Global Focus on Knowledge Lecture Series
“Challenging the Mind”
-The Cognitive Psychology of Attention -

Department of Psychology
Graduate School of Humanities and Sociology/
Faculty of Letters
The University of Tokyo

Kazuhiko Yokosawa

The figures, photos and moving images with ‡marks attached belong to their copyright holders. Reusing or reproducing them is prohibited unless permission is obtained directly from such copyright holders.

Introduction

- My name is Kazuhiko Yokosawa
- I am a Professor of Department of Psychology, Faculty of Letters
- I took up a post at the University of Tokyo on October 1,1998

Introduction

- My name is Kazuhiko Yokosawa.
- I am a Professor at the Department of Psychology, the Faculty of Letters.
- I took up a post at the University of Tokyo on October 1,1998.
- I have a PhD in Engineering.
- Before I joined the University of Tokyo, I was a Senior Research Scientist at NTT Basic Research Labs.

Introduction

- My name is Kazuhiko Yokosawa.
- I am a Professor in the Department of Psychology, the Faculty of Letters.
- I took up a post at the University of Tokyo on October 1,1998.
- I hold a PhD in Engineering (rather unique background).
- Before I joined the University of Tokyo, I was a Senior Research Scientist at NTT Basic Research Labs.
- I specialize in visual research – e.g., “attention” and “object recognition.”
- Lately, I have become interested in “multi-modal perception” and “visual-haptic interaction” as well.

Handouts

- The Asahi Shimbun- An interview

Characteristics of a Visual System

- Rapid and sophisticated information processing ability

Characteristics of a Visual System

- Rapid and sophisticated information processing ability.
- Slow and unreliable information processing ability.

Characteristics of a Visual System

- Rapid and sophisticated information processing ability.
- Slow and unreliable information processing ability.

Are these characteristics contradictory?

→ Both reflect an information processing process that centers on attention.

Cognitive Psychology of Attention

- This is a field of study examining the principles of human information processing.

What is Attention?

- Every one knows what attention is. It is the taking possession by the mind of one out of what seem several simultaneously possible objects or trains of thought.･･･It implies withdrawal from some things in order to deal effectively with others.

(The Principles of Psychology, 1890)

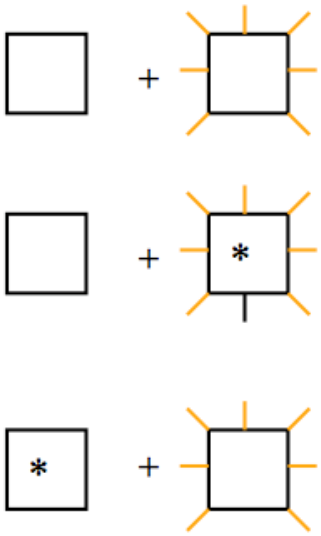
http://en.wikipedia.org/wiki/Image:Wm_james.jpg

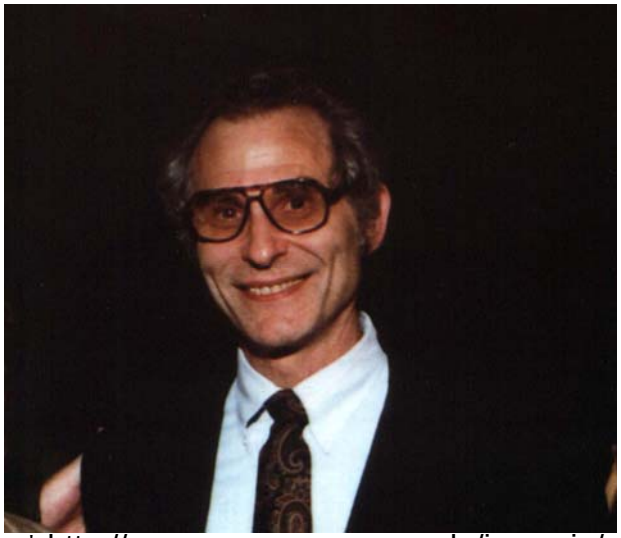
How to Confirm the Presence of Attention?

- Visual attention is not necessarily the same as fixing the gaze of the eye.
- When you look at me, this doesn’t necessarily mean that you are paying attention to me.
- Therefore, you can’t examine attention simply by measuring eye movement.

How to Confirm the Presence of Attention?

- Posner (1980)
  - A cue is given before a target is presented.



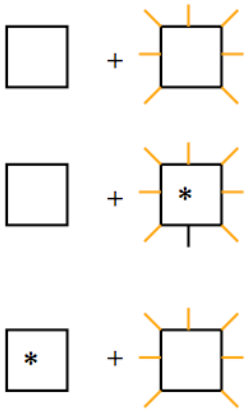


‡ http://www.neuro.uoregon.edu/ionmain/htdocs/faculty/posner.html☐

Posner & Raichle: Image of Mind, 1994

How to Confirm the Presence of Attention?

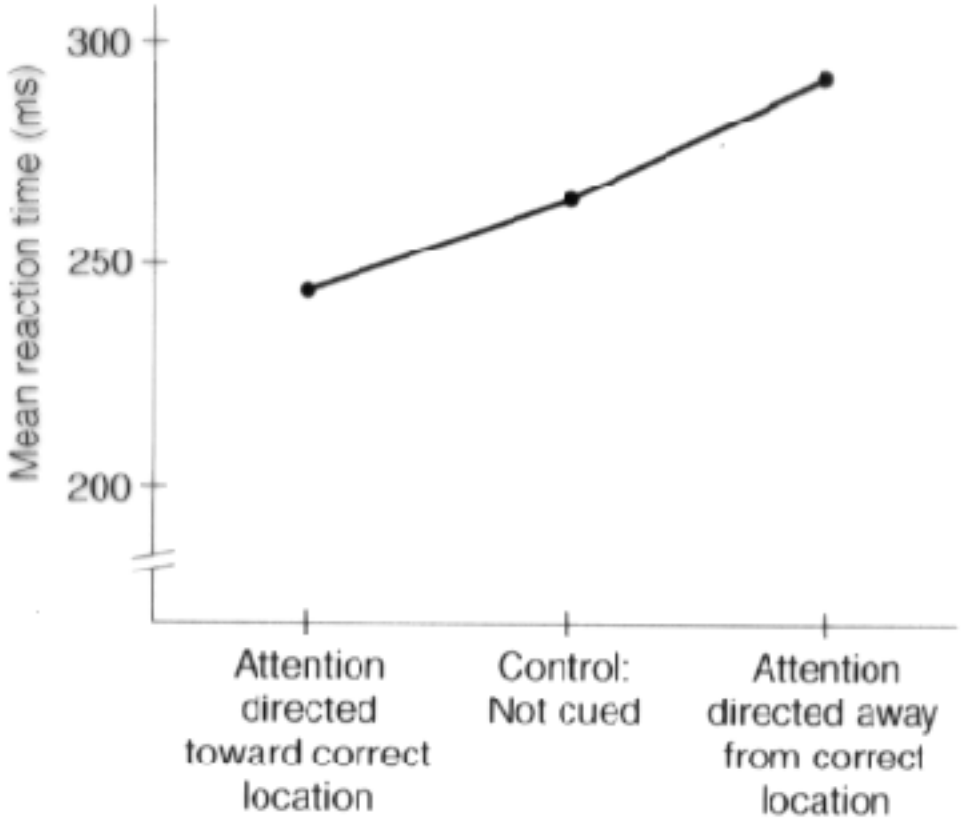
- Posner (1980)
  - A cue is given before a target is presented.
  - A target could be presented on the uncued side.



Posner & Raichle: Image of Mind, 1994

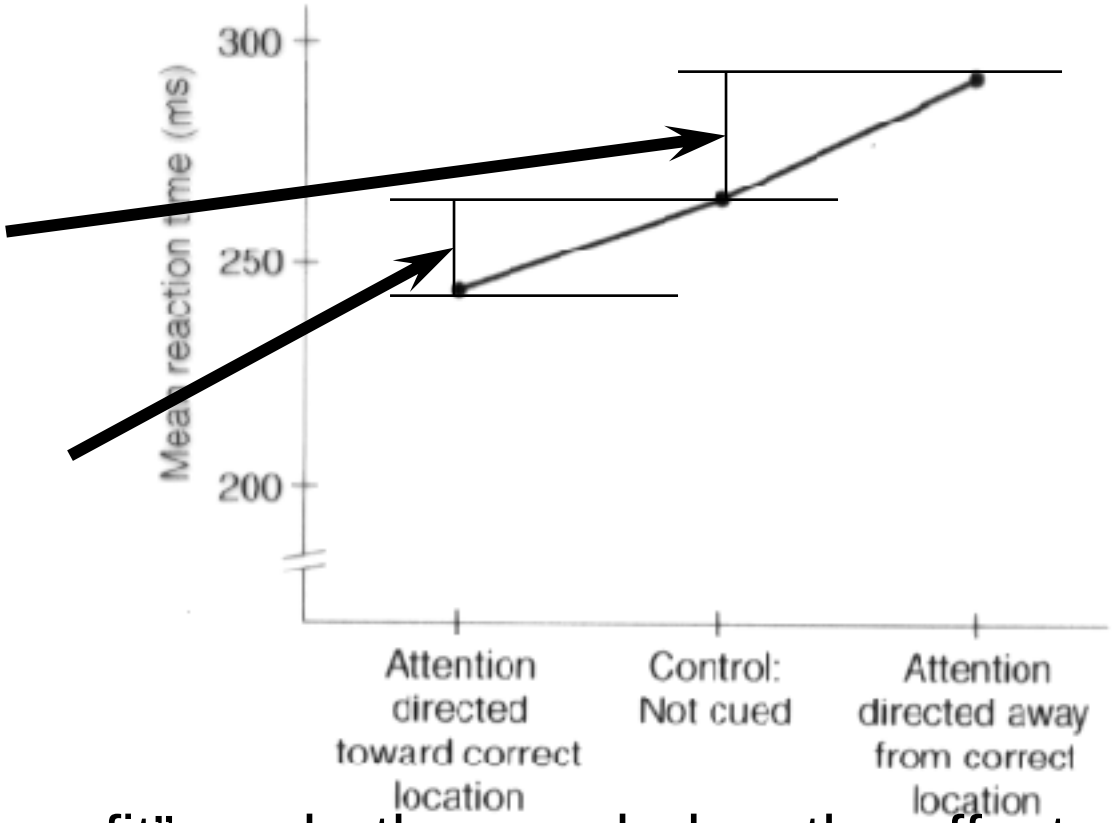
Cost-benefit Method

- Posner (1980)



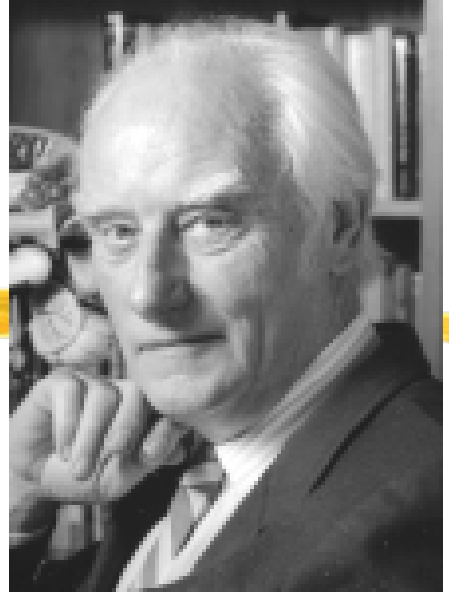
Cost-benefit Method

- Posner (1980)
  - Cost
  - Benefit



- "Cost" and "benefit" are both regarded as the effects of attention.

Crick's Hypothesis



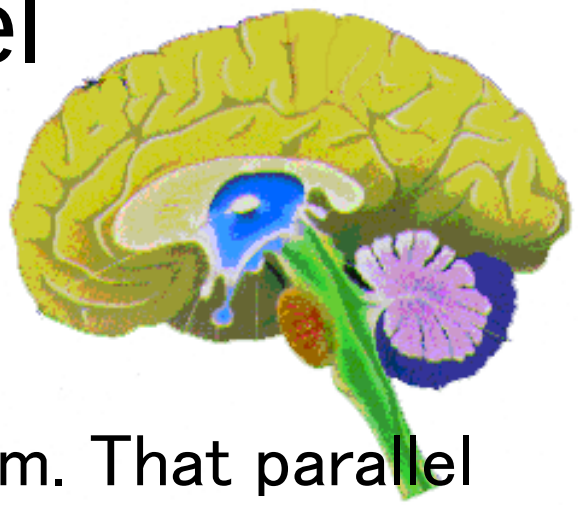
Francis Crick
(1916-2004)

‡
http://www.srl.cam.ac.uk/history/francis_crick.html

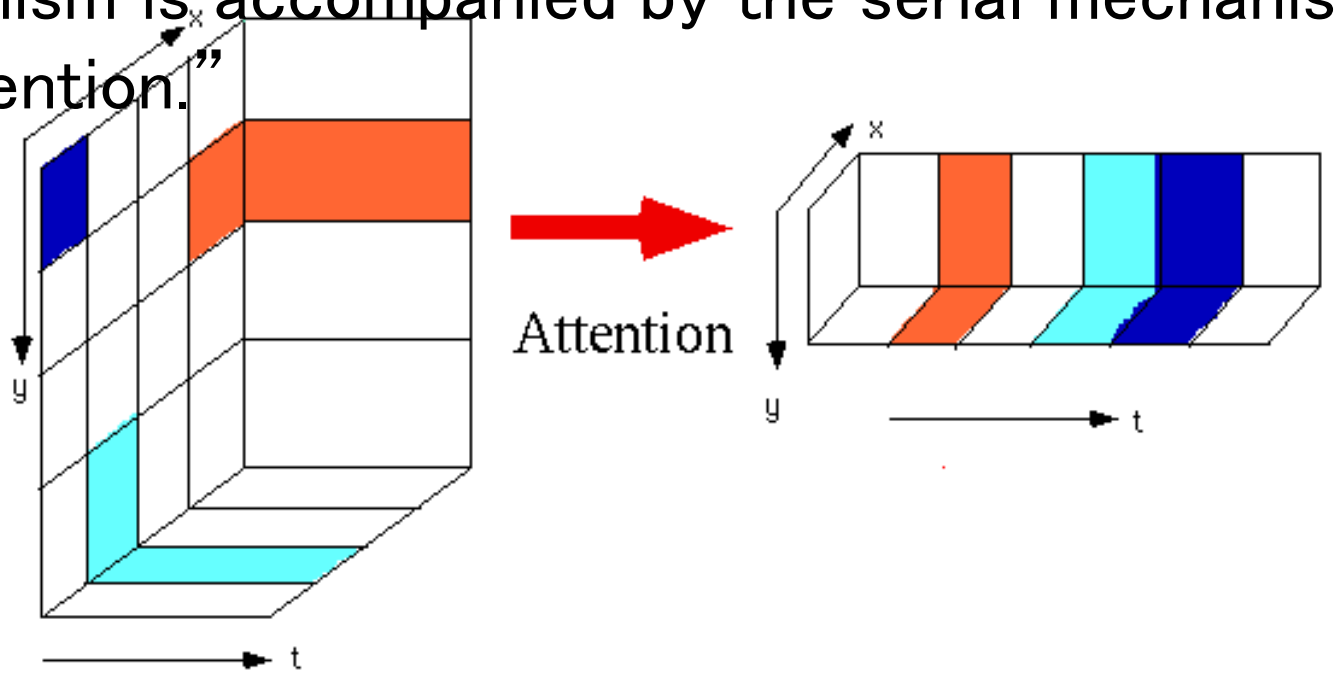
- Vision is a highly parallel system. That parallel mechanism is accompanied by the serial mechanism of "attention."

(Francis Crick: An Astonishing Hypothesis, 1994)

Vision is highly parallel



- Vision is a highly parallel system. That parallel mechanism is accompanied by the serial mechanism of “attention.”

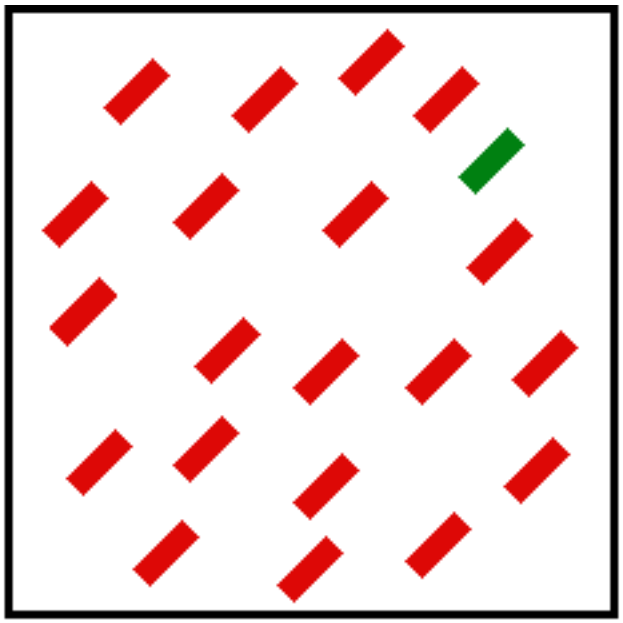


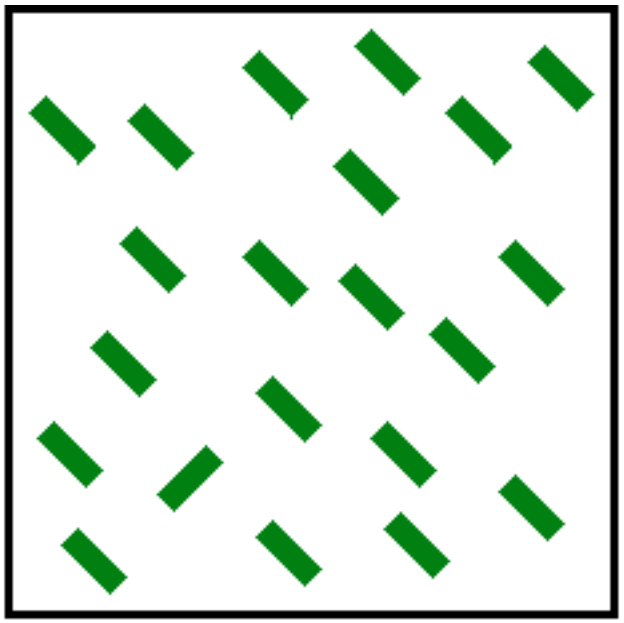
Visual Search

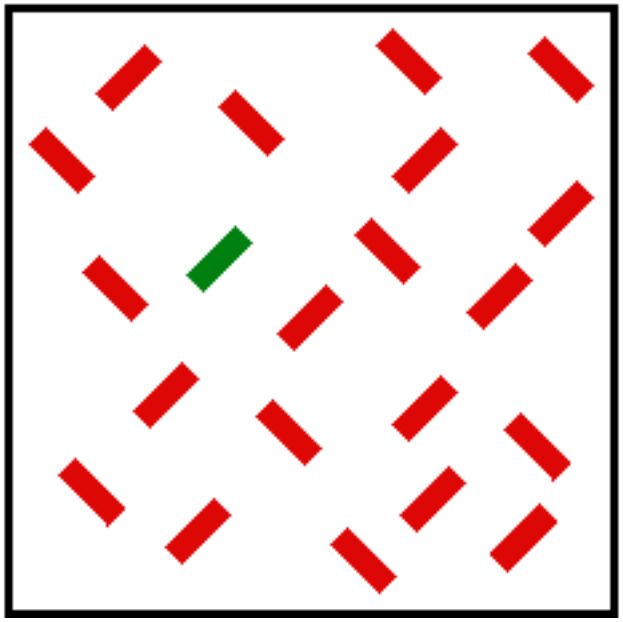
- This is a typical experimental paradigm in attention research.
- Why is it difficult to find Wally?

Where's Wally? By Martin Handford

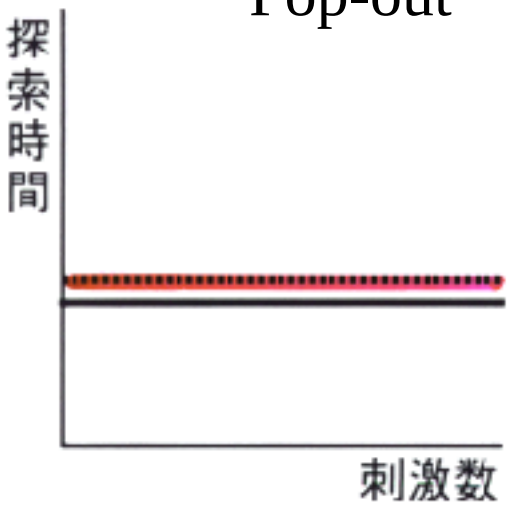
Figure removed due to copyright restrictions

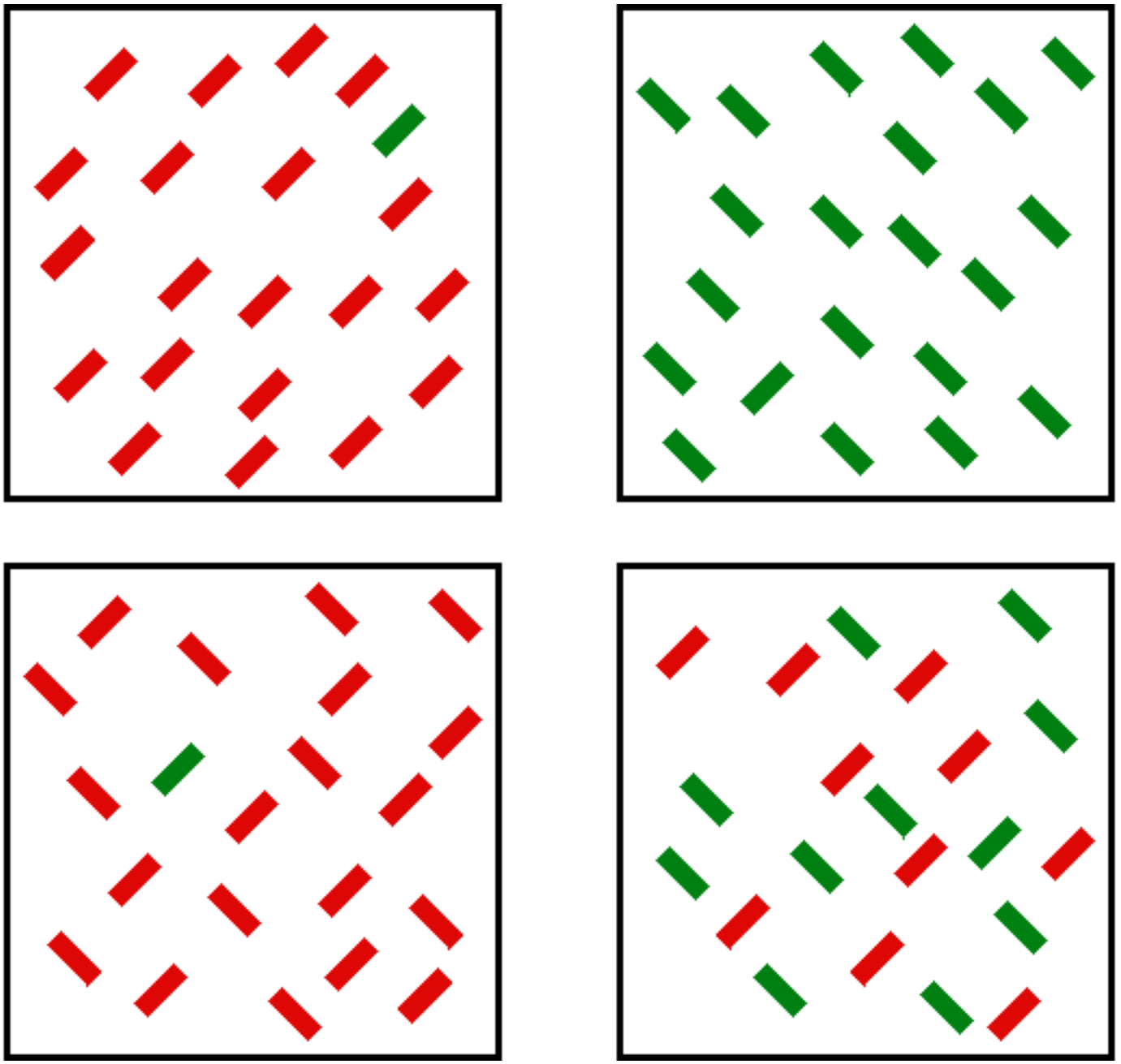


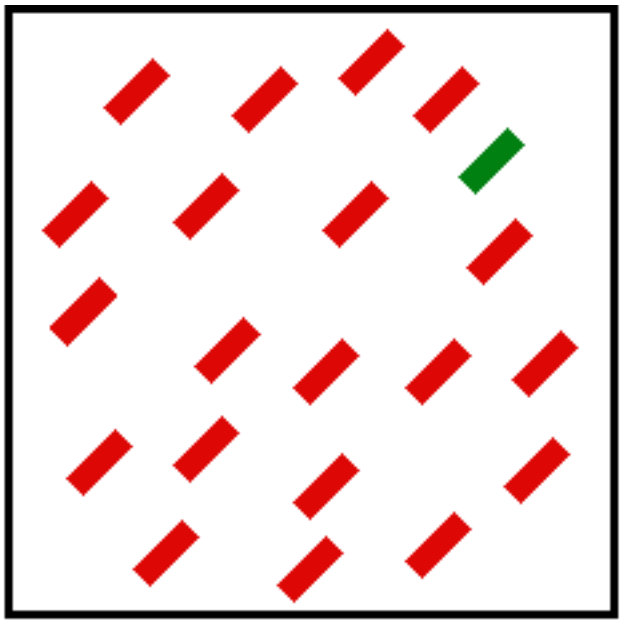


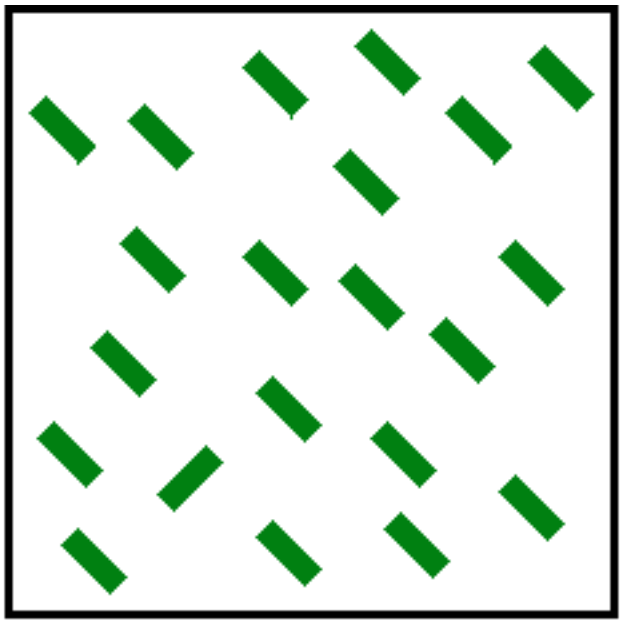


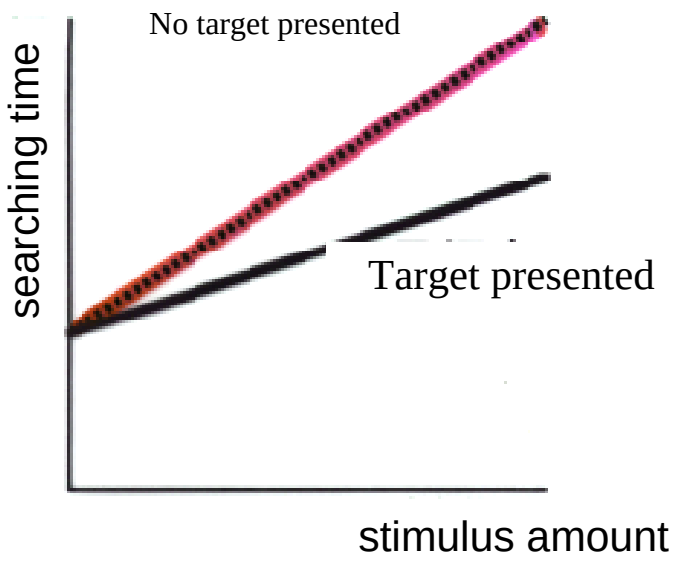
Pop-out

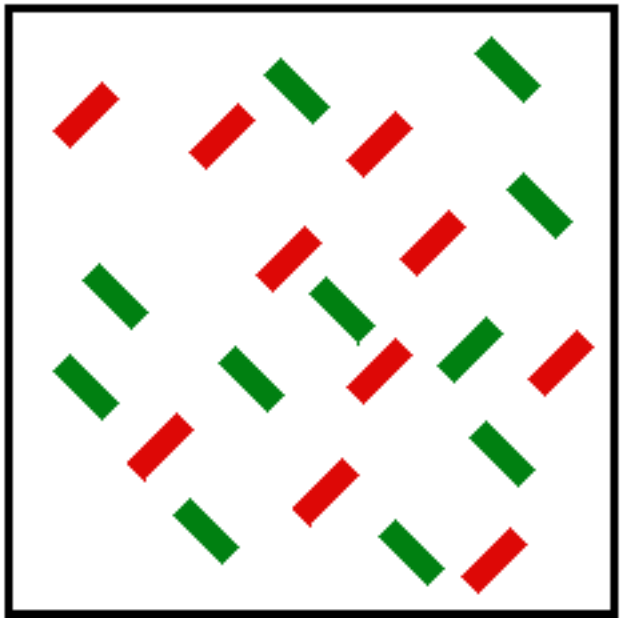




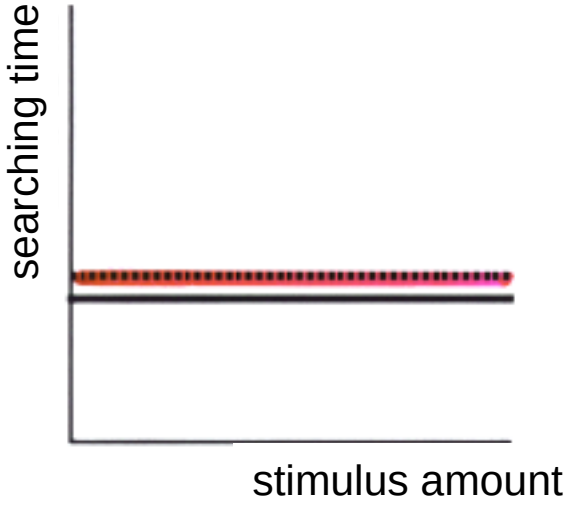


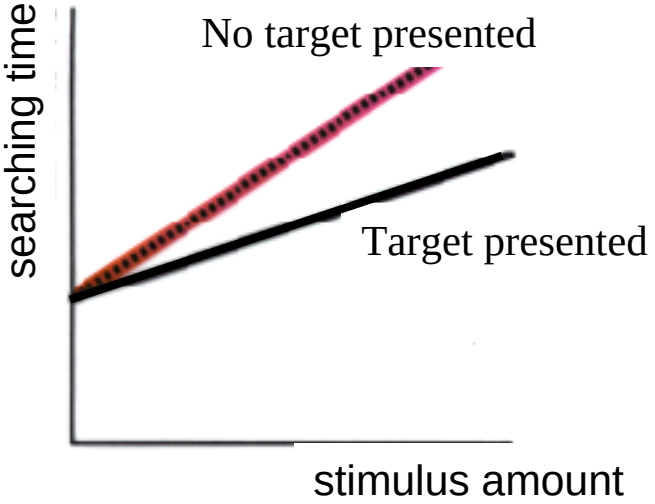



No target presented
searching time
Target presented
stimulus amount



Parallel Search and Serial Search





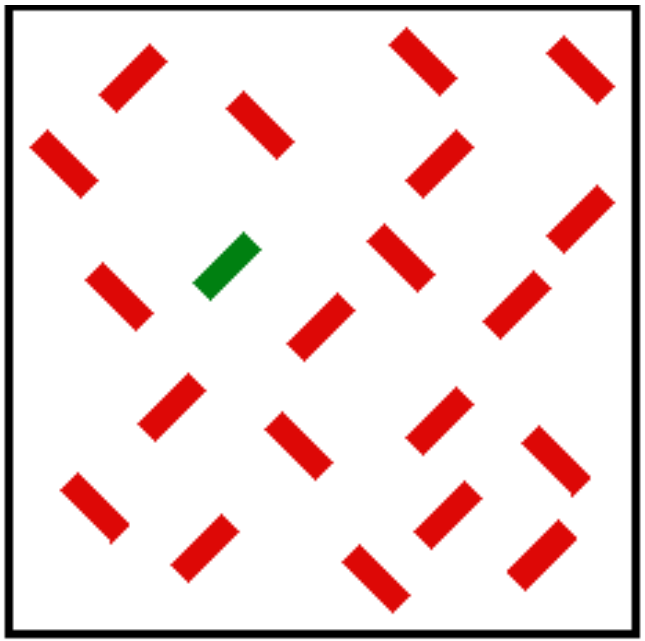
Cognitive Psychology of Attention

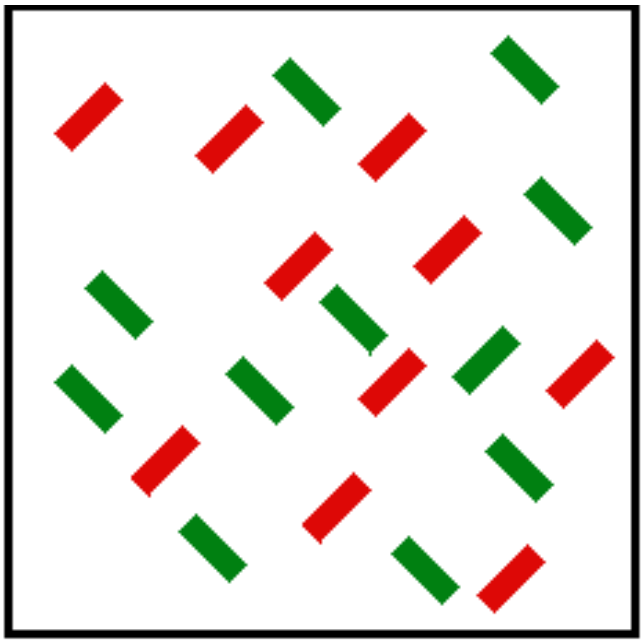
- This is a field of study examining the principles of human information processing.

- Attention is a great human ability; at the same time it also reflects the limits of human ability.

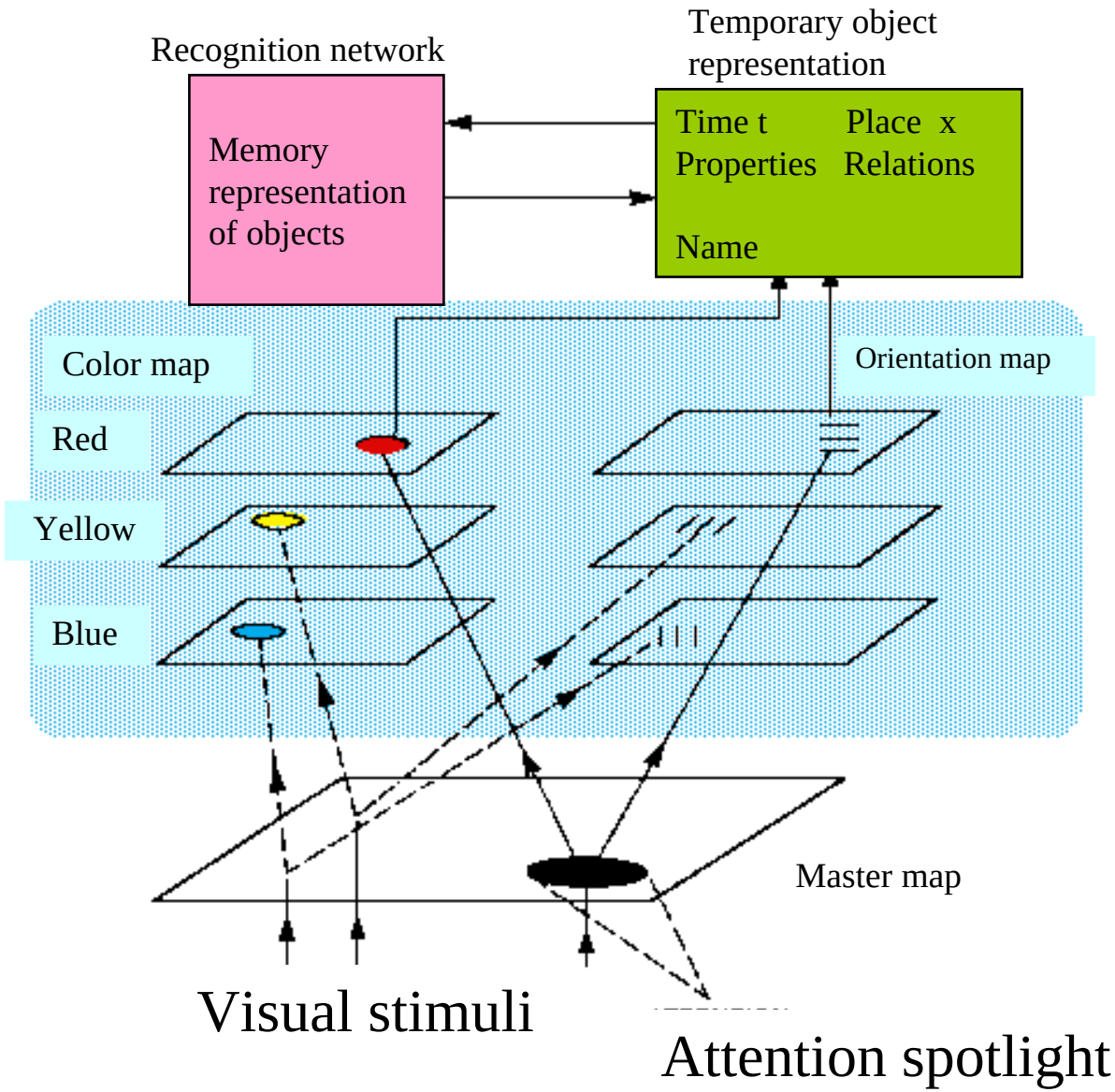
Feature Search and Conjunction Search

- Feature search：the search for targets defined by a single feature.
- Conjunction search：the search for targets defined by the conjunction of two or more features.





Feature integration theory:
A revised version of Treisman & Gelade's model (1980)



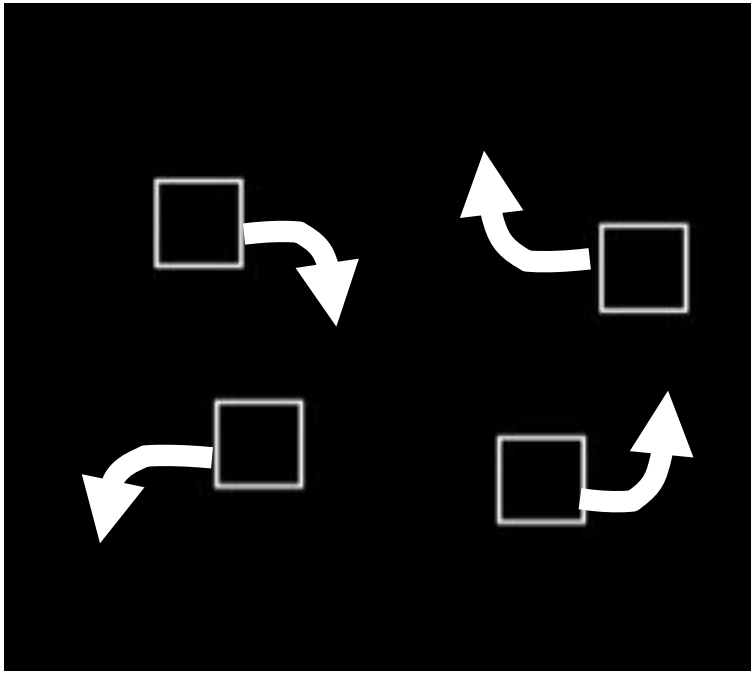
‡ http://weblamp.princeton.edu/~psych/psychology/research/treisman/index.php☐

Why is Attention Necessary?

- The bottleneck of information processing
  - Attention allows us to select necessary information and discard unnecessary information.
- Adaptation to circumstances
  - By emphasizing or amplifying information intentionally and consciously, attention helps turn information into memory or action.

Numerical Limit of Attention (Objects Tracked)

- Multiple Object Tracking
  - Subjects' task is to track the indicated target items among multiple (8~10) items.
  - All items move randomly for about 10 seconds.



Numerical Limit of Attention (Objects Tracked)

- Multiple Object Tracking
  - Subjects' task is to track the indicated targeted items among multiple (8~10) items.
  - All items move randomly for about 10 seconds.
  - Subjects are able to track up to five items with 85% accuracy.

Target Merging
(Scholl, Pylyshyn, & Feldman, 2001)

- Target merging makes the tracking task more difficult.
  - Two items are merged into a single object.
  - It is difficult to attend to part of an object.
  - Object-based visual processing is suggested.

- There is no point in arguing simply about a numerical limit to attention.

Change Blindness

- This is the phenomenon whereby a person viewing a visual scene fails to detect physical changes in a scene which seem to be visually recognizable enough, or an observer performs so poorly in detecting change that even he/she is surprised.

The Flicker Method

- Two images are alternately displayed.
- There is only one difference between the two images.

The Cut Method

- This time, you are asked to watch a video.
- In the same way as in the previous problem, you are asked to detect changes.

The Cut Method

- Again, you are asked to watch a video.
- In the same way as in the previous problem, you are asked to detect changes.

Change Blindness

- This is the phenomenon whereby a person viewing a visual scene fails to detect physical changes in the scene which seem to be visually recognizable enough, or an observer performs so poorly in detecting change that the observer him/herself is surprised.
- Observers rarely notice the discontinuity in a dialog just by looking at the scene once.
- Even when a change is made to the central actor in a scene, two-thirds of the observers don't notice it.

→ We are not able to detect change as efficiently as we think.

Change Blindness

- This is the phenomenon whereby a person viewing a visual scene fails to detect physical changes in the scene which seem to be visually recognizable enough, or an observer performs so poorly in detecting changes that the observer him/herself is surprised.
- Observers rarely notice the discontinuity in a dialog just by looking at the scene once.
- Even when a change is made to the central actor in a scene, two-thirds of the observers don't notice it.

- Experiential knowledge of filmmakers

  Movies are not necessarily shot in sequence; therefore small discrepancies in their details are common. Viewers, however, rarely notice them.

Figure removed due to
copyright restrictions

http://www.moviemistakes.com/

Change Blindness and Scene Context

Yokosawa & Mitsumatu (2003, Journal of Vision)

The effects of scene context on change detection

→ Comparing a meaningful scene and a meaningless scene.

The Scene Jumbling Experiment

K. Yokosawa & H. Mitsumatsu (2003). Does disruption of a scene impair change detection? Journal of Vision, 3, 1, 41-48.

Normal
（Meaningful）

Jumble 6
（Meaningless）

Jumble 24
（Meaningless）

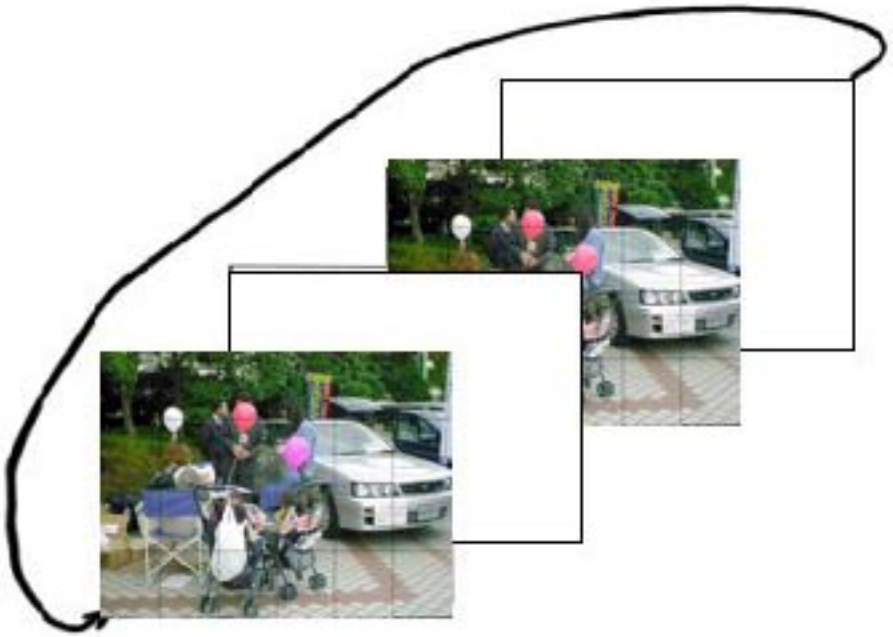
Types of change: color change, positional change, absence of objects

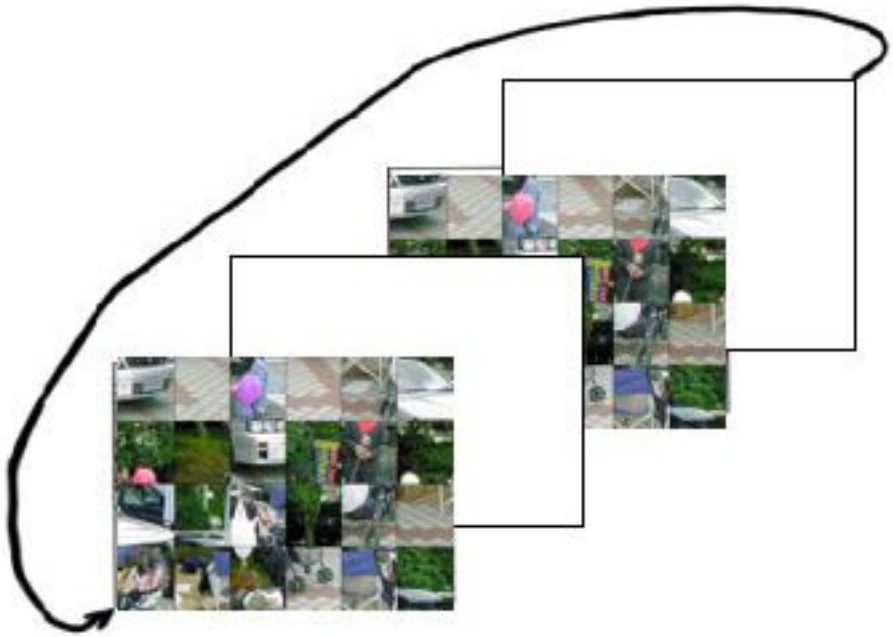
Change Blindness and Scene Context

Yokosawa & Mitsumatu (2003, Journal of Vision)

The effects of scene context on change detection

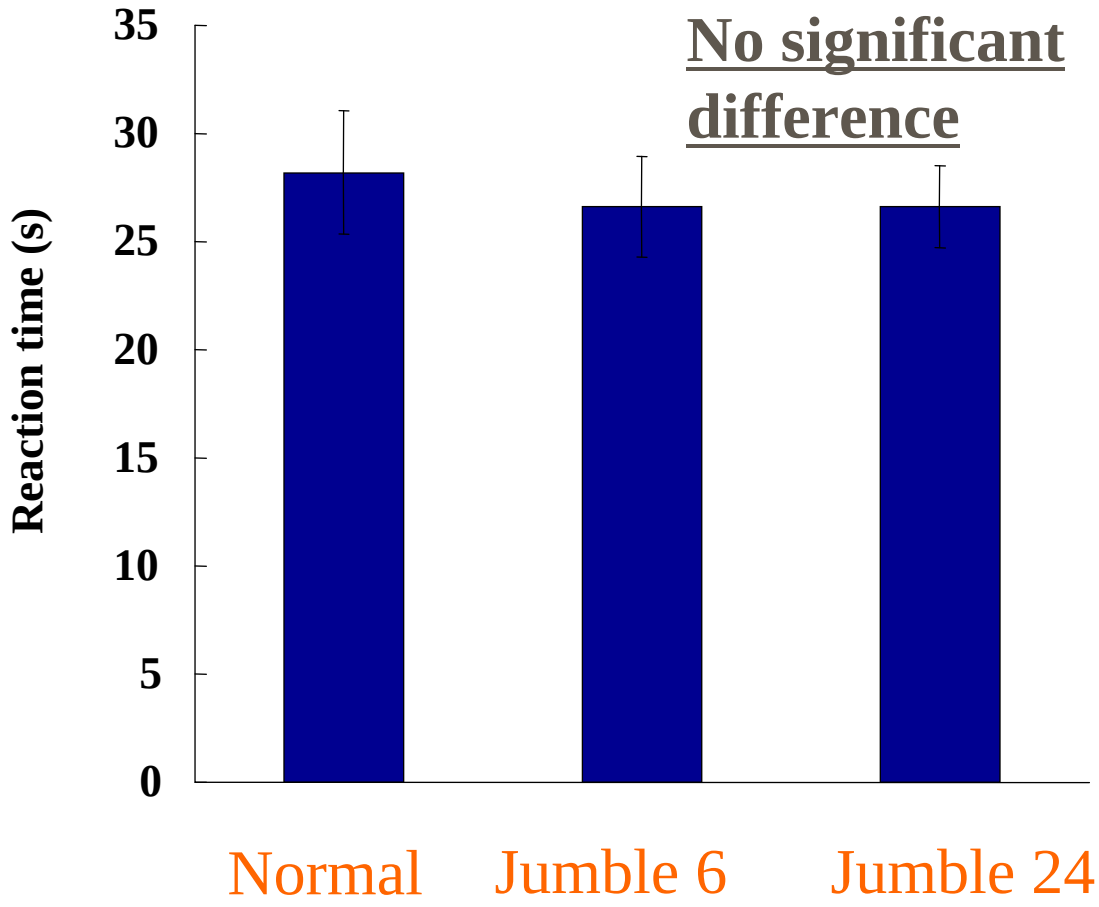
→ Comparing a meaningful scene and a meaningless scene.





Results of the Scene Jumbling Experiment

Yokosawa & Mitsumatu (2003, Journal of Vision)



The Partial Elimination Experiment

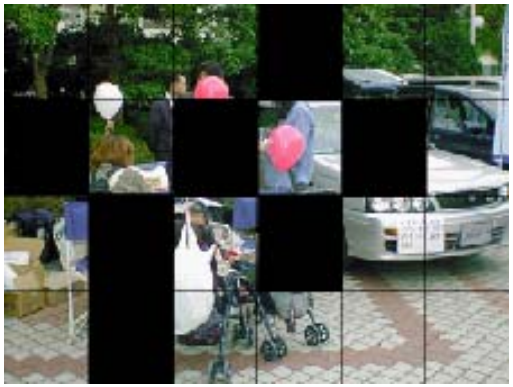
Normal condition

Number of sections displayed

3

10

17



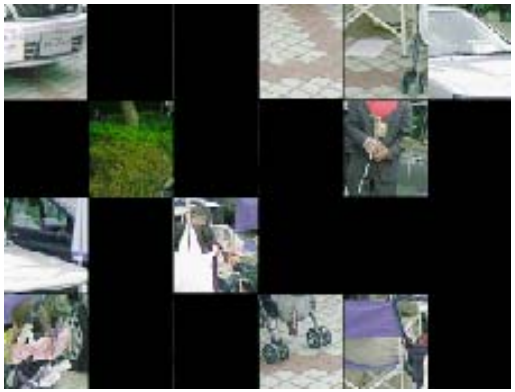
24

The Partial Elimination Experiment

Jumble condition

3

10



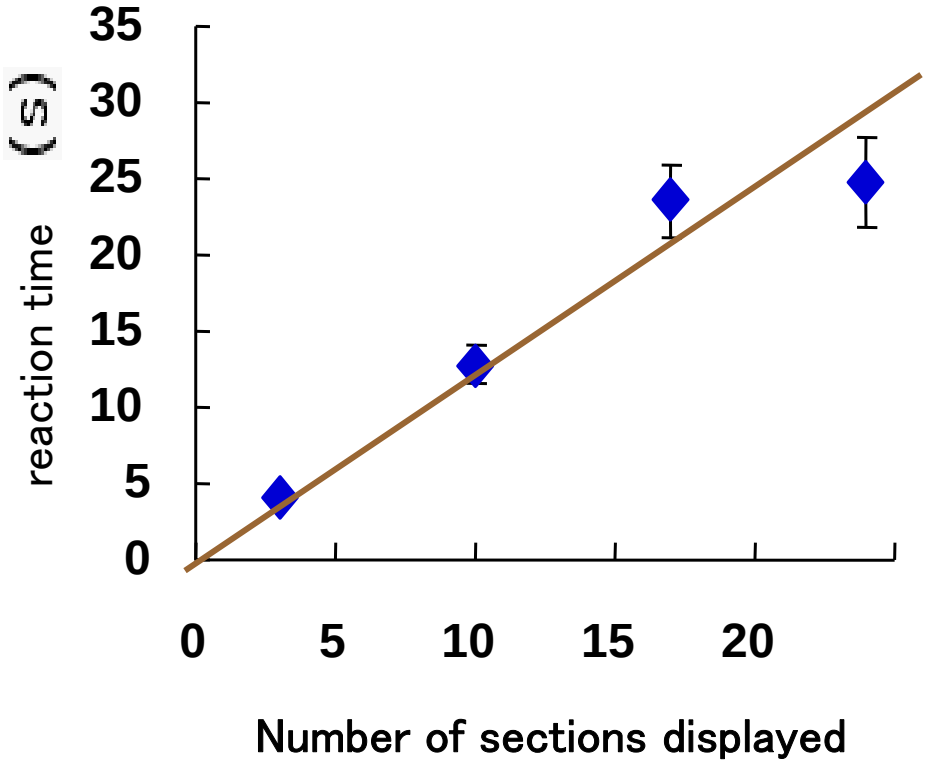
17

24

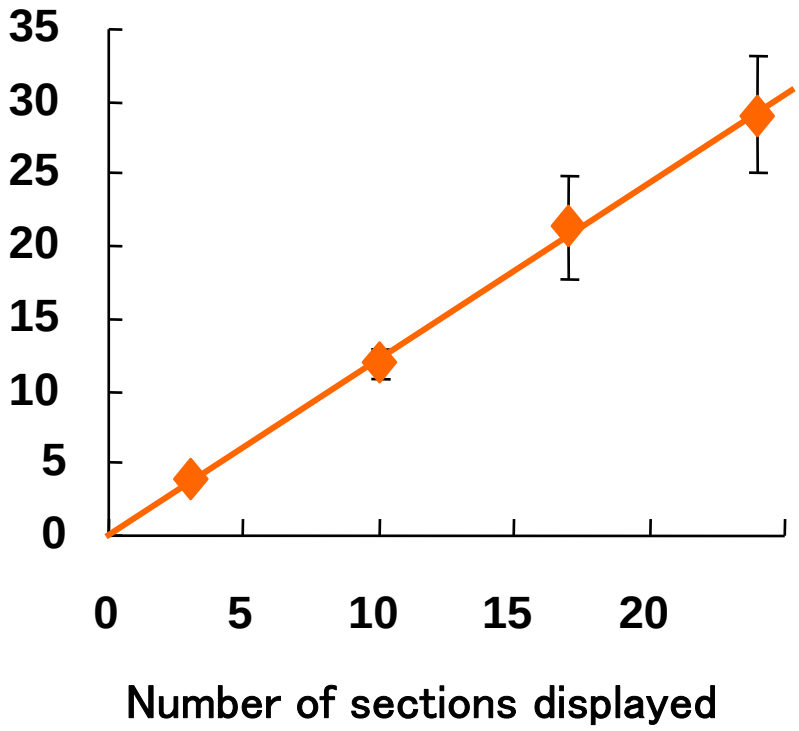
The Results of the Partial Elimination Experiment

Yokosawa & Mitsumatu (2003, Journal of Vision)

Normal conditions



Jumbled conditions

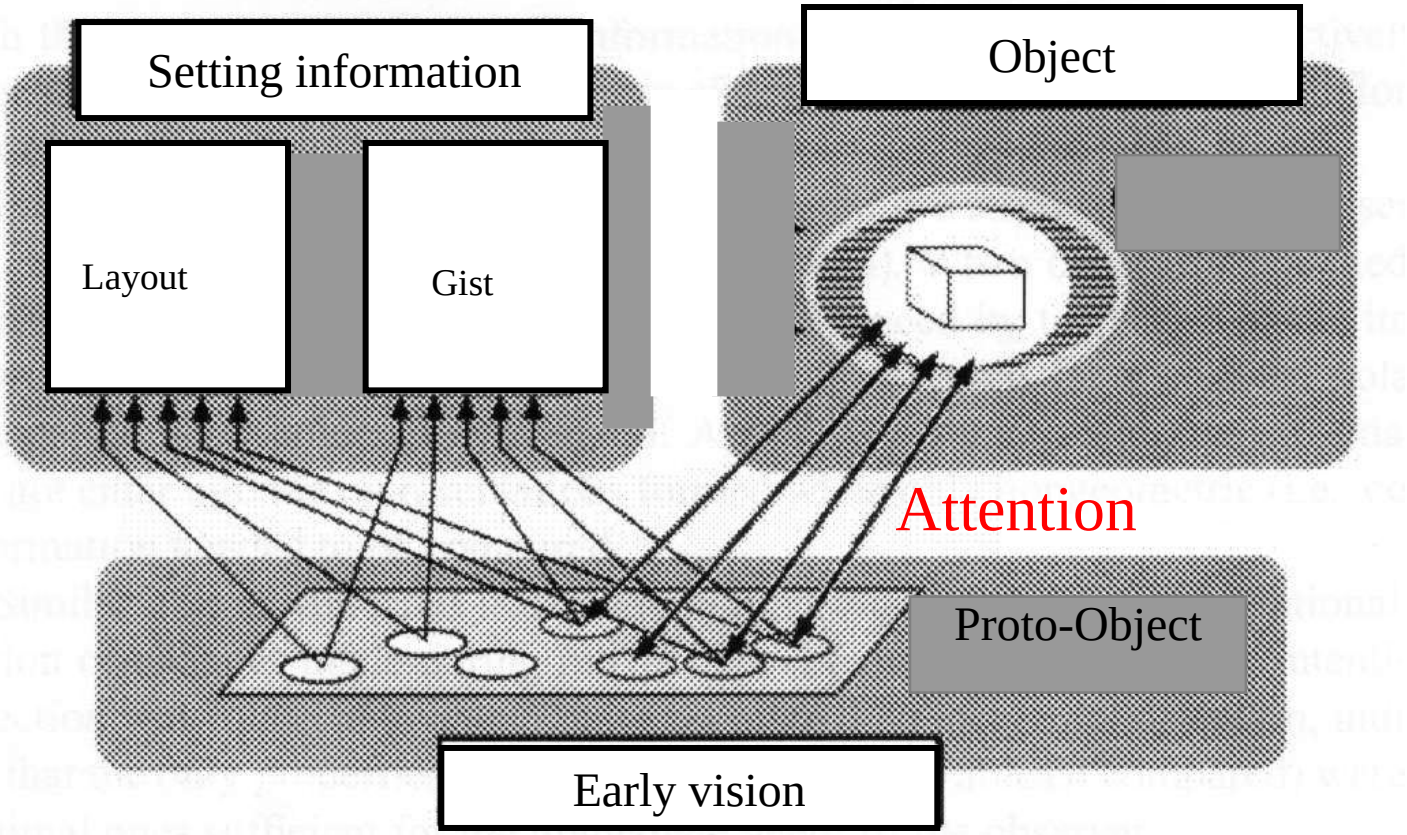


Characteristics of a Visual System

- Rapid and sophisticated information processing ability
  - Recognition through rapid serial visual presentation (RSVP), pop-out
- Slow and unreliable information processing ability
  - Change blindness, serial search

→ Both reflect an information processing process that centers on attention.

Triadic Architecture : A revised version of Rensink's model (2002, Ann. Rev. Psychol)



- Layout: The spatial arrangement of objects in the scene
- Gist: The abstract meaning of the scene

Cognitive Psychology of Attention

- This is a field of study examining principles of human information processing.
- Attention is a great human ability; at the same time it also reflects the limits of human ability.
- Surprisingly, we don’t know much about attention.
- It is a very important study area in the field of cognitive psychology.

Mini Report

- Write freely about the significance and importance of attention.