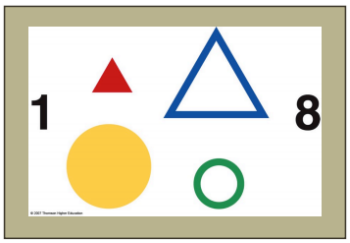
ATTENTION

Selective visual information processing and visual attention

- Too much information: whilst we take it all in, we don't process it all – this reduces load on the brain! Via…
- **Selective processing:** reducing the load of visual processing by filtering information.
  - Retinal filtering: we don't see colour (only black and white) in the periphery – colour information is only encoded in the central visual field. Why? The distribution of photoreceptors on the retina: bigger proportion of cones (colour) than rods (black and white). Now, look at real life: we typically see colour – this is due to the retina's focus on cones. This is one way that the brain reduces its load!
  - Cortical filtering: we don't see fine details (only blur) in the periphery – fine details are only represented in central vision. Why? The larger areas of the cortical only receive the same amount of space as the smaller areas of the cortical. Of course, smaller area + large space prevails over large area + large space i.e. the smaller area has a lot of clarity (HD), in a process known as cortical magnification. Again, this is the brain's way of reducing load.
  - It is the evident that the brain reduces its visual load by emphasising certain areas of the retina and cortical.
- **Selective attention:** focusing on specific objects and ignoring others.
  - Guided filtering: **eye movements** –
    - Fine details are only represented in central vision.
    - Eye movements control where we are looking.
    - Eye movements control the 'spotlight' of selective visual information.
    - Saccades – small, rapid eye movements (left/right).
    - Fixations – pauses in eye movements that indicate where a person is attending (location). There are approximately 3 fixations per second.
    - What determines where we look?
      - <u>Involuntary mechanisms</u>
        Stimulus salience – areas of stimuli that attract attention due to their properties. Colour, contrast and orientation are relevant properties. Saliency reveals fixations are related to the (initial) bottom-up process (unrelated to meaning).
      - <u>Voluntary/task-driven mechanisms</u>
        Scene schema – prior knowledge about what is found in typical scenes → fixations are influenced by this knowledge. Known as 'top-down' process.
        Task demands override stimulus salience. Eye movements and fixations are closely linked to the action the person is about to take.
- **Attention and eye movements**
  - How does attention move across the visual field?
    1. Exogenous attention (involuntary)
       - Guided by 'bottom-up' visual signals i.e. colour, contrast, orientation, saliency.
       - Guides your brain to things that are important, particularly survival things → react to potential threats in the world.
    2. Endogenous attention (voluntary/task)
       - Guided by 'top-down' visual signals i.e. task-driven choices.
       - Slow and sharp shifts, which are goal oriented.
    3. Dynamic attention (voluntary task)
       - Guided by 'top-down' visual signals.
       - Smooth shifts of attention over time.
       - Paying attention to more than one thing at a time.
  - Attention and eye movement are related but not the same. They are often separated with time. Shifts of attention often precede eye movements. Therefore, attending to something is NOT looking at it.
  - Attentional resolution is a form of reducing load on the brain.
- **What does attention do?**
  - Attended objects are processed more efficiently.
    - Posner et al. = pre-cues led to observes responding fastest when cues were consistent with light. This revealed that that attention speeds up the processing of

information → better acuity (capacity to differentiate fine lines e.g. blurry was HD), better recognition performance etc.

- Attention helps us find things.
  - Why are some searches more difficult? Because they require attention!
  - Narrowing/pinpointing to certain details is important e.g. 'where's Wally', 'find the red circle'.
  - What certain role does attention play in searching scenes? Treisman devised the visual search task to study visual attention.
    - The Visual Search Paradigm: searching for conjunctions of features. Set size matters – Treisman and Gelade (1980) found that reaction time increased linearly with set size. This involved 'serial' (from one point to another) and 'self-terminating' (stop once target has been found) characteristics.
    - One the other hand 'O' pops out if distractors are shapes without curves, or red pops out from a black and white image; therefore, are 'pop-outs' in displays and don't require a search per se.
    - Binding is a process by which features are combined to create coherent objects (e.g. distinguishing 'R' from 'P' in a large set size), accounting for why conjunction searches are slow.
      - The biggest binding problem are that features are processed separately in different areas of the brain: V1 = recognition and object representation; V2 = motion and location; V4 = colour;
      - How do features get bound in the brain? Treisman's 'Feature Integration Theory' –
        Objects → Features separated in pre-attentive state → if unattended = 'free-floating', if attended to → features combined in focused-attention stage → accounts for perception.
      - It is predicted that failures of attention can lead to illusory conjunctions: free-floating object features that should be associated with their particular object become incorrectly associated with another. Tested by Treisman and Schmidt: participants reported a 'yellow triangle' 18% of the time.
      - Balint's syndrome – patient's with parietal lobe damage show more incorrect combinations of features → can only identify features serially, not conjunctionally.



- **What can we attend to?**
  - Spatial attention: spotlight metaphor – attention is directed to highlighting a location/region within the visual field. Spotlight can expand in size e.g. "look to the left" – attention to the left magnified, whilst attention to the right shrunken. What are the implications of the spotlight metaphor for divided attention? If you are attending to two separate spatial locations – right and left – the centre is somewhat processed in the process too. Refer to Treisman and Gelade's experiment.
  - Feature-based attention: attention directed towards features (e.g. colour, orientation)
  - Object-based attention: attention directed towards objects (e.g. shapes).
- **Attention, eye movements and the brain**
  - Recording from visual neurons with target in receptive field (parietal lobe).
  - Attentional enhancement is greater in higher visual areas.
  - Attention, binding and the brain → Synchrony hypothesis: coherent visual perception requires synchronous activity in several brain areas.
- **Perception without attention:**
  - When can it occur? According to Li et al., 76% perceived animal within periphery, despite not attending to it.
  - There is convincing evidence for the phenomena of inattentional blindness and change blindness. Much change blindness occurs because there is a rapid overwriting of a previous visual representation by a current one. However, perhaps the single most important factor determining change blindness is whether the changed object was attended to prior to the change. There is often very good long-term visual memory for objects that have previously been fixated. Change blindness is also more likely when there is only a small change in the object and when the nature of the change is irrelevant to the individual's ongoing task.

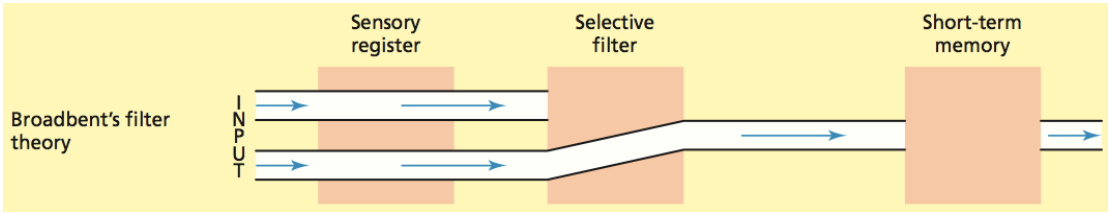
- **Attention and autism**
  - A major symptom of autism is withdrawal from contact with people.
  - People with autism can solve reasoning problems about social situations, but cannot function when placed in these situations.
  - As found in Klin et al., autistic observers look at socially irrelevant stimuli, thus, where autistic individuals pay attention in a social situation may lead to perceiving the world differently.

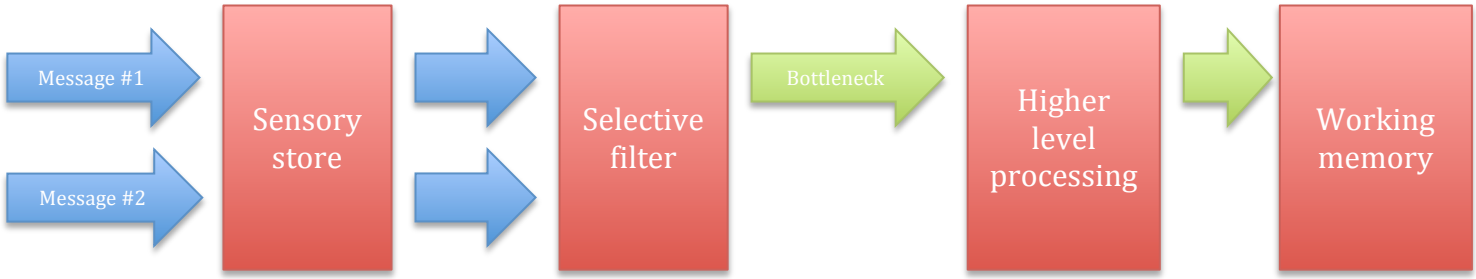
Compare and contrast the major theories of attention. What methods have been employed to test these theories? Critically analyse whether the findings support or refute the theoretical viewpoints (this involves an understanding of the logic of the experiments).

Focused (auditory) attention

Bottleneck theories of attention: all models assume transfer of information from sensory register to short-term memory store. They differ in *where* they regard the bottleneck is, and the *nature* of the bottleneck.

- Broadbent's filter model





Lets you notice physical characteristics, because the filter is located beyond the sensory store.

Unattended message is completely blocked off, filtered on the basis of their physical characteristics

Broadbent's filter model holds that both messages presented to the ears are processed in the sensory store, due to its large capacity. However, the sensory store only picks up distinct physical characteristics, such as tone and pitch (typically based on gender). From this point, the selective model drops the unattended messaged presented to one ear. This 'all-or-none' processing is where the bottleneck occurs, as only the attended message reaches higher level processing – this suits the working memory's limited capacity. Broadbent's filter model is consistent with the dichotic listening task as participants noticed when the voice in the unattended ear changed from a male's to a female's, suggesting that selectivity was based on sex of the speaker, due to the differences in their voices (males: deep tone, low pitch vs. females: soft tone, higher pitch). Additionally, this accounts for Cherry's 'cocktail party' theory, which claims that we can follow just one conversation, even when several people are talking, due to such physical characteristics of speech.