

# **9.00 Lecture -- Attention**

**John Gabrieli**

# **What is *attention*?**

- **“Everyone knows what attention is. It is the taking possession by the mind in clear and vivid form of one out of what seem several simultaneous objects or trains of thought... It implies withdrawal from some things in order to deal with others.”**

**- William James, 1890**

# ATTENTION

- awareness/consciousness
- we often attend to more than we realize
- we often attend to less than we realize

# **ATTENTION & CONSCIOUSNESS**

- 1. Attention as gatekeeper to perception and knowledge**
- 2. Attention is very limited - one thing at a time**  
**(we miss a lot)**
- 3. Unconscious/Unattended processes**  
**(do things we not notice influence us?)**
- 4. Some external stimuli “capture” our attention -**  
**“bottom-up” processing**
- 5. Some internal thoughts & goals direct our attention -**  
**“top-down” processing**

# Selective Visual Attention

Somewhere **Among** hidden **the** in **most** the  
**spectacular** Rocky Mountains **cognitive** near  
**abilities** Central City is Colorado **the** an **ability** old to  
miner **select** hid **one** a **message** box from of  
**another.** gold. **We** Although **do** several **this** hundred  
**by** people **focusing** have **our** looked **attention** for  
**on** it, **certain** they **cues** have **such** not as found **type**  
**it** or yet **style.**

# **Attention and Auditory Awareness**

- **Dichotic Listening/Shadowing Demo**

# SHADOWING & ATTENTION

## (Cherry, 1953)

- left ear - shadowed message
- right ear - second message

*What could be heard in unattended ear?*

- if a voice is present
- voice changes from man to woman
- voice becomes a tone

*What was not heard in unattended ear?*

- content of message
- language of message
- change in language of message
- speech vs. nonsense backward speech

# **SHADOWING & ATTENTION**

**(Cherry, 1953)**

**Paradox of cocktail party effect:**

**How can we notice something we do not attend to?**



# SHADOWING & ATTENTION

(MacKay, 1973)

- shadowed ear

*"The man approached the bank."*

- other ear

*"money" or "river"*

paraphrase

"The man went to the savings and loan association"

"The man went to the side of the river"

(Eich, 1984)

- shadowed ear

*essay*

- other ear

taxi fare (fair)

Recognition  
Spelling Bias

Attended

88 %

40%

Unattended

12%

41%

# SHADOWING & ATTENTION

(Cherry, 1953)

**Paradox of cocktail party effect:**

**How can we notice something we do not attend to?**

*some kinds of information are processed automatically/  
without attention*

# **ATTENTION & CONSCIOUSNESS**

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**A Penny for Your Thoughts**

# Attention and Memory

- **Less than half the participants thought the correct version of the penny was even a *plausible* answer.**
- **Without attention, learning is very hard, even with many, many exposures.**

# ATTENTION

- *controlled* or *top-down*

**conscious, effortful, selective, focused**

**goal driven**

**demands a lot of attention**

- *automatic* or *bottom-up*

**unconscious, easy**

**stimulus-driven**

**demands little or no attention**

# Stroop Effect

## Word Set #1

RED	GREEN	BLUE	YELLOW	PINK
ORANGE	BLUE	GREEN	BLUE	WHITE
GREEN	YELLOW	ORANGE	BLUE	WHITE
BROWN	RED	BLUE	YELLOW	GREEN
PINK	YELLOW	GREEN	BLUE	RED

Name the words – easy, automatic reading

## Word Set #2

RED	GREEN	BLUE	YELLOW	PINK
ORANGE	BLUE	GREEN	BLUE	WHITE
GREEN	YELLOW	ORANGE	BLUE	WHITE
BROWN	RED	BLUE	YELLOW	GREEN
PINK	YELLOW	GREEN	BLUE	RED

**Name the color of the PRINT – harder because of conflict between automatic reading process and controlled print naming**



# HYPNOSIS & STROOP EFFECT

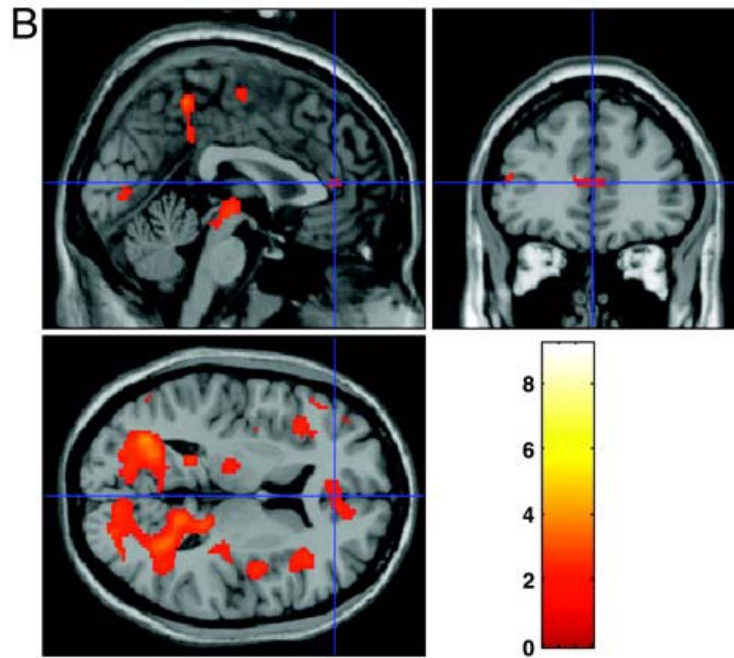
- Raz et al, 2008
- high & low hypnotizeable subjects
- perform normally
- meaningless characters in a foreign language you do not know
- interference

low subjects - 104 msec, 121 msec  
(hyp)

• high subjects - 157 msec, 5 msec  
(hyp)

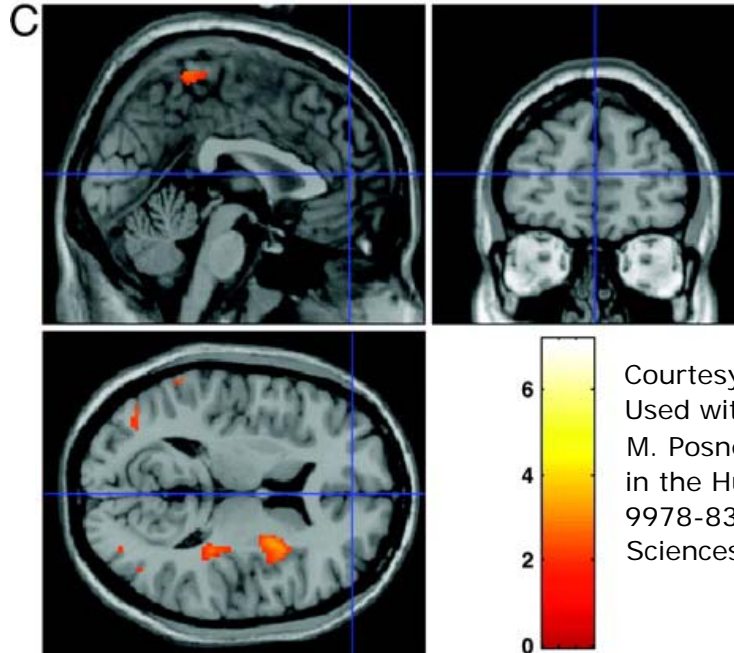
## High-Hypnosis Subjects

*No Hypnosis Activation for Incongruent > Congruent*



## High-Hypnosis Subjects

*Hypnosis Activation for Incongruent > Congruent*



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# ATTENTION

- *controlled* or *top-down*

**conscious, effortful, selective, focused**

**goal driven**

**demands a lot of attention**

- *automatic* or *bottom-up*

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# Visual Search

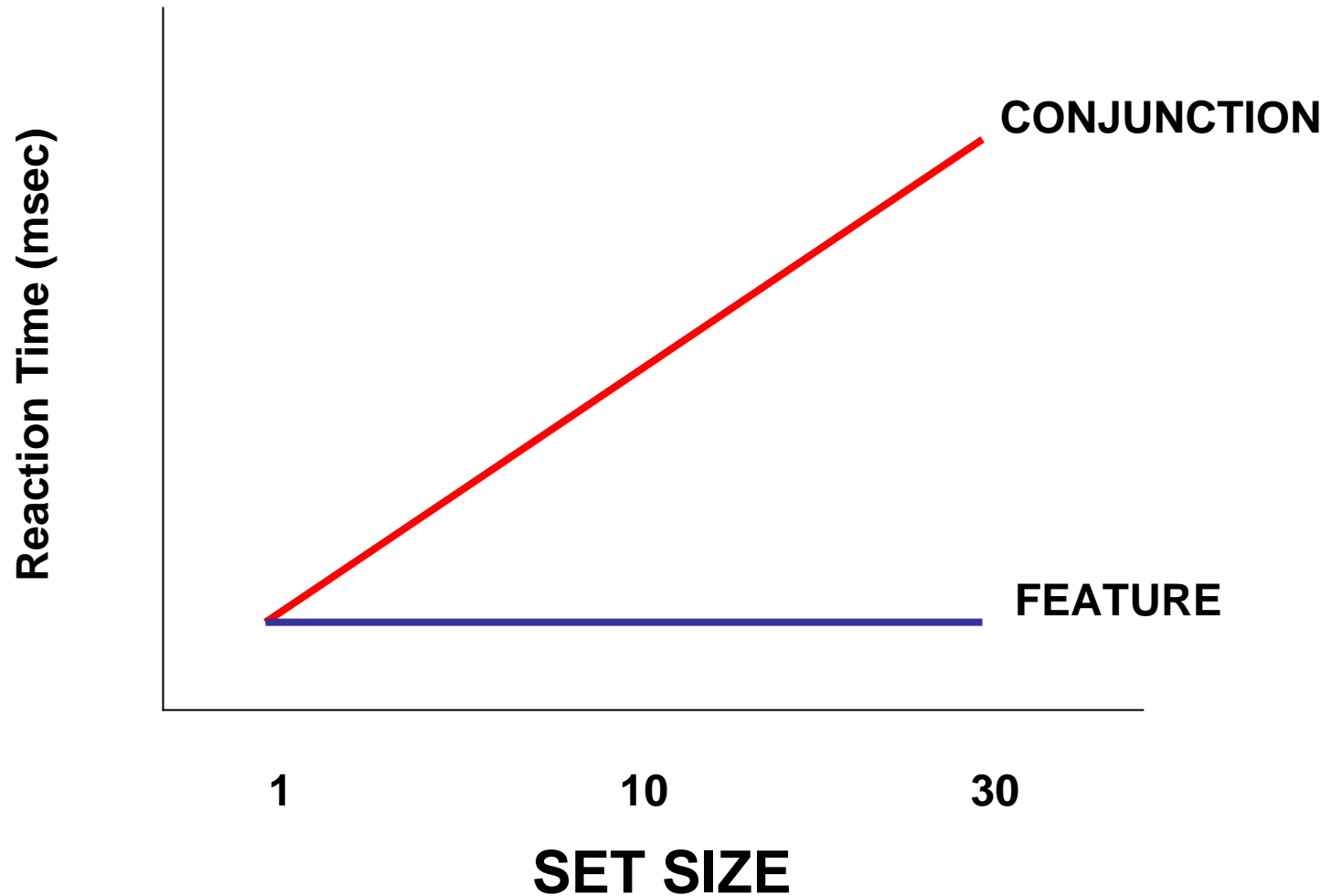
- *is there a red X in the display?*

# Features & Conjunctions

- *Features - defined by one dimension*  
shape (X,O), color (black, red)
- *Conjunctions - defined by co-occurrence of two dimensions*

X   O   X   O

# TWO KINDS OF VISUAL SEARCH



# TWO KINDS OF VISUAL SEARCH

## Preattentive

features

parallel

pop-out

flat slope

## Attentive

conjunctions

serial

no pop-out

steep slope

# **ILLUSORY CONJUNCTIONS**

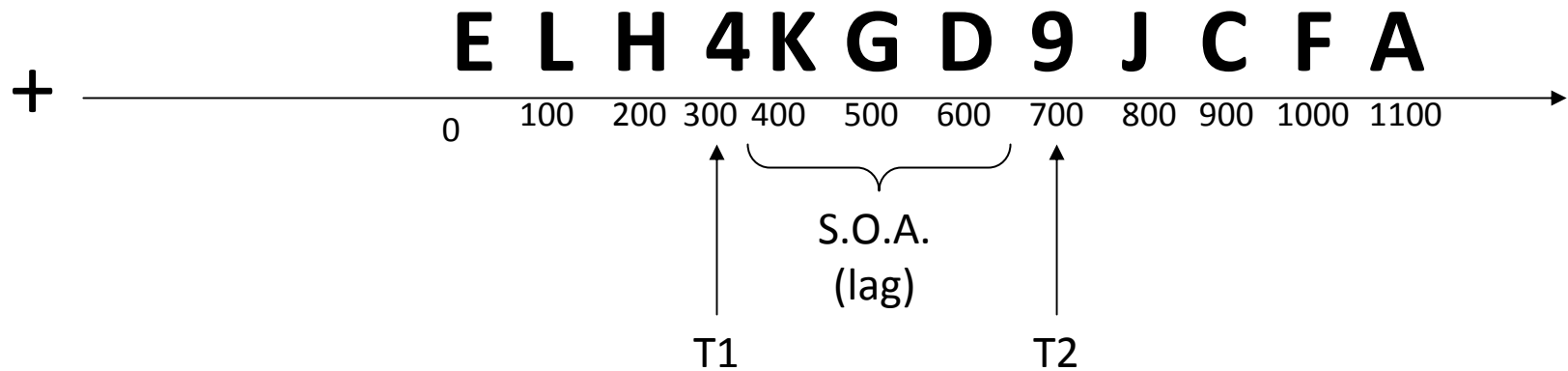
**Controlled attention  
binds features into  
coherent perceptions**



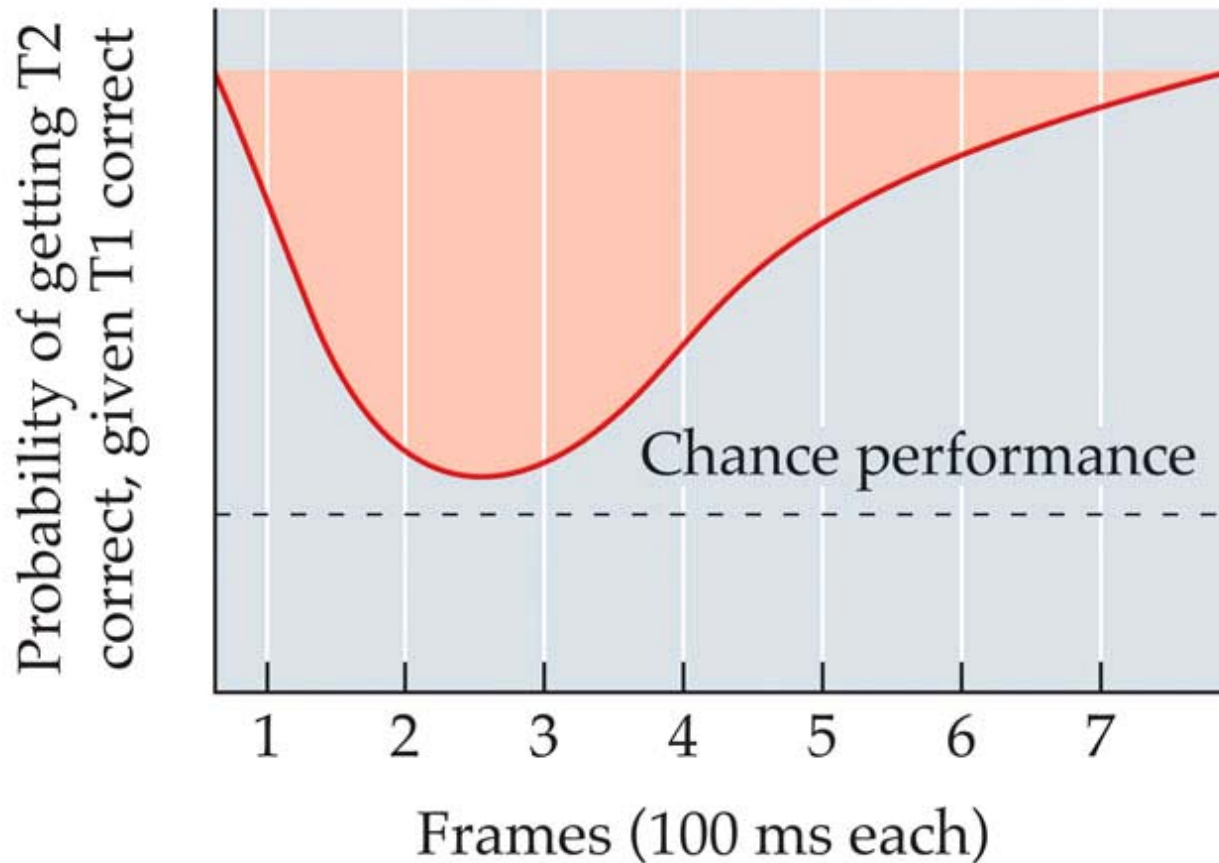
# Limits of Attention

- **Attention is a very constrained resource.**
  - **Temporal constraints**

# Attentional Blink



# Attentional Blink



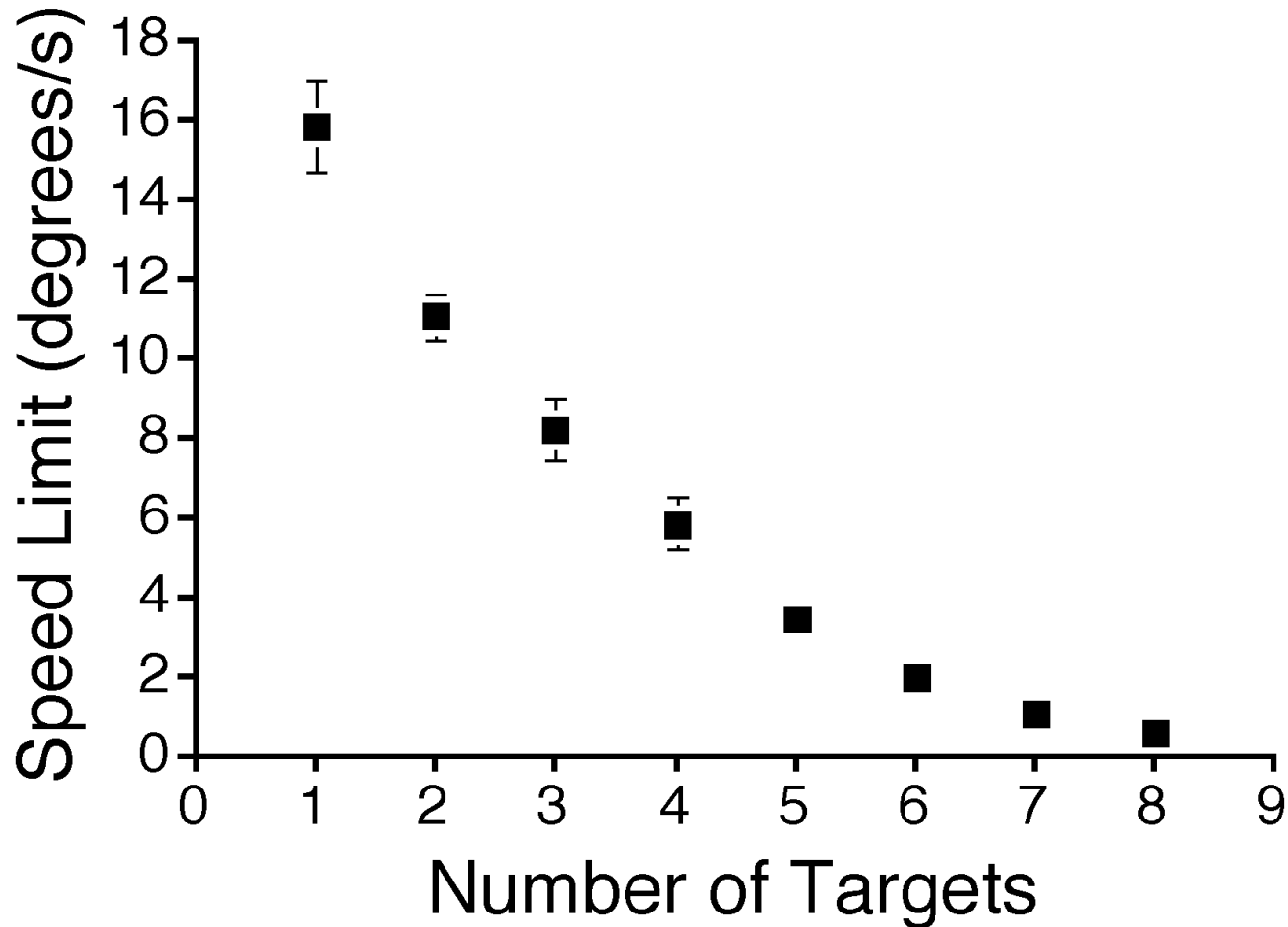
SENSATION AND PERCEPTION, Figure 8.19 © 2008 Sinauer Associates, Inc.

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# Limits of Attention

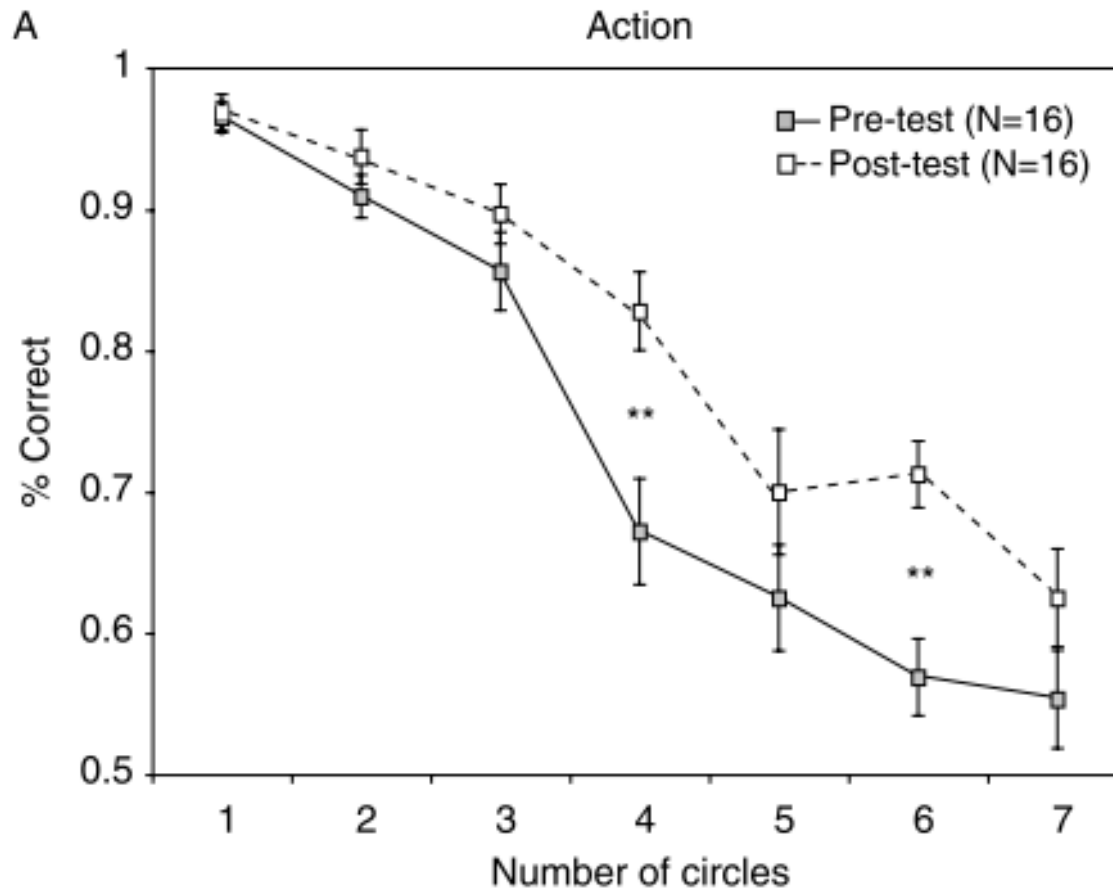
- **Attention is a very constrained resource.**
  - **Temporal and spatial constraints**

# Multiple Object Tracking



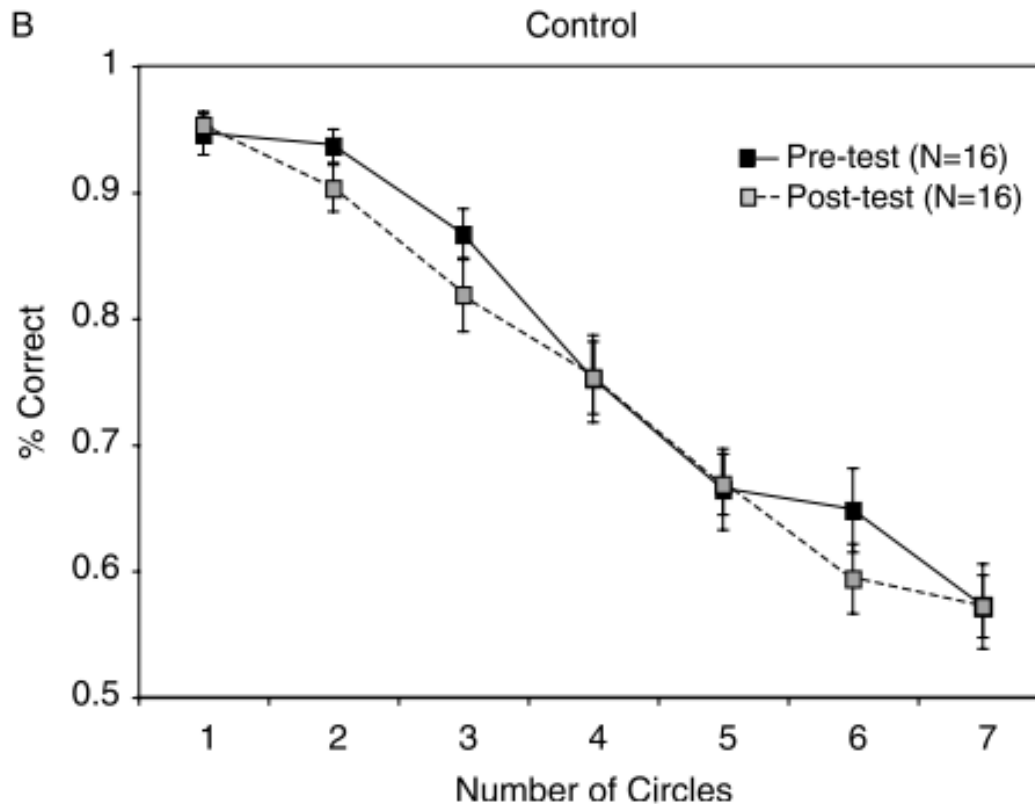
**How many targets can be accurately tracked**

# Number of Objects Tracked after 30h of Action Video Game training



Courtesy of Elsevier, Inc., <http://www.sciencedirect.com>. Used with permission. Source: Green, C., and D. Bavelier. "Enumeration Versus Multiple Object Tracking: The Case of Action Video Game Players." *Cognition* 101, no. 1 (2006): 217-45.

# Number of Objects Tracked in Control Group (Tetris) (No Improvement)



Courtesy of Elsevier, Inc., <http://www.sciencedirect.com>. Used with permission. Source: Green, C., and D. Bavelier. "Enumeration Versus Multiple Object Tracking: The Case of Action Video Game Players." *Cognition* 101, no. 1 (2006): 217-45.

# **Subliminal Perception**

- **Can non-attended stimuli still influence our actions?**



**KNOWING WITHOUT SEEING**

***SUBLIMINAL PERCEPTION***

# KNOWING WITHOUT SEEING SUBLIMINAL PERCEPTION

CHURCH



DOCTOR

*slower*

NURSE



DOCTOR

*faster*

XXXX

CHURCH

*(10 msec)*

XXXX



DOCTOR

*slower*

XXXX

NURSE

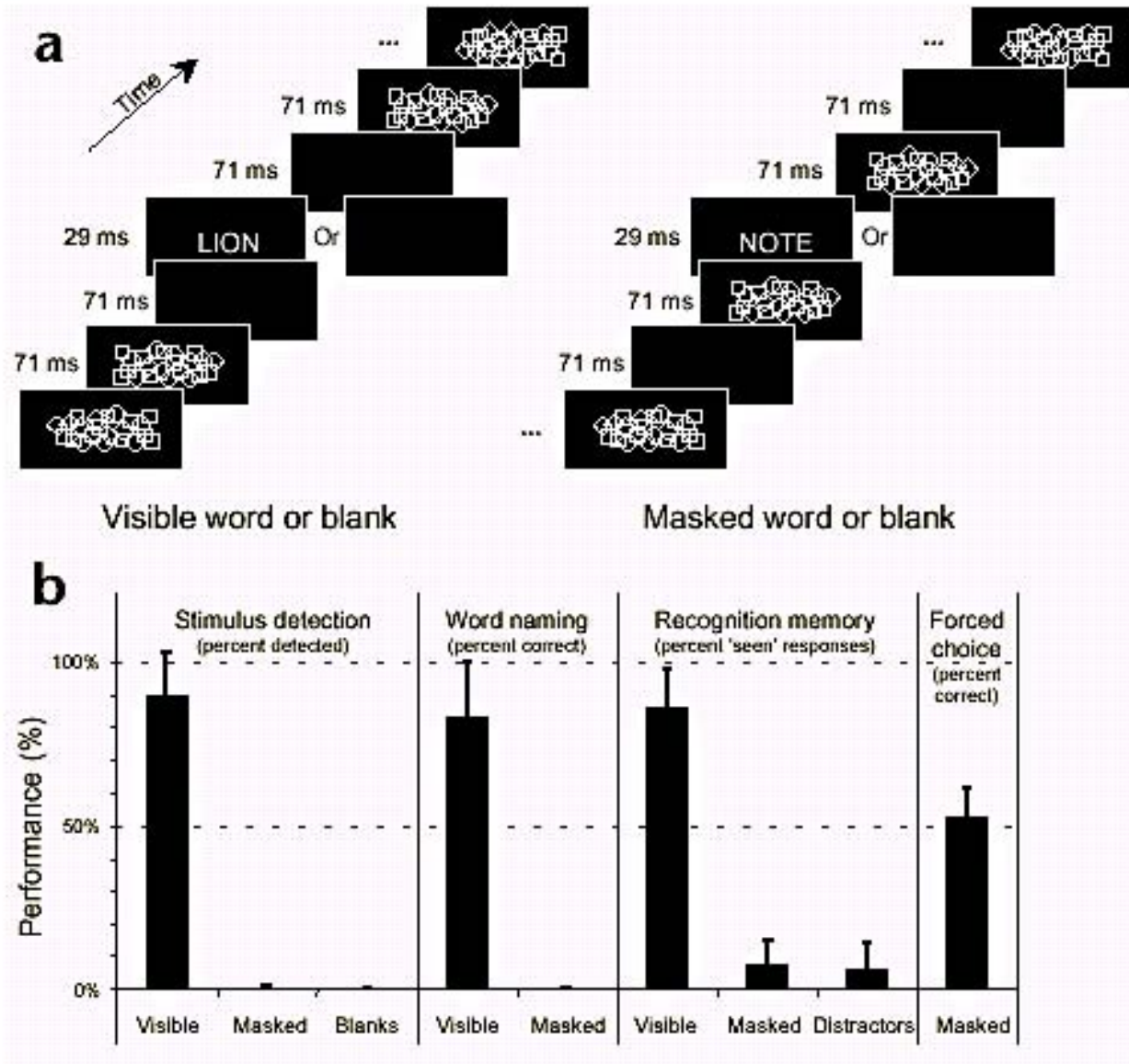
XXXX



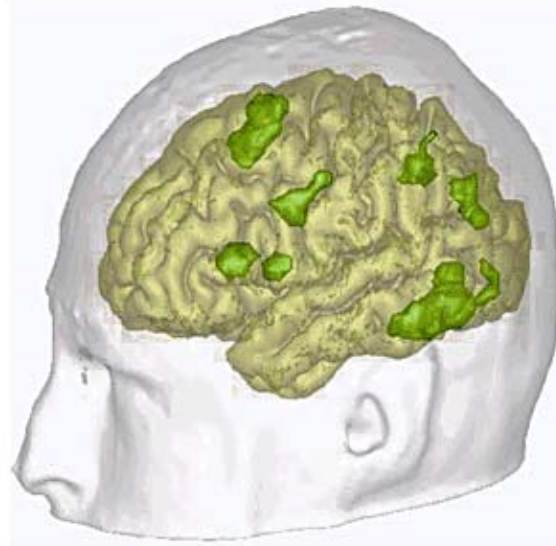
DOCTOR

*faster*

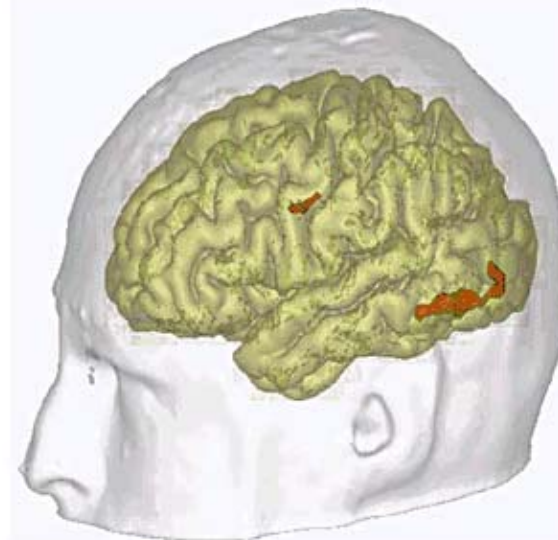
# DESIGN AND BEHAVIORAL RESULTS



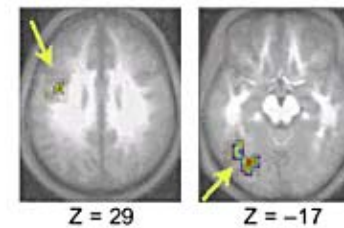
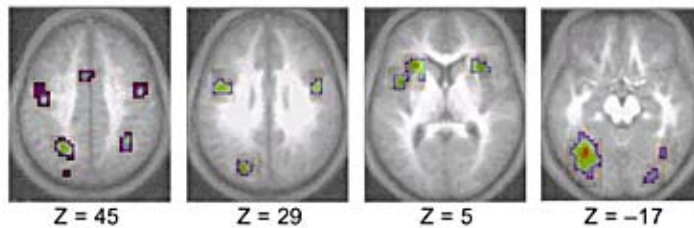
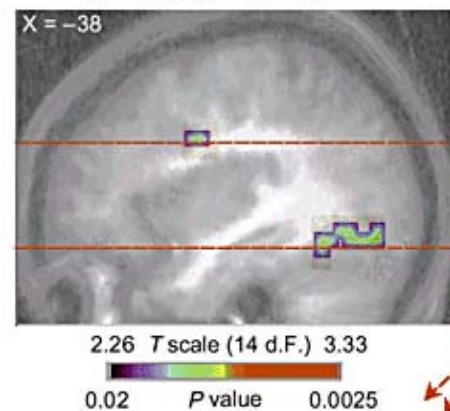
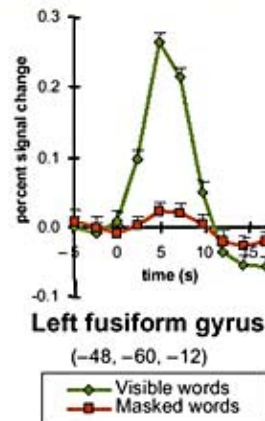
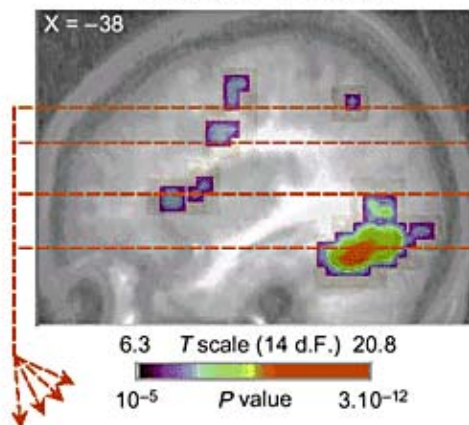
# fMRI



**Visible words**



**Masked words**



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