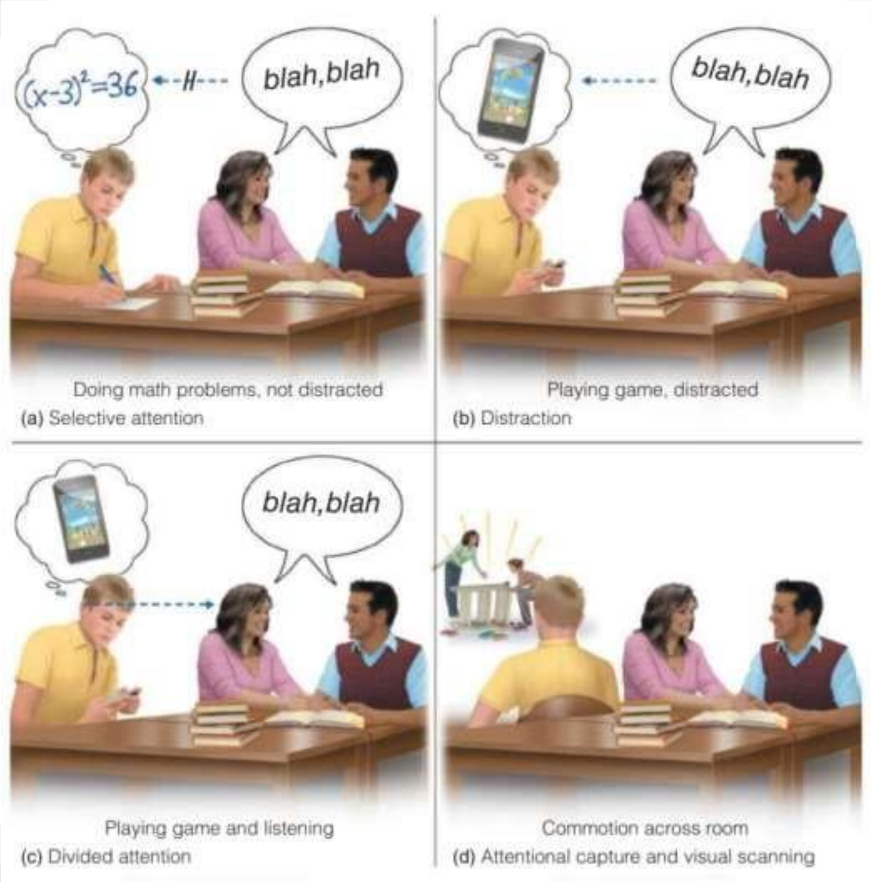
Attentional Processes

Reading: pp. 90-110; 115-120

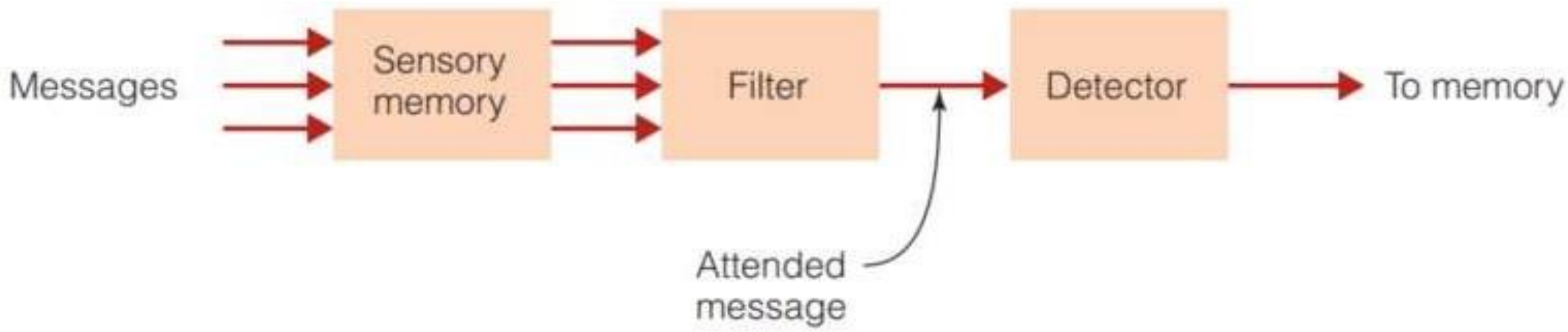
Types of attention

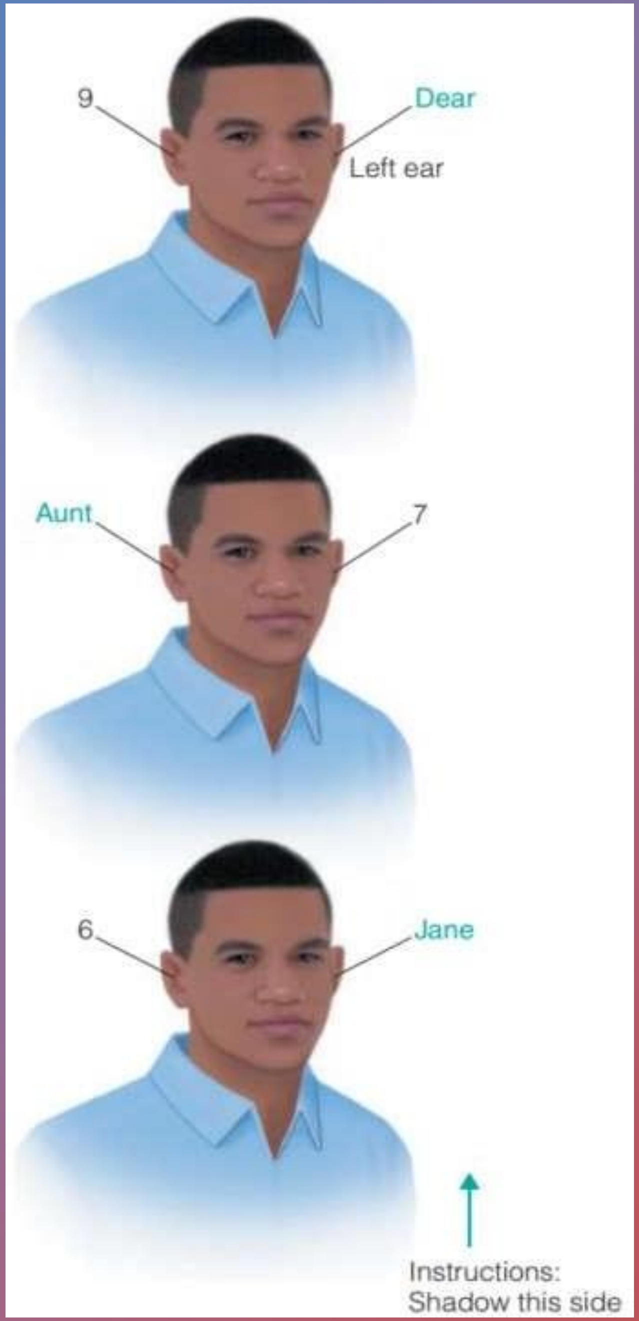
- Selective attention (focusing on one feature while ignoring others)
- Distraction (interference by unattended stimuli)
- Divided attention (shifting between target stimuli)
- Attentional capture (following sudden shift in context)



Models of attention

- Broadbent's original **filter model** of attention (1958) as an *early* selection model.
  - **Early** because 'extra' information is filtered at the *beginning* of the attending process.
  - Registration of sensory inputs (Sensory memory)
  - Detects the specific properties of the stimuli requiring attendance and 'filters' the relevant information
  - Meaning of the filtered information is derived through comparisons with known-characteristics in the 'detector'
  - Information goes to 'short-term' memory (10-15 seconds), which *may* get to long-term memory in certain contexts



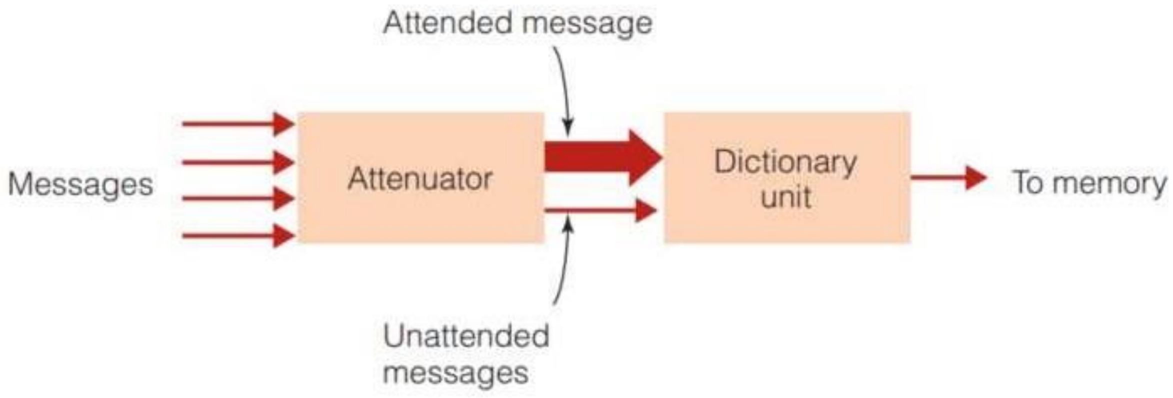


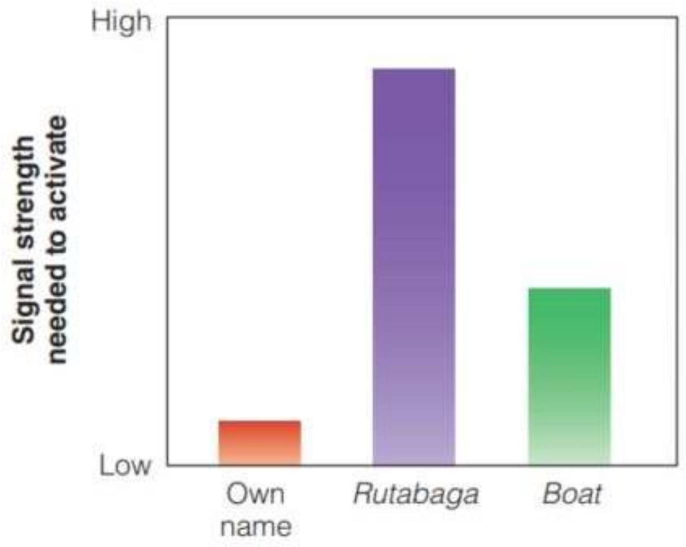
Detectors are not passive

- **Dichotic listening experiments** involve presenting alternate sounds to each year.
  - Participants are tasked to **shadow** what is being said across the dominant ear. Causes conscious recollection of ‘shadowed’ message, but not of what was said to the unattended ear
  - Integrate information over *both* ears when the emergent meaning made more ‘sense’ e.g., *Dear **Aunt** Jane* vs *Dear **7** Jane*
  - More meaningful/familiar stimuli more likely to be
  - attended from ‘noise’ – **cocktail party effect**

Early Feature Integration

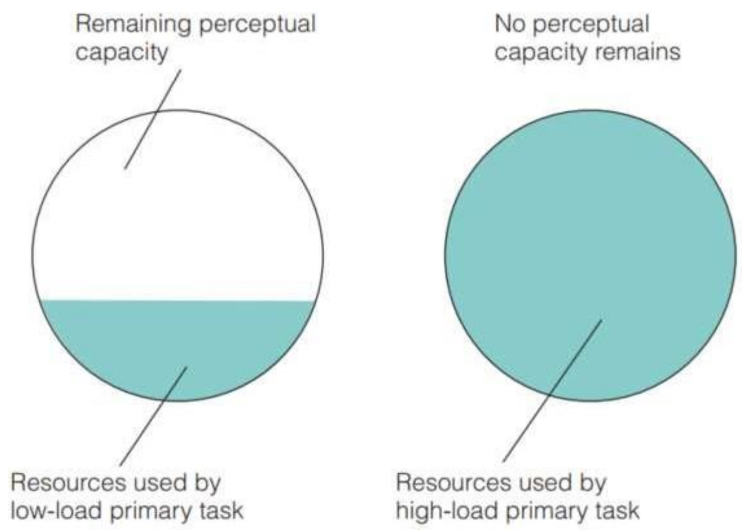
- Treisman (1964) updated Broadbent's model into **feature integration theory** constituting of a preattentive and focused attention phase
- Incoming information is filtered with an **attenuator** that amplifies relevant message and attenuates unattended information
  - Physical properties (e.g., sound pitch), *and*
  - Linguistic structure (syntax) and known meaning (semantics)
- A **dictionary** unit is the reference point for incoming information (e.g., deriving meaning of words)
  - Even 'weakly' attended stimuli may elicit responses

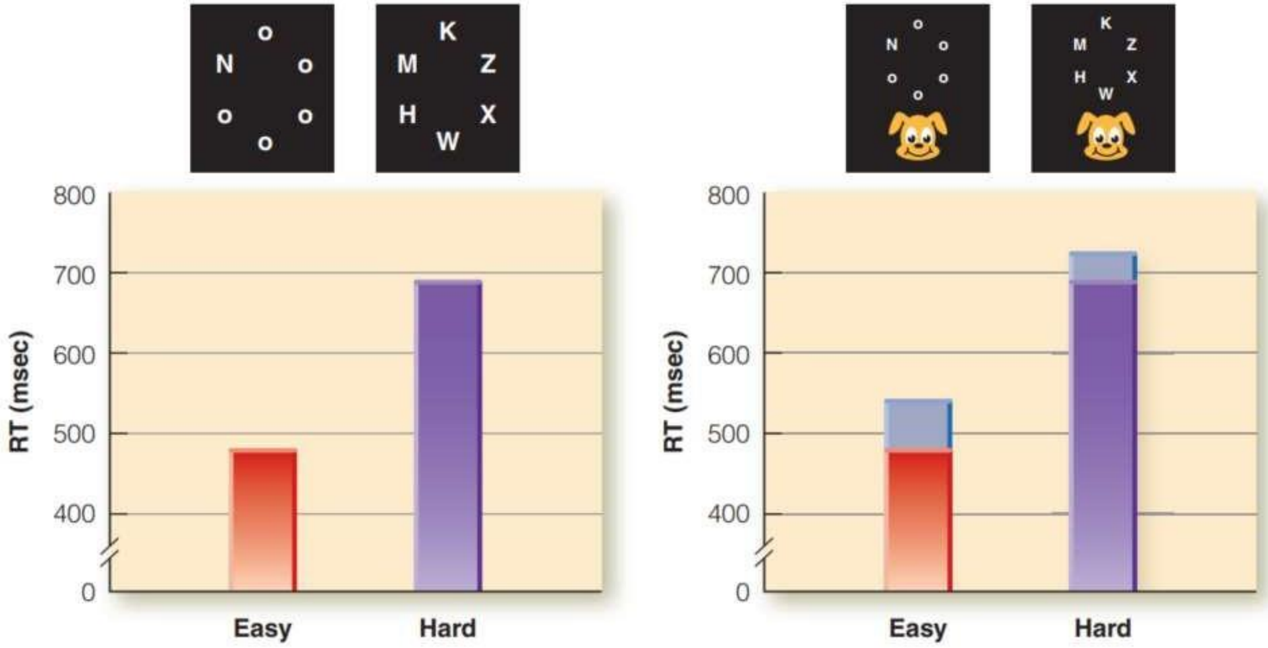




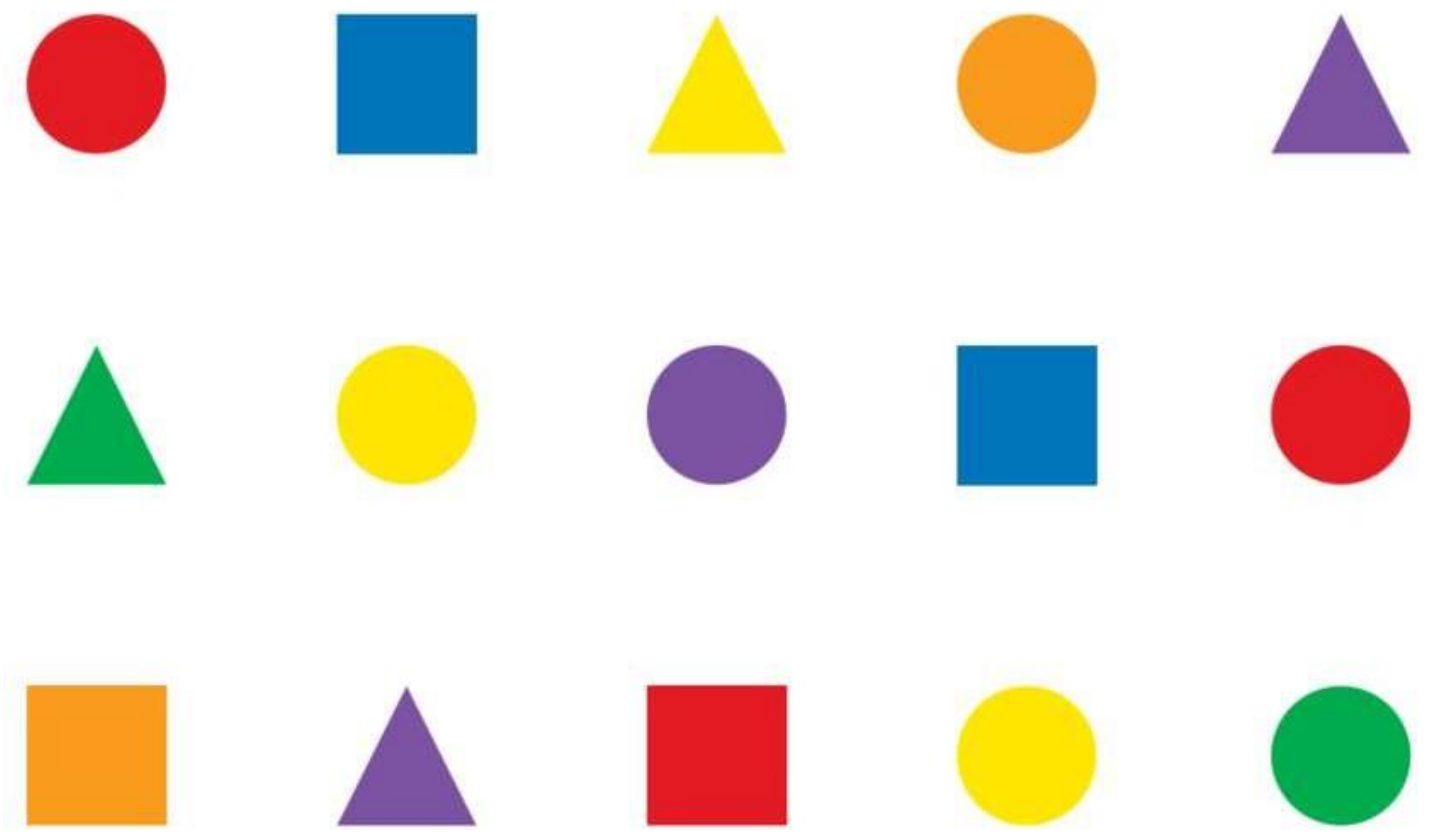
Load theory of Attention

- Processing capacity (how much information can be processed at once?)
  - Information can be processed without awareness if there are sufficient 'resources'
- Perceptual load (how difficult is the task?)
  - Low vs High perceptual load (attention difficulty)





Name the colors as fast as you can…



Name the colors as fast as you can…

YELLOW	RED	BLUE	PURPLE	GREEN
ORANGE	YELLOW	GREEN	BLUE	RED
GREEN	PURPLE	ORANGE	RED	BLUE

The Stroop effect

- What is the difference between *reading* and *labelling*?
- One is likely to be automated, through multiple iterations of practice
- The other requires a top-down attribution, and is more likely to be deliberate
- Both automatic and deliberate evaluations become *facilitated* when
- *Take away* – Information that conflicts with previous experiences causes 'interference' with overt expressions.

RED **BLUE** **GREEN** ← *Reading converges with Labelling*

RED **BLUE** **GREEN** ← *Reading diverges from Labelling*

Visual scanning and overt attention

- *Visual scanning* – **saccades** (rapid, jerky eye movements) move across various **fixation points**. Focusing on a fixation illustrates the point being attended to in **greater detail** (central vision) with the surrounding regions illustrated in lesser detail (peripheral vision).
- Eye movements are largely automated once context **selects** the stimulus to be attended

Bottom-up attentional capture

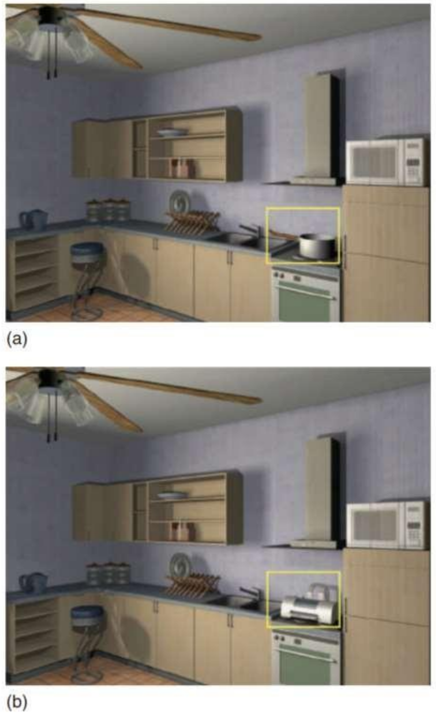
- Stimulus properties that ‘grab’
- attention (contrast, hue, movement)
- Imagine a ‘saliency map’ where the stimulus with the most attention grabbing properties (contextually determined) is the most salient
- Attention based on physical
- properties is generally ‘bottom-up’

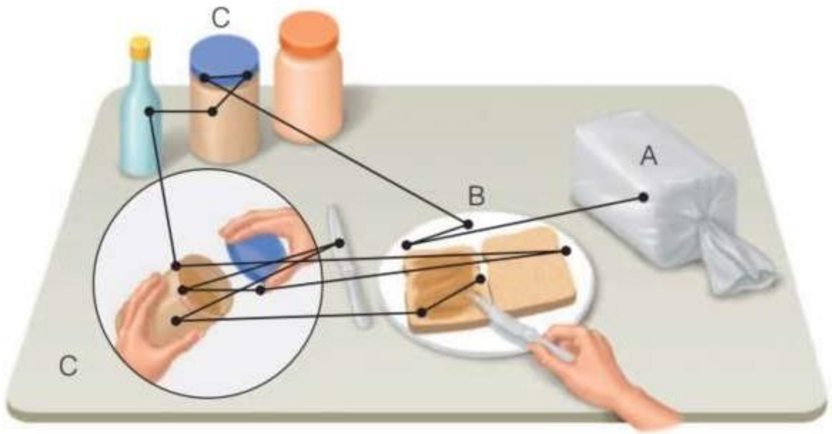
Fig. 8. Comparison of saliency maps from different models. First column: original images with fixation data. Second to the last column: saliency maps from CIOFM [3], Surprise [8], MRS [5], and the proposed model.

Fang, Y., Lin, W., Chen, Z., Tsai, C. M., & Lin, C. W. (2013). A video saliency detection model in compressed domain. *IEEE transactions on circuits and systems for video technology*, *24*(1), 27-38.

Top-down modulation

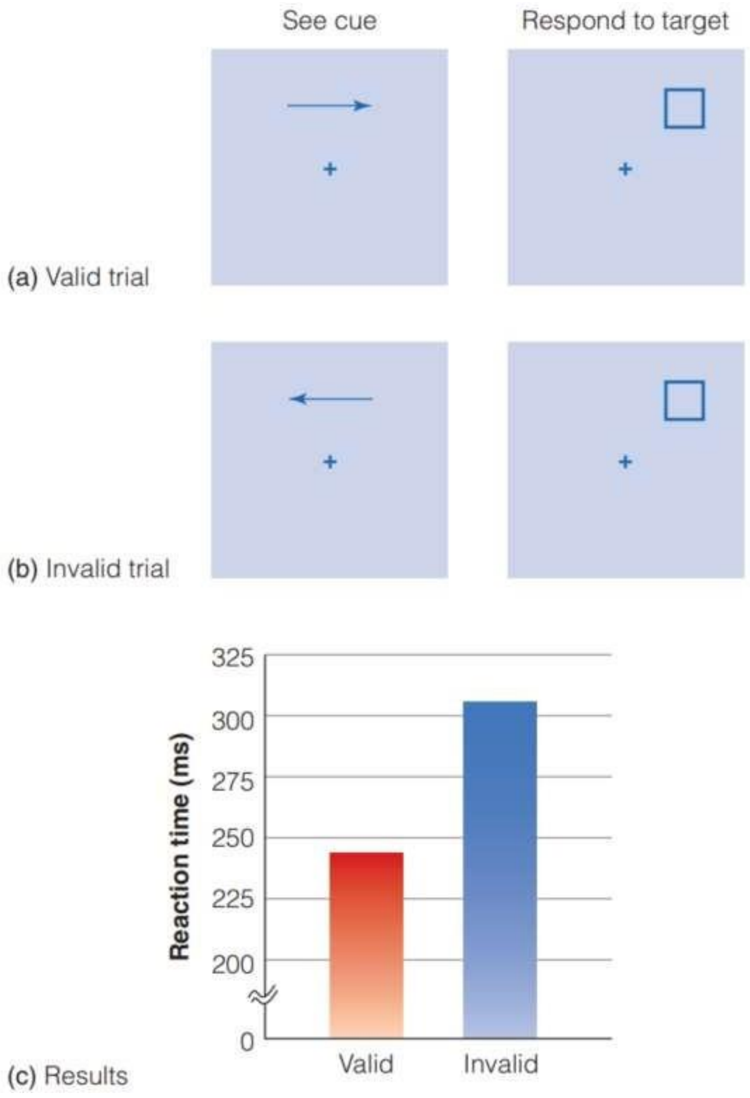
- Attention is moderated by context-specific expectations
  - Does a perceived object ‘go’ with it’s surroundings?
  - (**scene schemas**)
  - What kind of task is someone engaged in? (constructing a peanut butter sandwich)
  - Objects are scanned in accordance with their
  - *predicted* functions





Covert attention (anticipation)

- When the eyes remain still…
- Posner (1978) showed how *precueing* participants would facilitate attention towards the location being cued
- Attention was *covert* as eyes did not shift from a fixation point
- The arrow served as a spatial cue for *predicting* where the relevant (square) target will appear



Attentional outcomes

- Improved responding to attended objects
- (Physiological) **attention warping**
- – re-allocation of cortical resources to attention target
- Enhancement of perceived properties
  - Attended objects are clearer
- Generalization of attentional capture to other regions of the attended object
  - **Same-object advantage** (recall the
  - Gestalt laws of perception!)

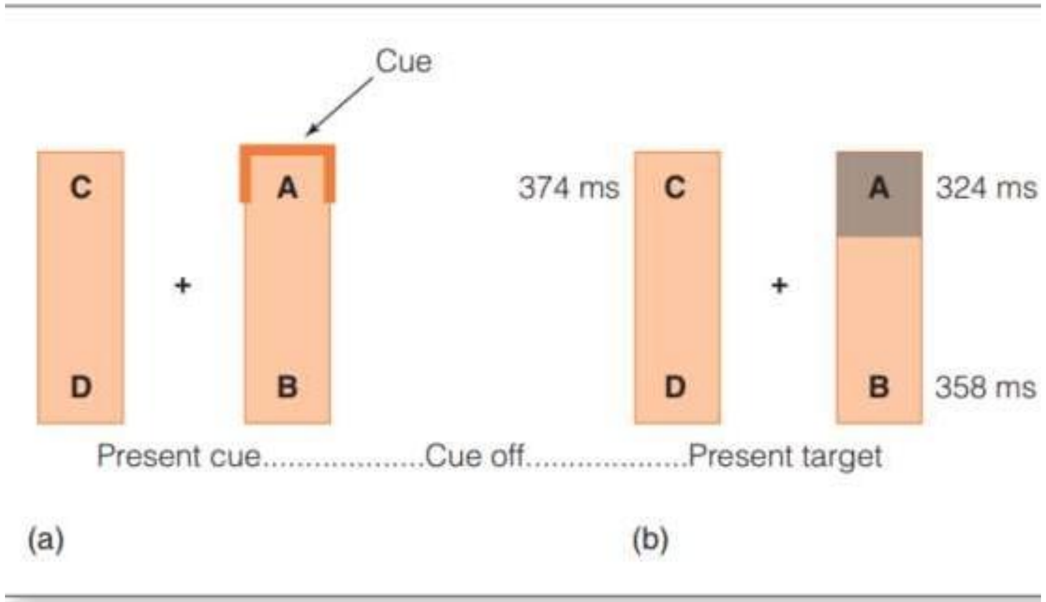
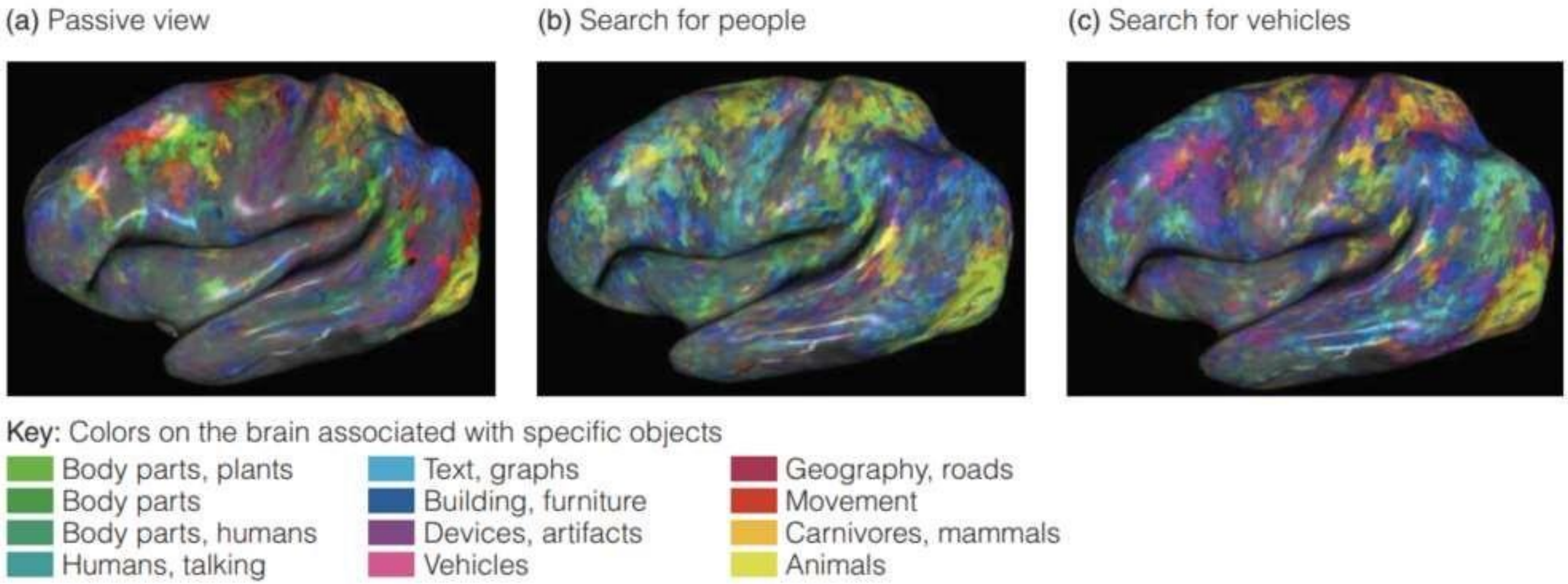


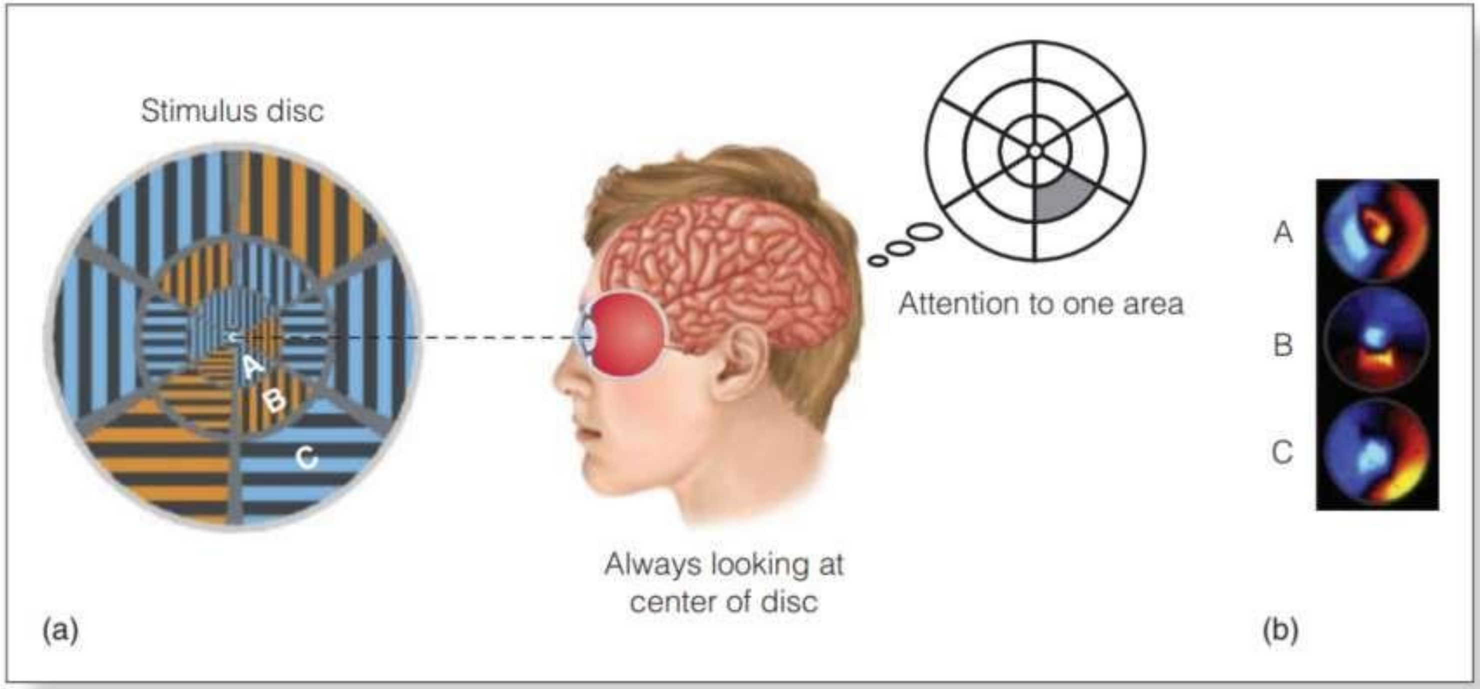
Figure 4.17 In Egly and coworkers' (1994) experiment, (a) a cue signal appears at one place on the display, then the cue is turned off and (b) a target is flashed at one of four possible locations, A, B, C, or D. The participants' task was to press a button when the target was presented anywhere on the display. Numbers are reaction times in ms for positions A, B and C when the cue signal appeared at position A.

Measuring attention without eye movements

- When looking for a specific category, dedicated cortical resources for that particular category is increased (and remaining categories are decreased)



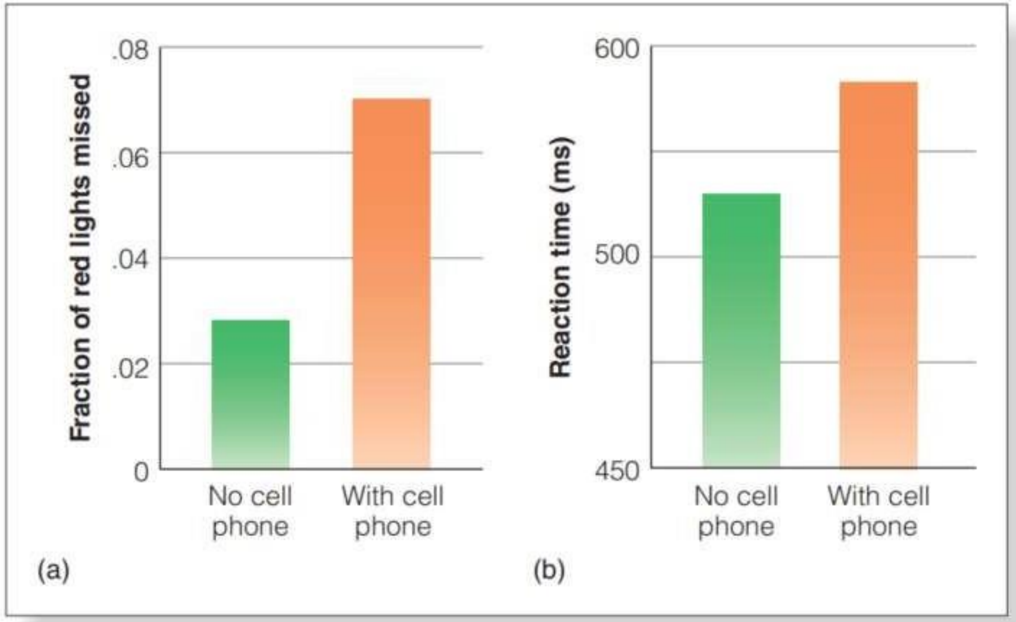
Predicting attention



➤ Figure 4.18 (a) Participants in Datta and DeYoe's (2009) experiment directed their attention to different areas of this circular display while keeping their eyes fixed on the center of the display. (b) Activation of the brain that occurred when participants attended to the areas indicated by the letters on the stimulus disc. The center of each circle is the place on the brain that corresponds to the center of the stimulus. The yellow "hot spot" is the area of the brain that is maximally activated by attention.

Distractions

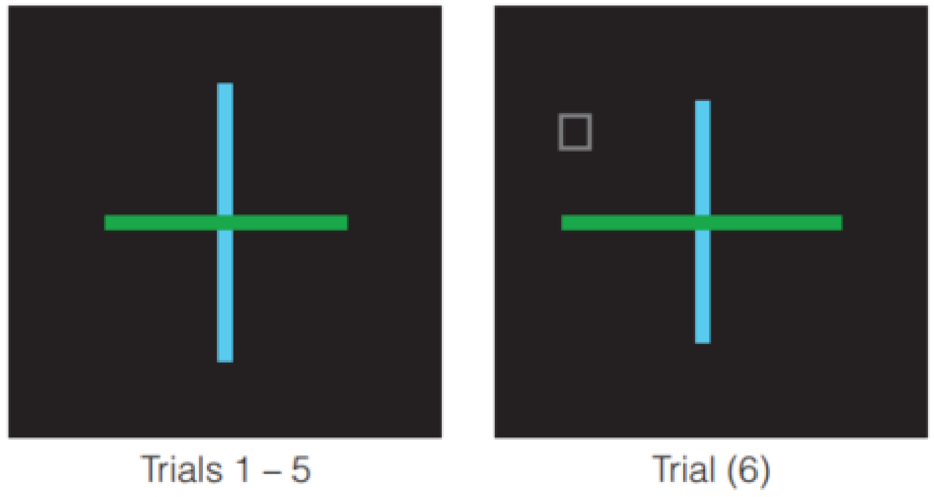
- Attention can be divided after extensive training, but it is easier to become *distracted*…
- By cell phones and internet
- By mind wandering
- [Can you accurately count the number of basketball throws?]



➤ **Figure 4.23** Result of Strayer and Johnston's (2001) cell phone experiment. When participants were talking on a cell phone, they (a) missed more red lights and (b) took longer to apply the brakes.

Change Blindness

- Inattentional blindness/deafness – unaware of otherwise clearly visible stimuli (recall the gorilla video)
- Change blindness – unaware of alterations across subsequent stimulus sets
- Attention is *limited*, and is allocated according to present demands



Conclusion

- Attention can be directed deliberately or automatically to relevant features of our context
- Attention is limited by perceptual load and capacity
- Attentional direction can be influenced by directional cues and experience
- Models of attention can be broadly categorized under early (Broadbent, Treisman), late (MacKay) or direct (Gibson) selection approaches
- Cortical resources are allocated according to the category being attended