Visual Attention

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Rensink (2011) The Management of Visual Attention in Graphic Displays

Ware (2013) Chapter 11

Outline

- What is attention?
  - How attention is situated in the visual system
  - Types of attention

- Attention and visual design
  - How to guide attention
  - How to increase attentional efficiency

What is attention?

- A set of processes that guide visual perception
- Processes are largely independent (Allport, 1993)
- Operate on raw outputs from early vision

Attention in the visual system

- Early vision
  - Rapid, parallel
  - Builds *proto-objects*
  - Unique objects pop-out (salience)
  - Is considered pre-attentive
- The relatively rough outputs of early vision start to guide attention

Types of visual attention

- Selective integration
  - Integrates features at a specific location into an *object file* (Wolfe 2000)
  - Serial
  - Slow if target is not salient

Types of visual attention

- Selective coherence
  - Proto-objects are selected together by coherence
  - Resulting structure is called a *coherence field* or *nexus*
  - Construction of coherence fields is rapid
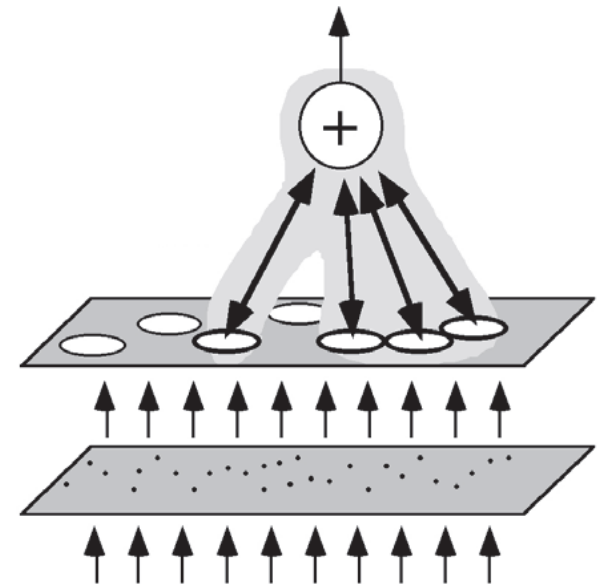
Types of visual attention

- Selective experience
  - Salient information may not be experienced
  - Inattentional blindness (Mack & Rock 1998; Simons & Chabris, 1999)

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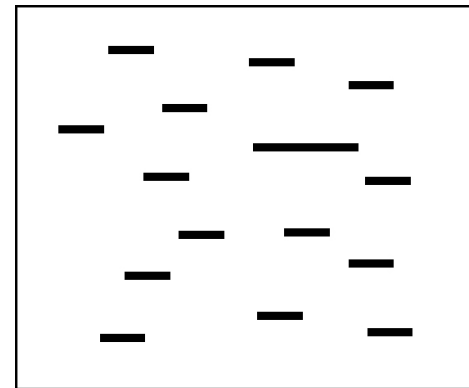
# Nonattentional processing

- Not all processing requires attention
- Some processes that can be done automatically:
  - Statistical summary
  - Scene gist/layout

How to guide attention

- Using low-level salience
    - Unique featural cues (e.g., orientation, length)
    - Increased illuminance
    - Increased level of detail
    - Configural focus (e.g., intersection of lines, paths of motion)

(a) Length cue
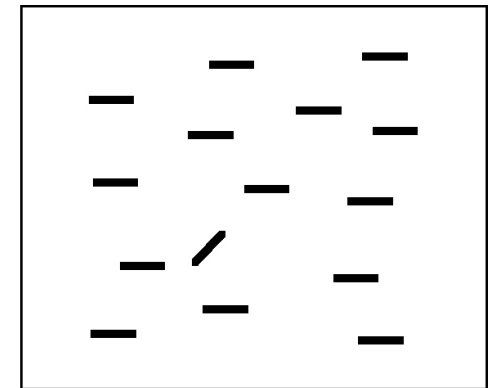
(b) Orientation cue

How to guide attention

- Using high-level interest

How to guide attention

- Using a combination of low-level and high-level mechanisms
 - Exploit learned associations
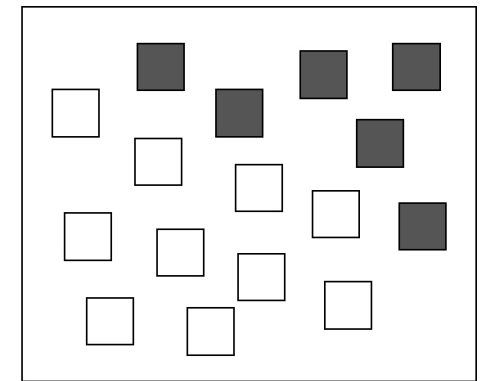
How to increase attentional efficiency

- In visual design, the goal is to reduce effort, avoid fatigue

- Use low-saliency design
  - Minimize salience of targets to avoid fatigue
  - Minimize salience of non-targets to avoid distraction

- Use perceptual organization (reduce clutter)

How to increase attentional efficiency

- Maximize compatibility with attentional mechanisms
  - Use a restricted set of values (limited colours, sizes, orientations)
  - Use restricted positioning
  - Use restricted number of elements
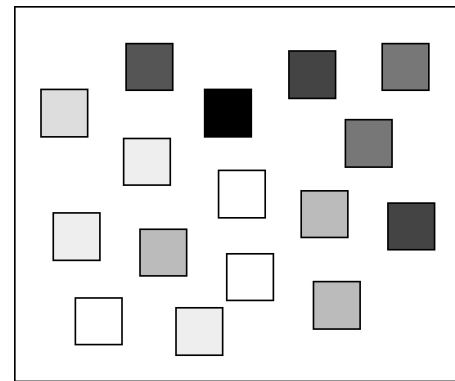
(a)   Unrestricted   (b)   Restricted

How to increase attentional efficiency

- Offload attentional processing onto nonattentional systems
    - Pattern detection for visual analytics
    - Statistical estimation

Conclusions

- A set of attentional mechanisms select low-level outputs for higher-level processing
    - But not all processing requires attention
- Low-level and high-level processes can be used to guide attention
- Visual design can increase attentional efficiency and minimize viewer fatigue