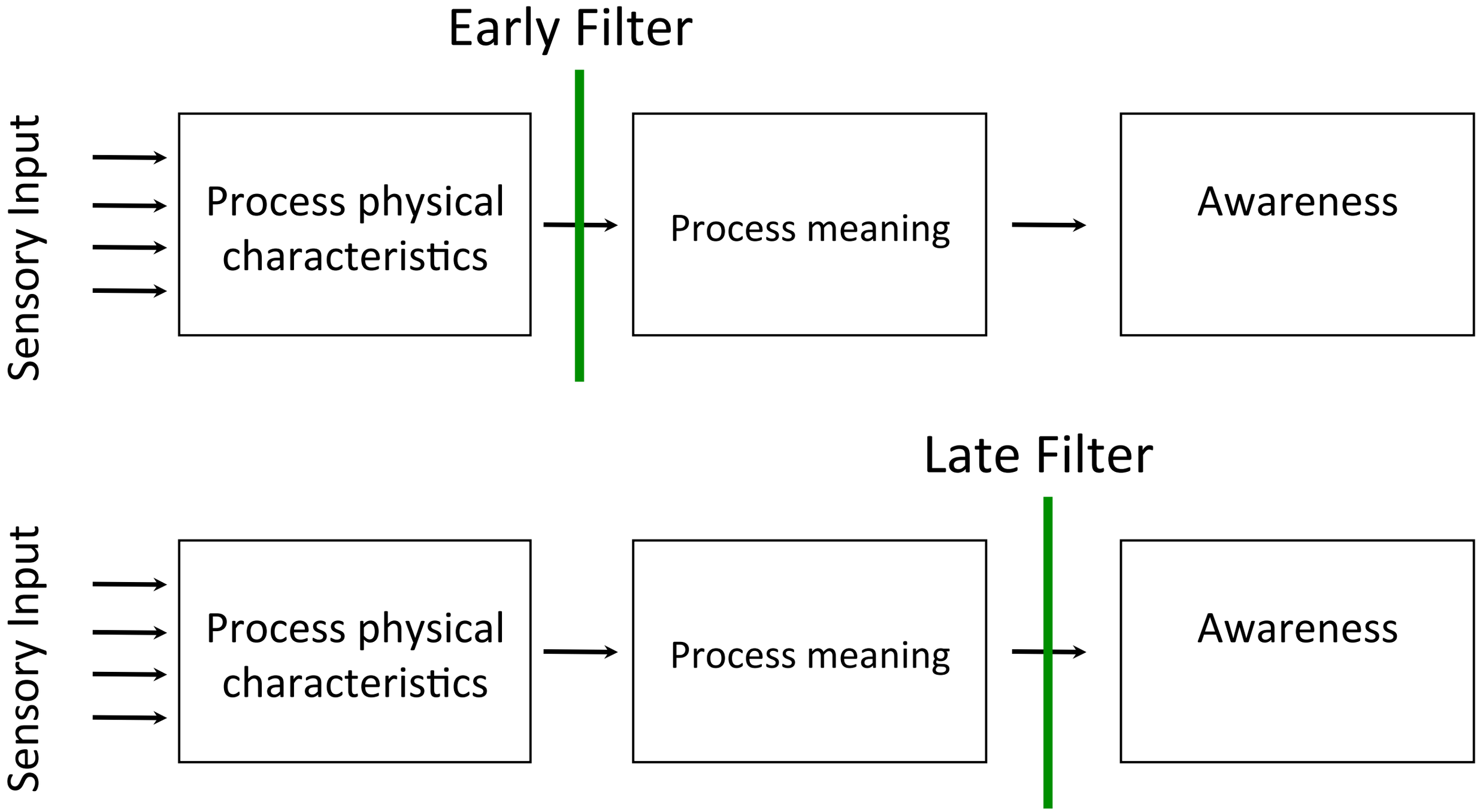
# Comments

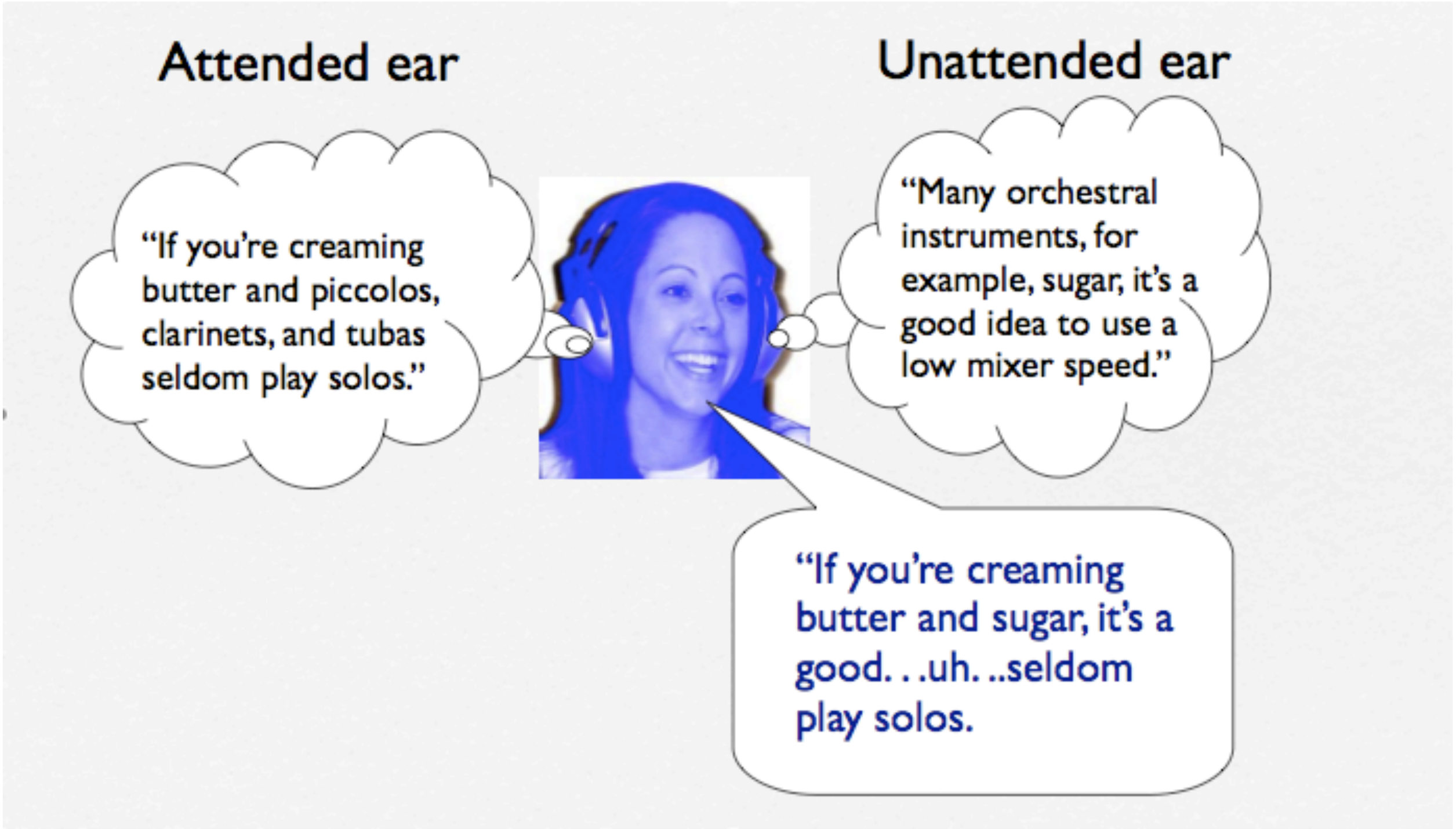
1. Early/late selection on the attended and unattended ear
2. Feature integration theory
3. Neglect
    - Forms of neglect
    - Vision's role in neglect
4. Visual perceptual learning (VPL)
    - Go over VPL
    - Neural changes associated with VPL

# Early vs. Late Selection



# Early Selection

# Late Selection



# Visual Search

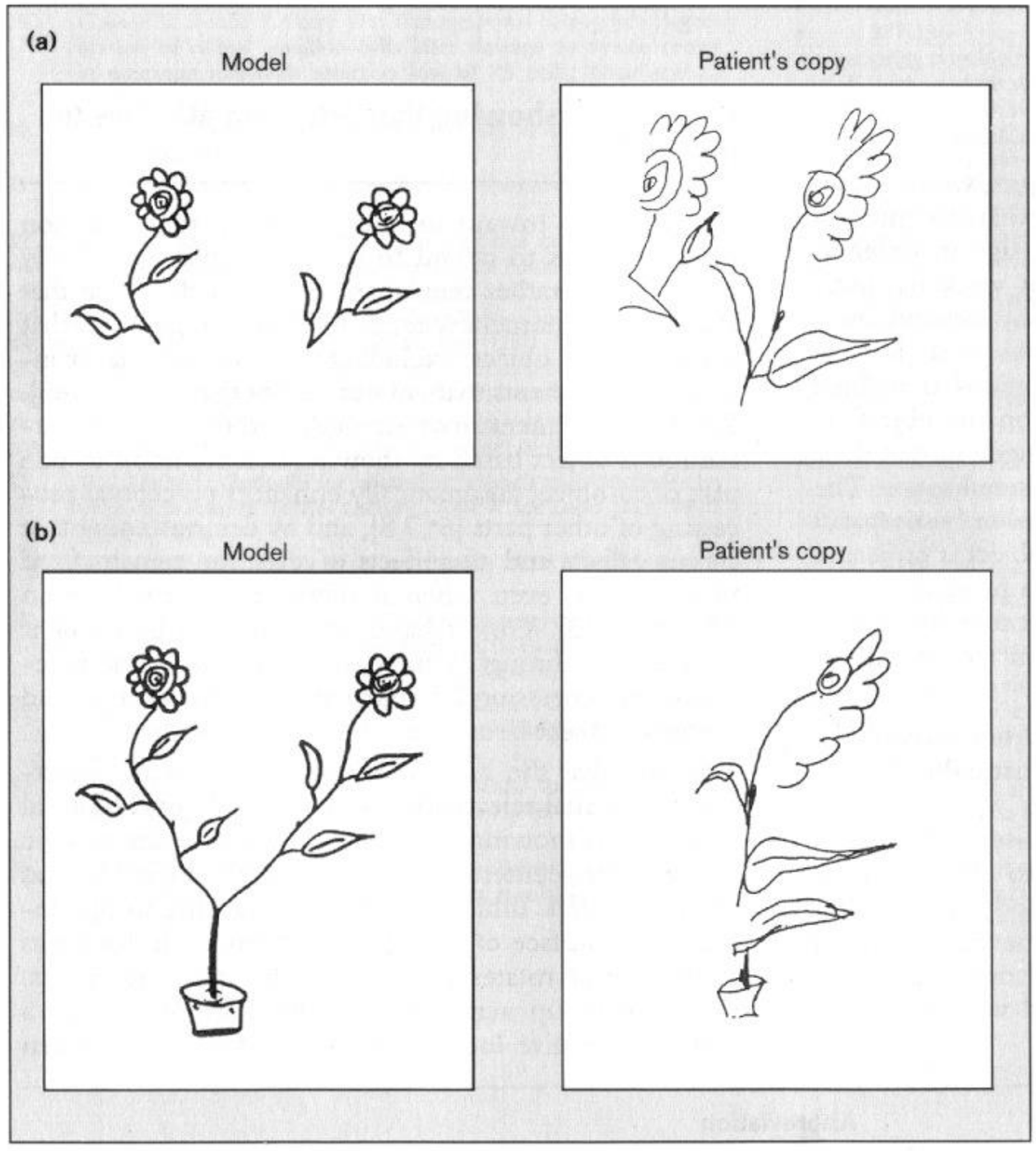
- Feature Integration Theory (Treisman and colleagues)
  - The individual features of an item can be detected "preattentively," or in parallel
  - However, binding multiple features together requires focused attention
  - In the case of inefficient search : target is defined by the conjunction of two or more features

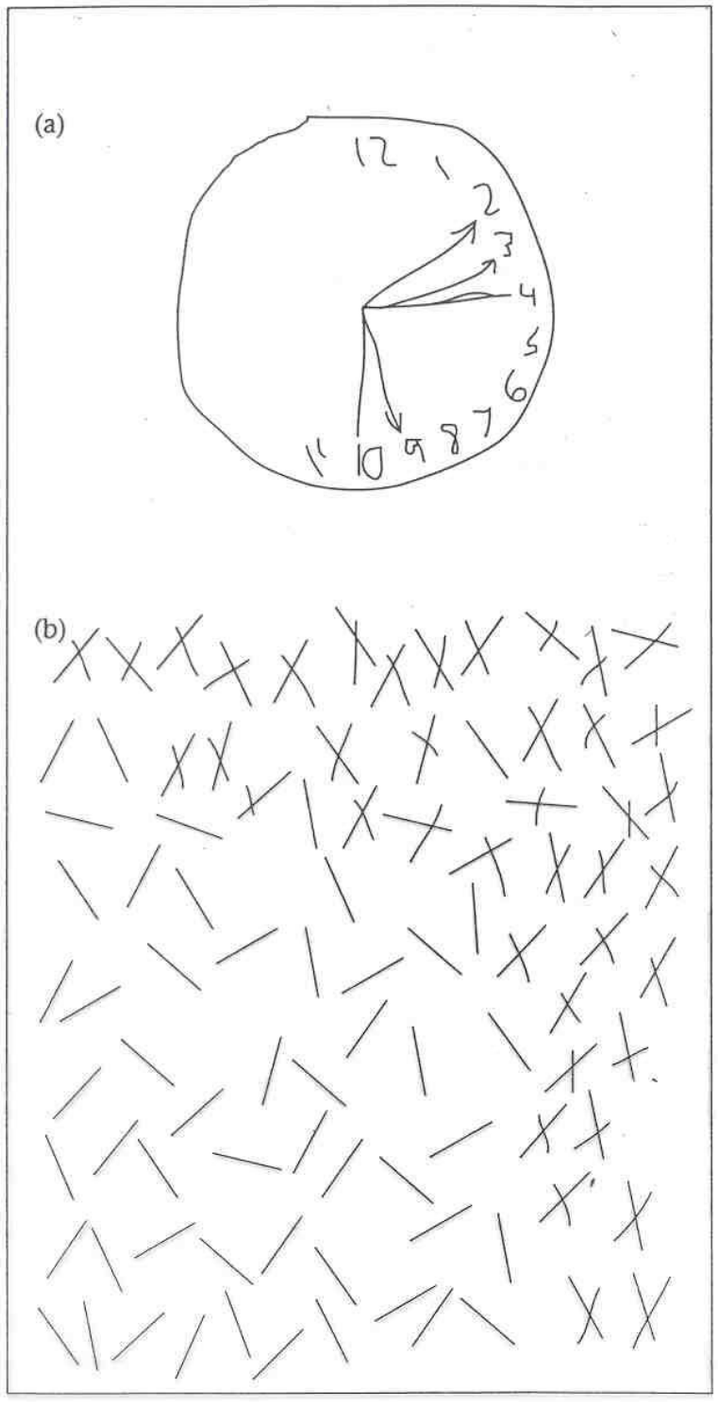
Elmers.com

# Neglect

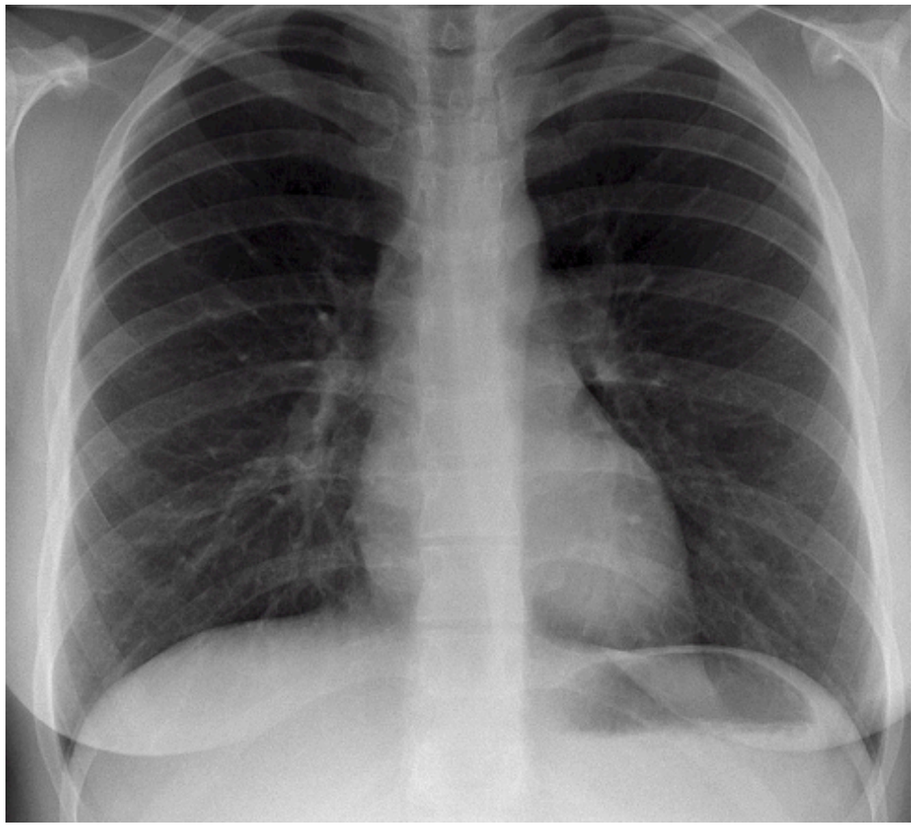
- A deficit in attention to one side of the fixation point
- Commonly after the damage on the right inferior parietal lobe

# Neglect



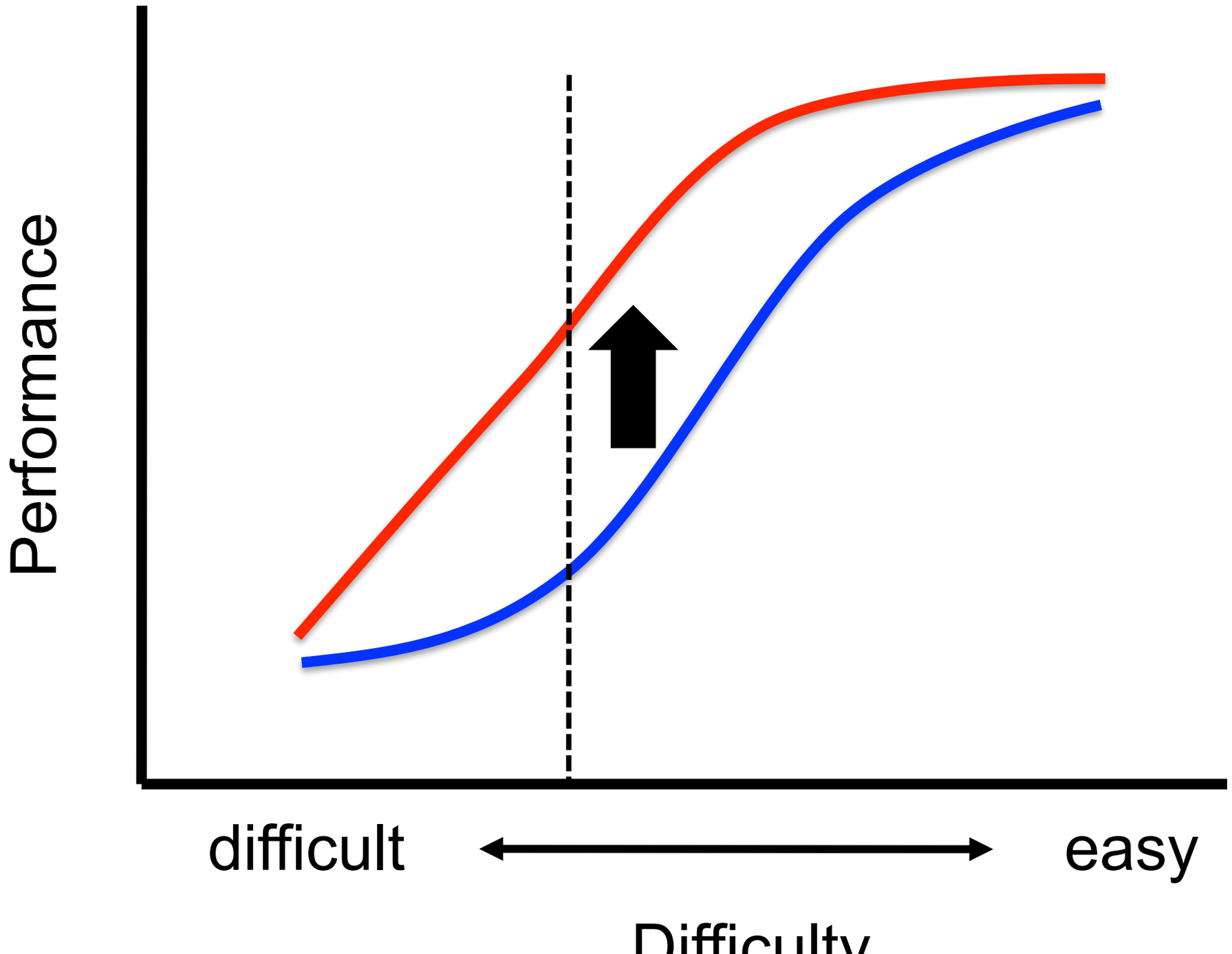



# Visual perceptual learning (VPL)



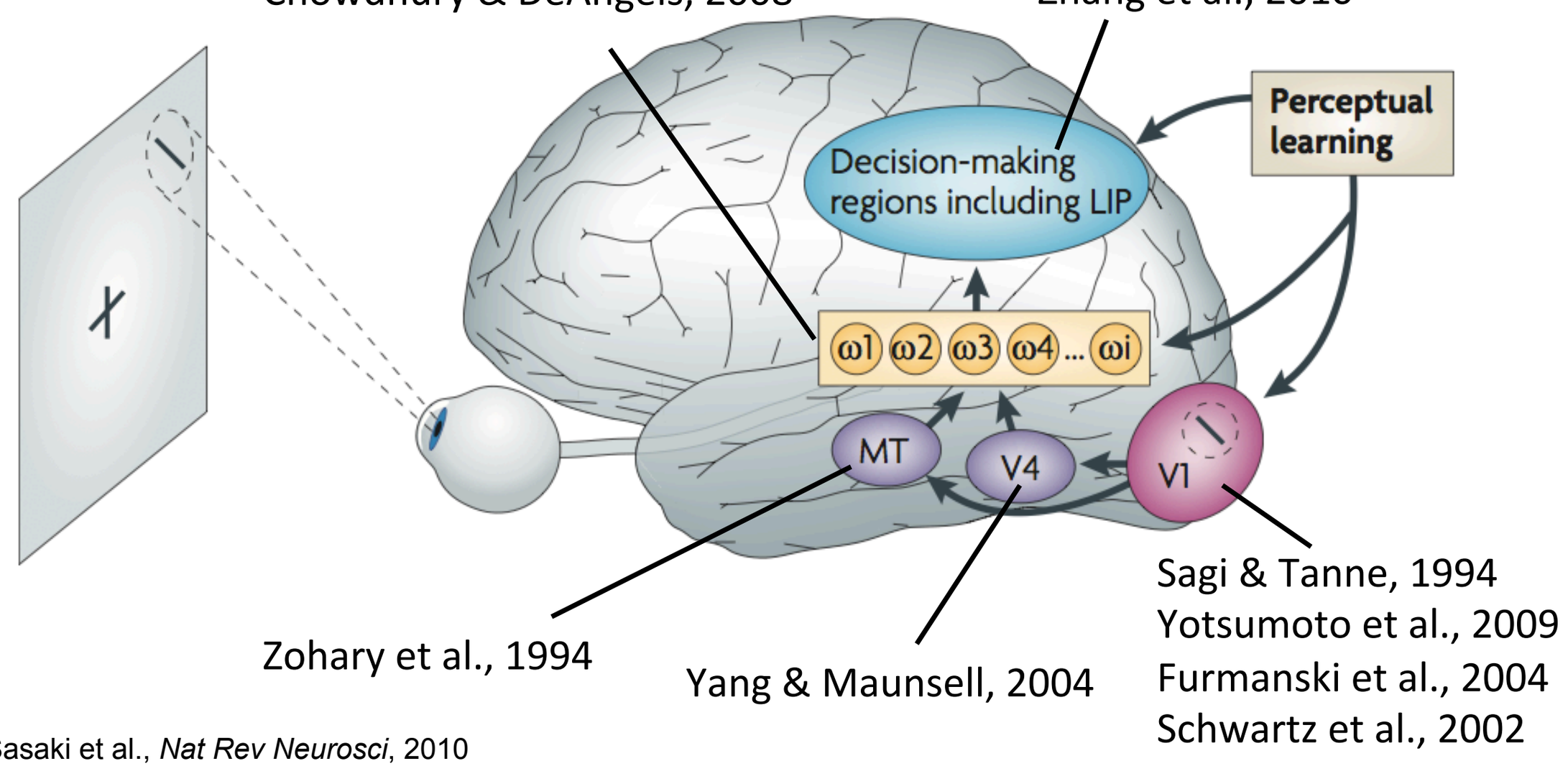
- Long-term performance improvement on a visual task as a result of visual training

# Performance improvement

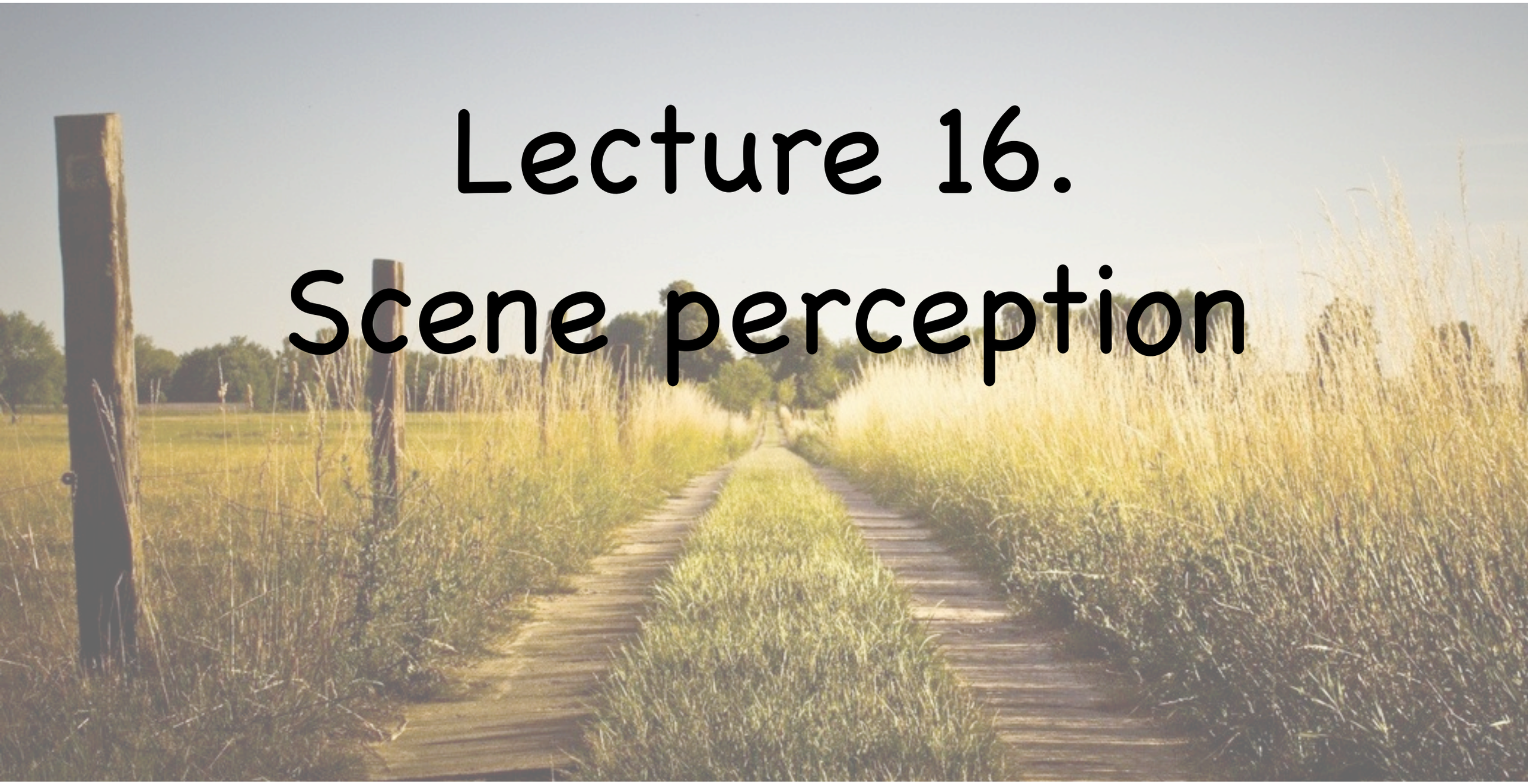


# Neural changes associated with VPL

- Many brain areas can be changed in association with perceptual learning




Sasaki et al., *Nat Rev Neurosci*, 2010



# Lecture 16.

# Scene perception

# Outline

1] Conscious perception limited by attention and memory
- Motion-induced blindness
- Change blindness

2] Limited capacity of visual working memory

3] The fate of unseen stimuli
- Influence by subliminal perception
- Invisible stimulus can attract attention

4] Understanding visual scenes
- Gist
- Spatial layout
- How can perceiving scenes be so fast?
- Guided search by global information of a scene
- Ensemble representations
- Memory for scenes
- Boundary extension
- Neural basis for scene perception

# 1. Conscious perception limited by attention and memory

1. Conscious perception limited by attention and memory

Did he guess right? Or is it an illusion?

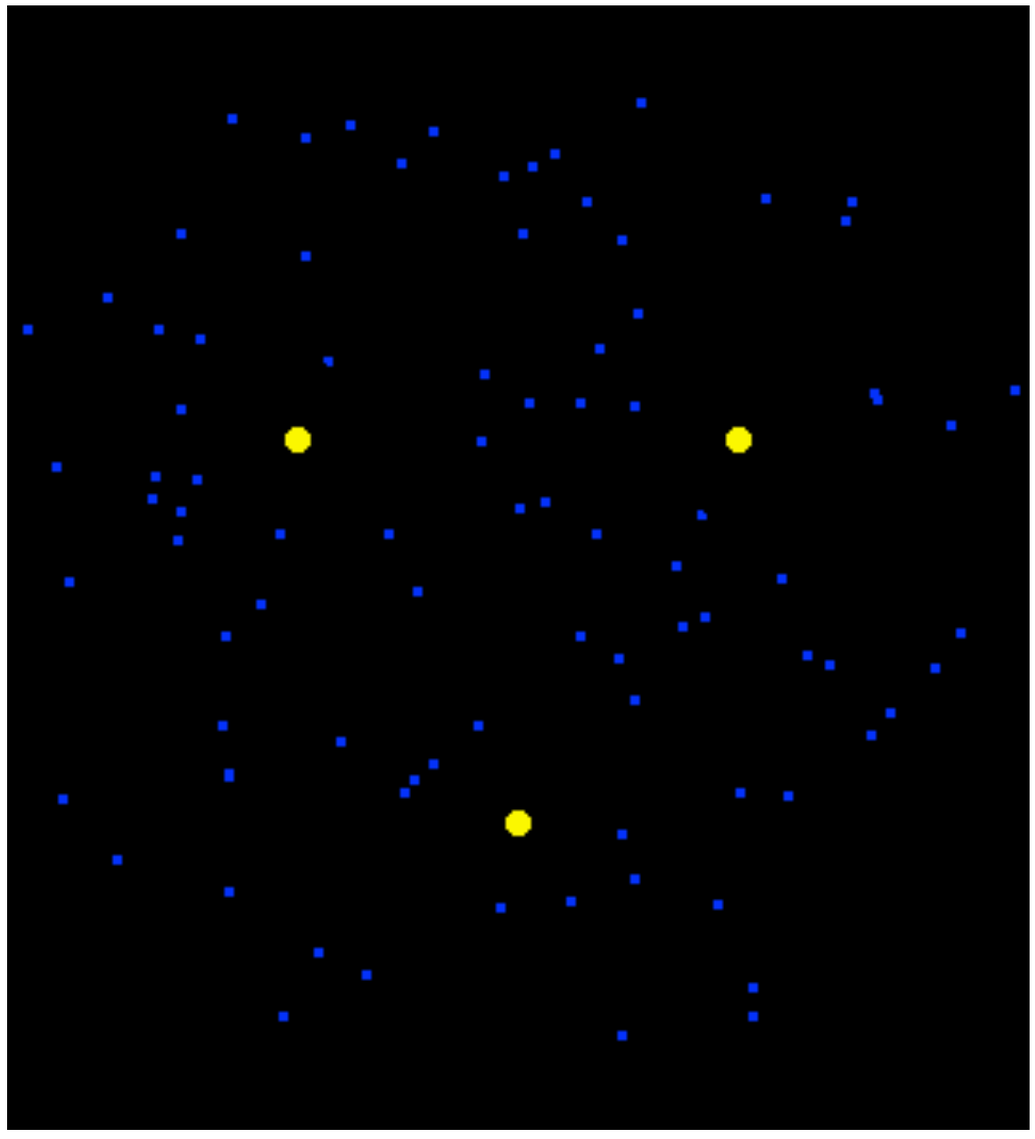
"We only see things we attend to"

Before

After

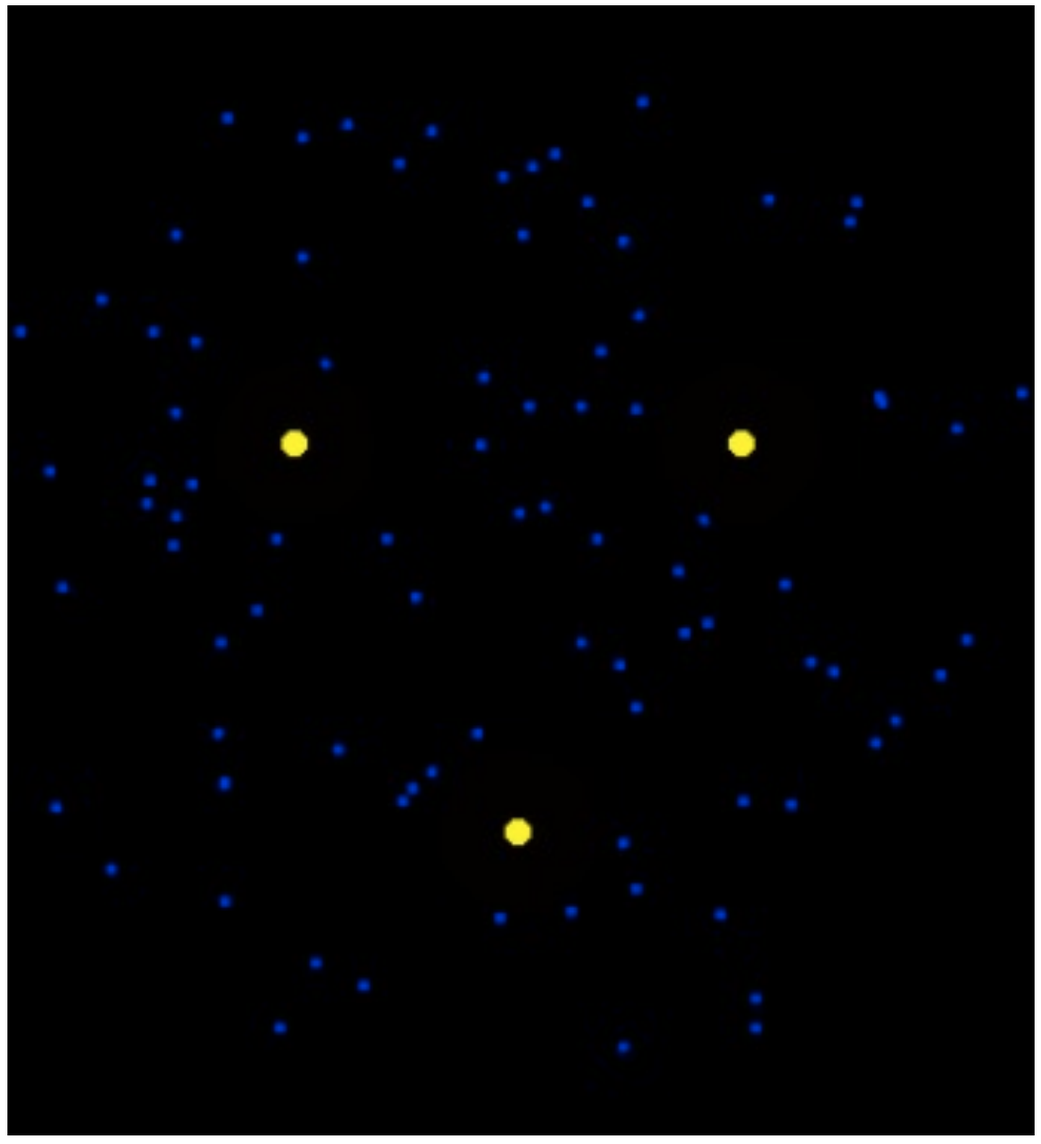
# Motion-induced blindness

Stare in the middle of the display. After several seconds, yellow dots will begin to disappear



# Motion-induced blindness

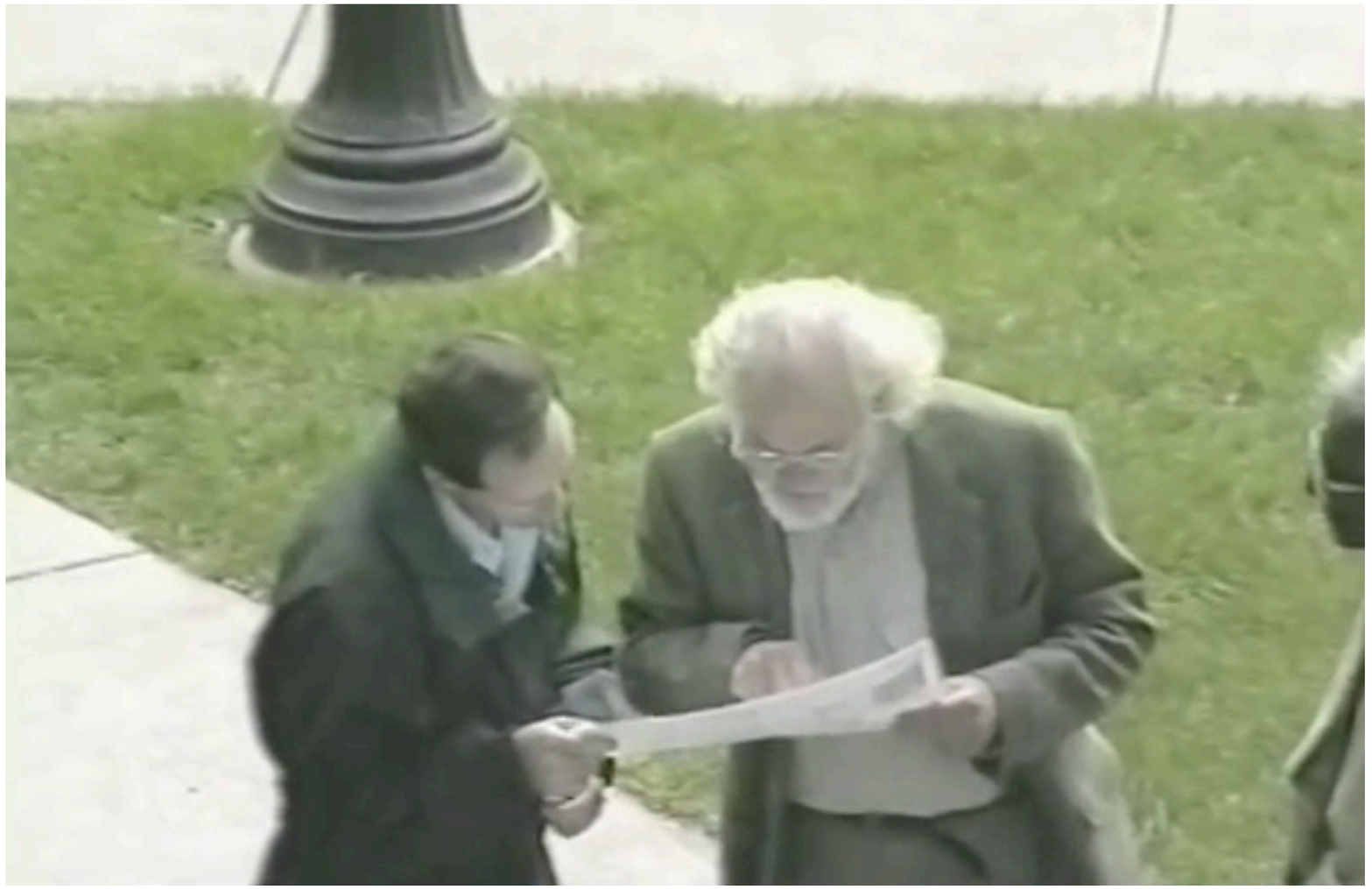
Attention for awareness:
Things may fade out of your attention, disappearing from awareness
(e.g., Concentrate on a book, and you are aware of little else)



# Change blindness

# Change blindness

He did not realize even when the person you were talking to switched (Simons & Ambinder, 2005)



"Perceiving things requires attention.
If attention is elsewhere, things can be missed"

# Change blindness demo- Spot the difference!

# Change blindness demo- Spot the difference!

## Changes go unnoticed when your attention is elsewhere (Simons & Levin, 1997)

# Only attended items enter visual short-term memory

Sensory memory (Iconic memory)

- Only lasts for 200-500 msec
- A kind of photographic memory

Attention

Access to awareness

Short-term memory (working memory)

- Lasts over many seconds
- Very limited capacity

Rehearsal

Long-term memory

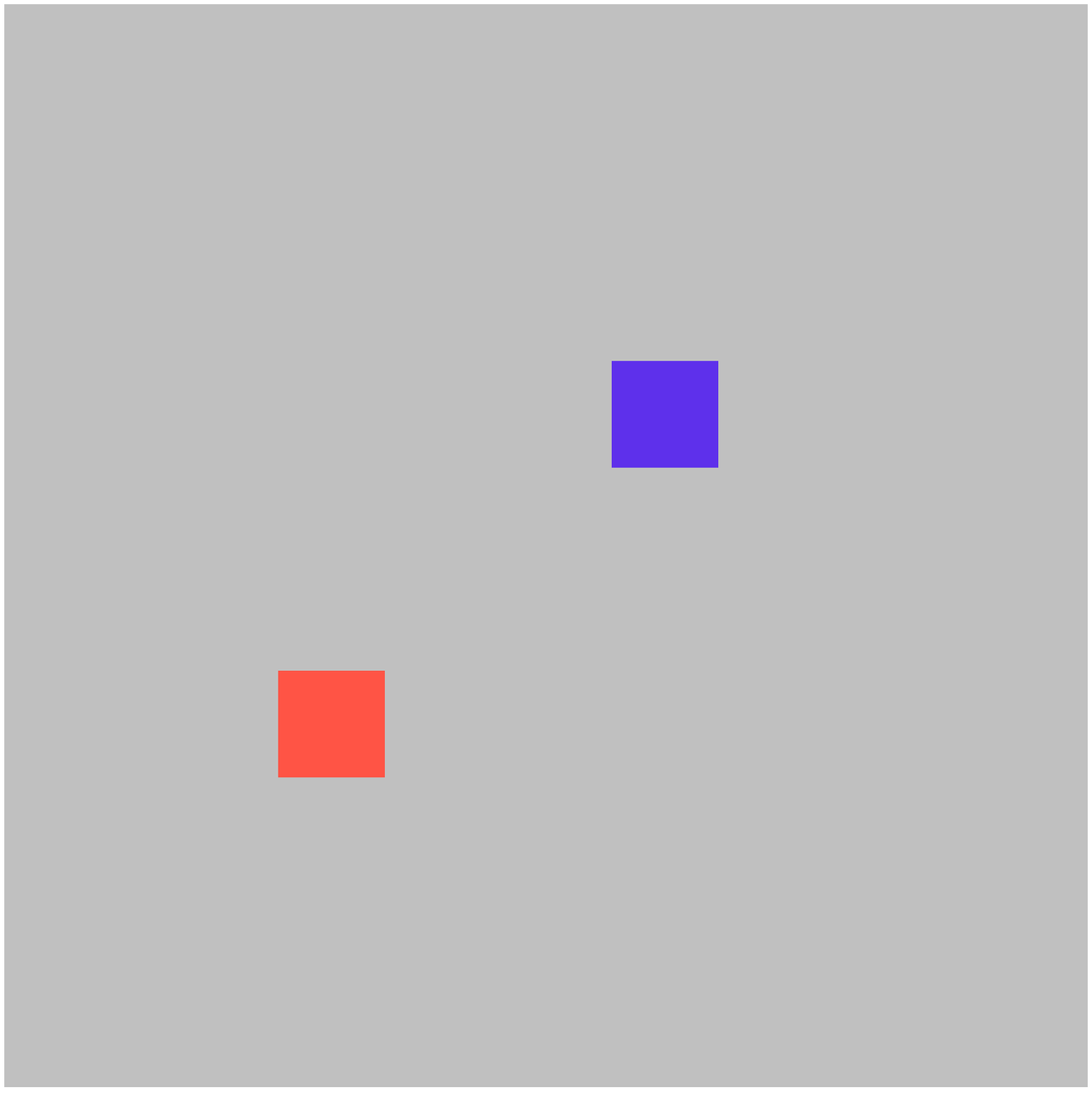
- Capacity and duration unlimited

# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #1

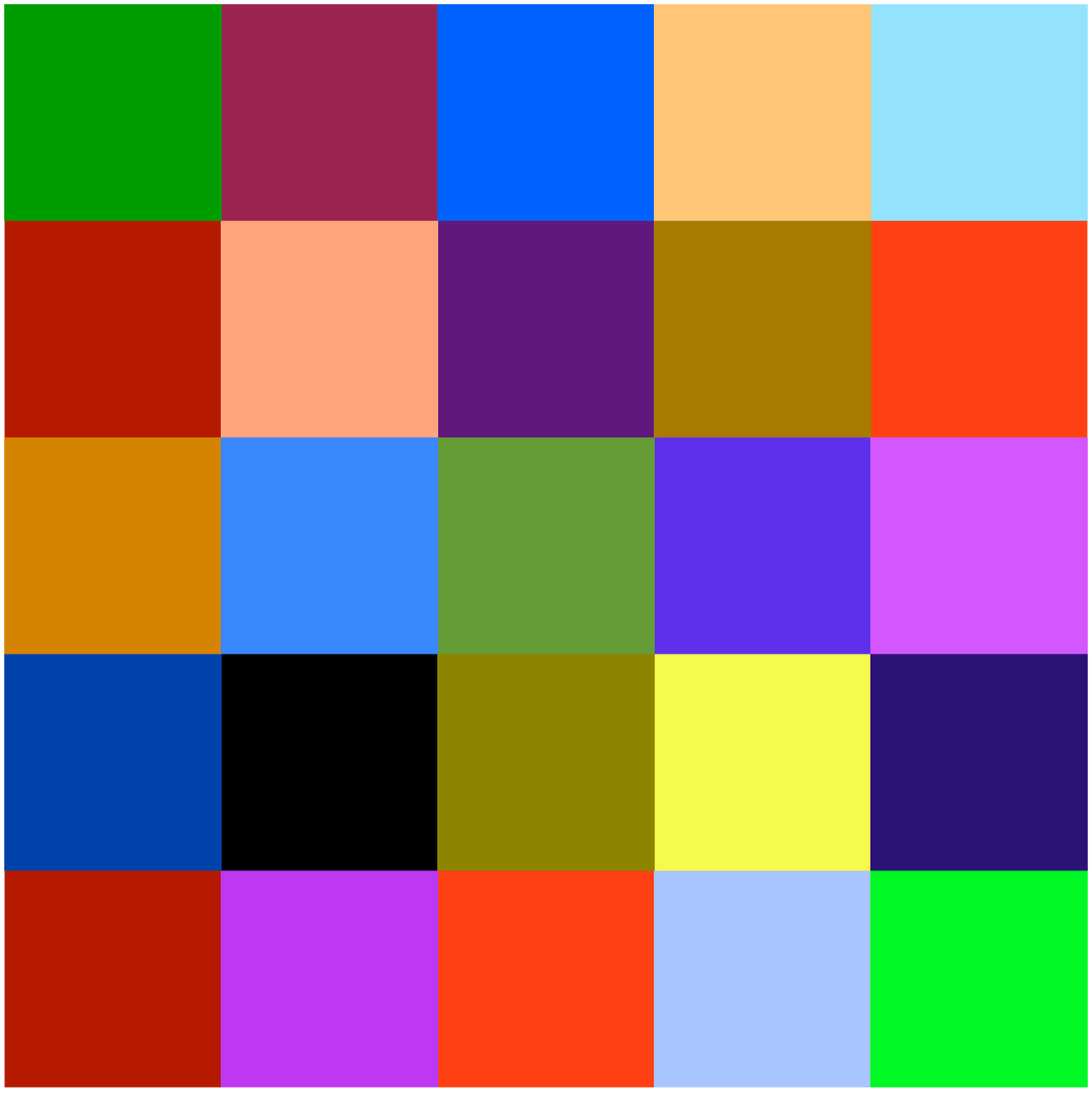


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #1

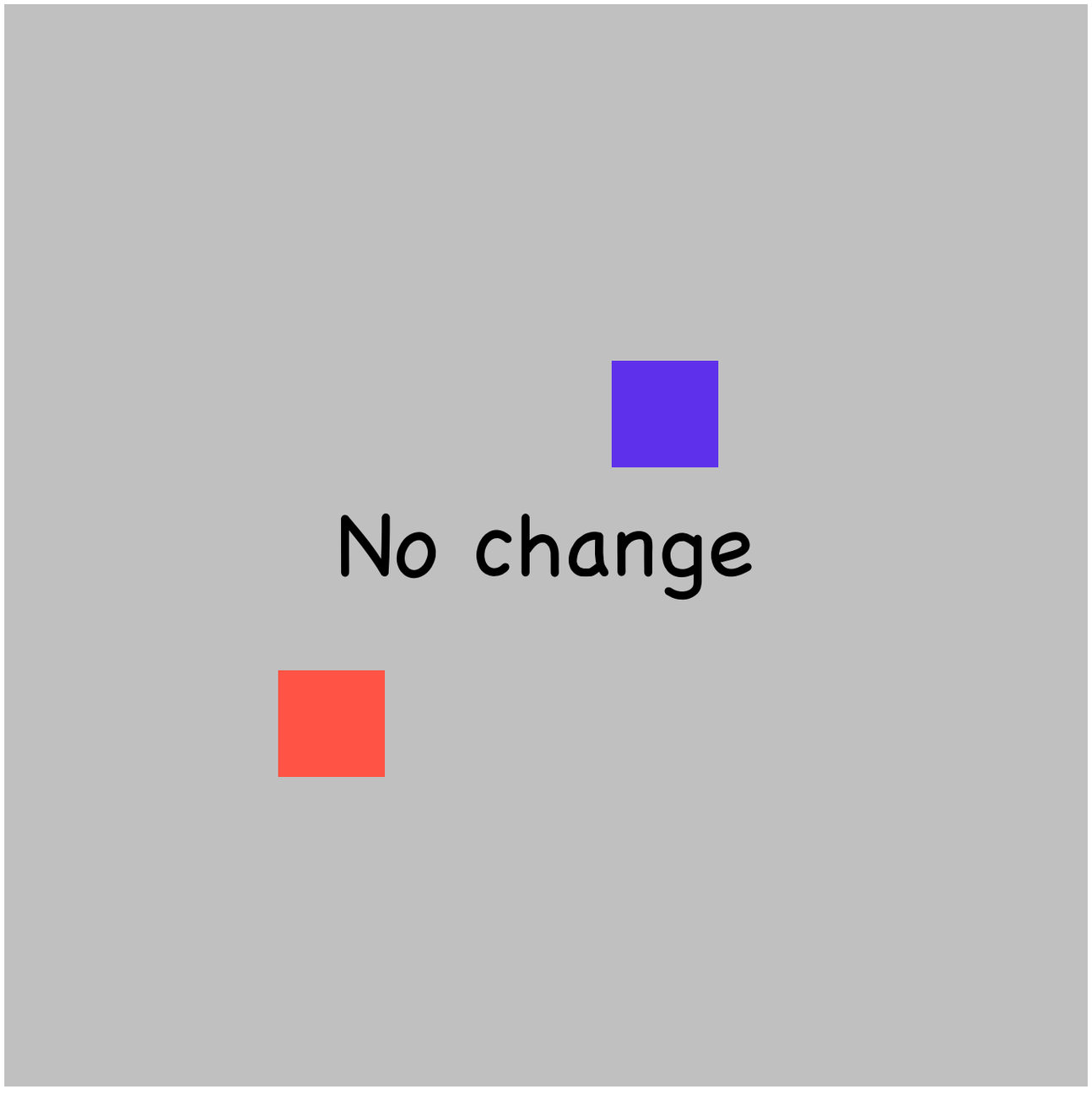


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #1

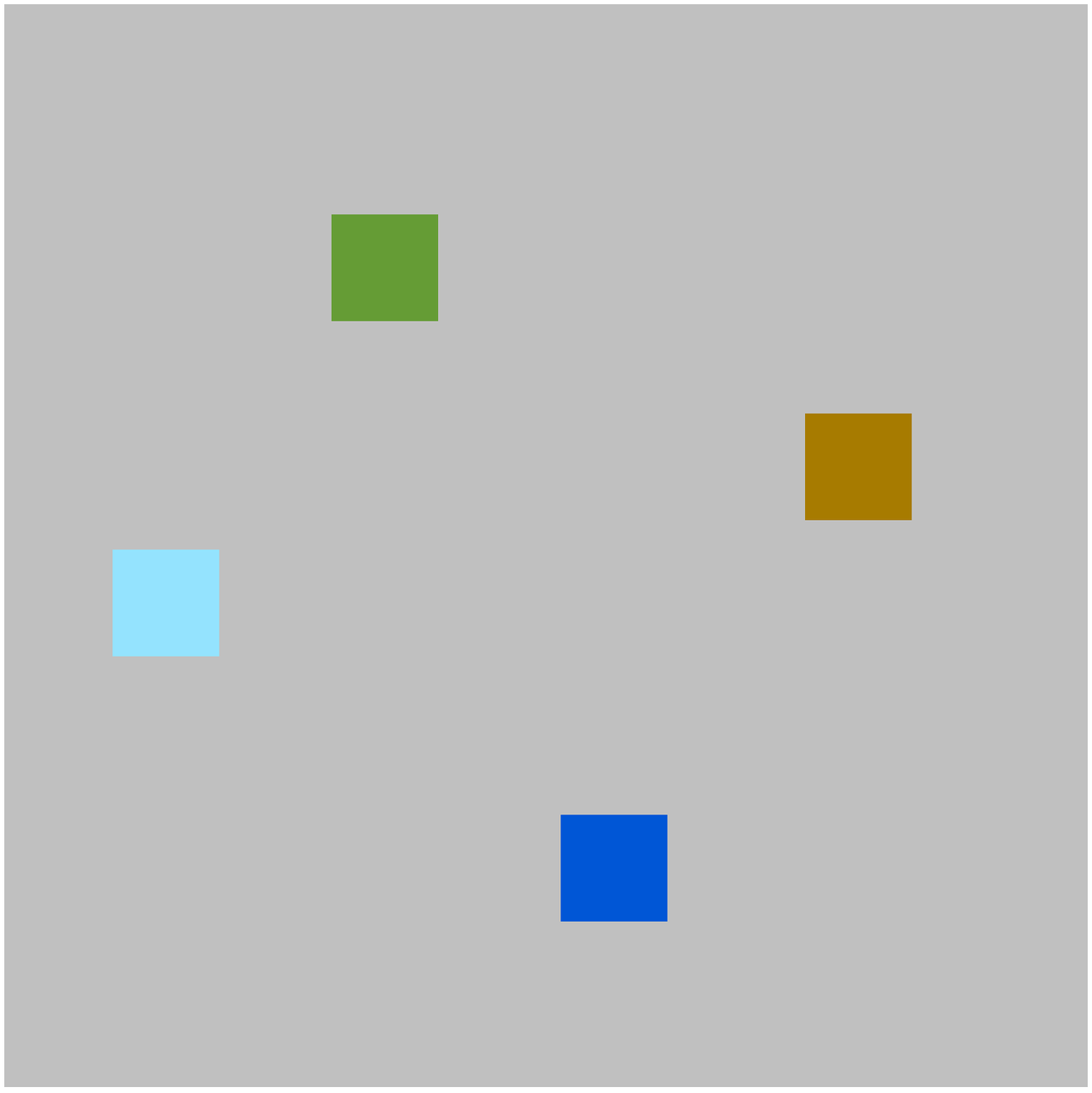


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #2

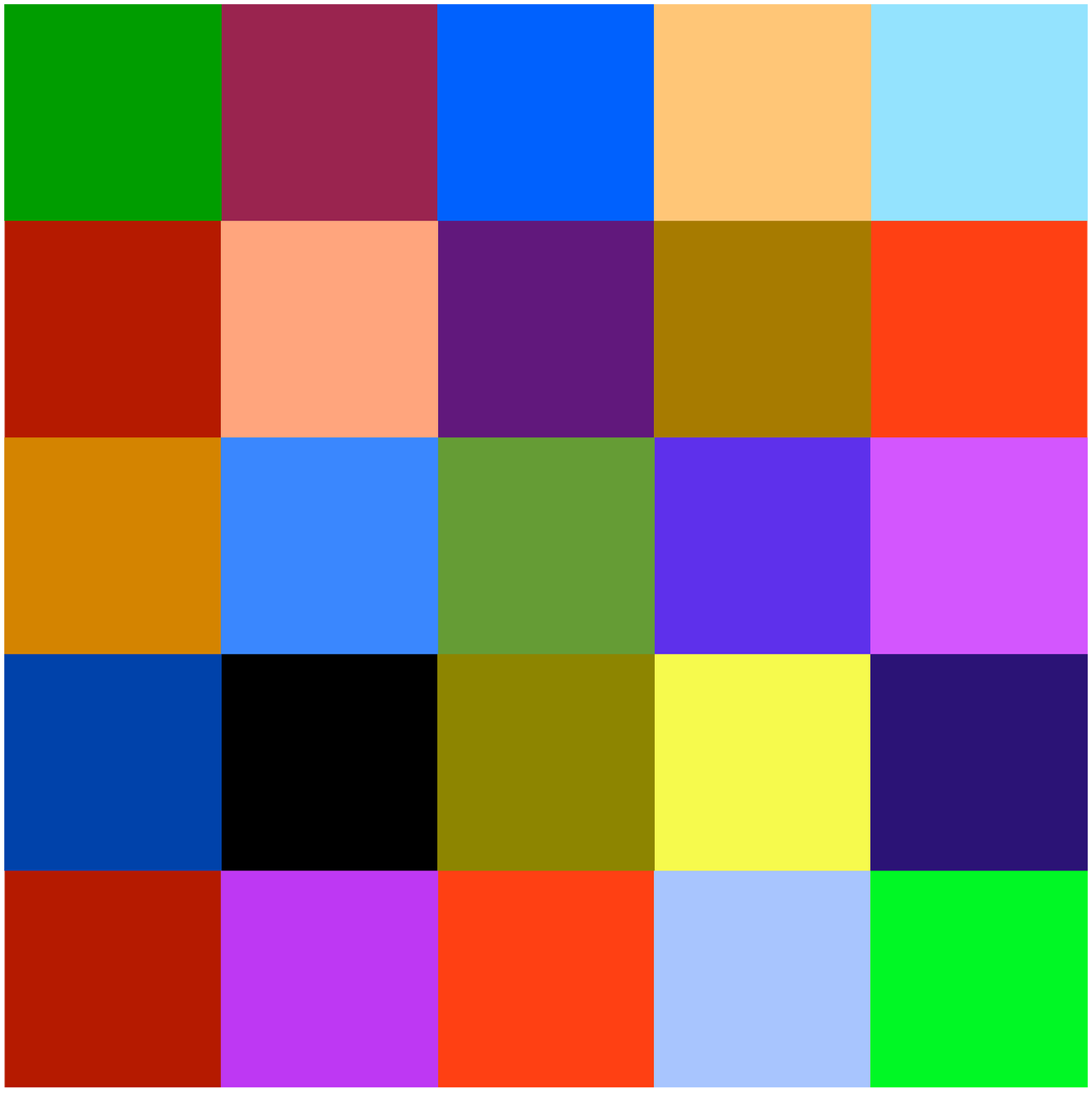


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #2



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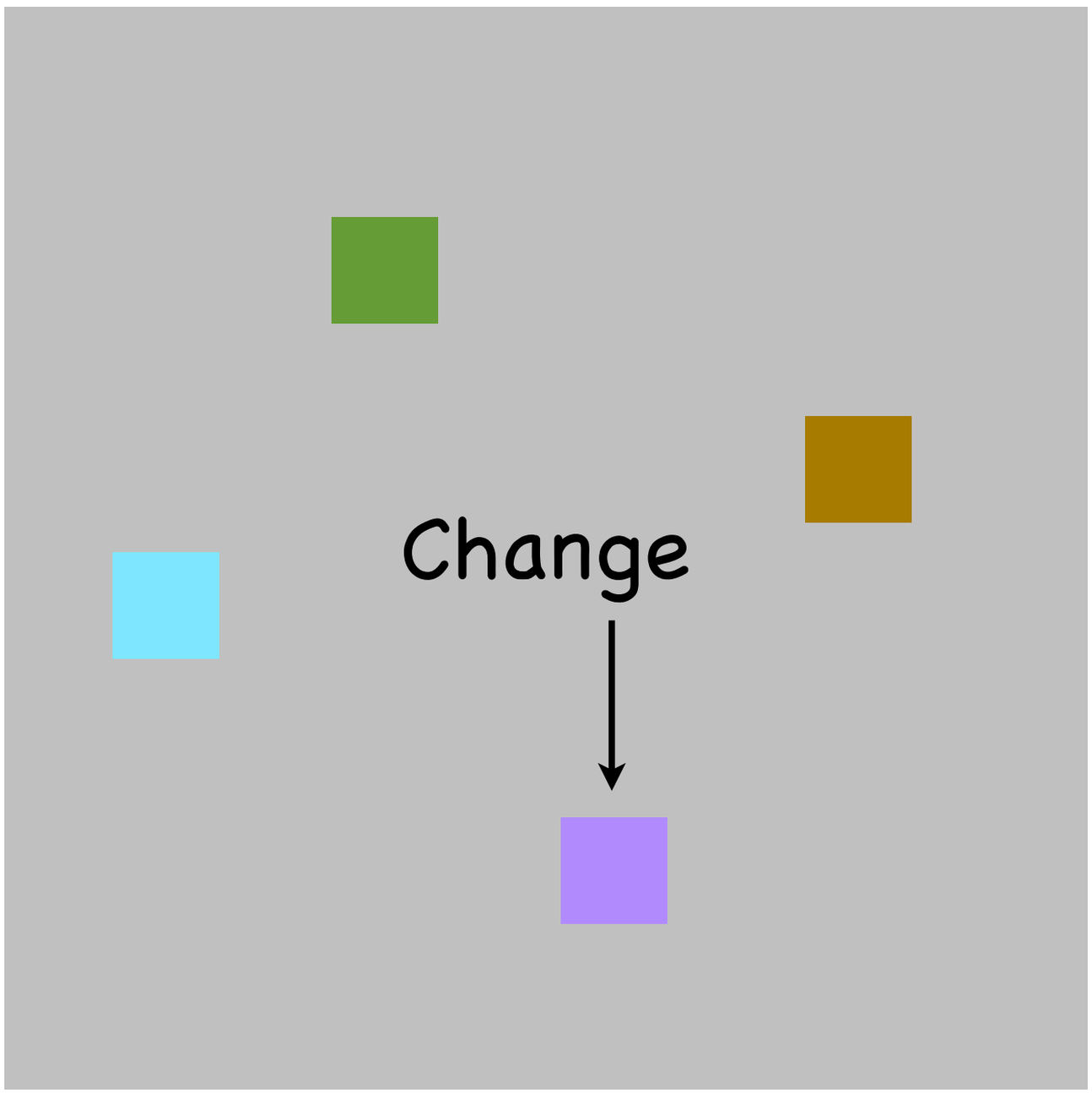
Trial #2

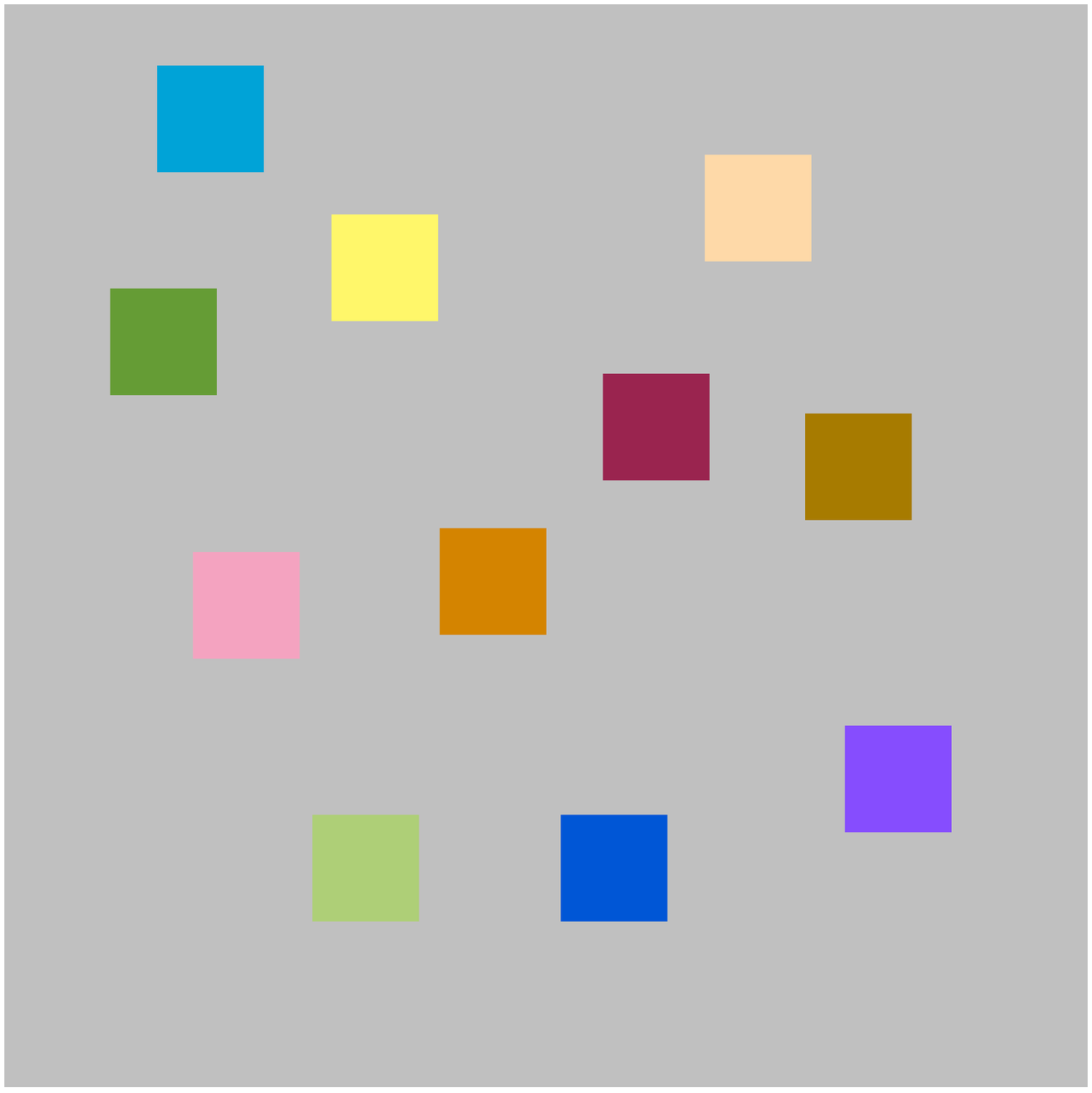


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #3

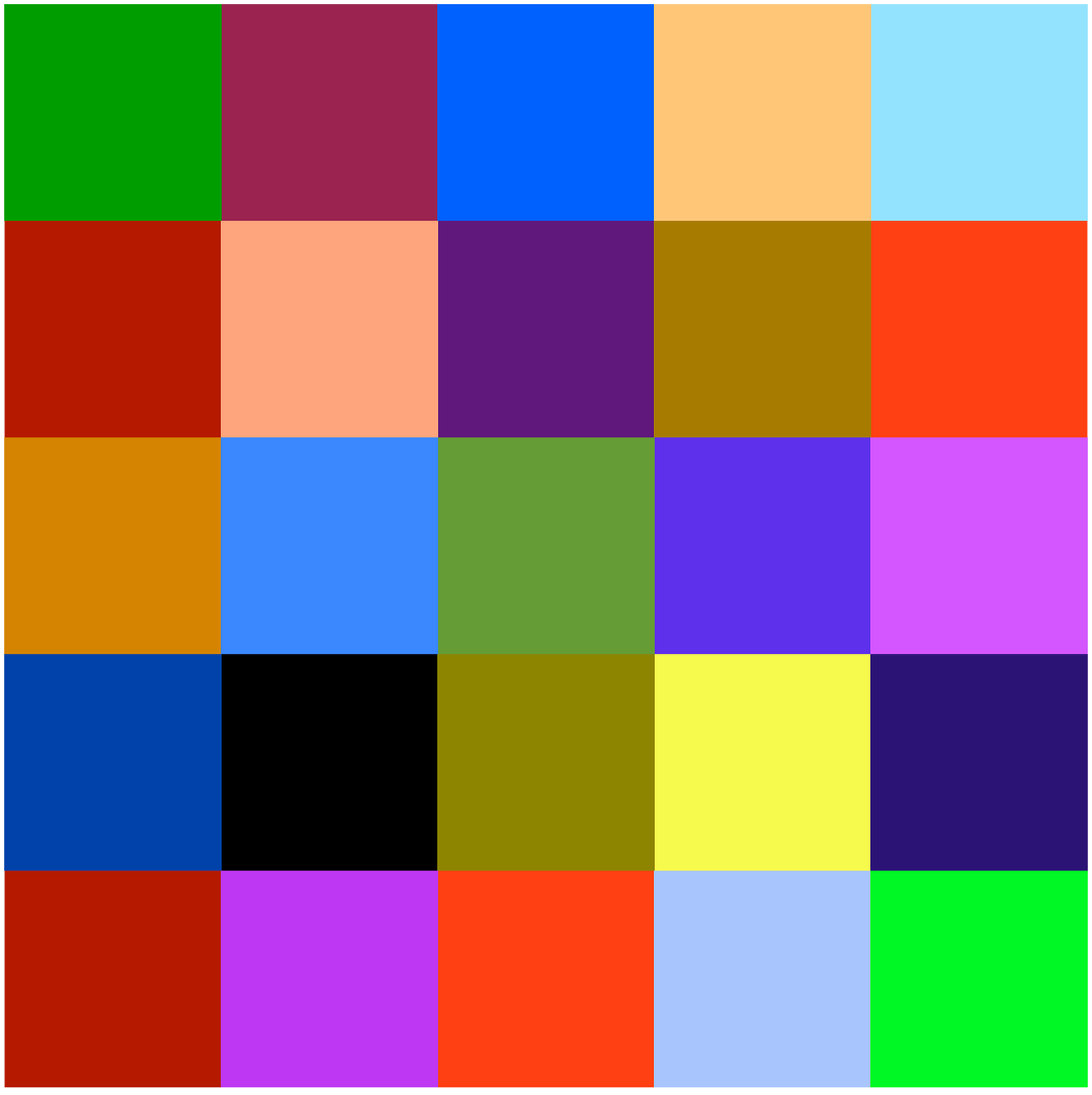


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

Change detection task: "Change? No change?"

Trial #3

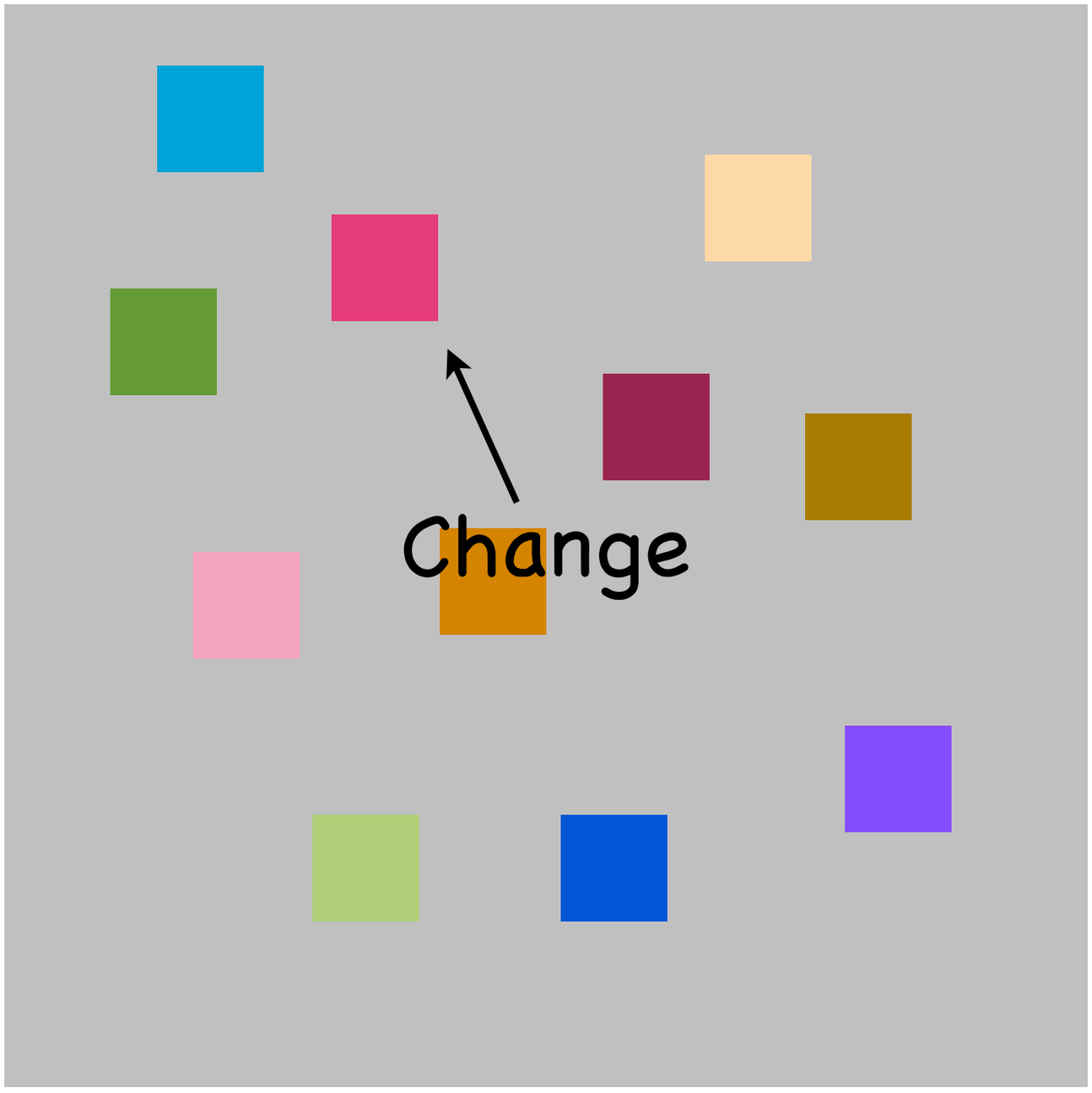


# 2. Limited capacity of visual short-term memory

## Testing your memory capacity

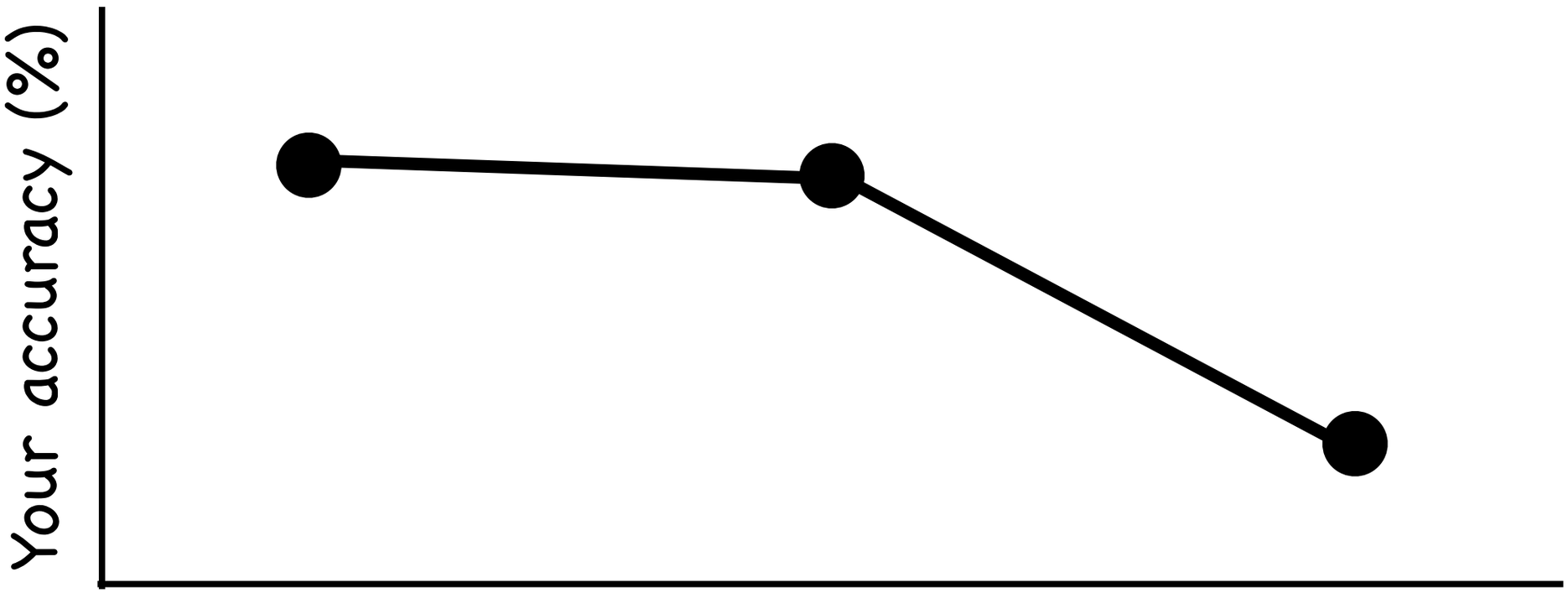
Change detection task: "Change? No change?"

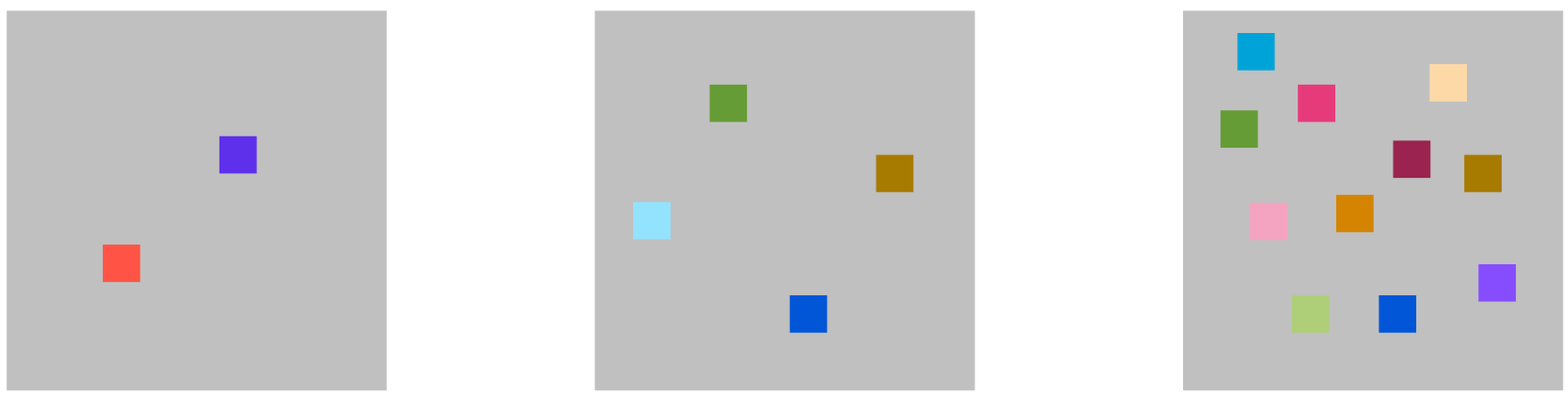
Trial #3



# 2. Limited capacity of visual short-term memory

You can remember only up to 4 items



# Conscious perception is limited

## … because your visual attention and memory are limited!

All these results show that you only aware of things that you select for your attention and working memory

Then, what about unattended things?

- Most of them will be decayed, forgotten, and discarded, so you cannot use them.

However…

# 3. The fate of unseen stimuli

Stimulus below an individual's threshold for conscious perception is registered and processed without our awareness

## Subliminal perception

Example 1


Only appeared for a single frame (too short to consciously pick up)

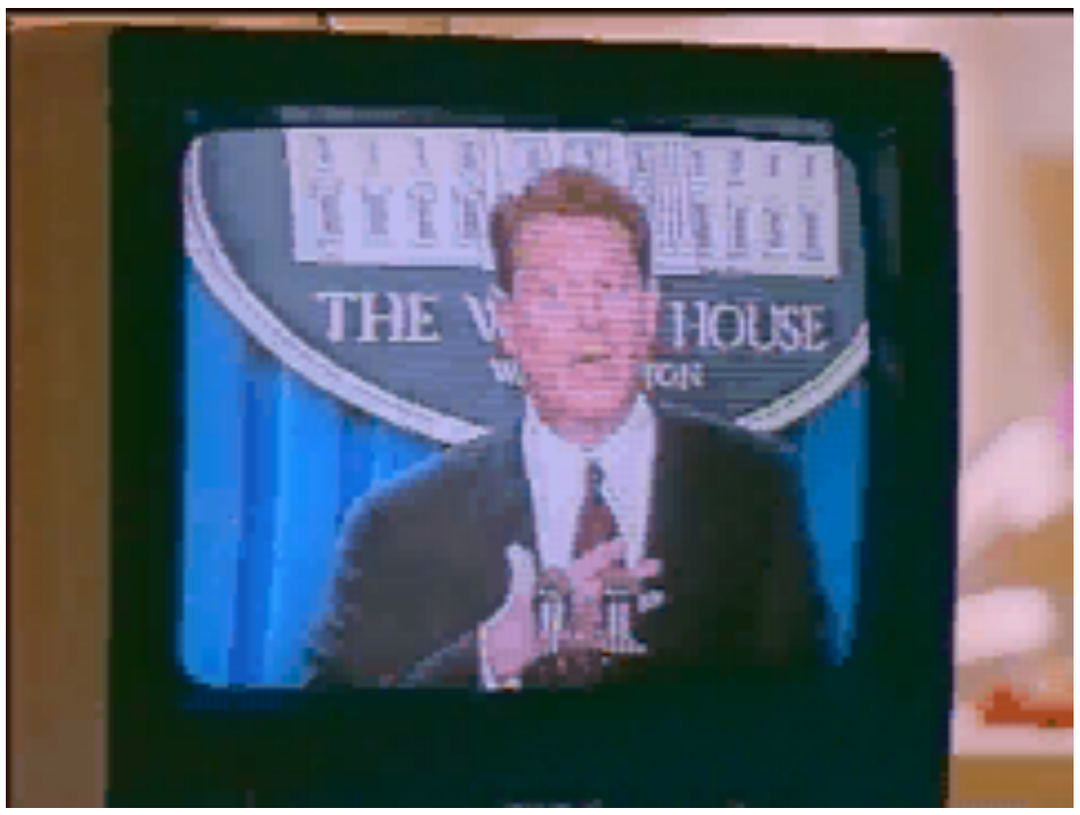

18.1% increase in sales


57.8% increase in sales

# Subliminal perception: Things we don't notice influences us, too

Stimulus below an individual's threshold for conscious perception is registered and processed without our awareness

Example 2

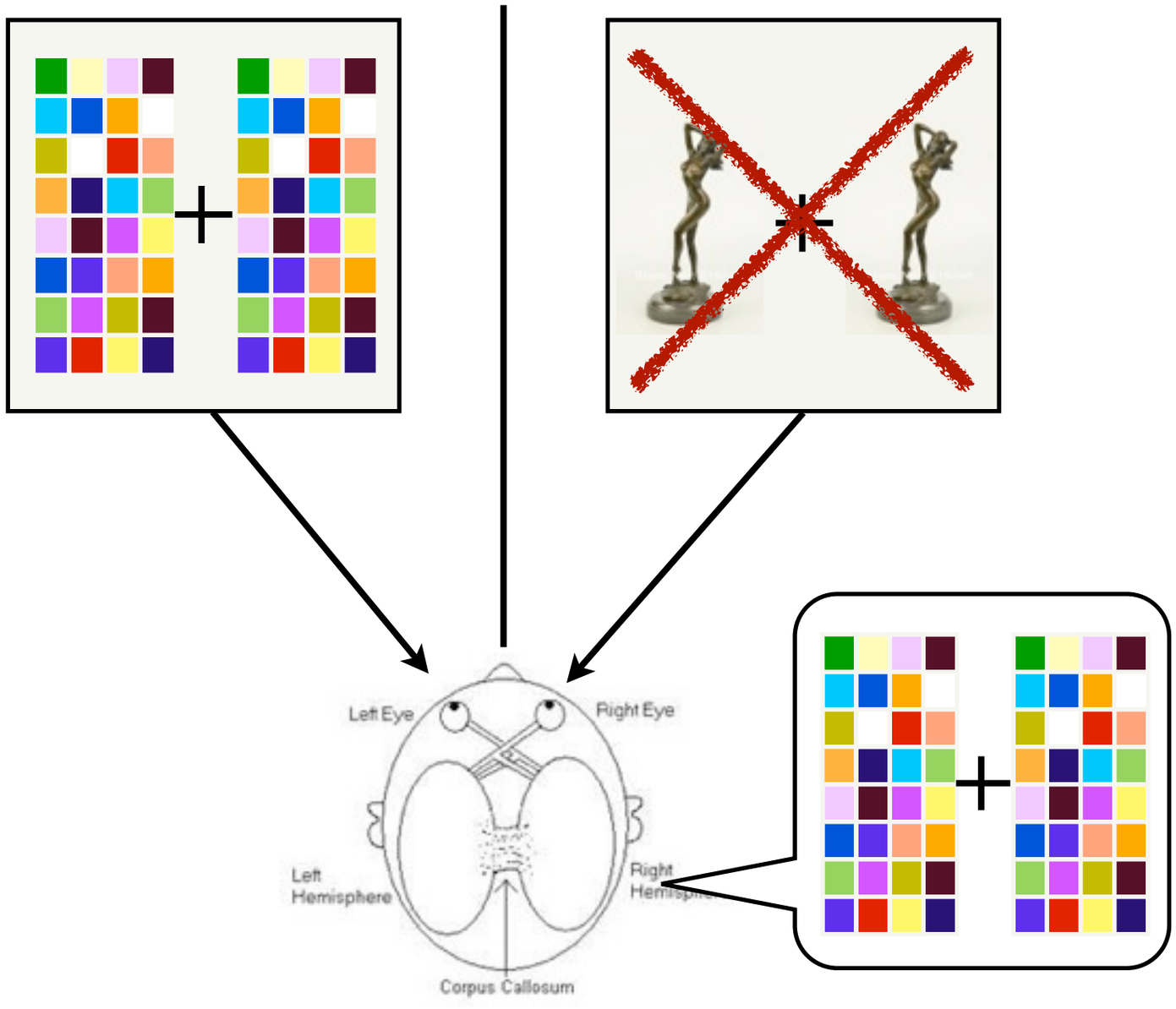


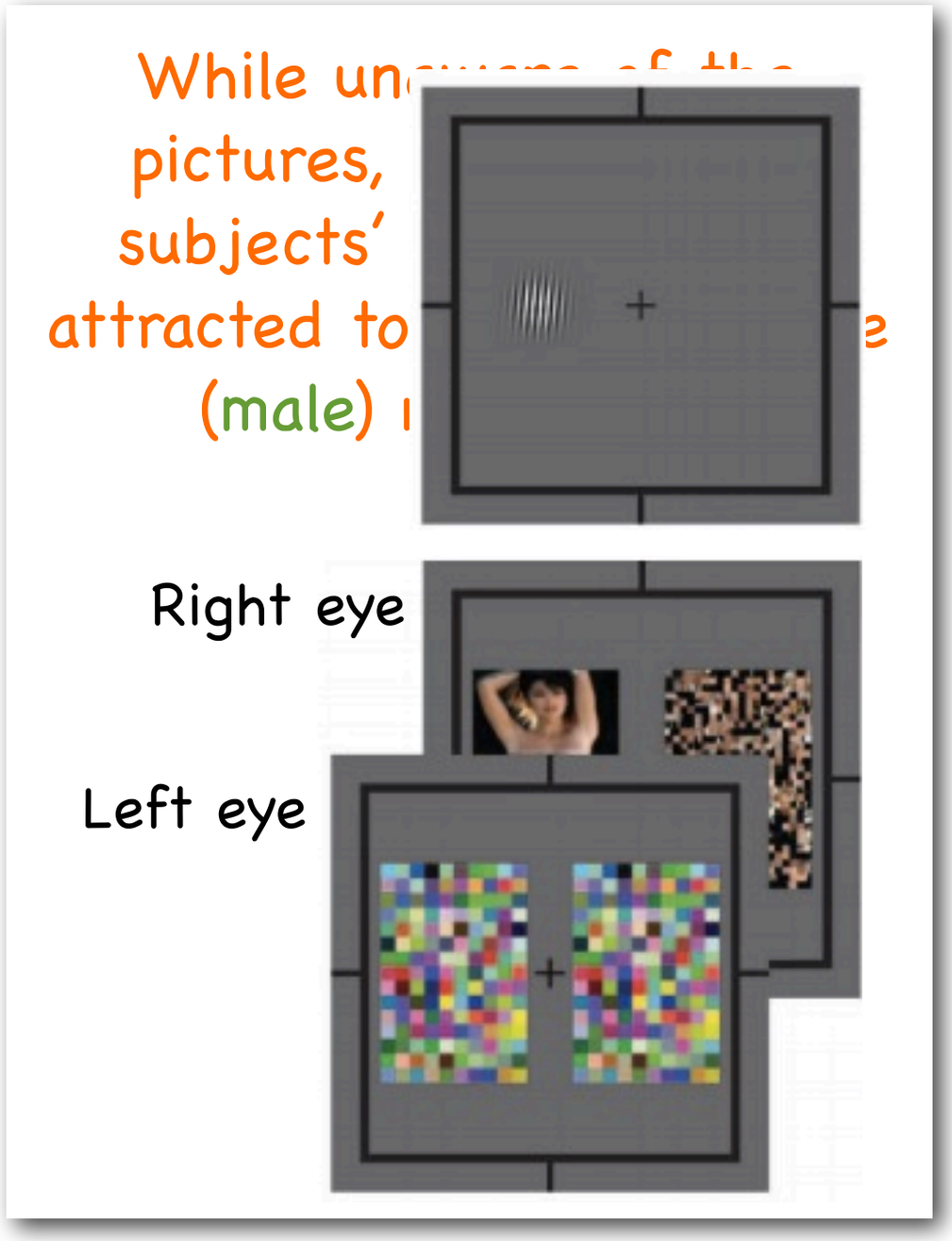


Republican ad, 2000 Bush campaign, shows Al Gore then "RATS" appears for one frame (1/30 of a second, but slowed to 1/15th in clip here)

# Invisible stimulus can attract attention

Interocular suppression: an image presented to one eye suppresses another image presented to the other eye




Jiang et al., (2006)

# Despite your limited conscious perception...

Despite your limited conscious perception...

Obviously, this is NOT something you see!

item 1

item 2


item 3


item 4 ...

# Your visual experiences of scenes are much richer

# Understanding visual scenes

1) Gist of a scene: fast visual scene understanding, even when the image is blurred

Oliva & Torralba, 2006

# Understanding visual scenes

1) Gist of a scene: you can recognize a scene within 20 msec

Outdoor/Indoor?
Natural/Man-made?
Open/Closed?
Navigable/Non-navigable?

Potter (1975); Oliva & Torralba (2001)

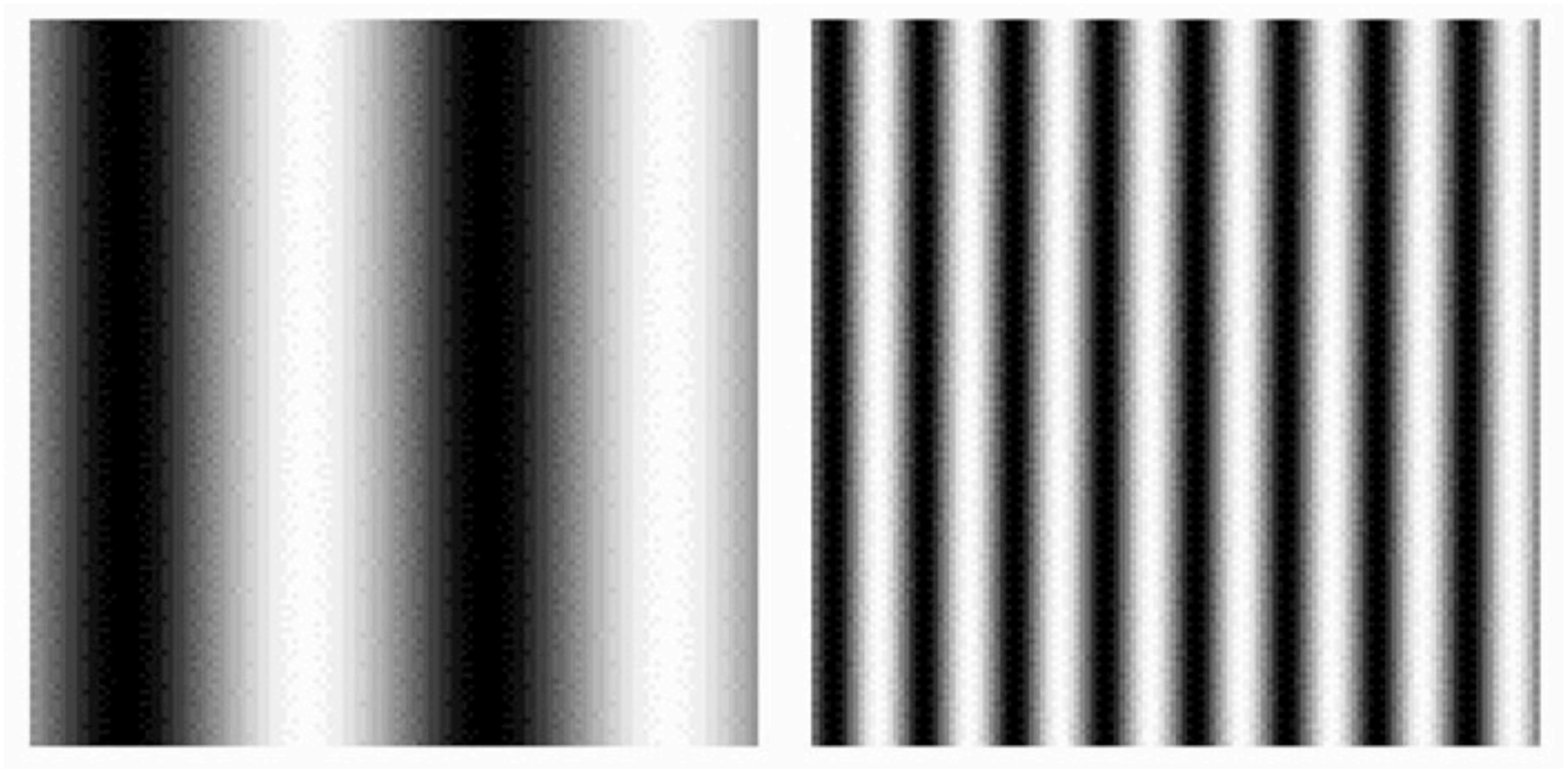
# Understanding visual scenes

2) Spatial layout of a scene (for global structure of the scene)

How can this be achieved so fast?

# How can perceiving scenes be so fast?

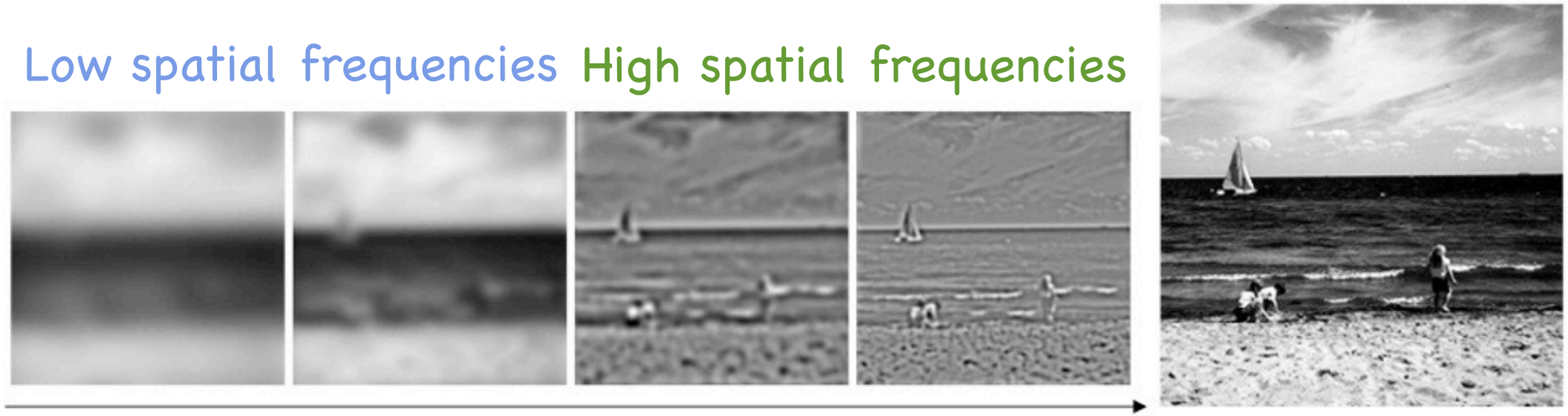
## Two different components of a visual scene



Low spatial frequency

High spatial frequency

# How can perceiving scenes be so fast?




Global information about a whole scene relies on the low-spatial frequency component. Visual system can quickly analyze this information while we are not aware of it at all.

# Guided search by global information of a scene


Gist of a scene (e.g., kitchen)
Spatial layout of a scene

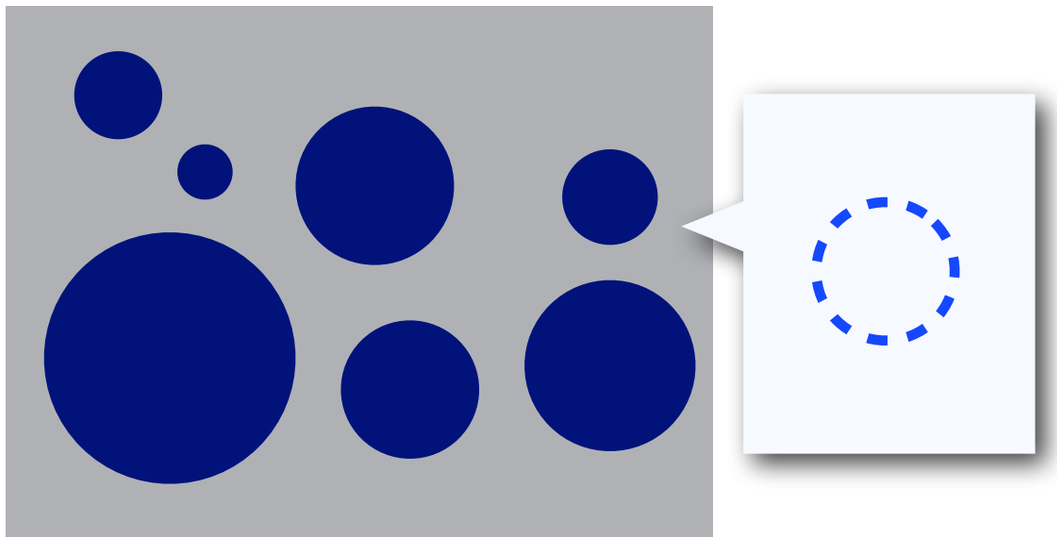
Your eye movement


Wolfe (2011)

# Ensemble representations

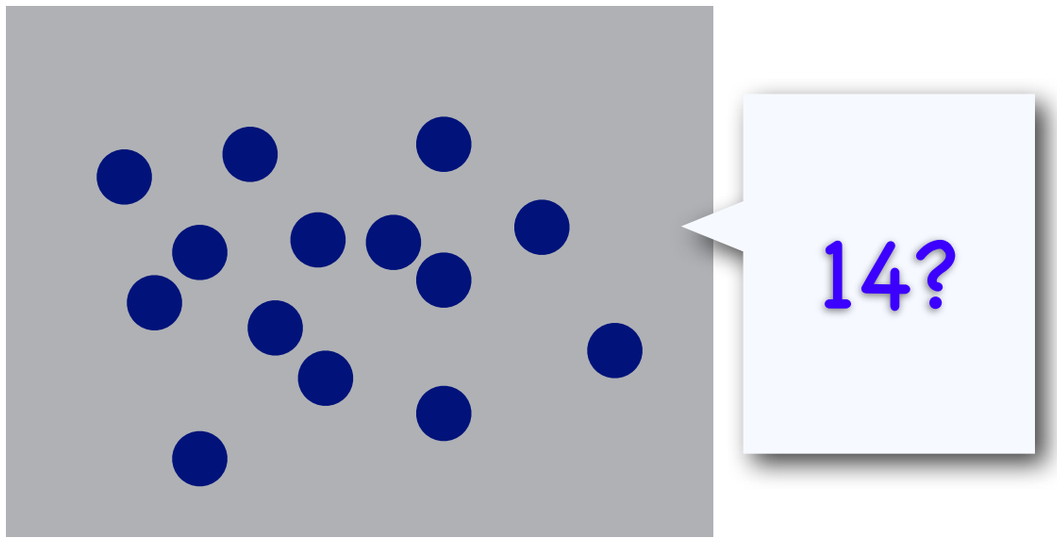
## Knowledge about the properties of a group of objects

### Mean size



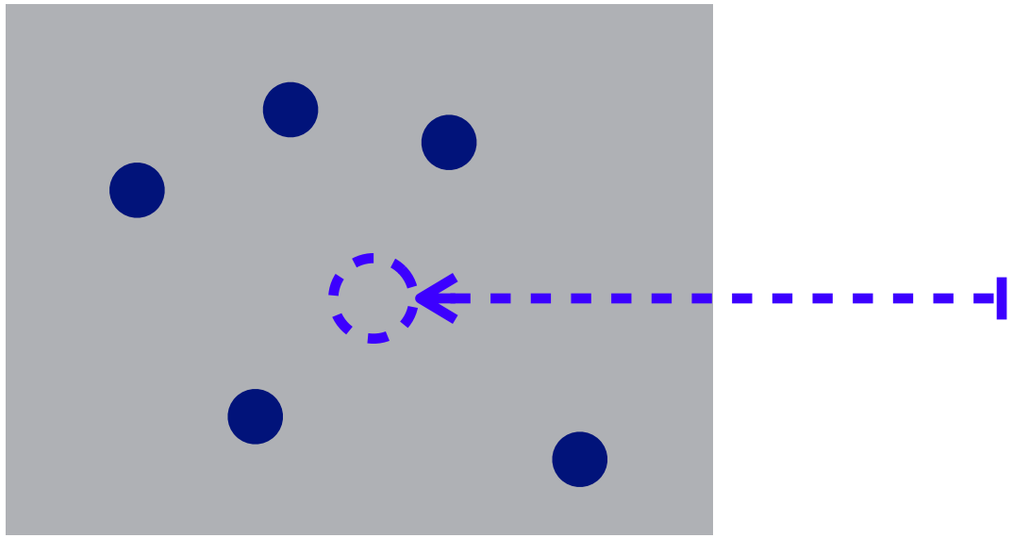
Ariely, 2001; Chong & Treisman, 2003

### Approximate number




Halberda, Sires, & Feigenson, 2006

### Centroid



Alvarez & Oliva, 2008

### Mean emotion

Haberman & Whitney, 2007

# Ensemble representations

They are about "groups" of similar objects

They are useful because the natural scenes often contain many similar objects

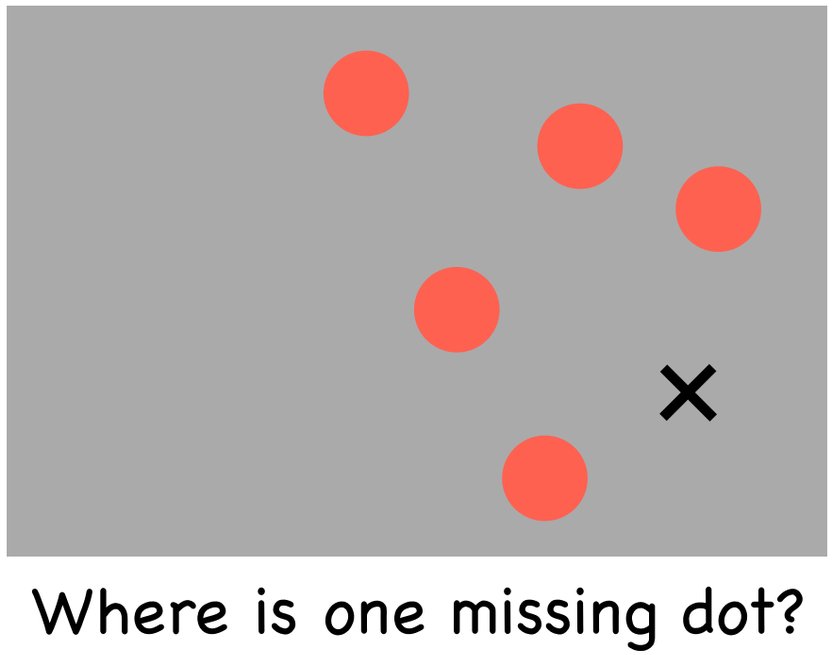
## Redundancy and regularity

# You use ensemble representations everyday

# You are very good at computing ensemble representations

## Better than you know about a single element

Remember all the locations of six red dots!

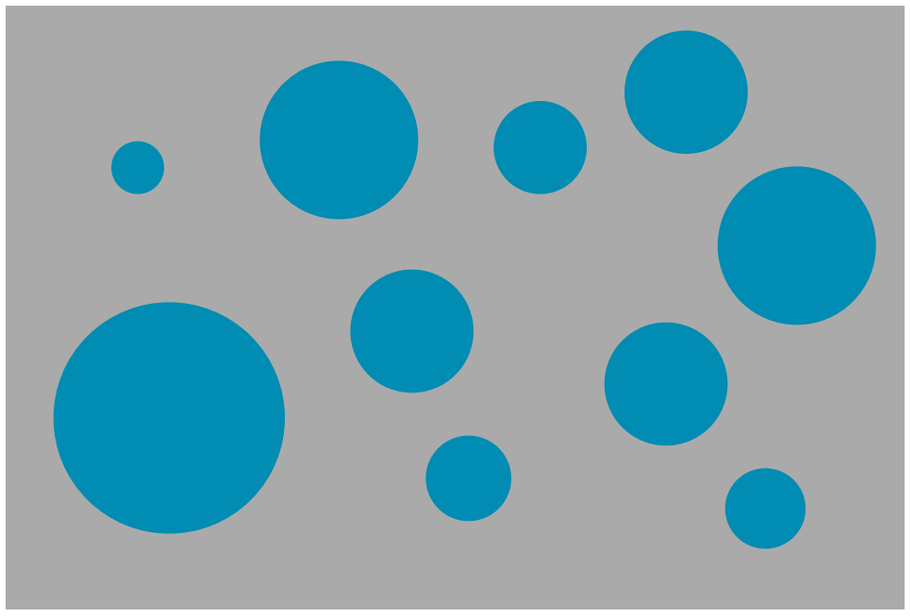


Where is one missing dot?

Where is the average location of the six dots?

# You are very good at computing ensemble representations

## Better than you know about a single element



Remember all the sizes of 10 circles!

Size of one circle?

Average size of all the circles?

# Even babies can use ensemble representations, too

Experimenters tested this by making infants get bored (Habituation)



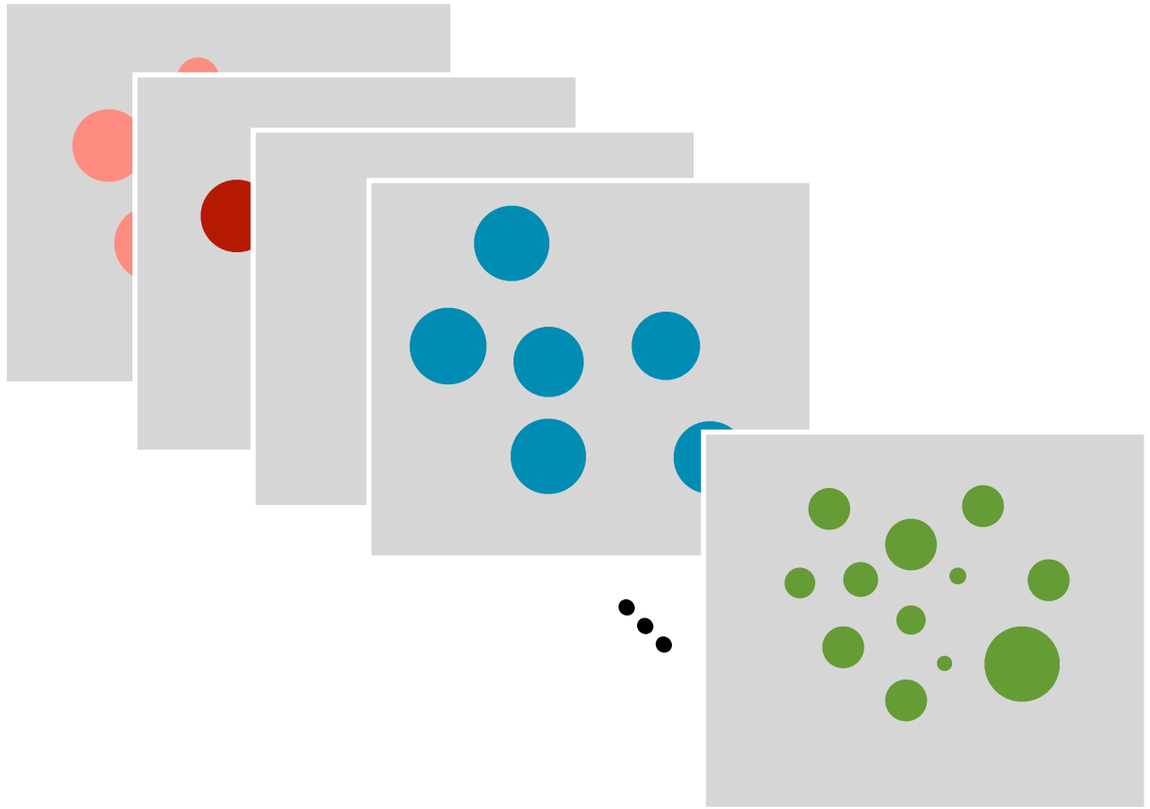
Something new!

Bored...(yawn)
-Habituated-

Something new!

# Even babies can use ensemble representations, too

Testing infants' ability to estimate the approximate number of items



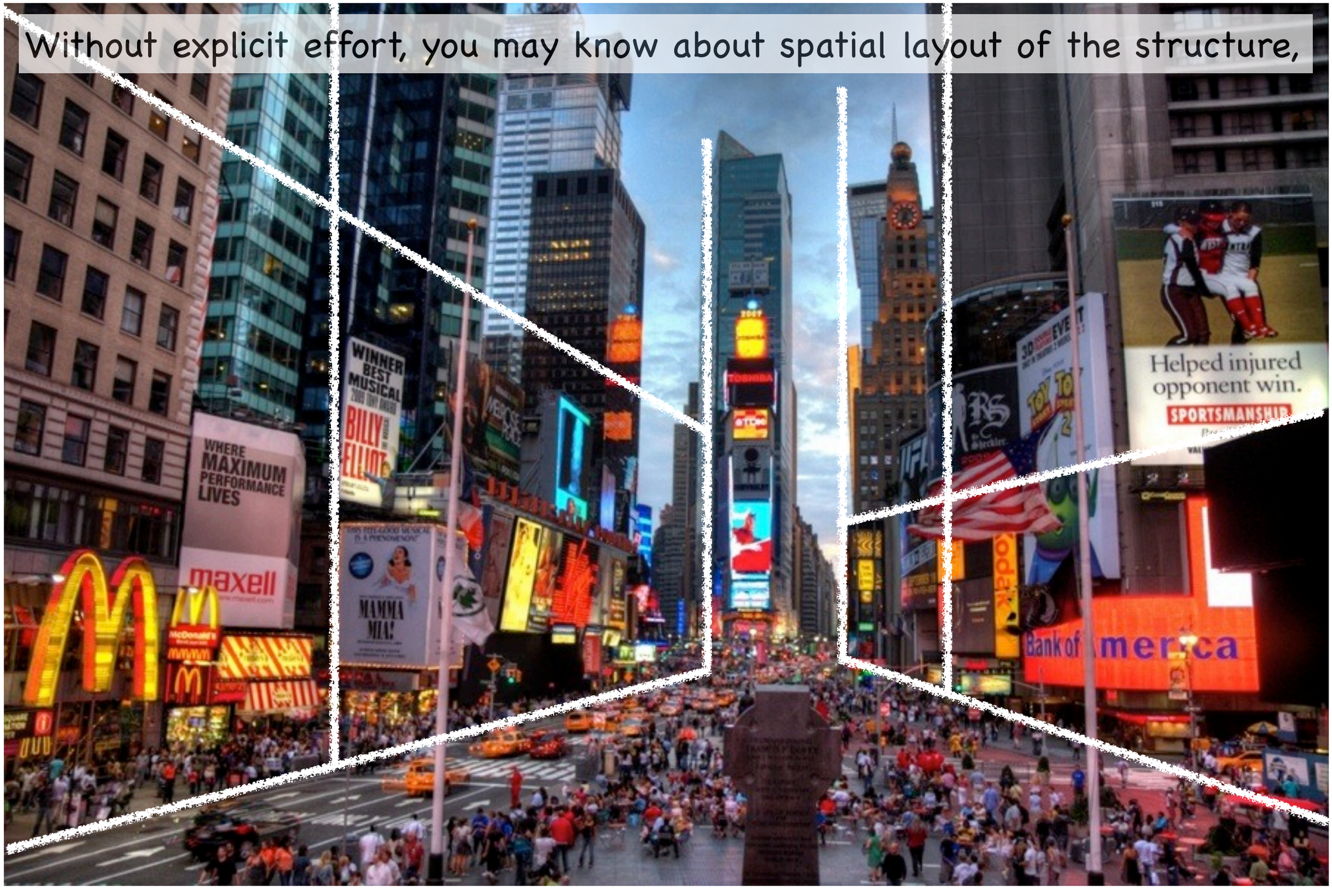
New!!!!

6-month-old infants can successfully discriminate big numbers (with the ratio of 1:2)

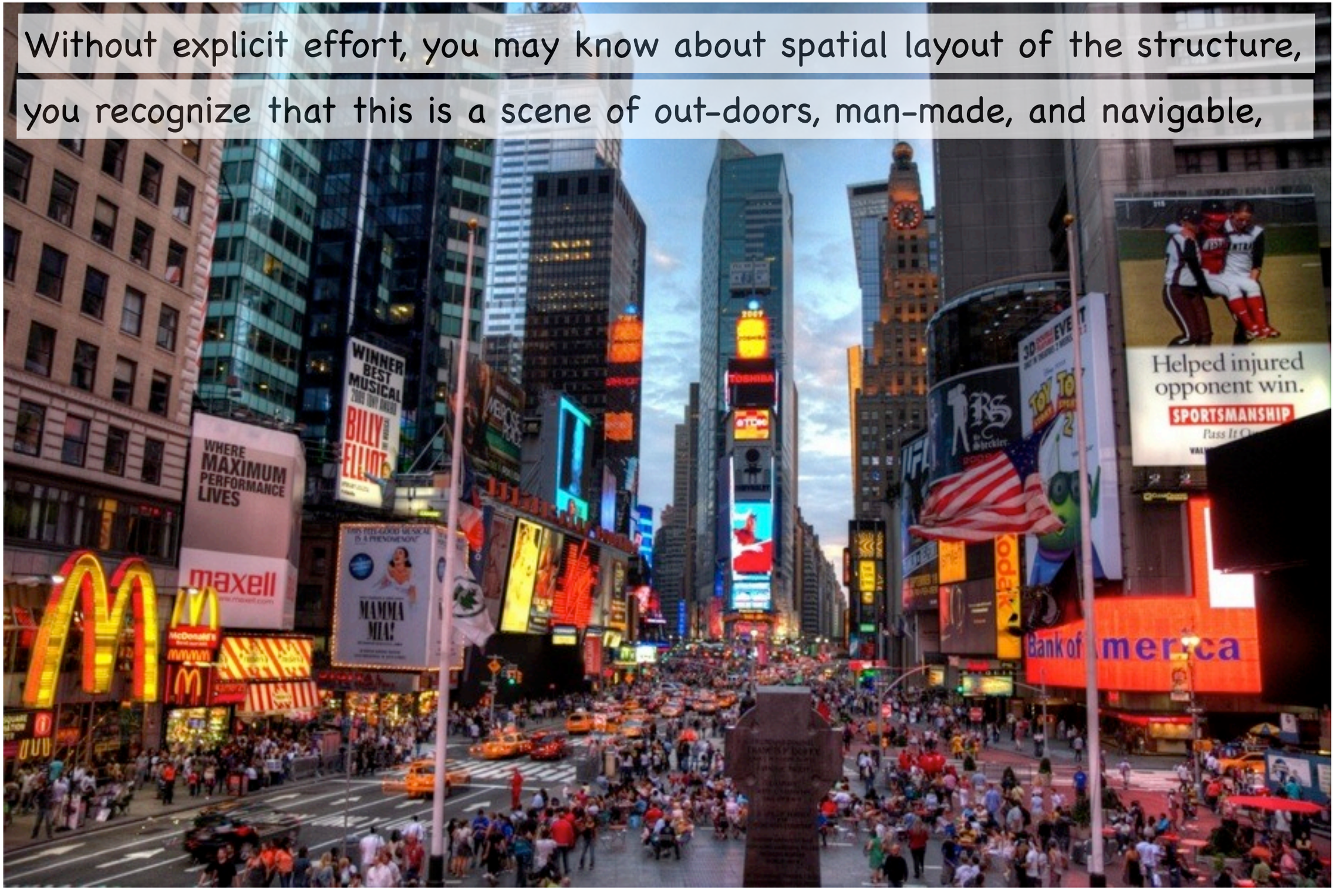
12-month-old infants can successfully discriminate harder ratios (e.g., 2:3 ratio: 12 vs. 18 or 16 vs. 24)

Xu & Spelke (2000)

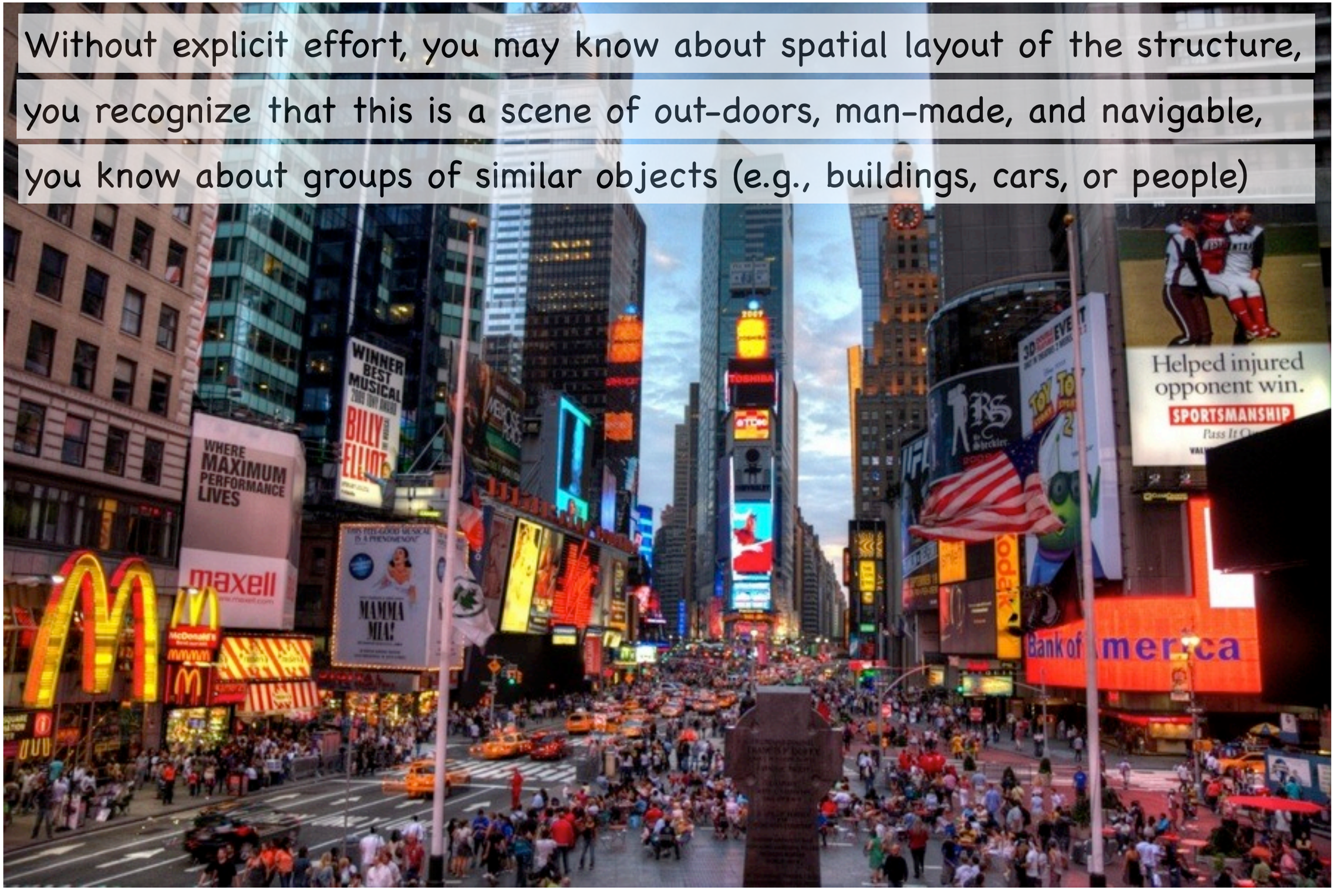
# Global information makes your visual experiences of a scene rich and vivid



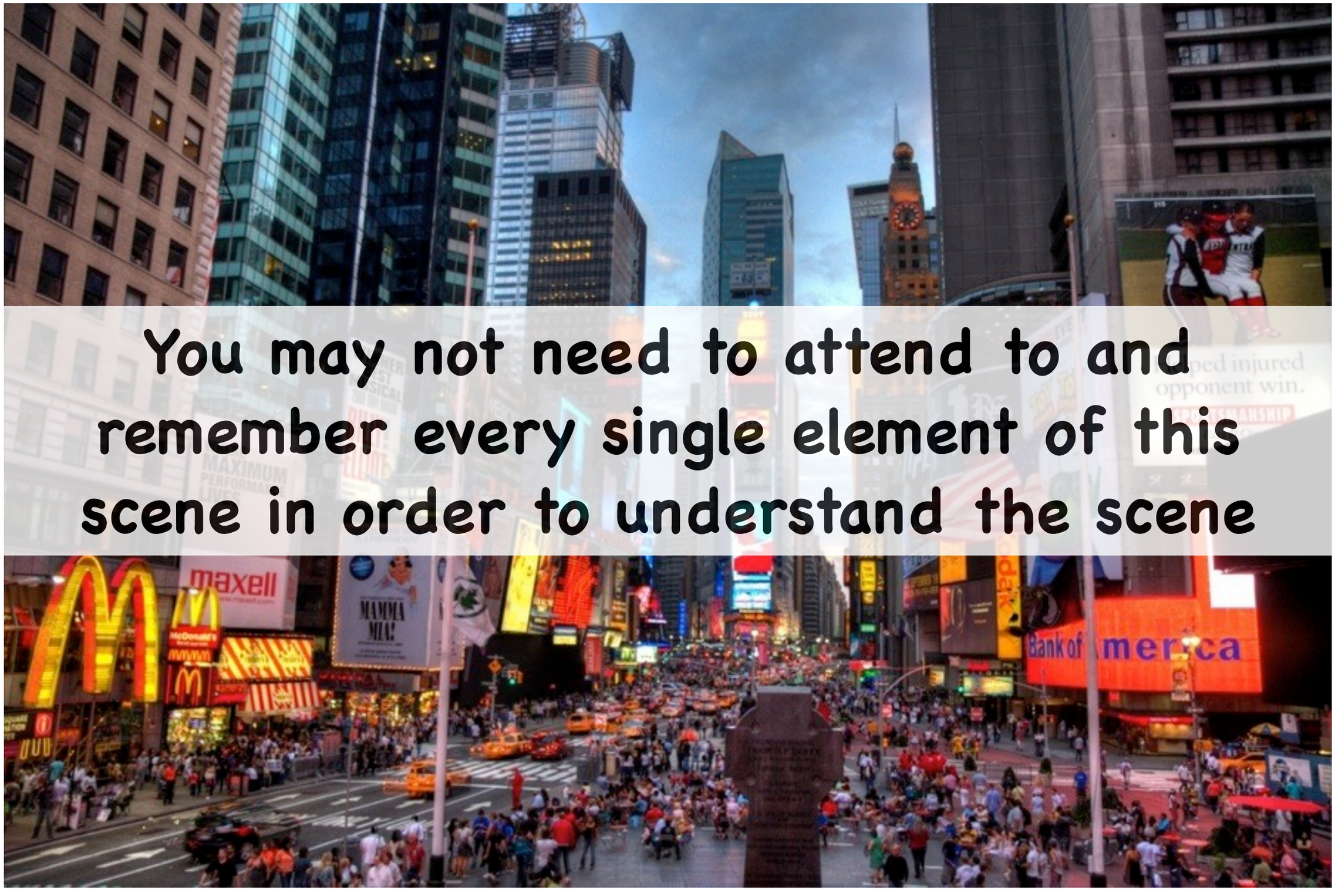
# Global information makes your visual experiences of a scene rich and vivid



# Global information makes your visual experiences of a scene rich and vivid

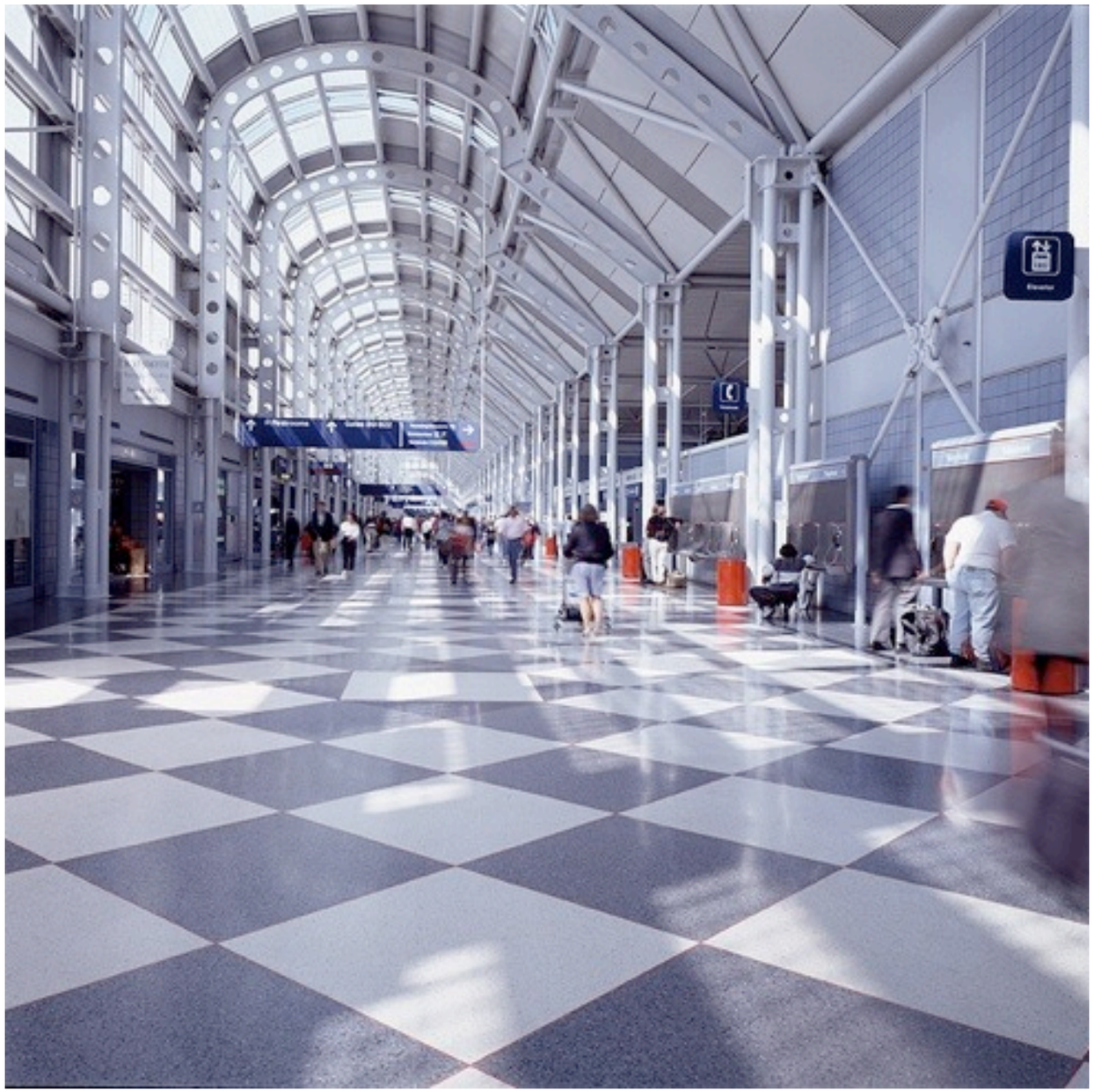


# Global information help you to deal with complex visual scenes efficiently



# Memory for scenes

The last demo for today!
Simply look at pictures for 2 sec each



# Memory for scenes is amazingly good

Participants were shown 10000(!?!!) images for 5 seconds each.

They were about 90% correct about the images when quizzed 2 days later!!

Can you spot one new picture?


Standing (1973)

# Memory for scenes is amazingly good

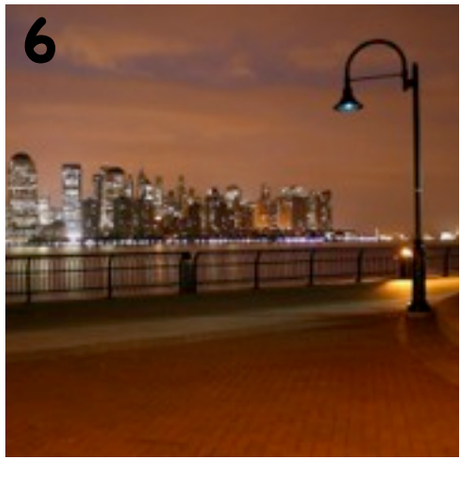
-Because you can understand visual scenes fast and efficiently

-Because you already have so much knowledge about scenes in your long-term memory

Can you spot one new picture?





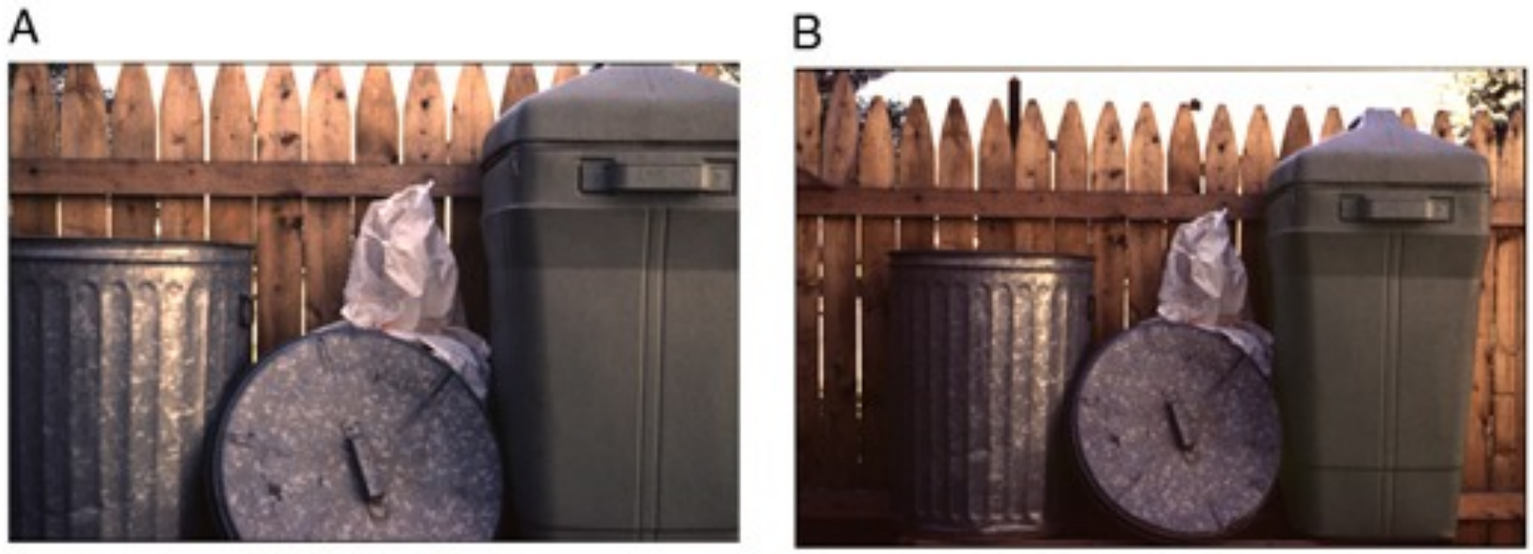







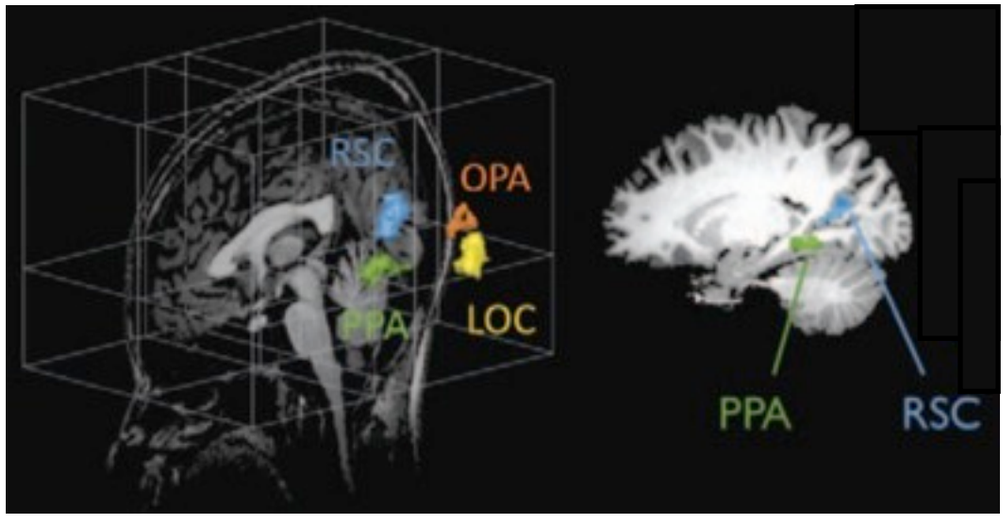
# Boundary extension

People tend to remember having seen a greater expanse of a scene than was actually shown




Intraub & Hoggman (1992)

# Neural basis for scene perception





Parahippocampal place area (PPA)

Retrosplenial complex (RSC)

Complimentary functions of the PPA and RSC

- PPA treats each view of panoramic scene as different images (Viewpoint-specific representation)
- RSC treats different views of panorama as the same stimulus

Together they enable both specific and integrative representations of scenes across several viewpoints

# Summary

1] Conscious perception limited by attention and memory
- Motion-induced blindness & Change blindness
- Limited memory capacity (up to 4 items)

2] Effect by unseen stimulus
- Subliminal perception
- Attention attracted by suppressed image

3] Global processing for scene perception
- Fast, non-selective
- Gist, Spatial layout, Ensemble representations
- Remarkable memory for scenes (however, boundary extension!)
- Neural basis for scene perception: PPA & RSC (complementary & integrative)

Next week...