Attention I

Failures to Select Information

What is attention?

- How is the word used?

- Examples:
  - something bright caught my attention
  - I didn't see you, I was paying attention to the game
  - I struggled to pay attention to the lecture
  - I don't remember even cleaning the table, I must not have been paying attention

- Attention refers to many different kinds of mechanisms

Attention

- **Attention** enhances some information and inhibits other information.

- The **enhancement** enables us to select some information for further processing

- The **inhibition** enables us to set some information aside

Attention and limits on information

- We need attention to limit the amount of information that is processed

- Why are there limits on the amount of information we can process?
  - limited sensory systems

When perceiving a scene, can only get "pieces" of it at any instant; need to move eyes around to see scene

Need to move eyes around to see the worlds

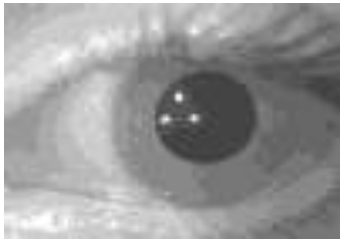
Eye movements make jumps called saccades

Eye tracking

- Eye-tracking studies can tell us which information is attended to
  - Our eyes are drawn both by top-down information (e.g. a goal to find specific information) as well as bottom-up information (e.g. a flashing light)

- Commercial intro on eye-tracking
  - **Fixations**: ~200-300ms; information is acquired
  - **Saccades**: extremely rapid movements between fixations

Eye tracking device



Eye movements during reading

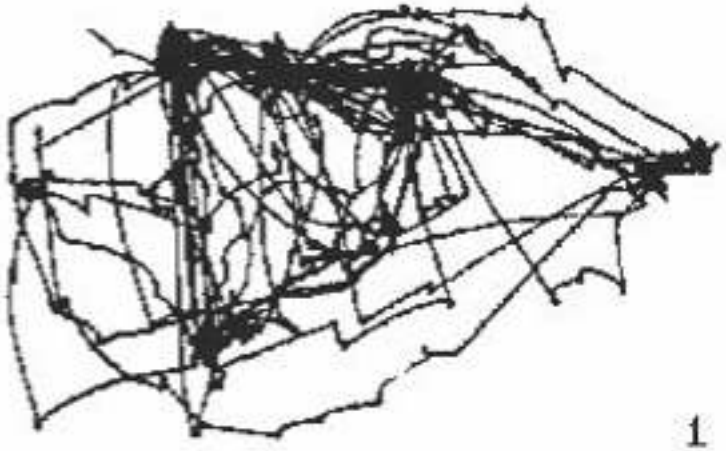
Eye tracking

Eye tracking and Visual Attention

- Subjects viewed ambiguous pictures that allowed two different interpretations A and B.
- They were asked to press and hold a particular button while perceiving interpretation A, and a different button for interpretation B.
- Afterwards, the fixations recorded during the perception of interpretations A and B were separated and separately visualized in the original image.

Eye tracking and Visual Attention

Painting by Giuseppe Arcimboldo. *Earth.* c.1570. Oil on wood. Private collection, Vienna, Austria.



1

Free examination.

How the task given to a person influences his or her eye movements.

3

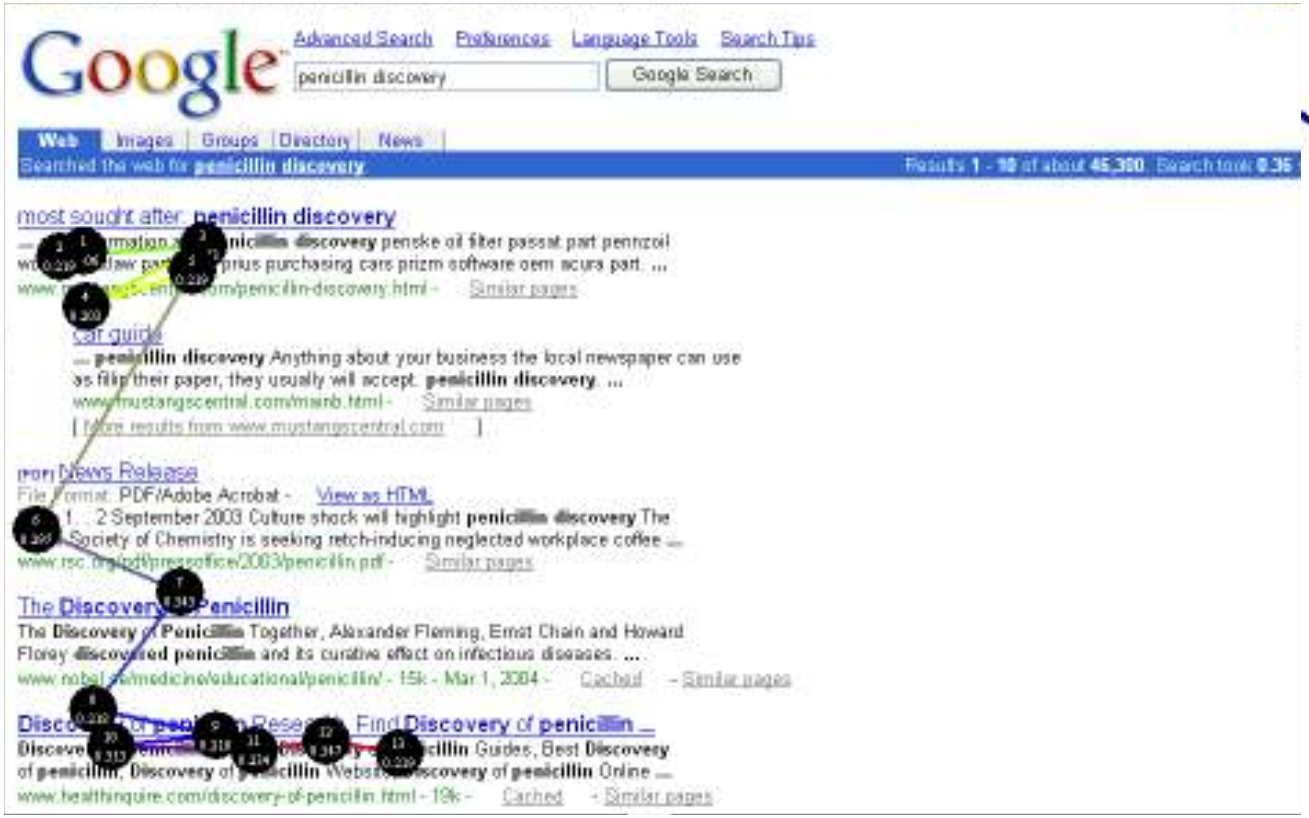
Give the ages of the people.

4

Surmise what the family had been doing before the arrival of the unexpected visitor.

[Yarbus 1967]

Improving layout with eye-tracking studies



David Hockney's photo collage might be a metaphor for the way we see scenes

1 photo = 1 gaze

Attention and limits on information

- Human information processing is massively parallel, up to a point where we have serial **bottlenecks**

- **Bottleneck**: a restriction on the amount of information that can be processed at once forcing serial processing

Serial bottlenecks:

limited sensory systems

limited effector （受动器；感受器） systems

movements must be planned sequentially

words can only be spoken sequentially

Inattentional Blindness

- After bottleneck, it is the allocation of our attention that determines what is analyzed.

- Often, we are unable to process information that is unattended. This can lead to inattentional blindness (非注意盲视) (related to change blindness) (变化盲视)

We often do not detect large changes to objects and scenes ('change blindness'). Furthermore, without attention, we may not even perceive objects ('inattentional blindness').

Do you notice the change?

Some of these demos are from: Simons & Levin, 1997, TINS, 1, 261-267

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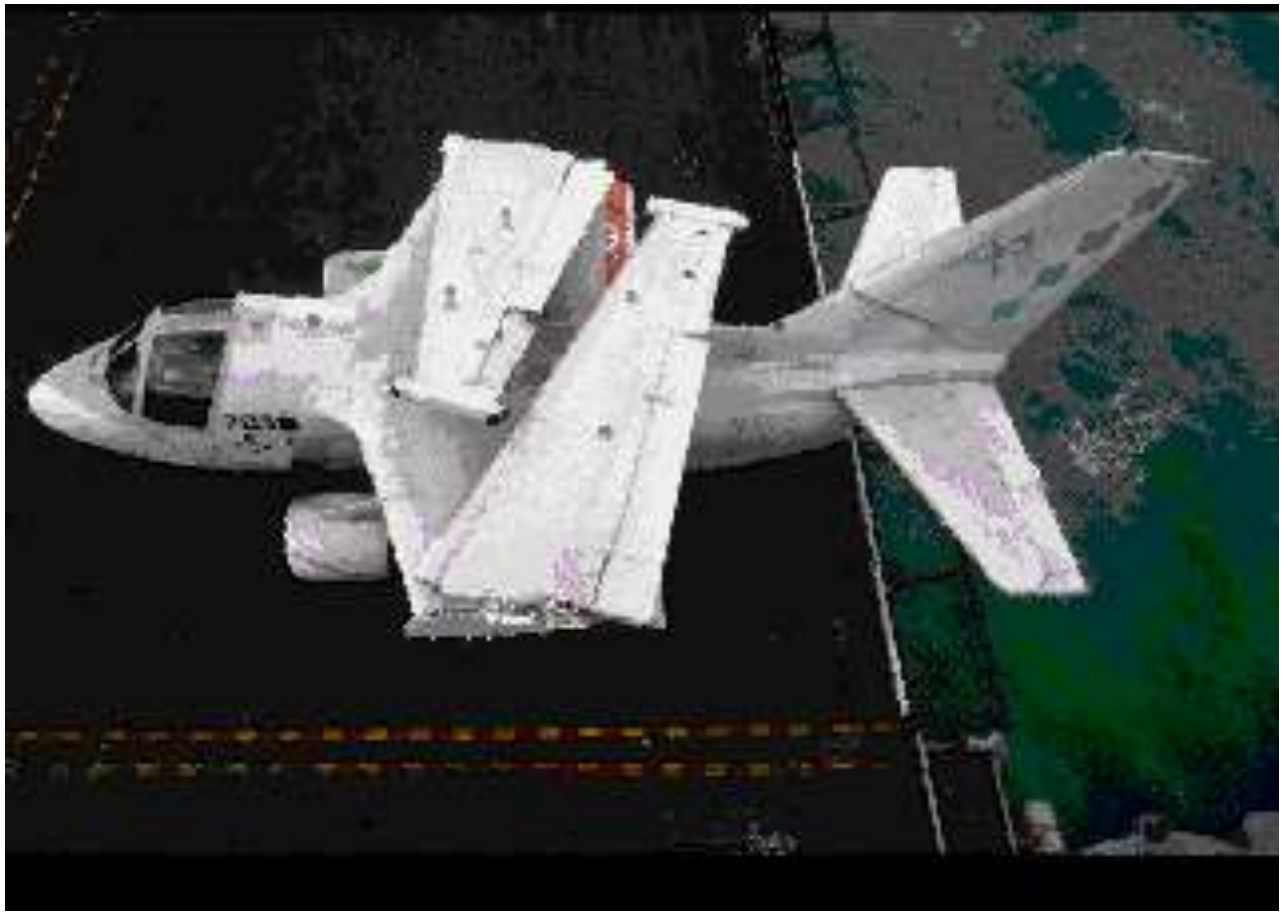

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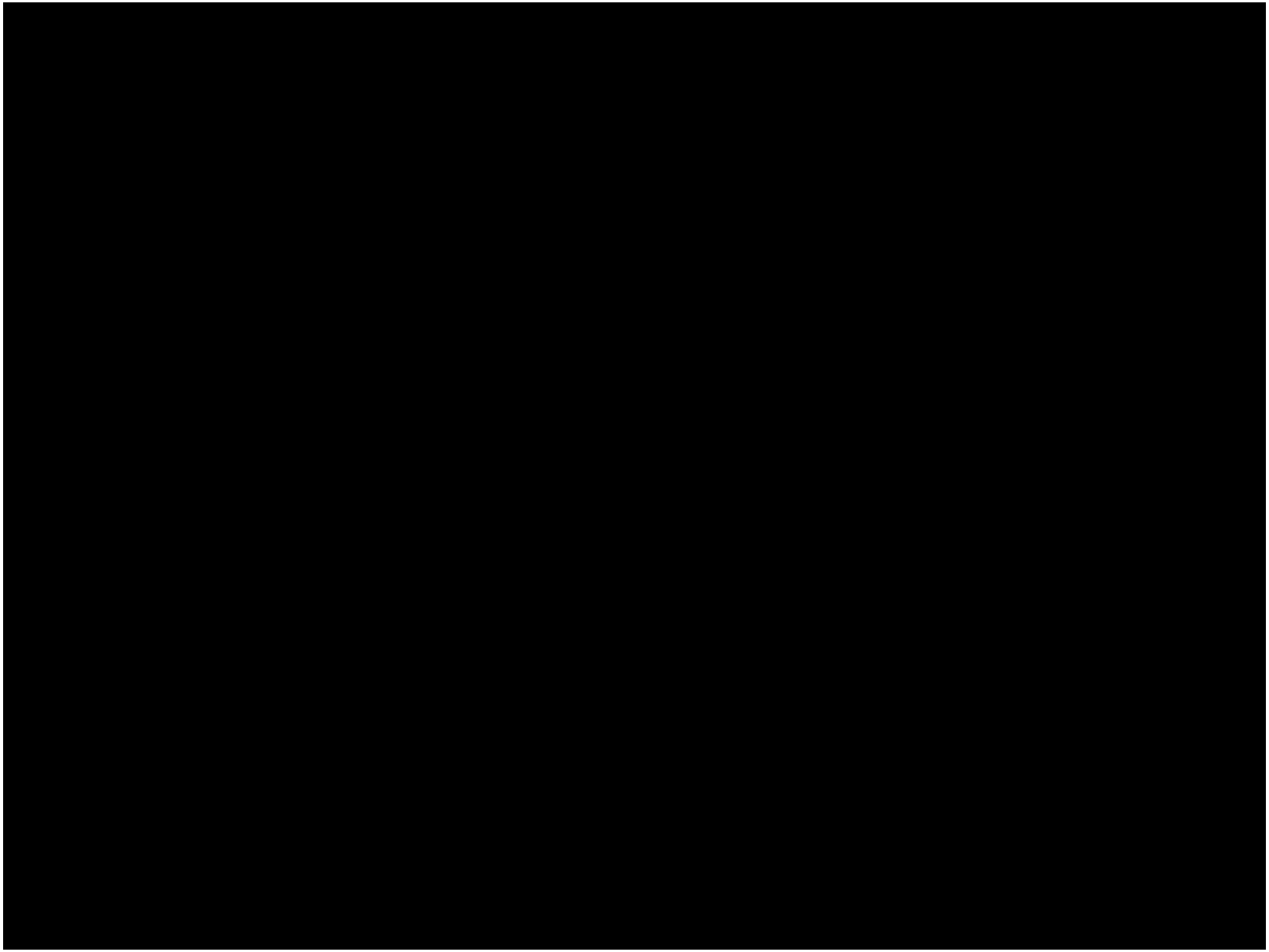
Inattentional Blindness

- Why is it hard to notice the change (initially)?
- When motion detection is disrupted, it is very difficult to observe changes to unattended image locations
- Brain makes reasonable assumption that things do not change unexpectedly (in the absence of motion cues)

Attention Test



(not) noticing person changes

During each conversation, two people carrying a door walked between the experimenter and the pedestrian. As they did, the experimenter switched places with a second experimenter who had been concealed behind the door as it was being carried. This second experimenter then continued the conversation with the pedestrian. Only half the pedestrians reported noticing the change of speaker—even when they were explicitly asked, “Did you notice that I am not the same person who first approached you to ask for directions?”

see also letter task: http://www.dualtask.org/

Inattentional Blindness

- Shows there are remarkable gaps in our perception
- Human's interpretation of the visual field is much sparser than the subjective experience of "seeing" suggests
- Only the parts of the environment that observers attend to and encode as interesting are available for making comparisons
- Our visual system might be overwhelmed without change blindness -- in a real-world setting with many moving objects, it might make sense to "track" only a few objects
- The visual world acts as an external memory (background)

Attention

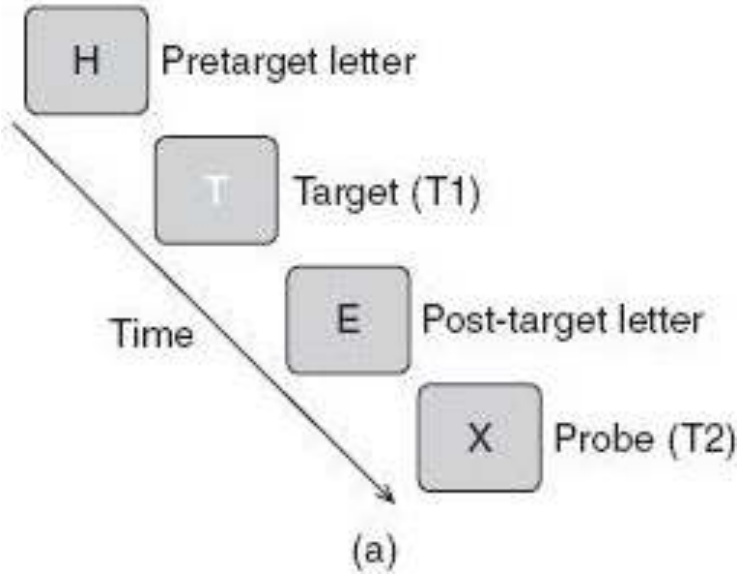

AAMC
KHAN
ACADEMY
A video in collaboration between the Association of American Medical Colleges and Khan Academy
www.khanacademy.org

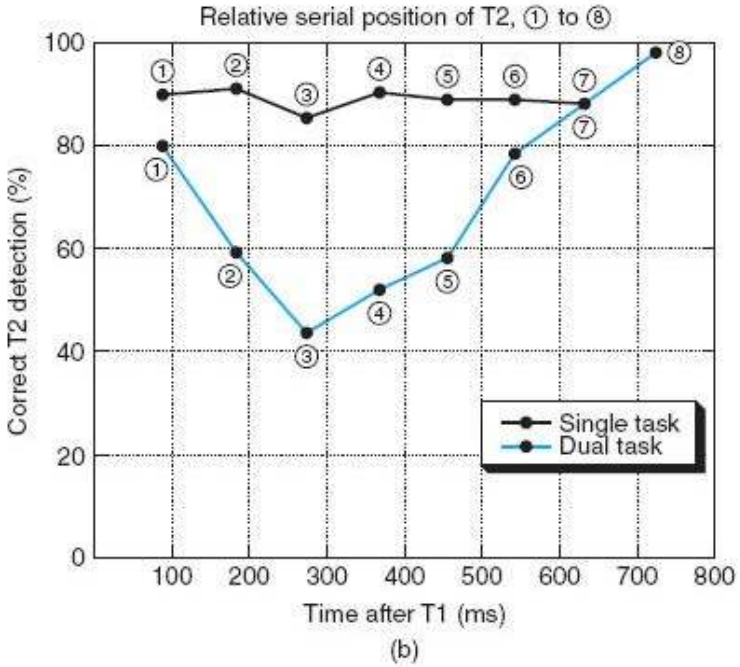
Failures of Selection in Time

- When new information (even if only a small amount) arrives in a rapid stream, spending time processing it will cause you to miss some other incoming information, resulting in what are called **failures of selection in time**

Attentional Blink

- One mechanism that may give rise to the attentional blink is that both targets (T1 and T2) can be processed in parallel if presented close enough together; otherwise serial processing takes over, which creates a temporary bottleneck for subsequent processing of T2 from visual short-term memory





Sources of Limitation

- The **attentional blink** is a short period during which incoming information is not registered, similar in effect to the physical blanking out of visual information during the blink of an eye

- Divided-attention studies demonstrate that performance is hampered when you have to attend to two separate sources of visual information or two separate visual events. In all these cases, the decrement in performance is referred to as **dual-task interference**