Cognitive Psychology

Lecture 4: Attention

What is attention?

- Attention is **selective**
  - Attention is the cognitive process of selectively concentrating on one aspect of the external or internal environment while ignoring other aspects.
- Attention is **limited in capacity**
  - Resource-demanding / we can't attend to everything
- Attention **can be voluntarily controlled**
  - Internal thoughts and goals can direct attention (top-down)
  - External stimuli can also "capture" our attention (bottom-up)

Outline for today

- Top-down vs. bottom-up attention
  - To what do we direct our attention?
- Divided attention and inattention
- Models of attention
  - Early filter model
  - Late filter model
  - Attenuation model
  - Perceptual load

What stimuli do we attend to?

- Attention can be controlled or automatic
- Top-down processes can guide attention
  - knowledge, goals, expectations
- Bottom-up processes can also guide attention
  - Salient stimuli can “capture” attention
- Importantly, top-down and bottom-up processes often interact

What stimuli do we attend to?

Controlled Attention
- Slow
- Effortful
- Prepared
- Voluntary
- Flexible

Automatic Attention
- Fast
- Effortless
- Involuntary
- Rigid

What stimuli do we attend to?

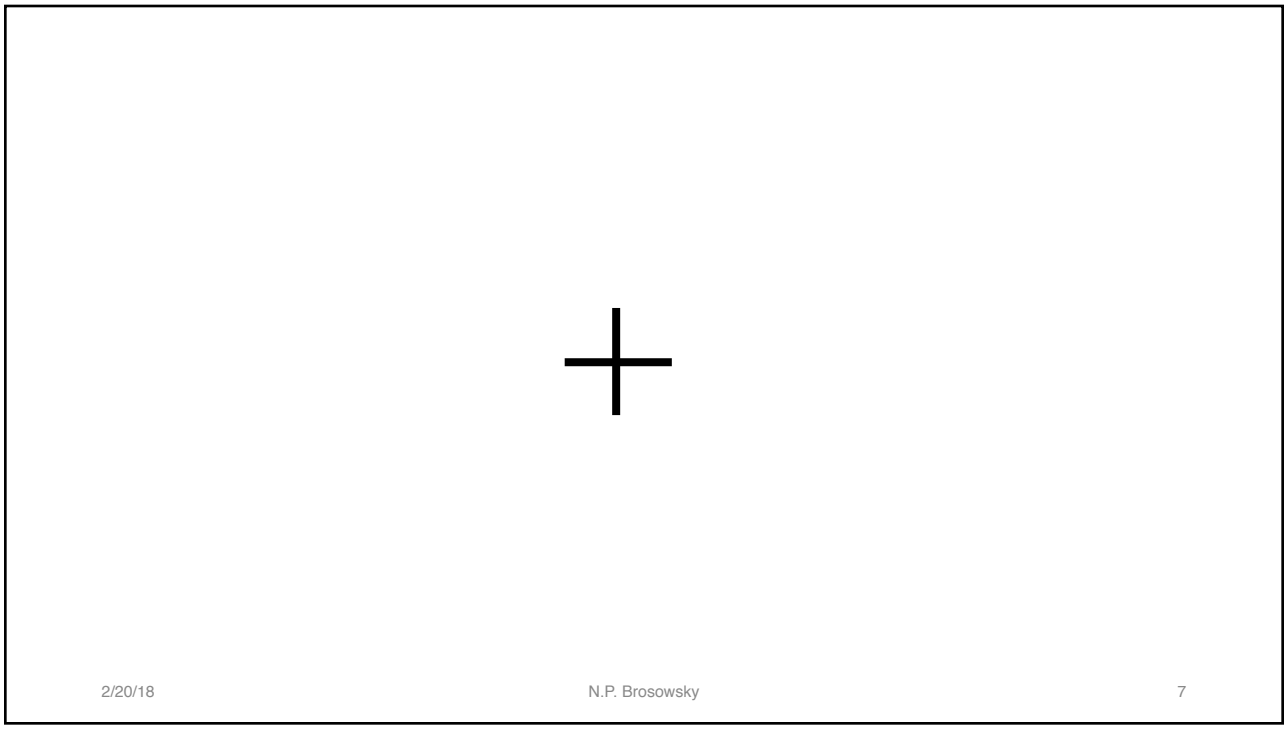
- The visual search task demonstrates top-down vs. bottom-up

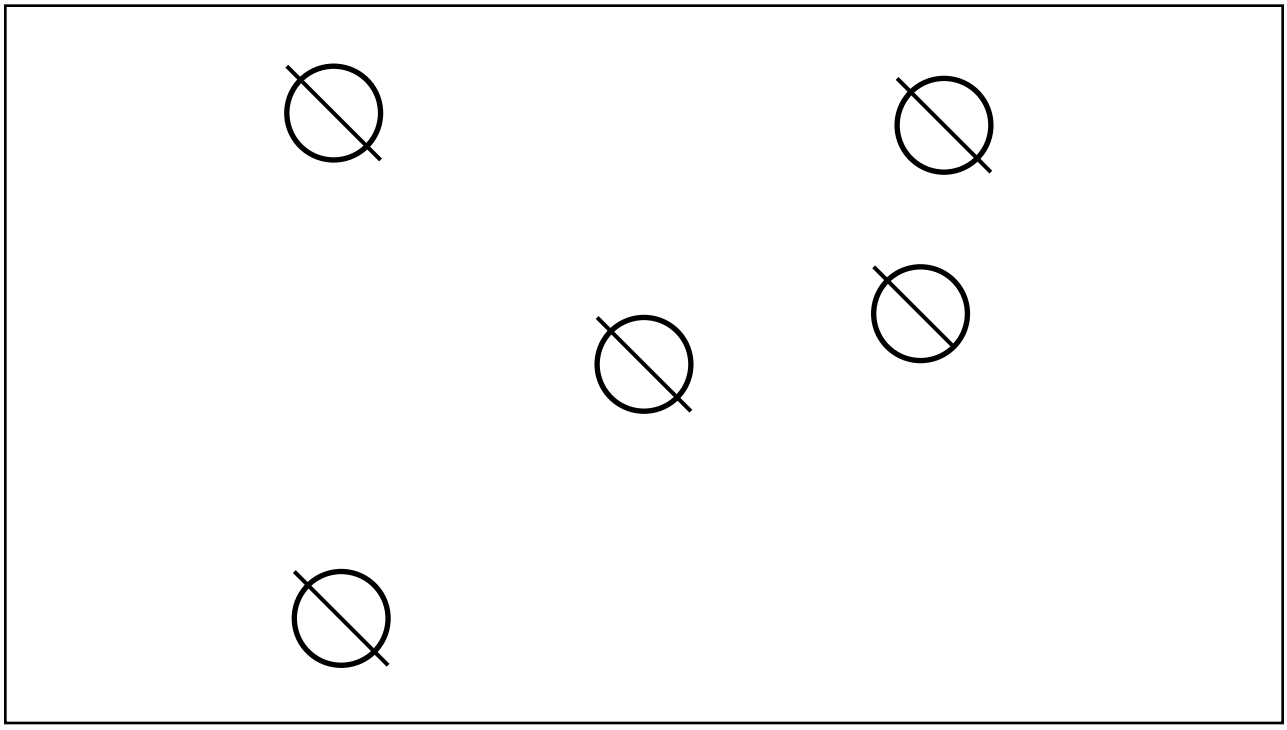
Targets

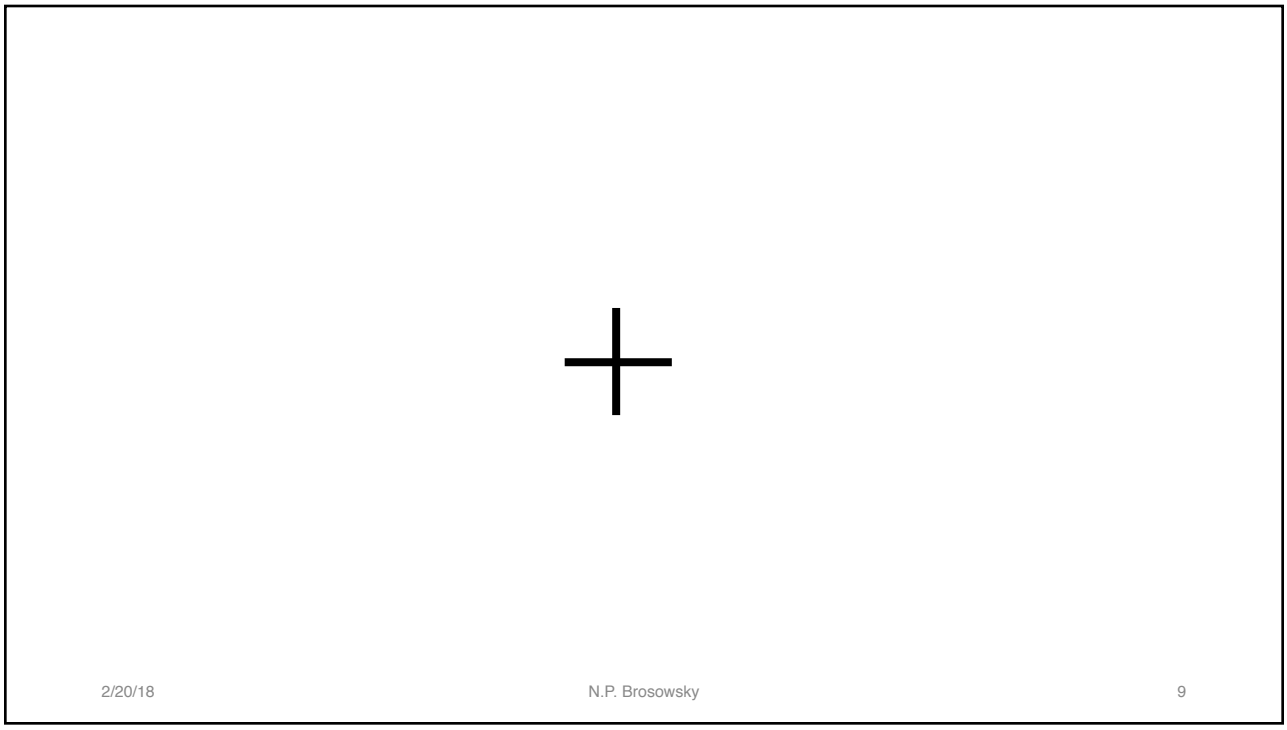
Say Up

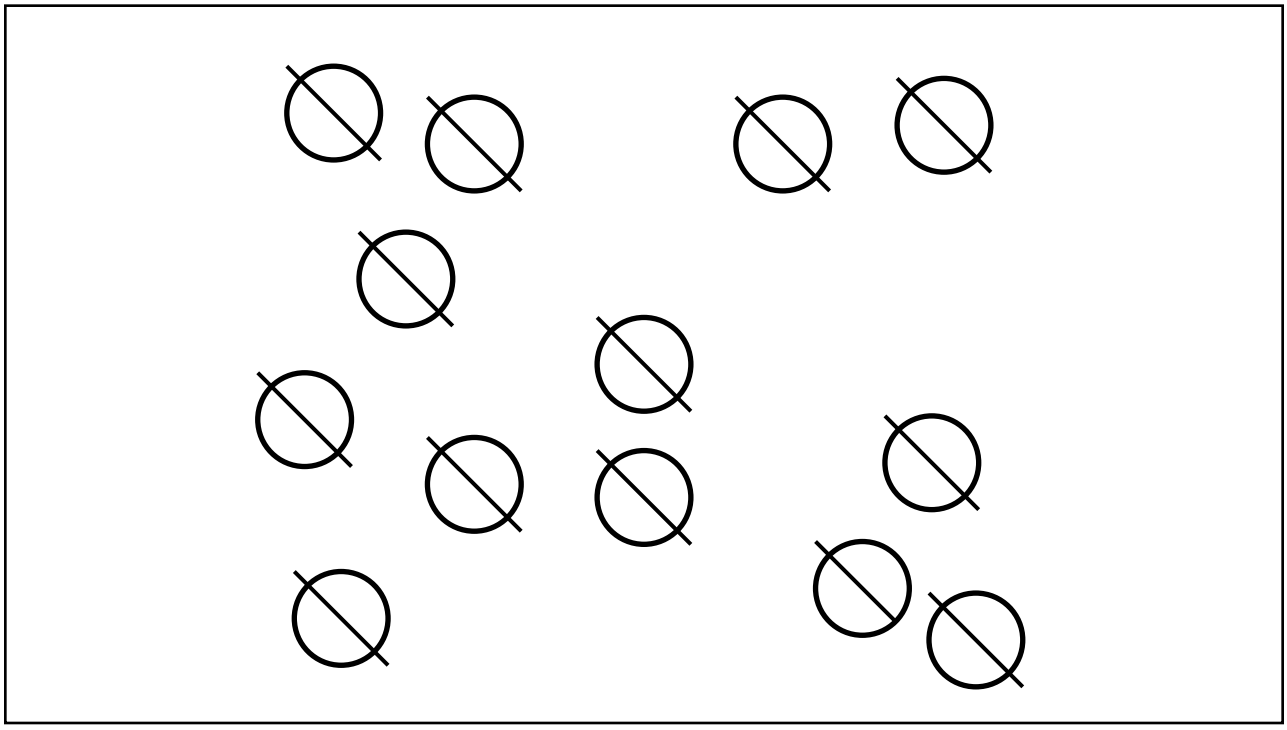
Say Down

Distractors



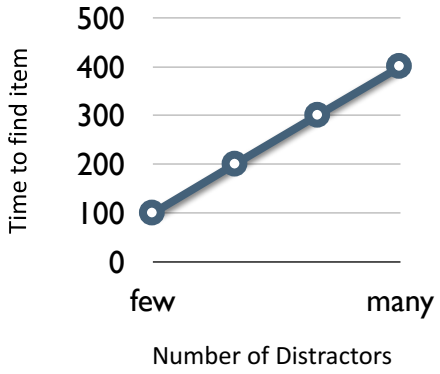


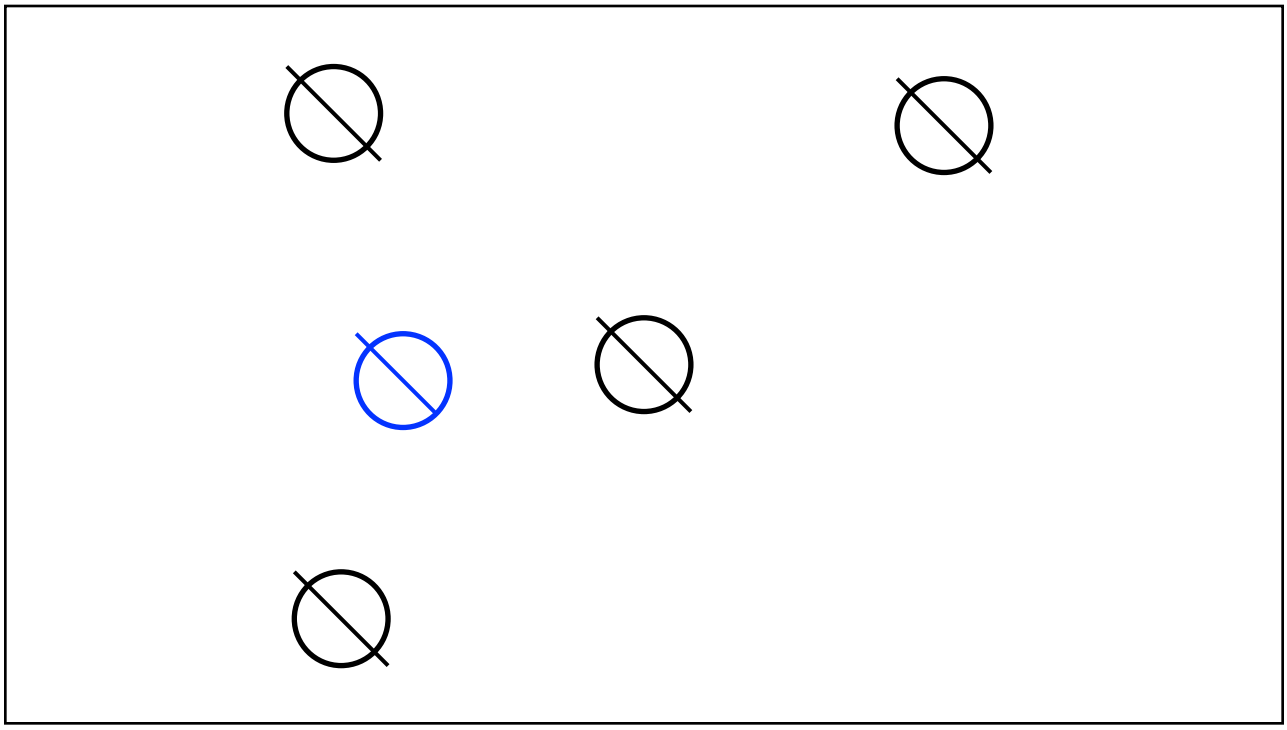


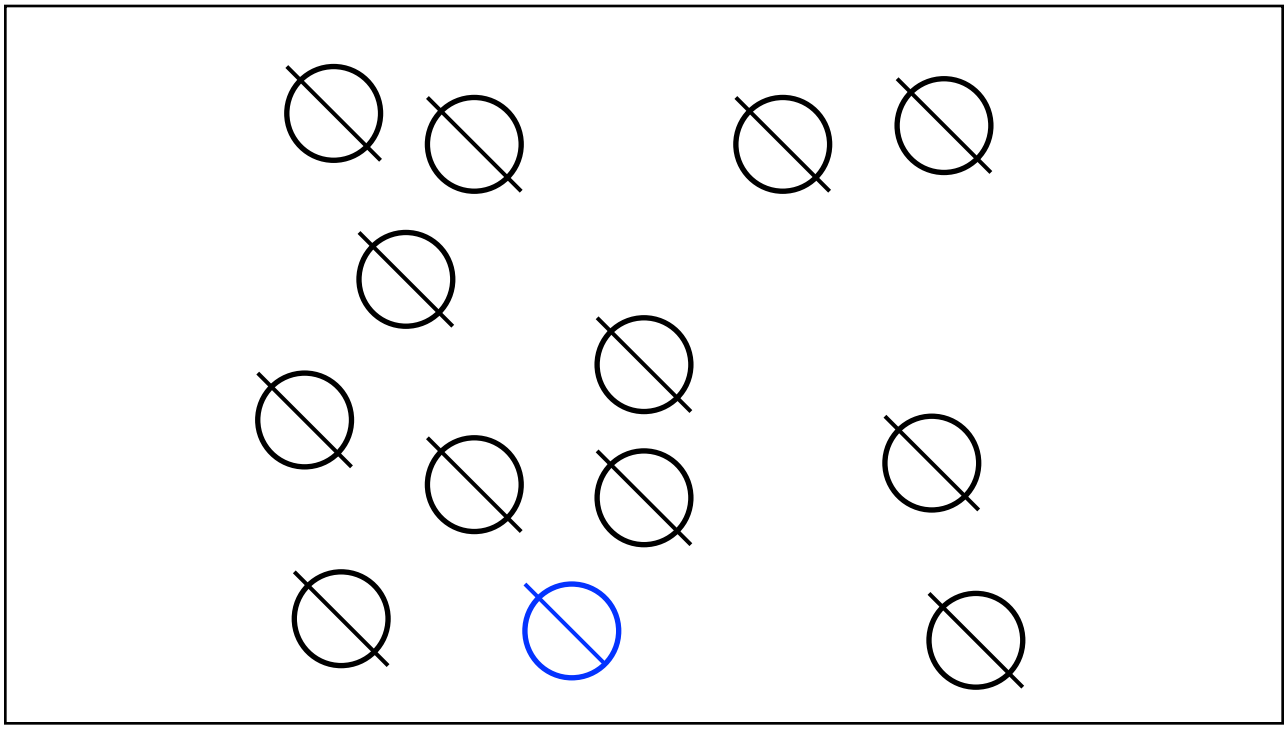


Set Size effects

- Top-down / controlled
- Visual scanning & overt attention
  - Each time you paused on one circle, you were making a **fixation**
  - When you moved from one circle to another, you were making a **saccadic eye movement**
- Covert attention
  - Although visual attention is influenced by our eye movements, it can operate independently

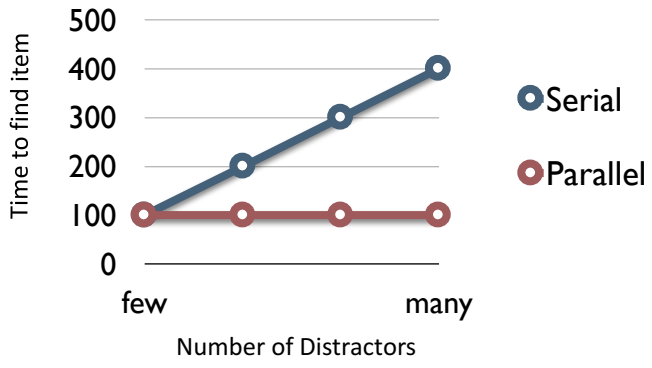






Pop-out effects

- Attention capture
  - Attention is directed automatically (bottom-up)
  - **Stimulus salience**
  - **Saliency map**



Controlled versus automatic

Like perception, how we attend changes with experience, knowledge, and expectations

E.g., the Stroop effect

- Experience can create interference
- Reading becomes automatic through experience

red
blue
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red
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red
green
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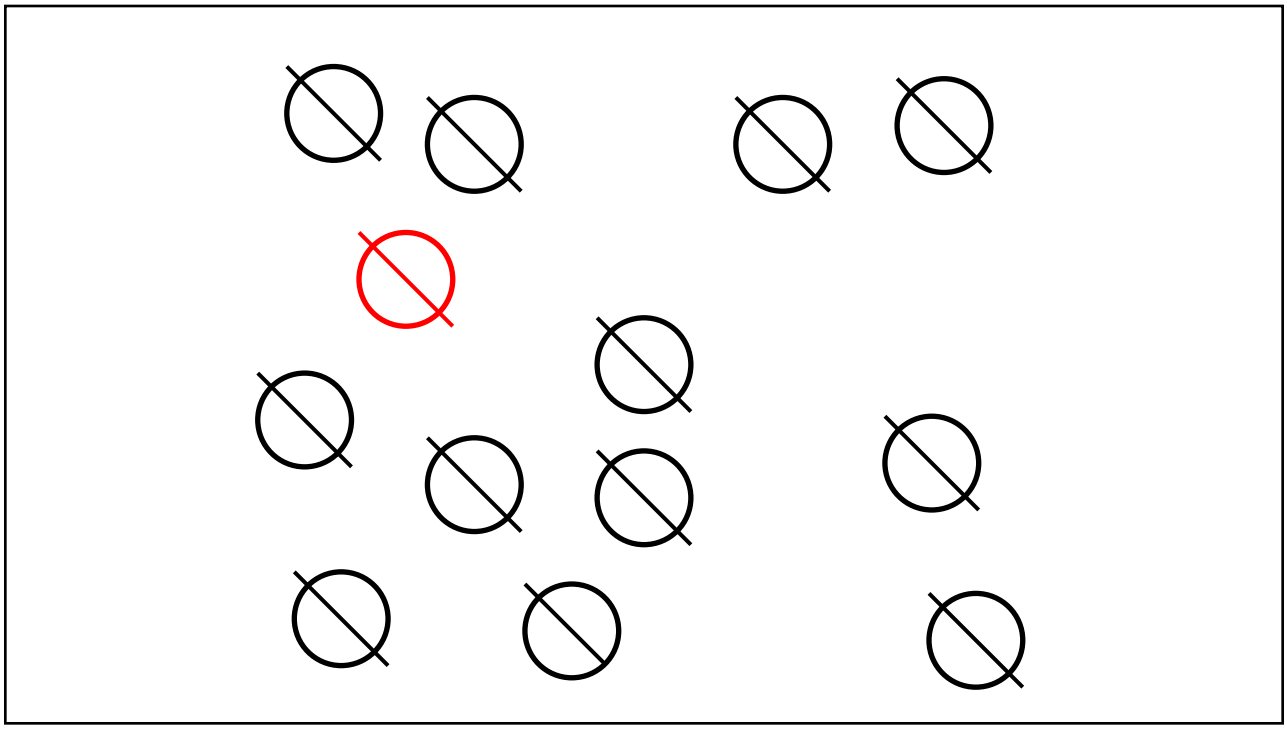
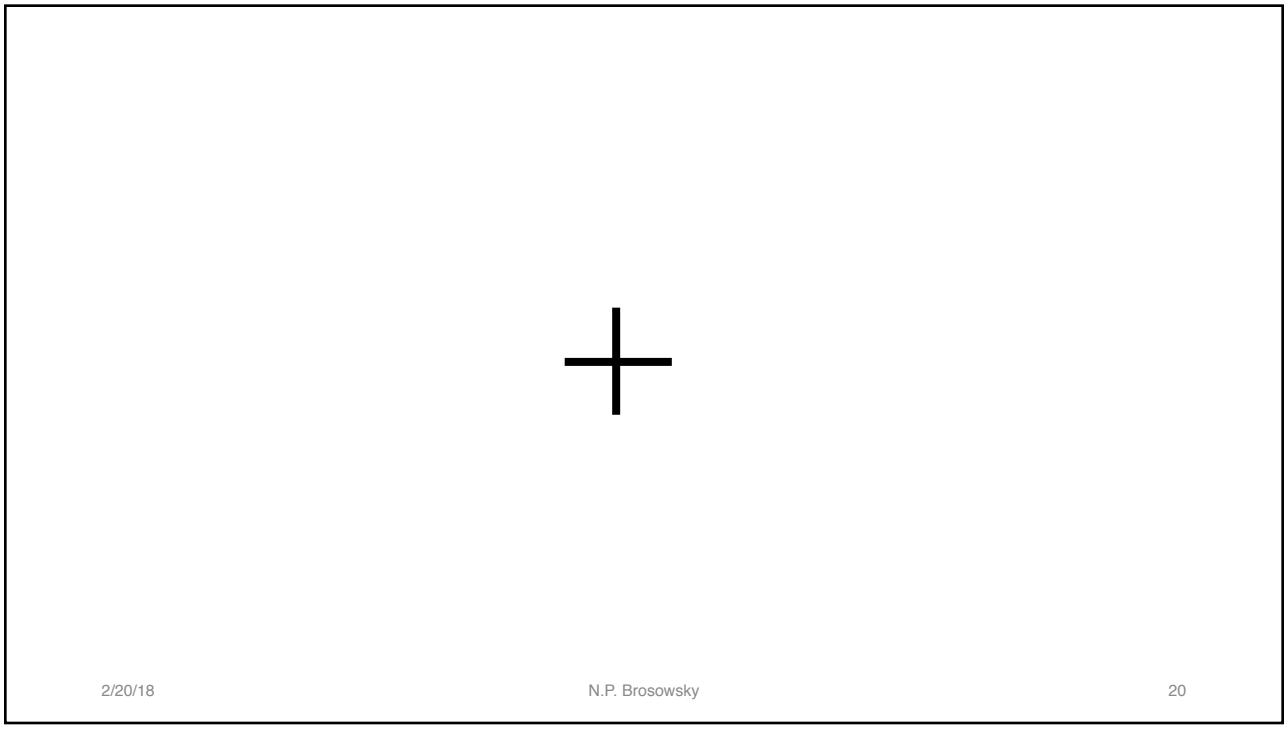
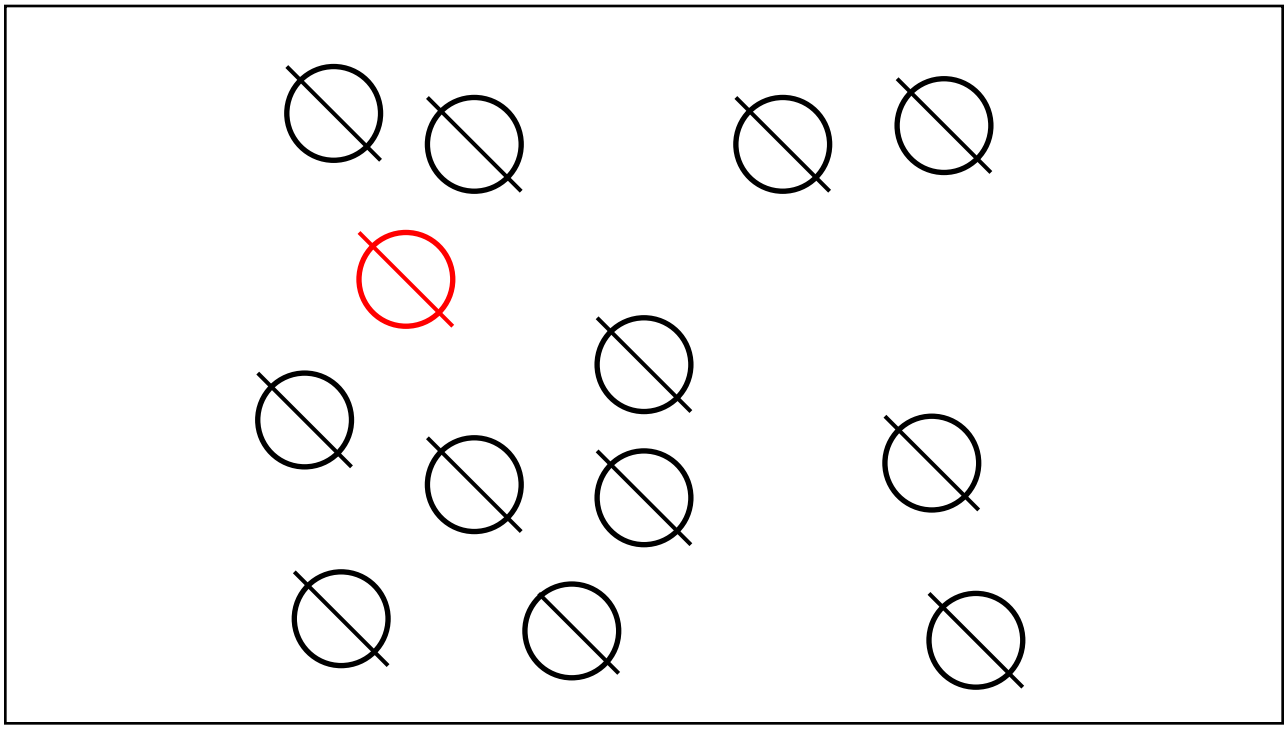
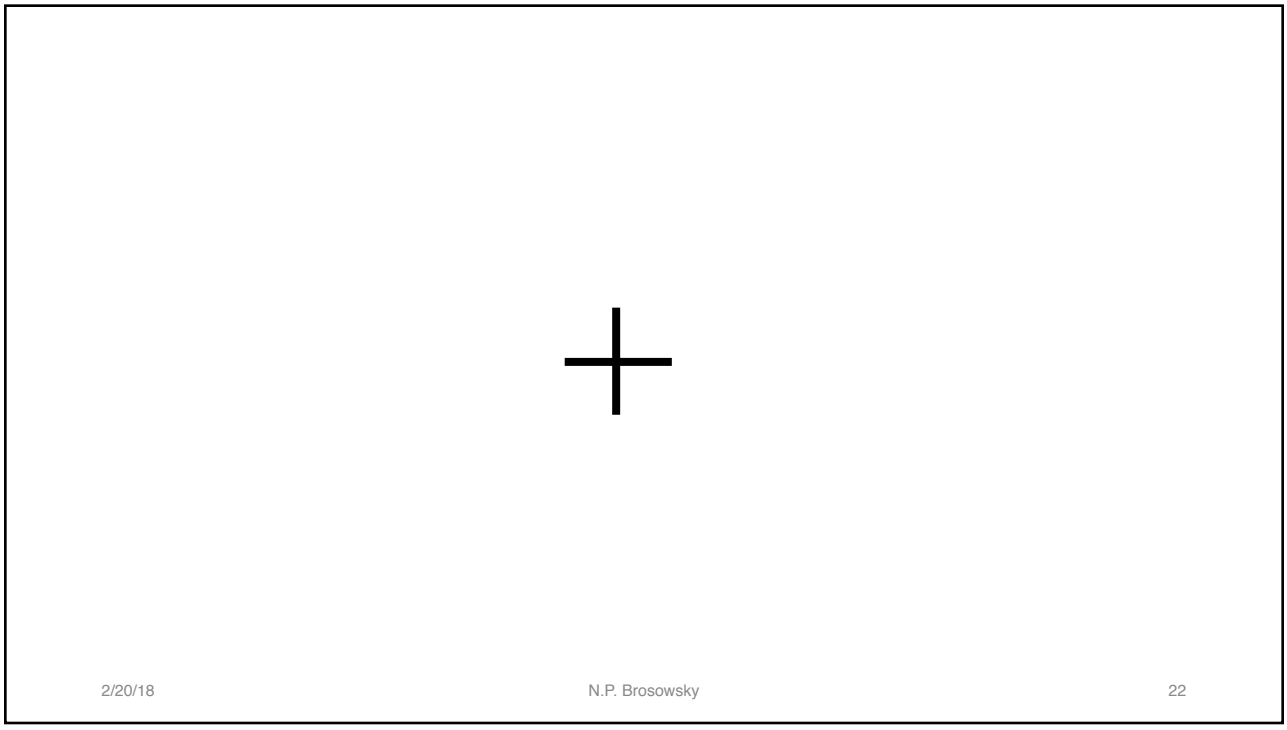
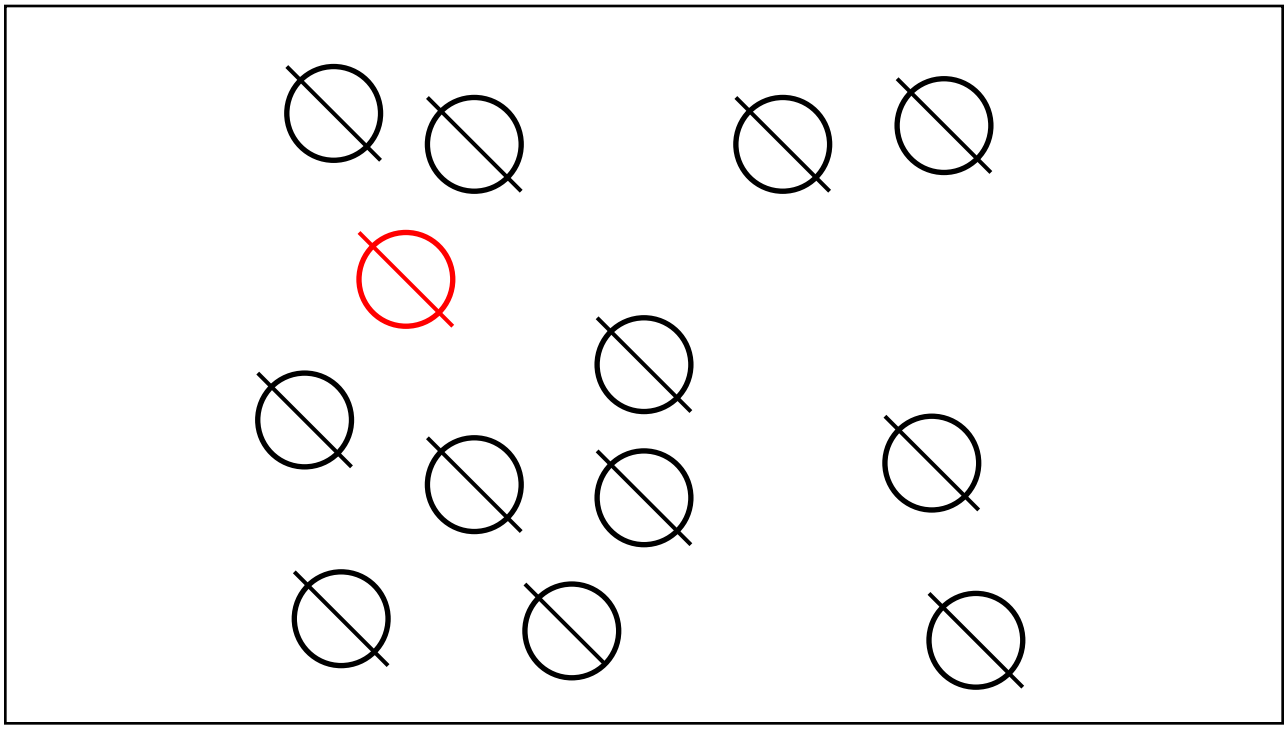
blue











Divided Attention & Inattention

- Can we divide our attention between two tasks?

Divided Attention

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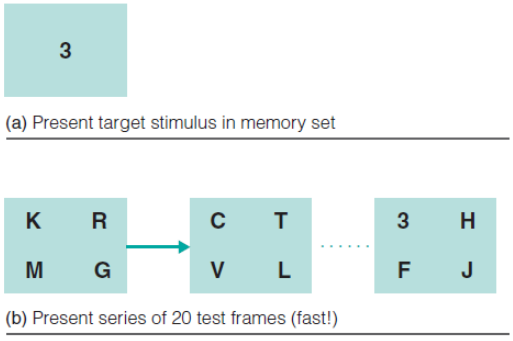
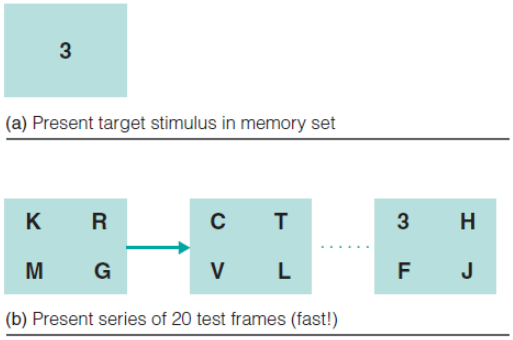
- Yes.. sometimes
  - The task must be easy, **well-practiced** and **automatized**



Divided Attention

- Can we divide our attention between two tasks?
- Yes.. sometimes
  - The task must be easy, **well-practiced** and **automatized**
- Difficult tasks, even with practice cannot become automatized
  - E.g., switching between letter and number targets, using letter target and distractors



Inattention

- What happens when we don't attend?

Change Blindness – Flicker paradigm

Change blindness – Flicker paradigm

- Explanation
  - The “bottom-up“ perceptual processing is optimized towards continuous input.
  - In continuous input, changes are easily detected (usually changes are due to motion). Motion is highly salient and pulls our attention towards it.
  - The brief blank screen between the two pictures disrupt the basic bottom-up processing. No continuous motion can be detected.
  - Changes have to be searched for by deliberate attentional “top-down“ control, searching location by location…

Perception sometimes requires attention

- If we look around us we experience an amazing richness of detail.
- But we do not notice the detail of objects unless attention is directed to them.

Demonstration: Without looking!

- What color shirt is the person behind you wearing?
- On your mobile phone, what's the bottom right item?
- Which way is Lincoln facing on the penny?

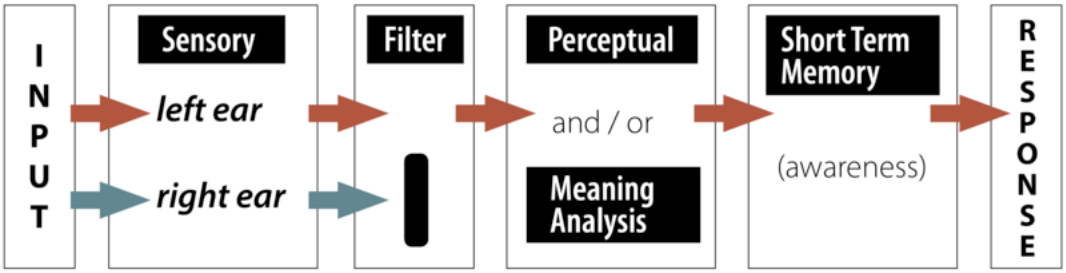
Models of attention

- At what stage of processing do we filter information?

- Early selection model (Broadbent, 1958)
- Attenuator model (Treisman, 1964)
- Late-selection model (Deutsch & Deutsch, 1963)
- Theory of perceptual load (Lavie, 1995)

Early selection models

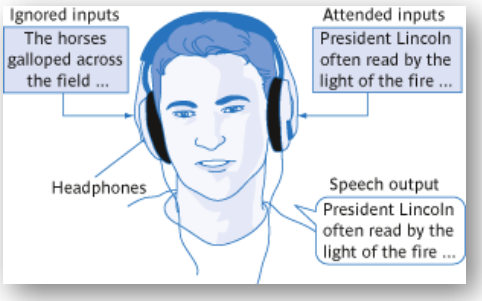
- Broadbent's filter model
  - Filters before analysis for meaning



Evidence for early filters

How much is retained from the unattended message?

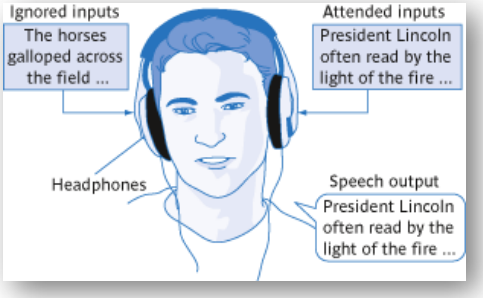
- A different message is played to each ear **(dichotic listening task).**
- Overtly repeat message played to one ear **(shadowing task)**.



Evidence for early filters

How much is retained from the unattended message?

- Overt repetition requires strong focusing of attention on the attended input.
- Consequently, no attention on the ignored input.
- Was anything of the ignored remembered or recognized?



Evidence for early filters

How much is retained from the unattended message?

- Mostly physical properties (e.g. tonality) were noticed
- Virtually no noticing of
  - Meaning of the message
  - Change in language (English to German)
  - Change in gender (male to female)
  - Message in reverse speech
- This suggests that filter is **early** in processing (before meaning is processed)

- However…
- How would you hear your name if it was filtered out?
  - Moray (1959)
- Broadbent model is not able to account for this effect

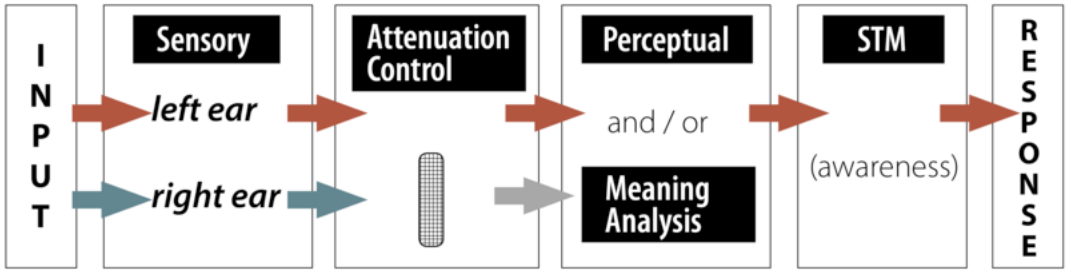
Attenuator model

- Treisman, 1964
- Is based on Broadbent‘s filter model
- Different mechanism for filtering:
  - Not by an all-or-nothing filter (Broadbent)
  - But by a gradual working “attenuator“

Anne Treisman (with her husband, Daniel Kahneman, Psychologist and 2002 Nobel Prize Winner)

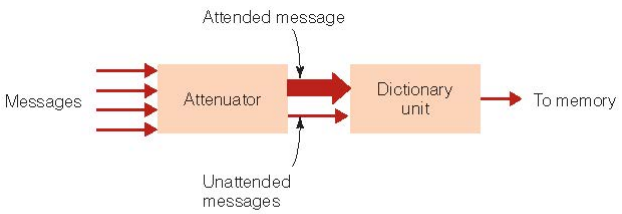
Attenuator Model

- Information is not blocked completely, but is weakened or attenuated



Attenuator model

- Intermediate-selection model
  - Attended message can be separated from unattended message early in the information-processing system
  - However, selection can also occur later in the dictionary unit, if threshold is met



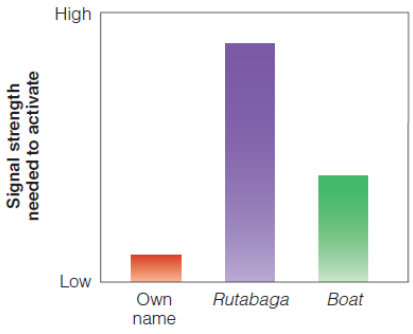
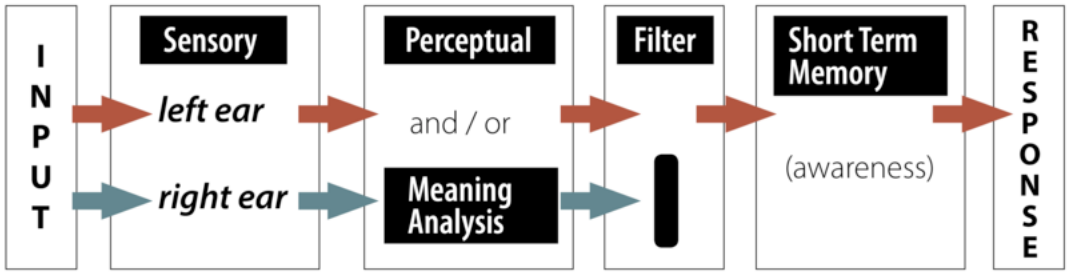


Figure 4.5 Flow diagram for Treisman's attenuation model of selective attention. © Cengage Learning

Late-selection models

- Selection of stimuli for final processing does not occur until after information has been analyzed for meaning



Evidence for Late-selection

This model suggests that even ”ignored” stimuli are processed fully

- McKay (1973)
  - In attending ear, participants heard ambiguous sentences
    - “They were throwing stones at the bank.”
  - In unattended ear, participants heard either
    - “river”
    - “money”

Evidence for Late-selection

- McKay (1973)
  - In test, participants had to choose which was closest to the meaning of attended to message:
    - They threw stones toward the side of the river yesterday
    - They threw stones at the savings and loan association yesterday
  - The meaning of the biasing word affected participants' choice
  - Participants were unaware of the presentation of the biasing words
- Also, some evidence for "subliminal priming"
  - (Dehaene et al., 1998)

Early vs. Late selection

- Early selection:
  - Pros: Very efficient. Only spend resources on what we direct our attention
  - Cons: Since we filter before meaning, it's very likely we'll miss something important
- Late selection
  - Pros: Since all information is processed, it is unlikely that important information is missed.
  - Cons: Very resource demanding.

Perceptual Load

- Which model is correct?
  - Maybe both?

Perceptual Load model of attention:

- Maybe sometimes selection is early, and sometimes late?
  - But what determines whether selection is early or late?

Perceptual Load

- Theory of perceptual load (Lavie; 1995, 2000)
  - "load theory"

Difficult tasks

- E.g., find a specific book among other books
- Require a lot of attentional resources
- Selection is early to make resources available

Easy tasks

- E.g., find a DVD among books
- Require only little attentional resources
- Selection is late since resources are available

Perceptual Load

- E.g., find the book called "all families are psychotic"
- Difficult task (high-load)
  - Shift to early filter
  - no resources available for irrelevant information
  - Won't be distracted

Perceptual Load

- E.g. find the purple book
- Easy task (low load)
  - Shift to late filter
  - Could be distracted easily by someone talking

Model summary:

- Early selection model (Broadbent, 1958)
  - Unattended information is filtered out completely early in processing
- Attenuator model (Treisman, 1964)
  - Unattended information is attenuated early in processing
- Late-selection model (Deutsch & Deutsch, 1963)
  - All information is processed, it is filtered out only late in processing
- Theory of perceptual load (Lavie, 1995)
  - Selection is early in difficult task, and late in easy tasks

Other topics

- How does attention enable **feature binding**?
  - What is feature integration theory?
  - What is an illusory conjunction?
- What does the physiological evidence tell us about attention?
  - What is the topographic map?
  - What is Balint's syndrome, and what does it tell us about attention?