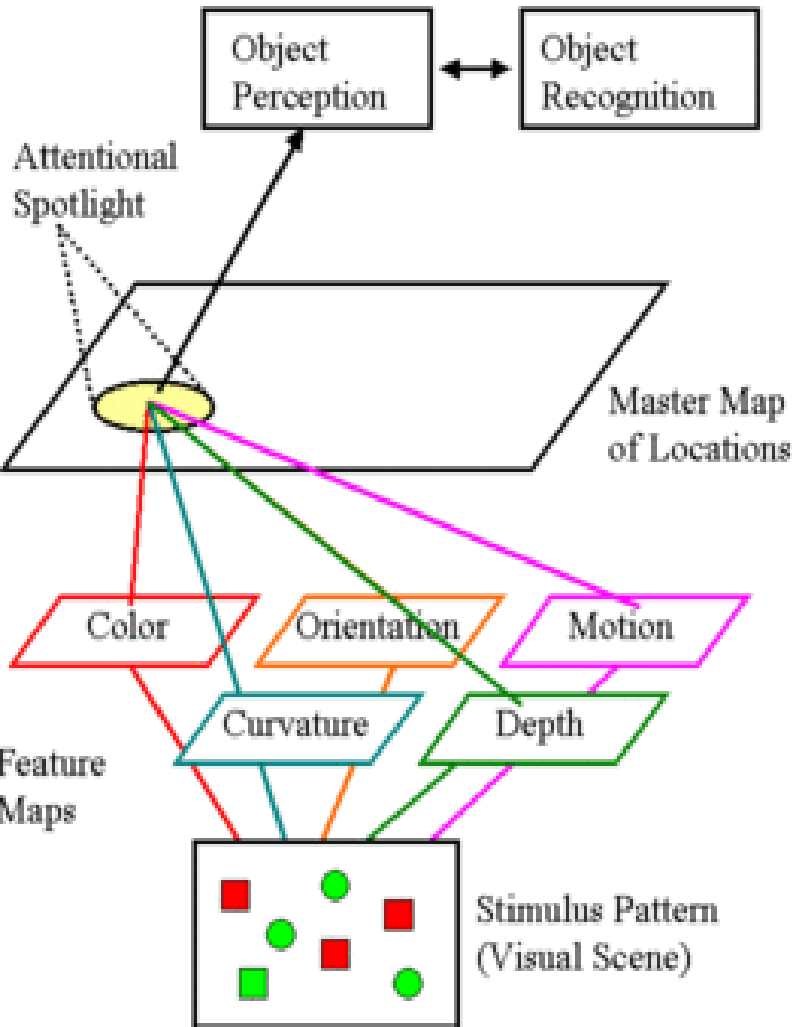
Treisman (1988, 1992); Treisman & Gelade (1980)

- Extends spotlight of attention to a “moving window”
 - Distinction between Features of objects (e.g., size, shape, colour) vs. Whole objects
 - Parallel processing of features (fast) to begin, then....
 - Serial process to combine features (slow)
 - The more objects that need to be searched the more difficult the task
 - Focused attention is the “glue” to form an object
 - Stored knowledge can influence combinations (e.g., we know oranges are orange in colour).
 - Lack of focused attention or stored knowledge can lead to “Illusory conjunctions”
- 

Feature Integration Theory (FIT):

Treisman (1988, 1992); Treisman & Gelade (1980)

Feature Integration Theory (Treisman)



- Parallel processing of features in visual field produce maps of where features are located.
 - E.g., colour map shows where a particular colour is and the type of “red” there.
 - Then there will be a different map of a line edge.
- Attention uses master map to show features binding into a construct of the object in a representation format, which enters an object file in STM.

FIT: Evidence

- Treisman & Gelade (1980): set-size & search time
- Transcranial magnetic stimulation (TMS) led to more illusory conjunctions when applied early in the search task – Braet & Humphreys (2009)
- However: Duncan & Humphreys (1989; 1992) note that distractors play role in search time depending on their similarity to targets.
- This led to a FIT Update: Treisman (1993)
 - Selection of location
 - Selection by features
 - Object-defined locations
 - Object file

Four types of attentional selection proposed.

Attention operates at any stage depending on task demands

Alternative Theories

- Guided Search Theory: Wolfe (1998; 2003)
- Decision-integration hypothesis: Palmer et al. (2000)

Conclusion

- Spotlight of attention facilitates feature detection (Posner) and feature binding (Treisman).
- Spotlight is directed toward location and enhances stimuli in its beam while focusing attentional resources helps bind different features together to form the percept of the object.
- But the debate on exact role of visual attention is ongoing.



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Divided Attention

- Exploring maximum amount of information that can be attended to at any one time.
- Studied through Dual-task Technique: Ps attend and respond to both messages
 - Examines continuous performance
- Provides information about limitations of attention & capacity of attention.
- Dual-task performance is constrained by 4 main factors.....



Divided Attention

1. Task difficulty: interference is worse when task components are demanding (see Wickens, 1980).
 2. Skill: being skilled can protect performer from dual-task interference, possibly through automatisisation reducing the need for resource allocation (Allport et al., 1972; Hatano et al., 1977; Hirst et al., 1980).
 3. Task similarity: interference increases when tasks are similar or involve same sensory modalities (Wickens, 1984b; McLeod, 1977).
 4. Emergent properties: e.g., tapping your head while rubbing your stomach – timings and directions make them incompatible (Duncan, 1979; Wickens, 1992).
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Limited capacity/Parallel-processing Models

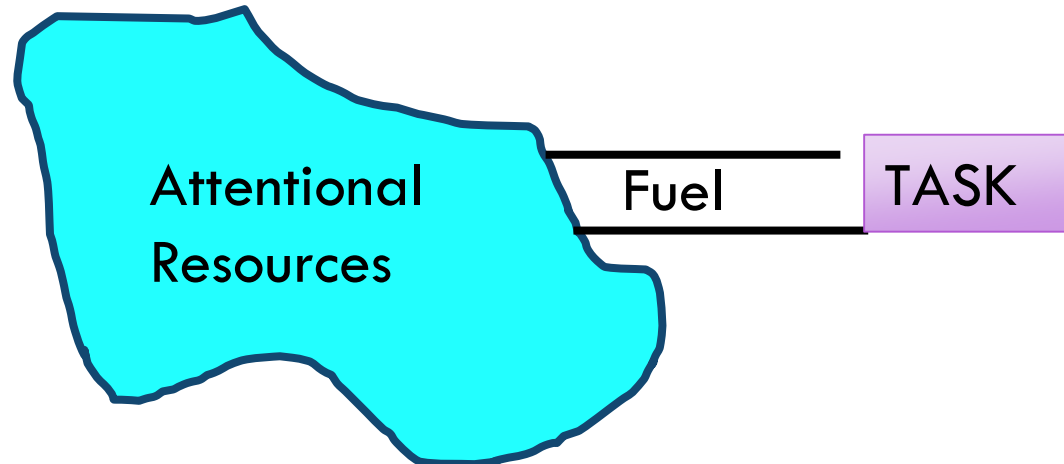
Limited capacity theories are interested in our capacity for processing more than one stimuli at the same time and see attention as a *parallel-process*.

- We have a limited amount of processing capacity
 - Kahneman's (1973) Central Resource Model
 - Norman & Bobrow's (1975) central capacity interference theory
- We can process information in parallel but performance worsens as capacity is reached.



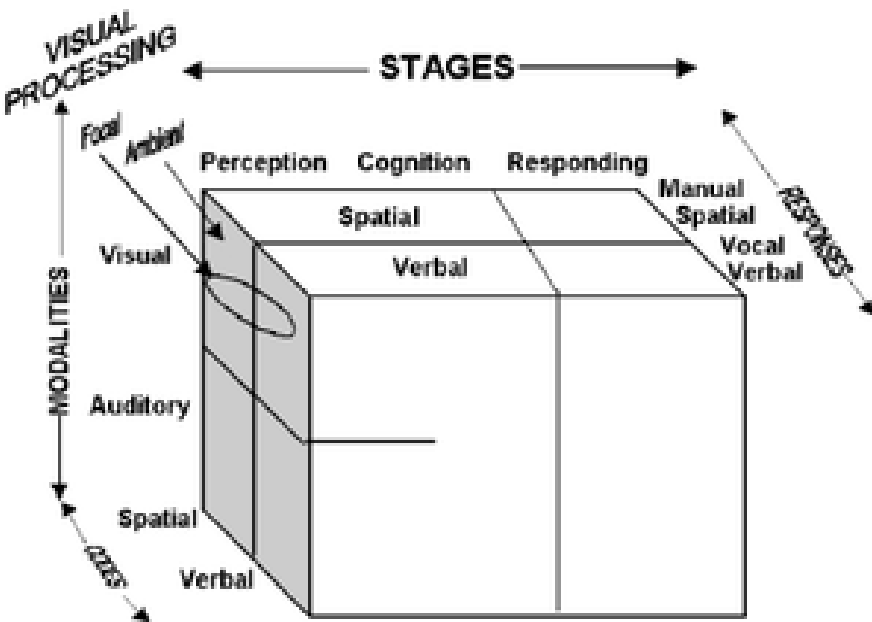
Central Resource Model: Kahneman (1973)

- A **Central Processor** is responsible for allocation of attentional resources.
- **Resource theory:** dual-task interference emerges from an insufficiency of processing “energy”.
 - Attentional resources can be flexibly allocated to more than one task at a time, until all attention has been allocated.
- Hypothesises a “pool” of attentional resources and “fuel” needed to perform a task is taken from a central reservoir.



Alternative model: Multiple Resources

- Wickens (1984): There are independent processing mechanisms in the form of multiple resources.
- Put forward 3D structure of processing with 3 stages
- Helps explain why similarity of task is critical.
 - i.e., 2 tasks that are similar will compete for the same resources and cause more interference.

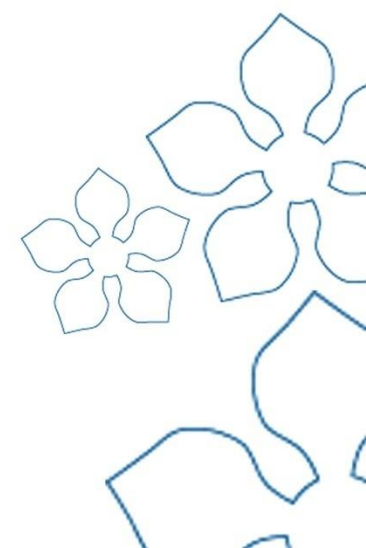


- More interference when 2 tasks share the same modality: e.g., 2 auditory messages harder to follow than 1 auditory and 1 visual message (Treisman & Davies, 1973).



Can we ever perform 2
different tasks to a similarly
high standard?

If so, what process allows us
to do this?



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Automatic Processing

- If a certain task is practiced enough it may become *automatic*
- If *automatic* then they make no demands on the attention processes.
- It is therefore possible to perform two tasks simultaneously and efficiently



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Stroop

- Competition between word and colour recognition.
- Interference when colours & words are incongruent

Yellow, Green, Black, Red, Purple, Orange, Blue

VS.

Yellow, Green, Black, Red, Purple, Orange, Blue

VS.

Yellow, Green, Black, Red, Purple, Orange, Blue



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Summary....

- Difference between Focused and Divided attention.
 - Various models of both auditory and visual focused attention.
 - Various models of capabilities when attention is divided.
 - What do they tell us about how attention operates and the processes involved?
- 

Next Lecture...

- Short-term memory
- Reading
 - Eysenck, M. W., & Keane, M. T. *Cognitive psychology: Chapter 6*



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