

# **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**

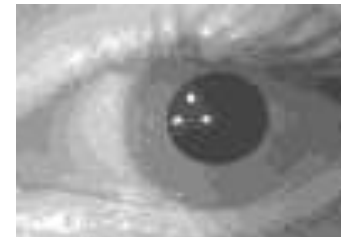


# Eye tracking

- 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.

# Improving layout with eye-tracking studies

The image shows a screenshot of a Google search results page for the query "penicillin discovery". The page includes the Google logo, search bar, and navigation links. The search results are listed below, with eye-tracking data overlaid as black circles and lines. The data points are numbered 1 through 13, showing the path of a user's gaze across the page. The path starts at the search bar (1), moves to the search results (2-4), then to the "most sought after" section (5-7), then to the "from News Release" section (8-10), then to "The Discovery of Penicillin" (11-12), and finally to the "Discovery of Penicillin" section (13). The eye-tracking data indicates that users spend significant time on the search results and the "Discovery of Penicillin" section.

Google [Advanced Search](#) [Preferences](#) [Language Tools](#) [Search Tips](#)  
penicillin discovery

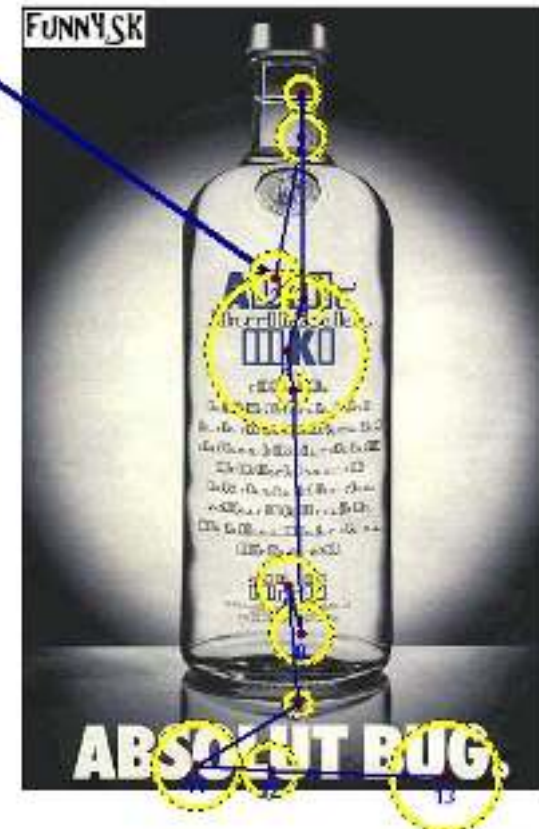
Web Images Groups Directory News  
Searched the web for **penicillin discovery**. Results 1 - 10 of about 45,300. Search took 0.36

most sought after: **penicillin discovery**  
1. [penicillin discovery](#) penske of filter passat part pentzoi  
www.0.220.04.com/penicillin-discovery.html - [Similar pages](#)  
2. [penicillin discovery](#) Anything about your business the local newspaper can use  
as fill their paper, they usually will accept. [penicillin discovery](#) ...  
www.mustangscenral.com/mianb.html - [Similar pages](#)  
[ [More results from www.mustangscenral.com](#) ]

from News Release  
File format: PDF/Adobe Acrobat - [View as HTML](#)  
3. 1. 2-September 2003 Culture shock will highlight [penicillin discovery](#) The  
Society of Chemistry is seeking retch-inducing neglected workplace coffee ...  
www.isc.org/nd/presoffice/2003/penicillin.pdf - [Similar pages](#)

**The Discovery of Penicillin**  
The Discovery of Penicillin Together, Alexander Fleming, Ernst Chain and Howard  
Florey discovered penicillin and its curative effect on infectious diseases. ...  
www.nobelprize.org/educational/penicillin/ - 15k - Mar 1, 2004 - [Cached](#) - [Similar pages](#)

**Discovery of Penicillin Research** Find Discovery of penicillin ...  
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# 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** (related to change blindness) (非注意盲视) (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?



# Do you notice the change?



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

# Do you notice the change?



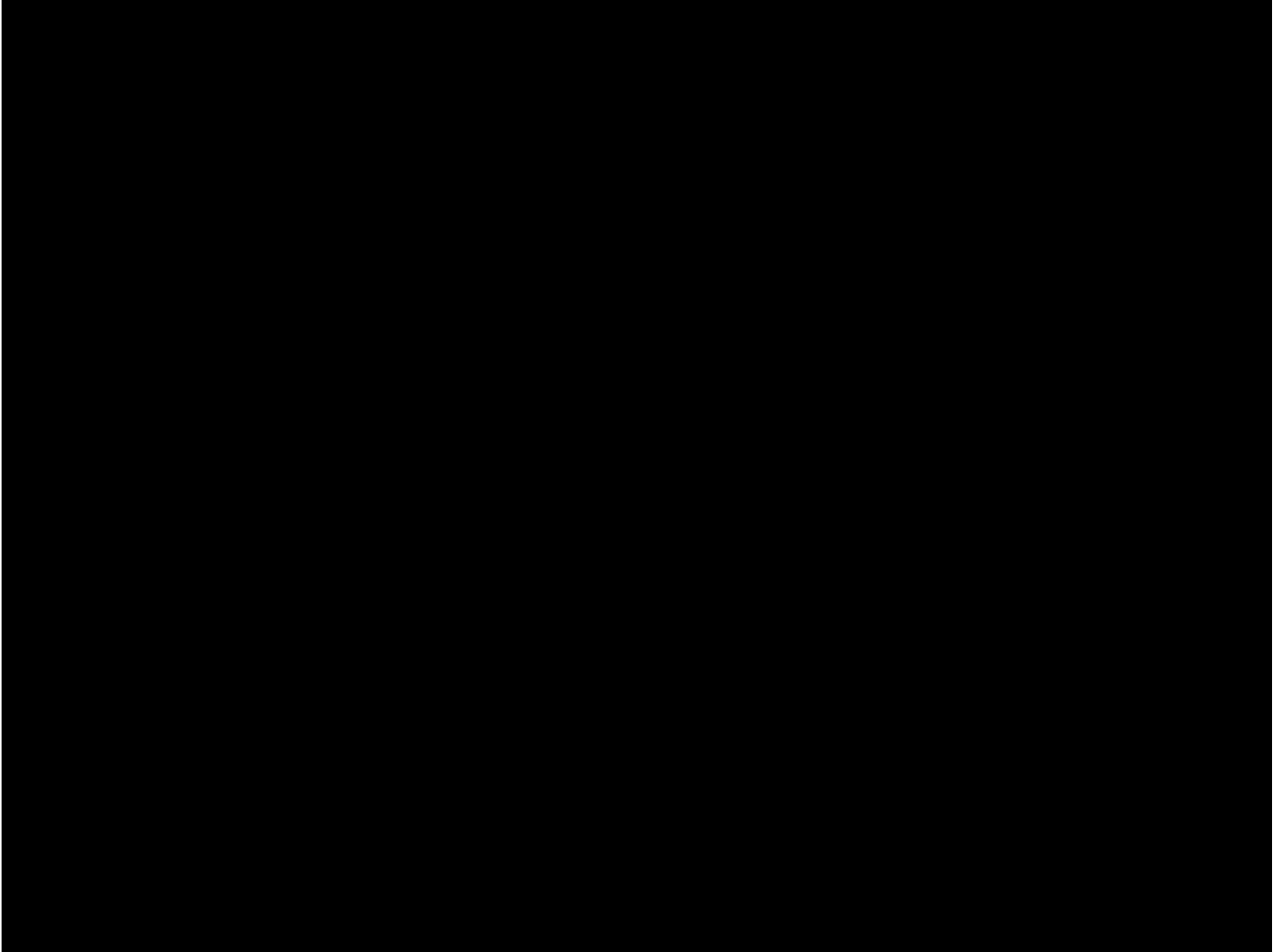
# Do you notice the change?



# 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?”



# 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



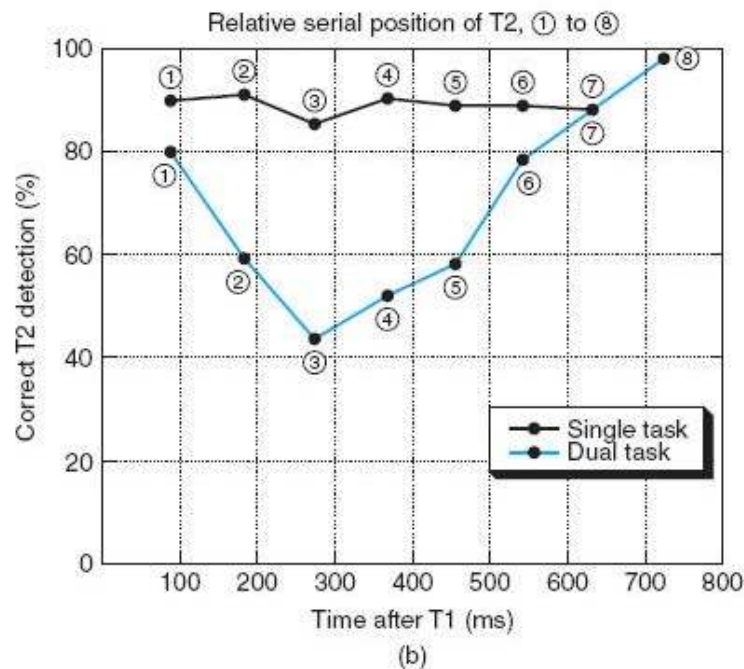
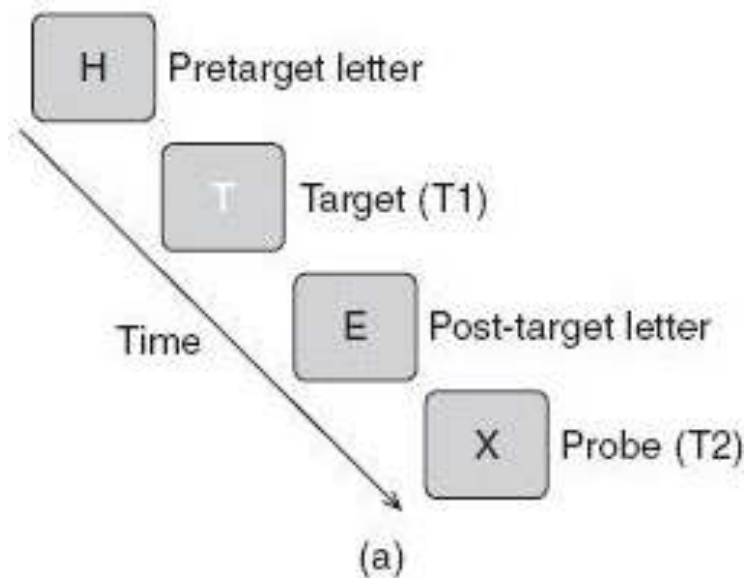
A video in collaboration between the Association of  
American Medical Colleges and Khan Academy

# 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**