Psyc2207
Oppmerksomhet 3

Thomas Espeseth

Aug2016

What is attention?

- "Everyone knows what attention is. It is the taking possession of the mind in clear and vivid form of one out of what seem several simultaneous objects or trains of thought." (James, 1890).

- "In involuntary attention of the immediate sensorial sort the stimulus is either a sense-impression, very intense, voluminous, or sudden; or it is an instinctive stimulus, a perception which, by reason of its nature rather than its mere force, appeals to some of our congenital impulses

  … these stimuli differ from one animal to another, and what most of them are in man: strange things, moving things, wild animals, bright things, pretty things, metallic things, blows, blood, etc." (James, 1890)

What is attention?

- No one knows what attention is, and . . . there may even not be an “it” there to be known about (although of course there might be). (Pashler, 1998, p. 1)

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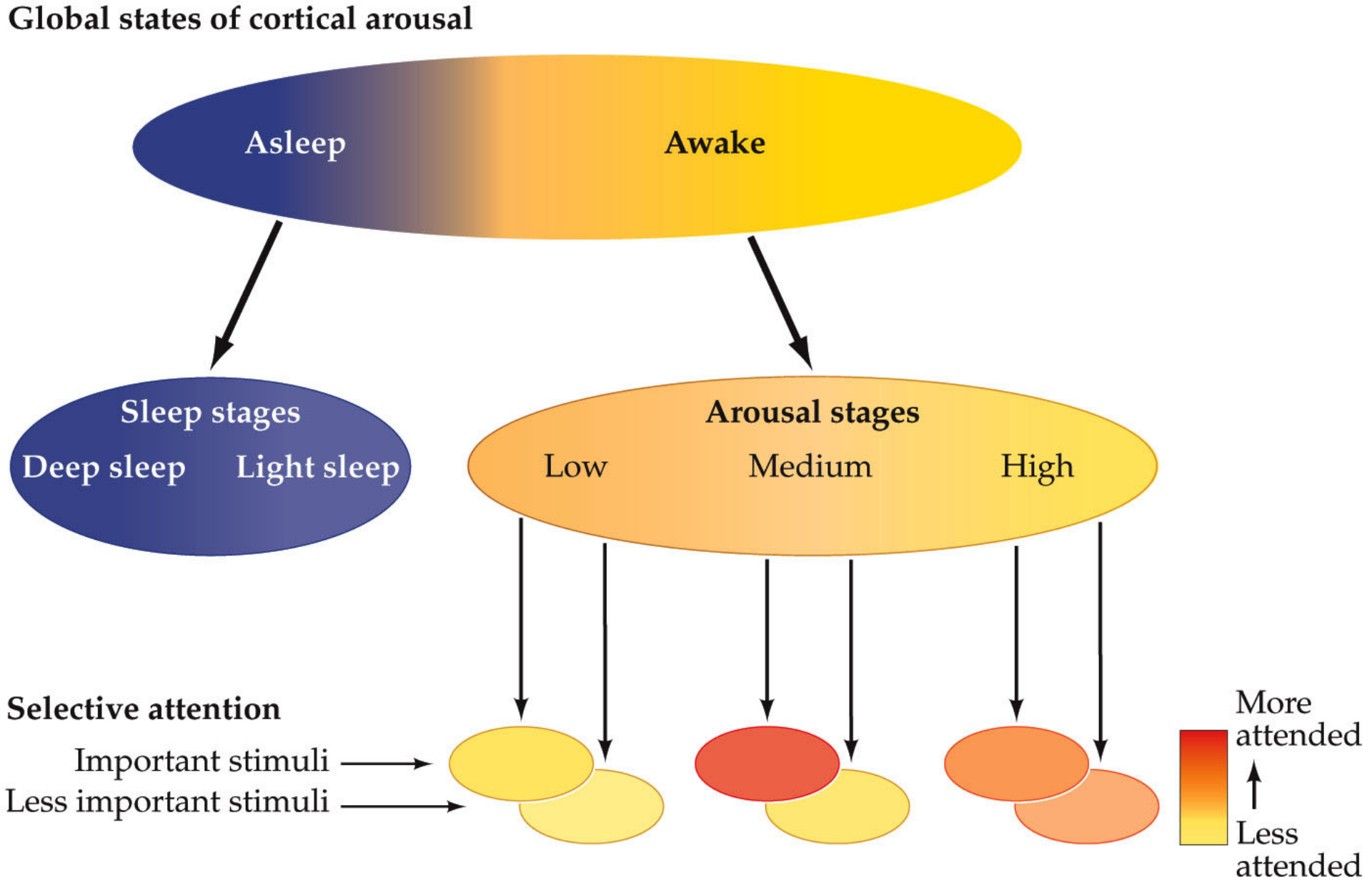
- "…we are left with wondering if the attempt to elucidate the nature of selective attention emprically is ultimately a futile one" (Johnston & Dark, 1986)

- …a dull, sinking feeling comes with the acknowledgment that James was much brighter than we and he eventually abandoned psychology altogether." (Johnston & Dark, 1986)



***Principles of Cognitive Neuroscience*, Figure 10.1**

What is attention?

- William James (1890/1983) distinguished between attention as an *effect* and attention as a *cause*. The former, conceptualized as the end product of attentive analyses, is readily available to phenomenological introspection.

- The latter, the mechanisms thought to generate the product of attention, can not be captured by introspective analyses.

- This distinction is fundamental in modern theories on attention as well. For example, LaBerge (1995) separates the *expression* of attention, and the *mechanism(s)* by which that expression is achieved.

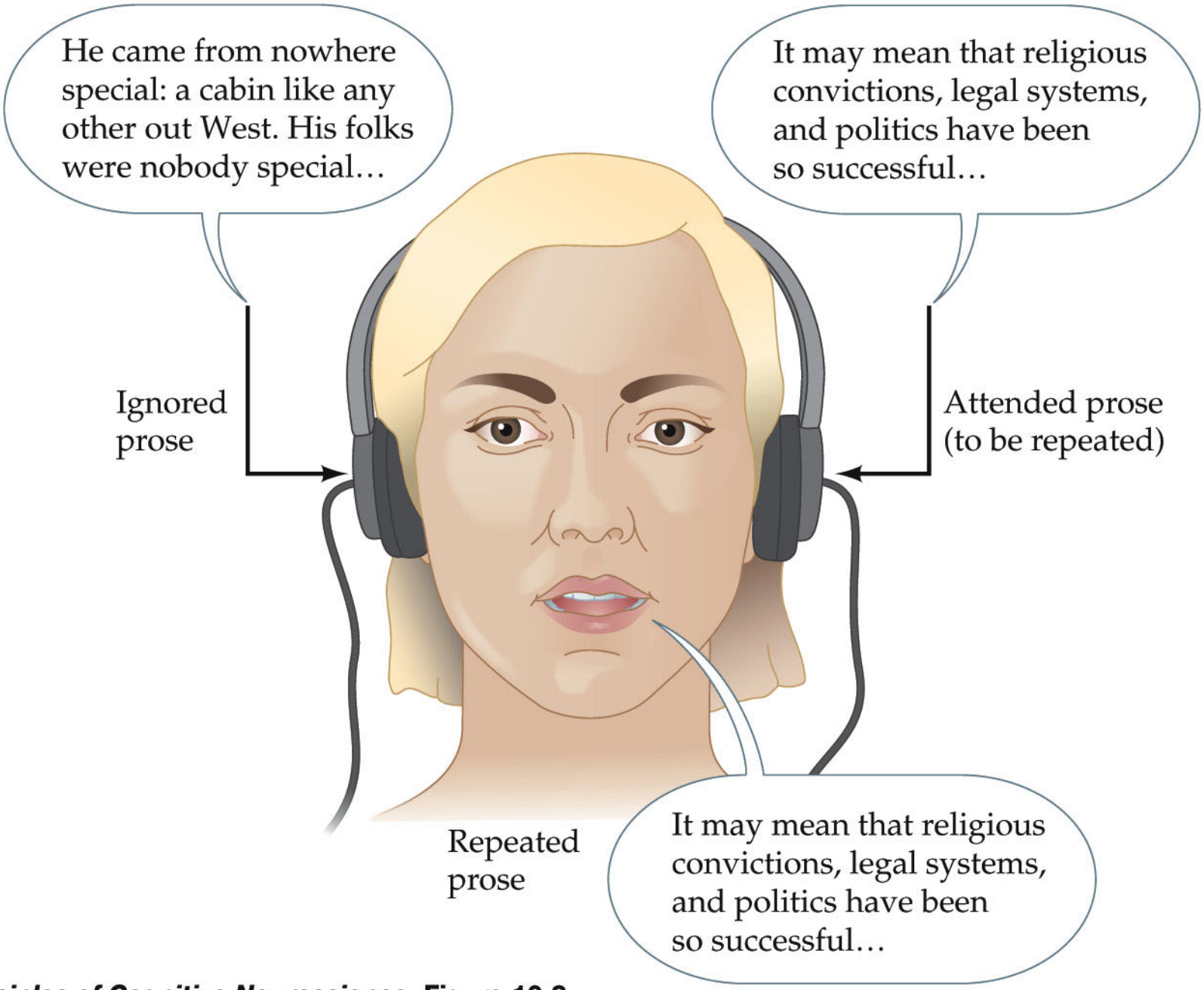
- Experimental psychology typically focus on attentional mechanisms.

What is attention?

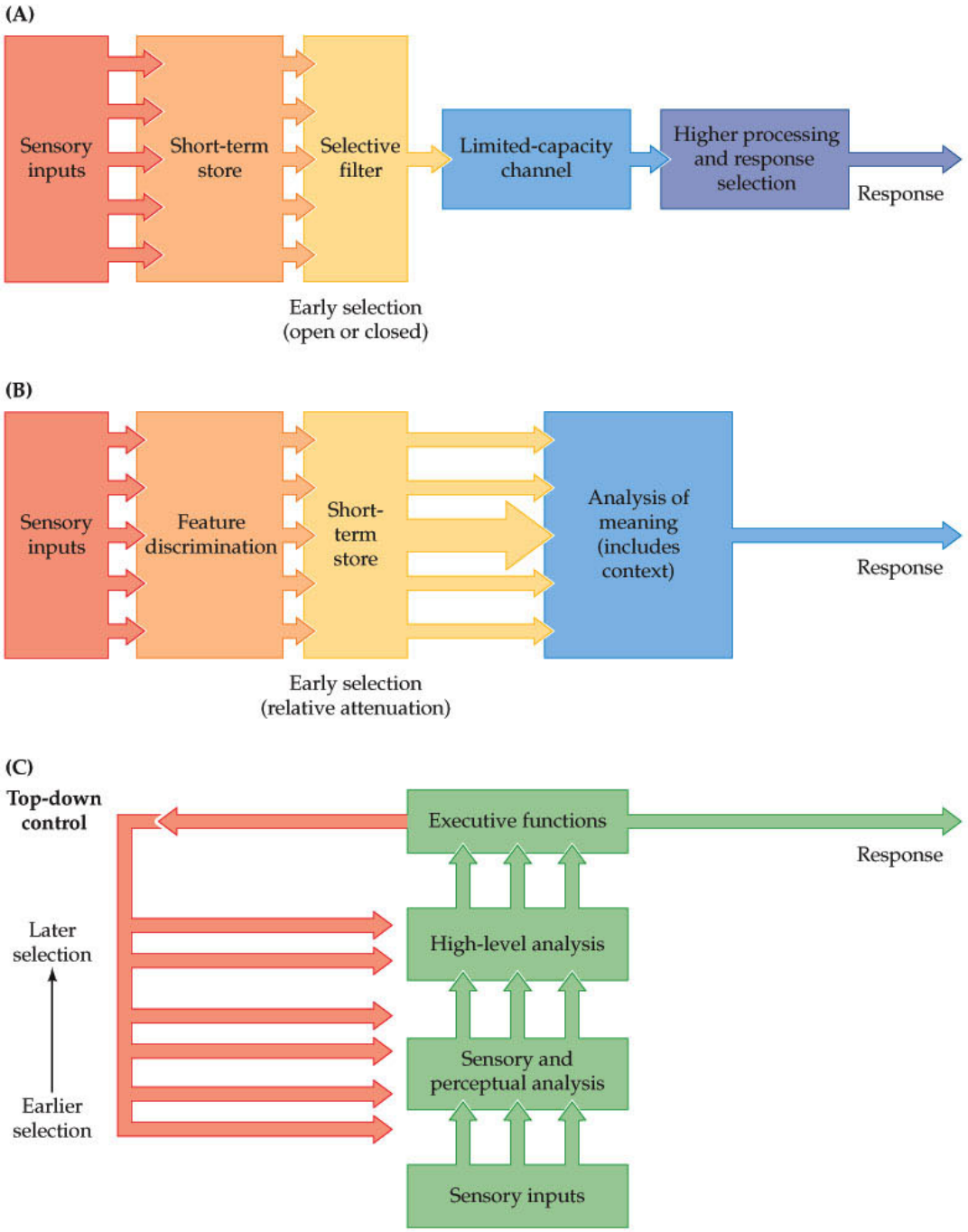
- Another important distinction is that between voluntary and involuntary process

- Roughly similar pairs of concepts are:
  - top-down vs. bottom-up
  - goal-directed vs. stimulus-driven
  - endogenous vs. exogenous

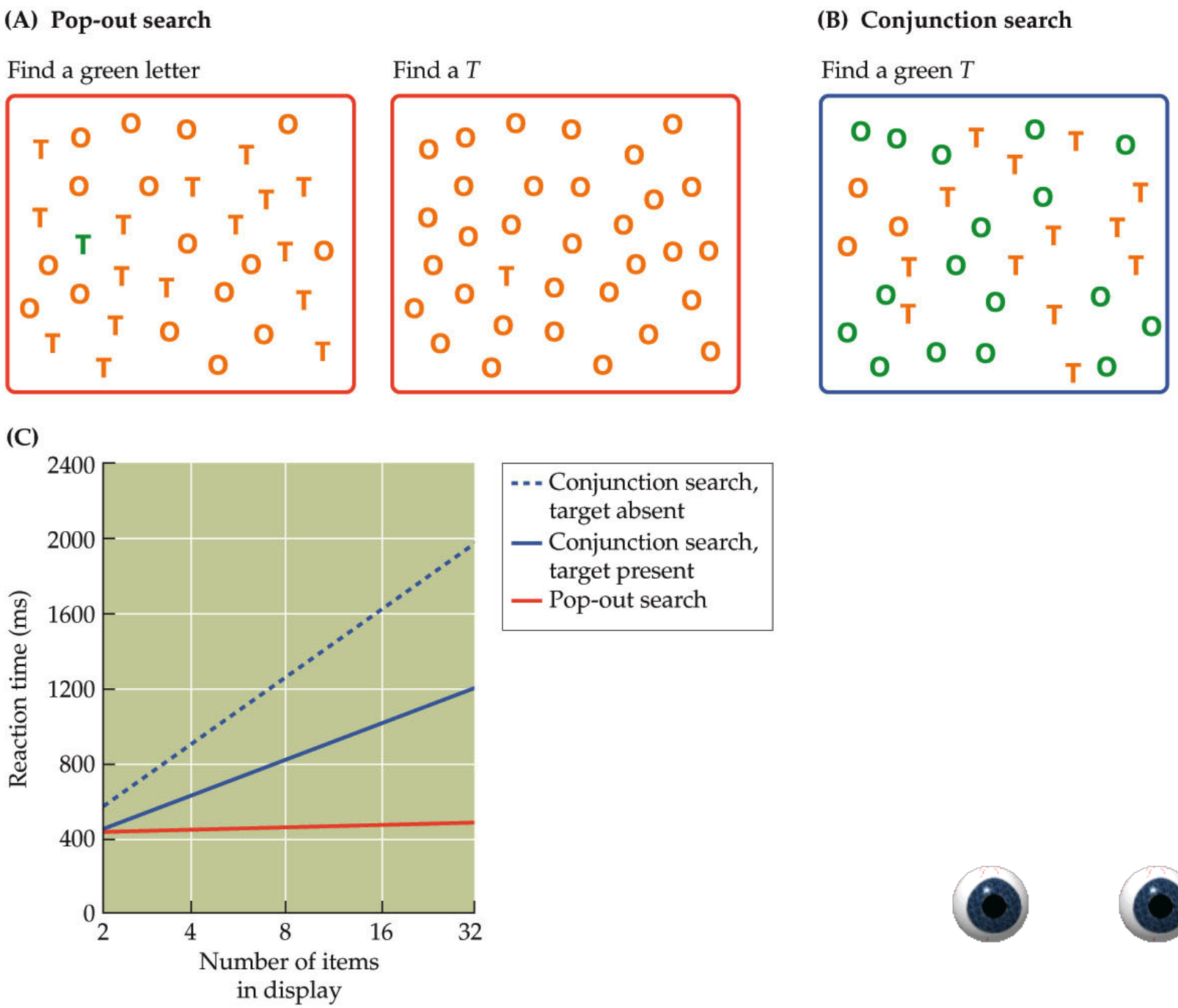
- The distinction is between selection generated by behaviorally relevant goals of the organism, and selection generated by properties of the stimuli themselves



***Principles of Cognitive Neuroscience*, Figure 10.3**

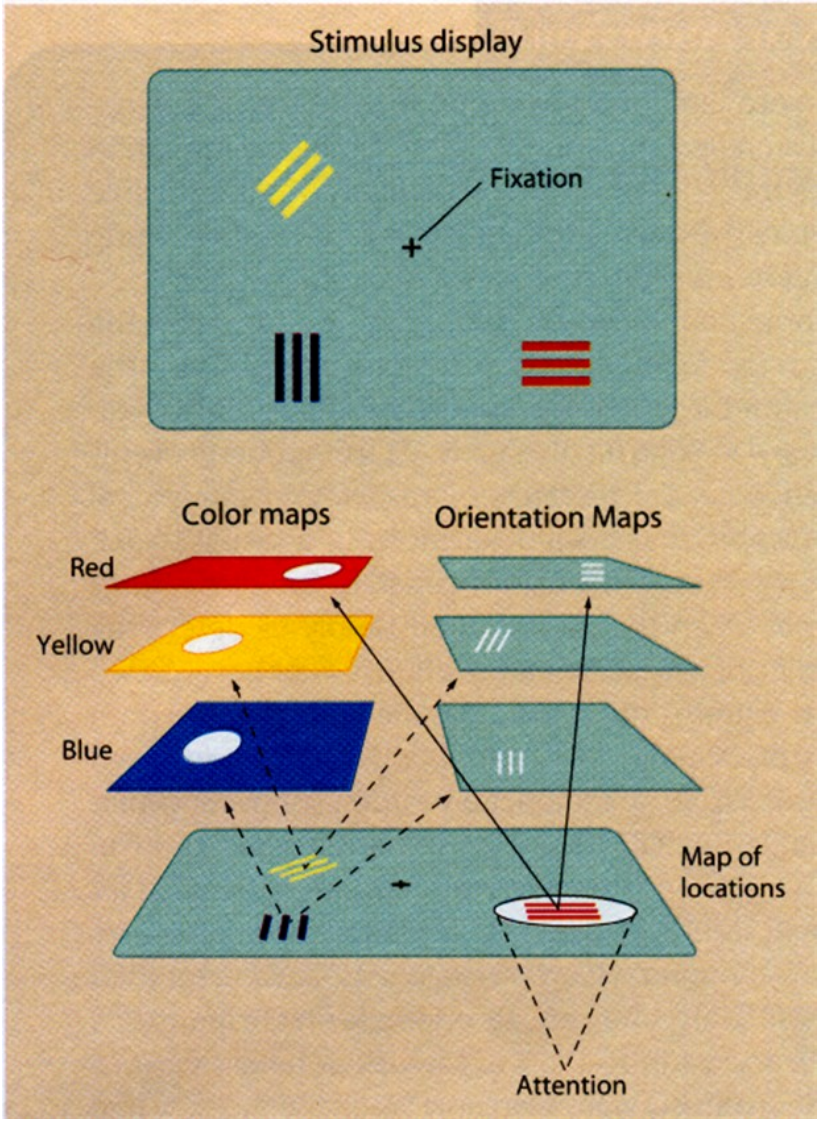


***Principles of Cognitive Neuroscience*, Figure 10.4**

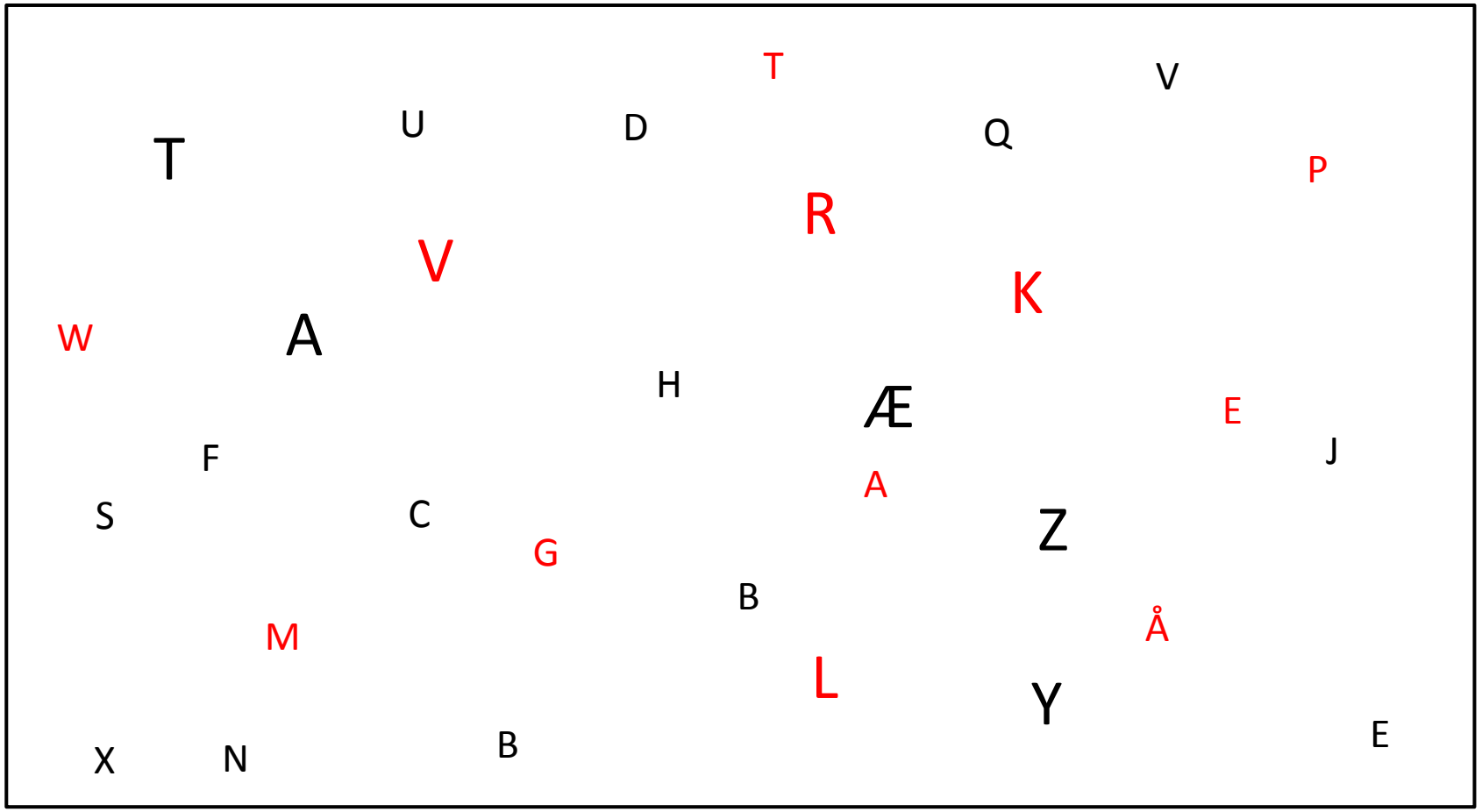


***Principles of Cognitive Neuroscience*, Figure 10.9**

Feature Integration Theory



Feature guidance: Finding an “F” versus a red “A”



Journal of Experimental Psychology:
Human Perception and Performance
1989, Vol. 15, No. 3, 419-433

0096-1523/89/$00.75

Guided Search: An Alternative to the Feature Integration Model for Visual Search

Jeremy M. Wolfe, Kyle R. Cave, and Susan L. Franzel
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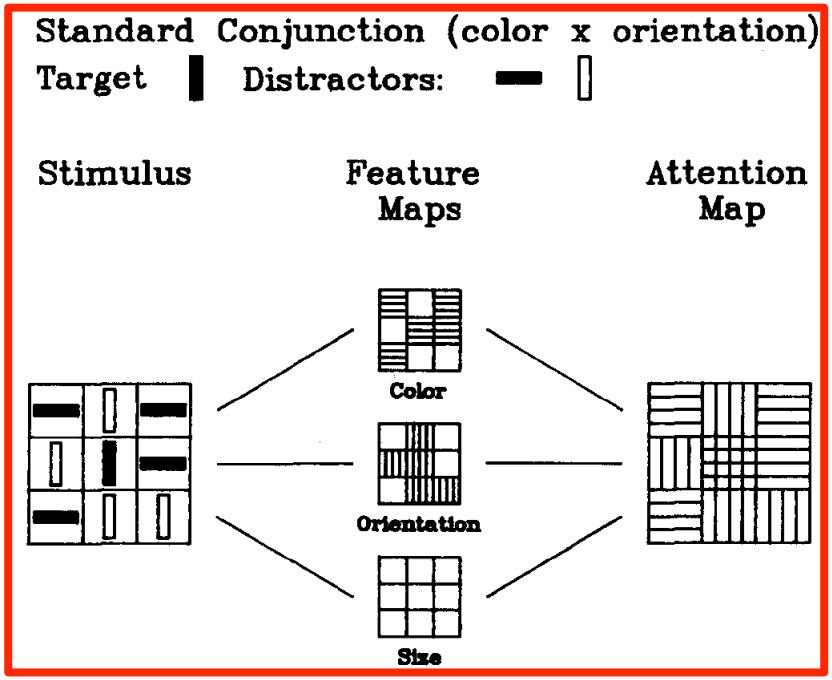

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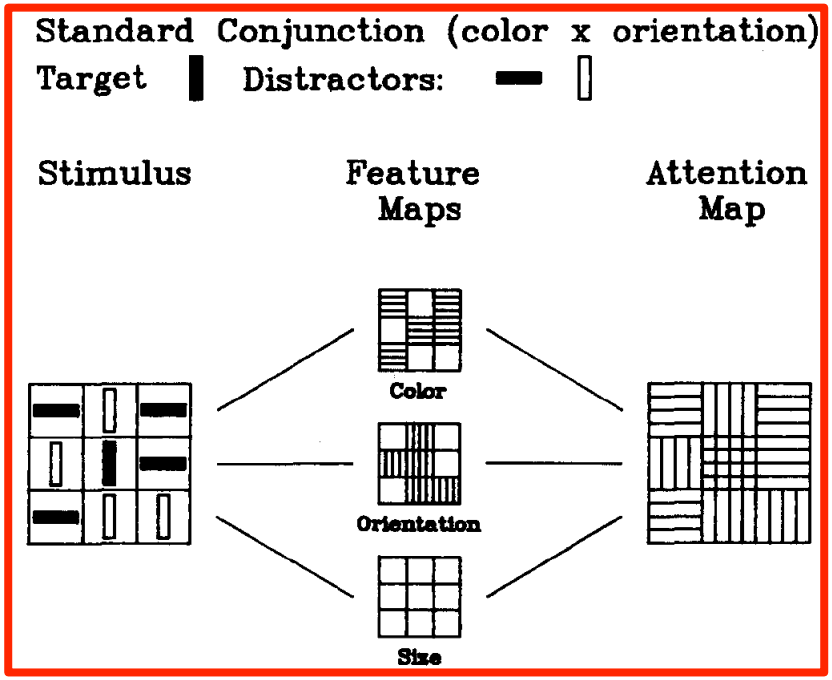
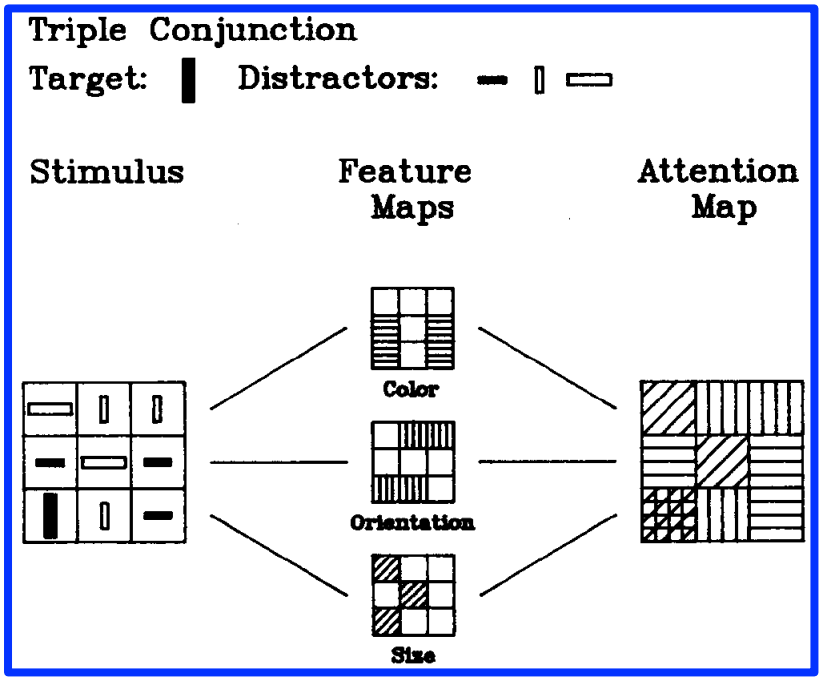
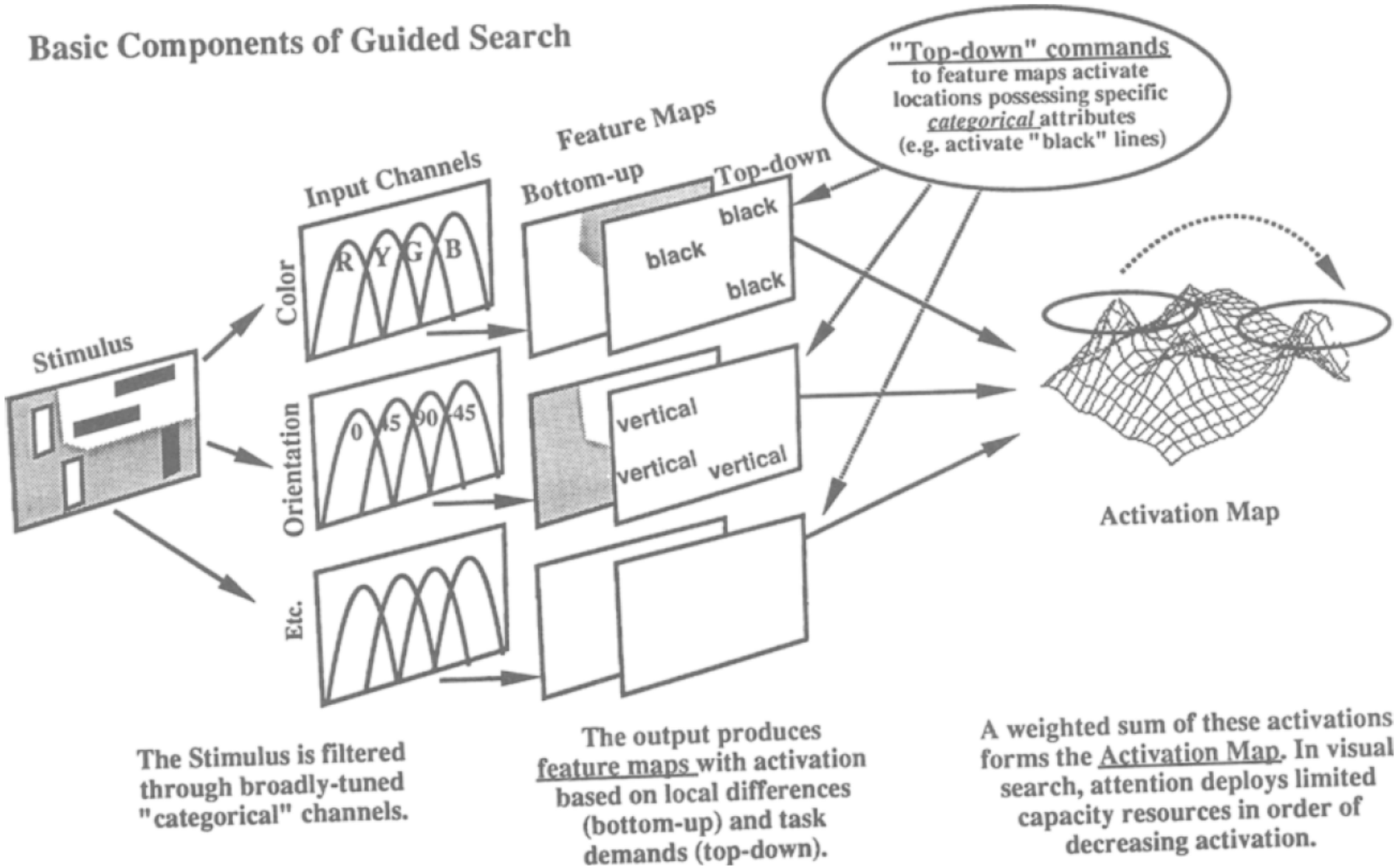
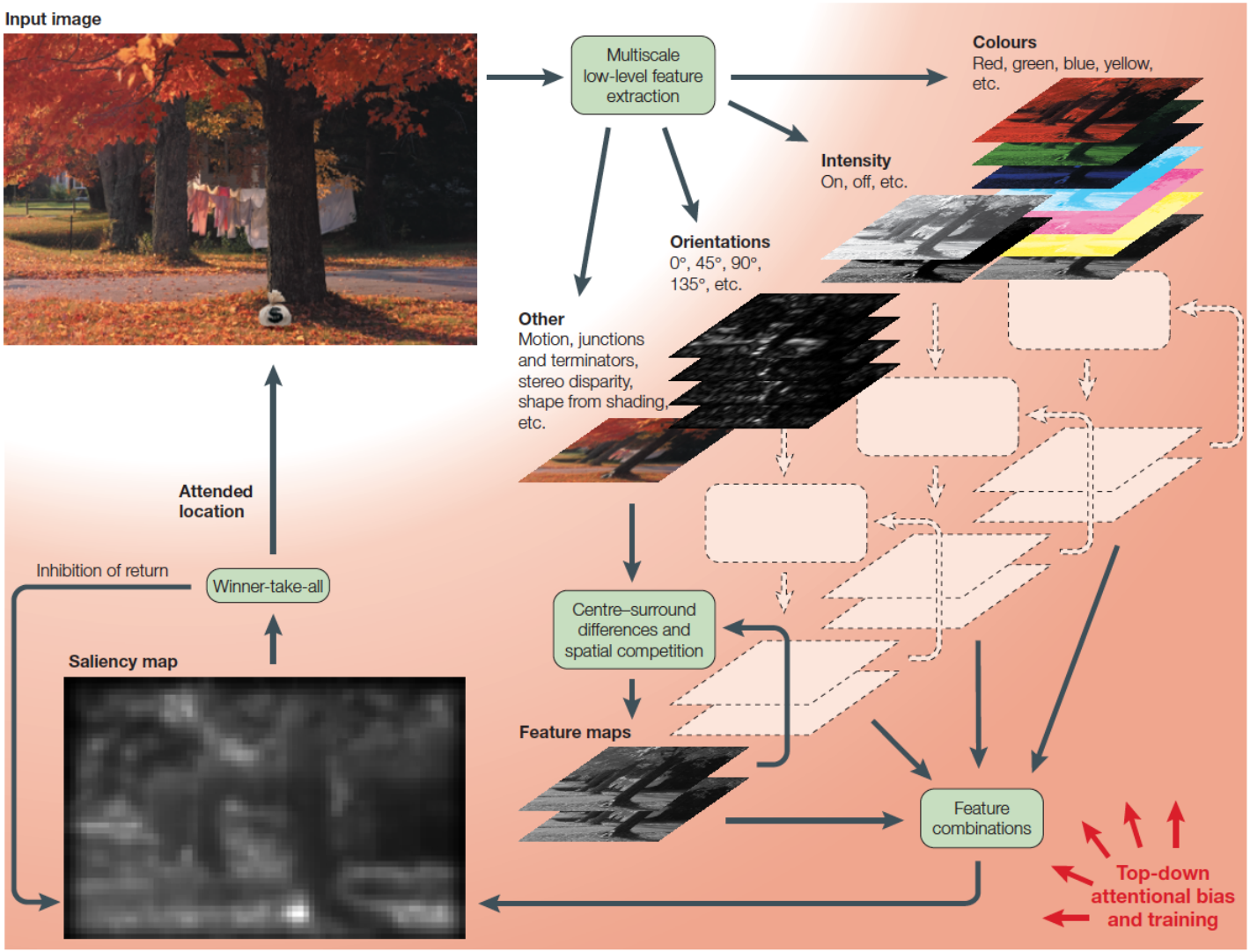





Basic Components of Guided Search
"Top-down" commands
to feature maps activate
locations possessing specific
categorical attributes
(e.g. activate "black" lines)
Feature Maps
Input Channels
Bottom-up
Top-down
Color
R
Y
G
B
black
black
black
Stimulus
Orientation
0
45
90
45
vertical
vertical
vertical
Etc.
Activation Map
The Stimulus is filtered through broadly-tuned "categorical" channels.
The output produces feature maps with activation based on local differences (bottom-up) and task demands (top-down).
A weighted sum of these activations forms the Activation Map. In visual search, attention deploys limited capacity resources in order of decreasing activation.

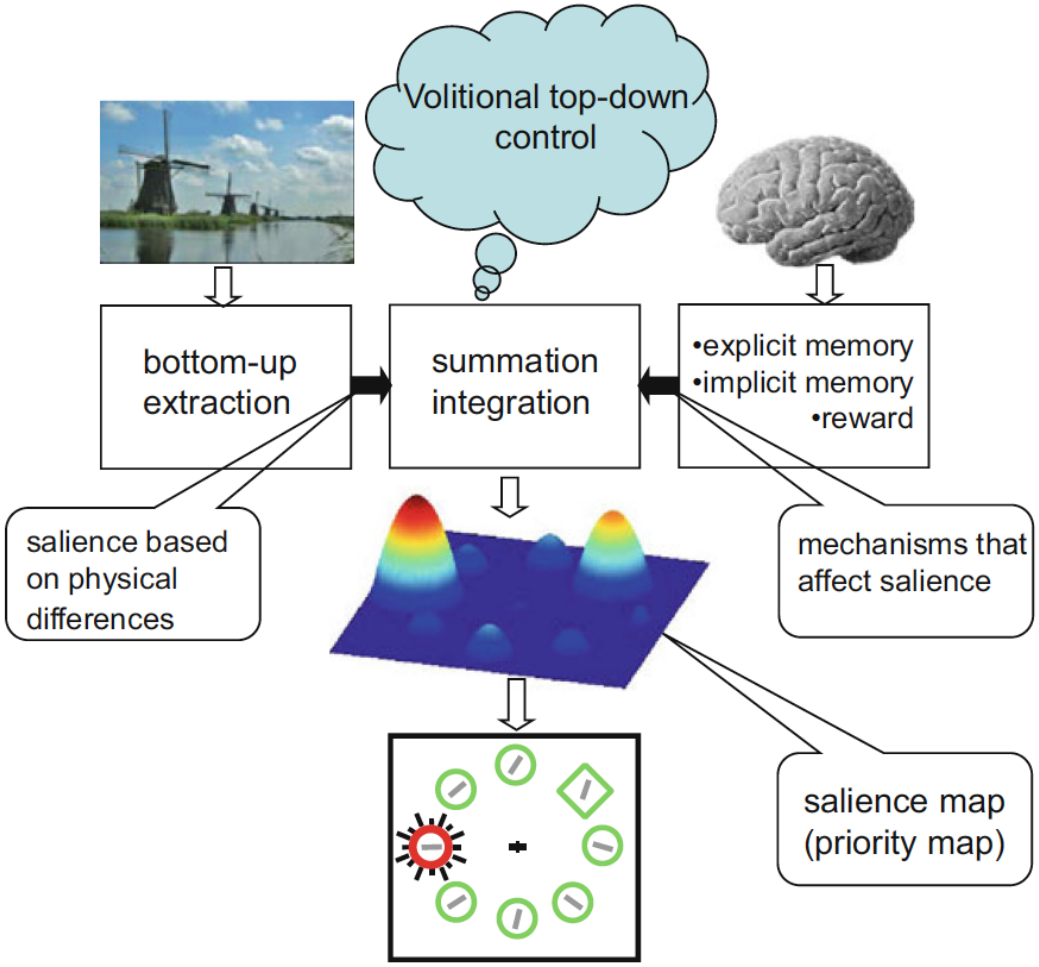
Wolfe, 1994

Saliency maps



Itti & Koch, 2001

Attentional priority maps



Theeuwes, 2012

Attention as an organ system

- ”Organ” in Webster’s dictionary:

  “An organ system may be defined a differentiated structures in animals and plants made up of various cell and tissues and adapted for the performance of some specific function and grouped with other structures into a system”.

- Posner & Fan, 2004:

  “We believe that viewing attention as an organ system aids in answering many perplexing issues raised in cognitive psychology, psychiatry and neurology”.

Attention as an organ system

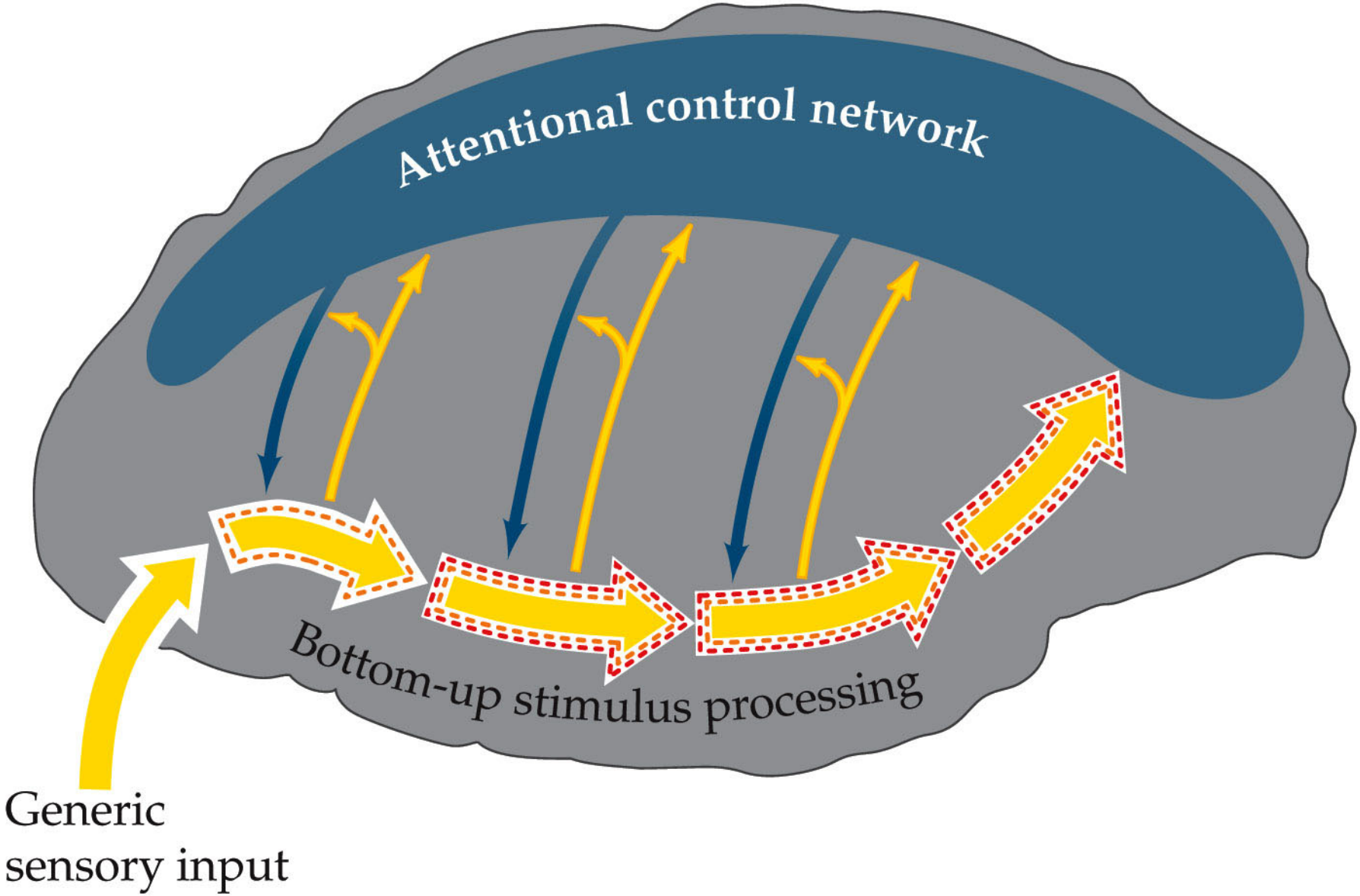
Posner & Petersen (1990):

Attention emerges from a collection of separable cognitive processes suberved by anatomically and physiologically distinct neural networks

Lesions to particular parts of these networks result in the same symptoms regardless of the cause of the lesion (e.g. stroke, hemorrhage, or tumor, etc.)

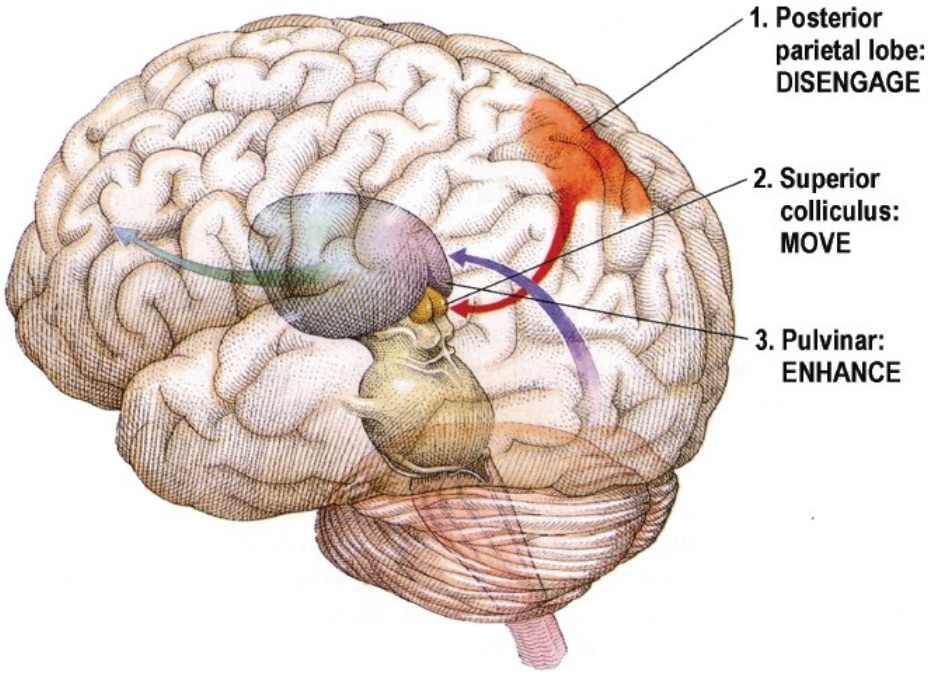
Each of these networks is expressed at anatomical, chemical, physiological, and behavioral levels. Attentional features at each of these levels can be operationalized and measured

Sources of attention – brain areas from which top-down feedback is generated – is distinguished from the sites of attention – areas in which top-down feedback modulates normal processing

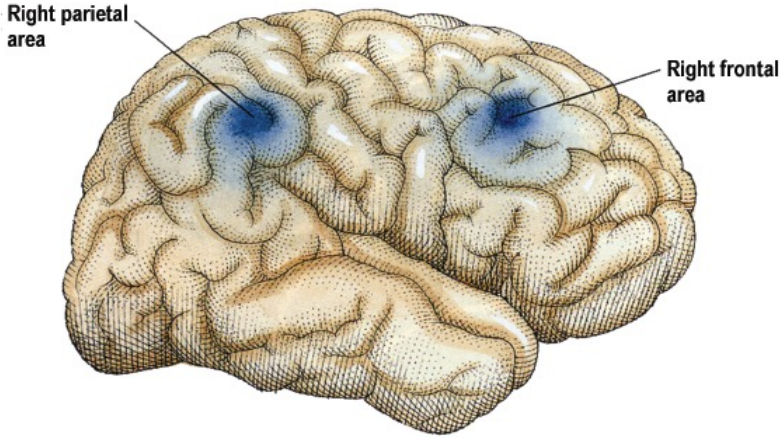


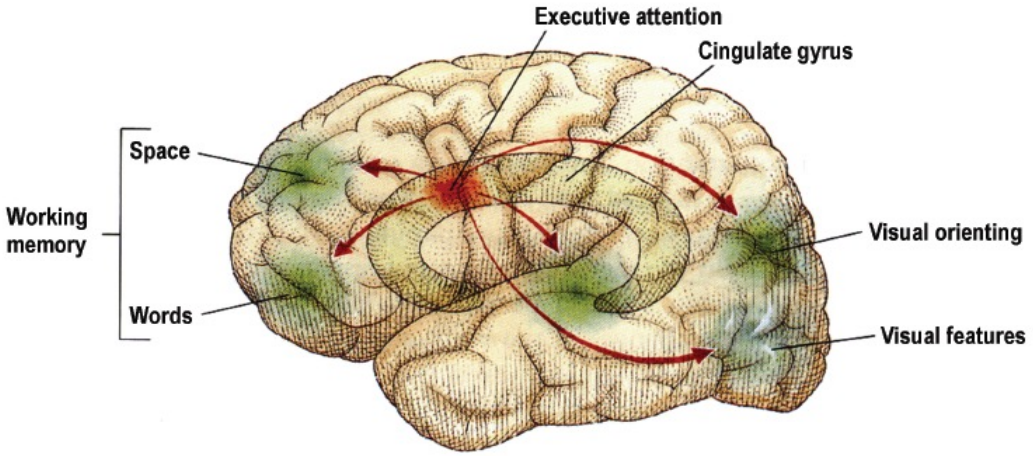
***Principles of Cognitive Neuroscience*, Figure 10.10**

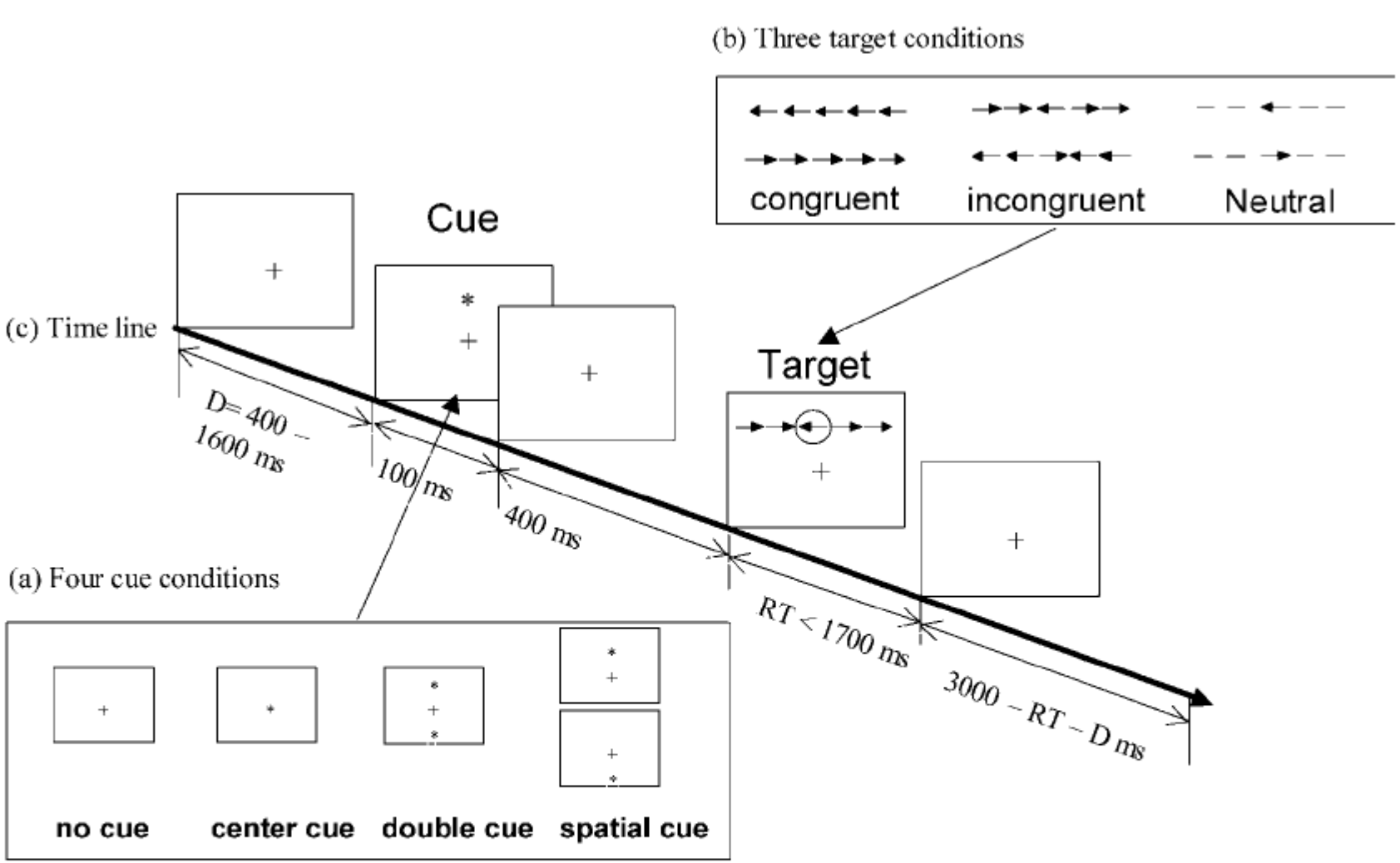
Three top-down networks (the Posner model)



Function	Structures	Modulator
Orient	Superior parietal Temporal parietal junction Frontal eye fields Superior colliculus	Acetylcholine
Alert	Locus coeruleus Right frontal Parietal cortex	Norepinephrine
Executive attention	Anterior cingulate Lateral ventral Prefrontal Basal ganglia	Dopamine







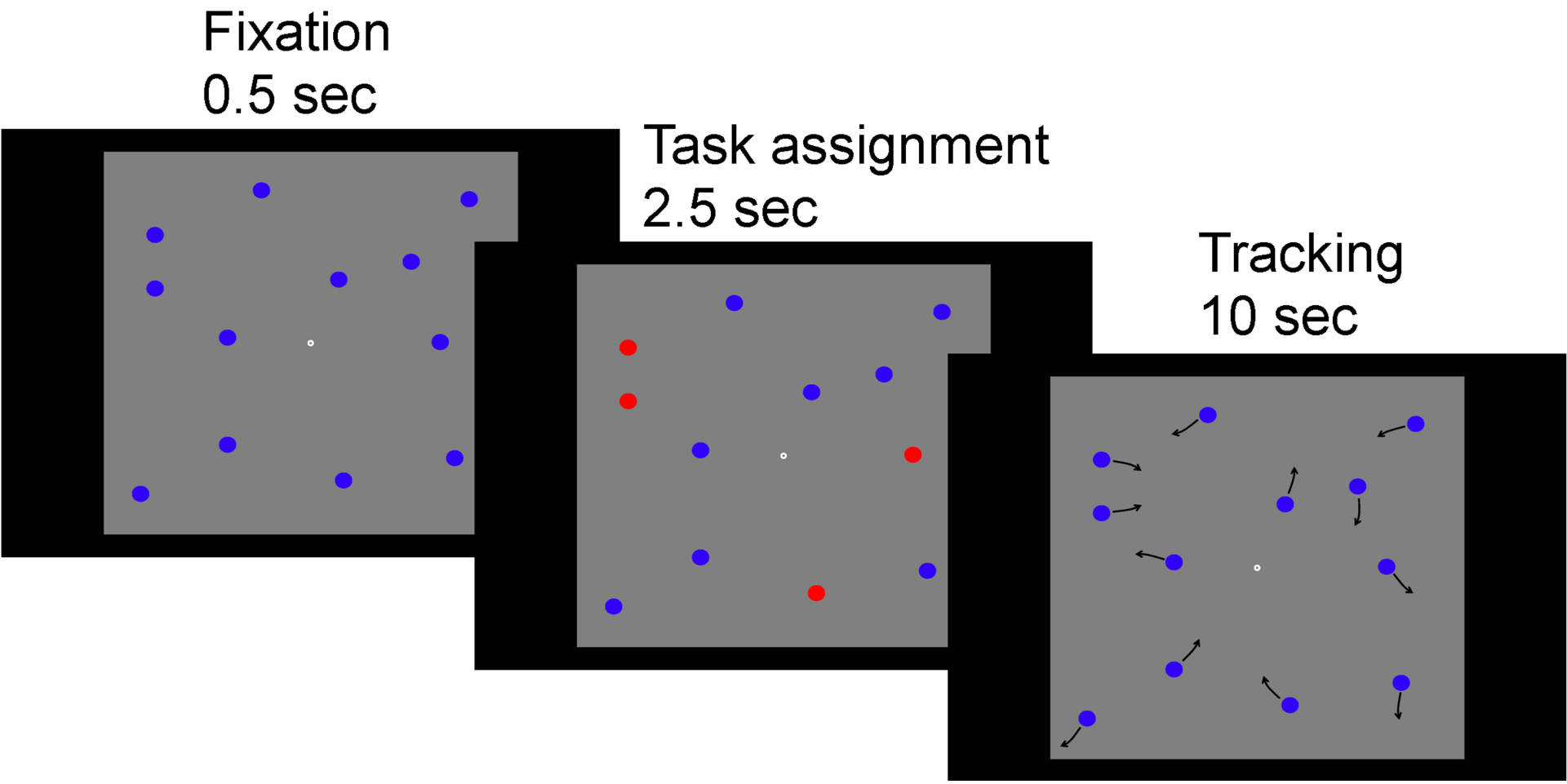
(d) Three subtractions

ALERTING = NO CUE RT – DOUBLE CUE RT
ORIENTING = CENTER CUE RT – SPATIAL CUE RT
CONFLICT = INCONGRUENT TARGET RT – CONGRUENT TARGET RT

Network	Measurement	Average Value*	Heritability**
Executive	$RT_{Incongruent} - RT_{Congruent}$	84	.89
Alerting	$RT_{Double\ cue} - RT_{No\ cue}$	47	.18
Orienting	$RT_{Valid\ cue} - RT_{Central\ cue}$	51	0

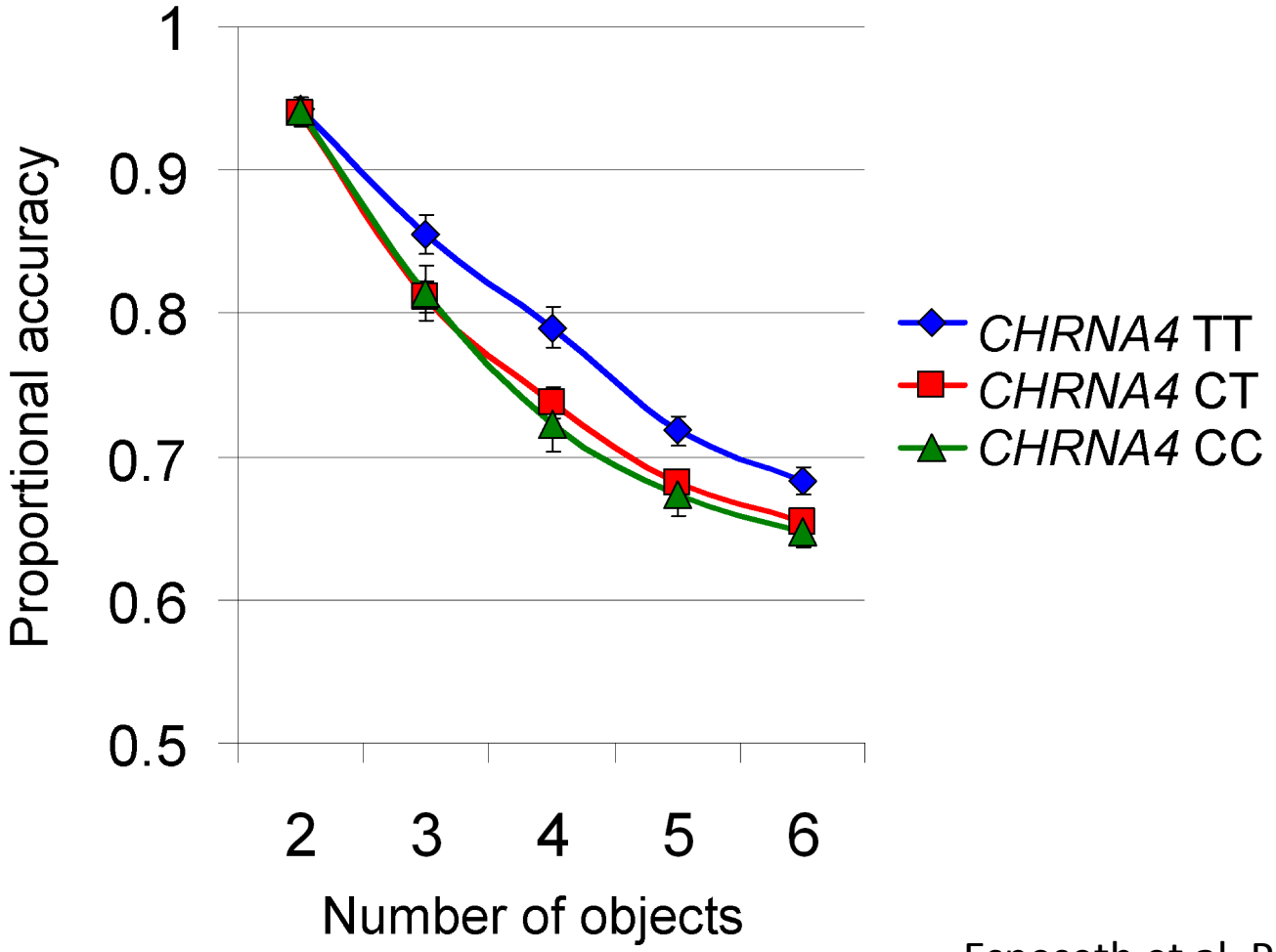
* As measured from 40 normal subjects (Fan et al, in press)
** From a study of 26 pairs of monozygotic and 26 pairs of same sex dizygotic twins (Fan et al, 2001b)

Multiple object tracking – NCNG version



Espeseth et al, PLoS ONE, 2010

CHRNA4 and MOT



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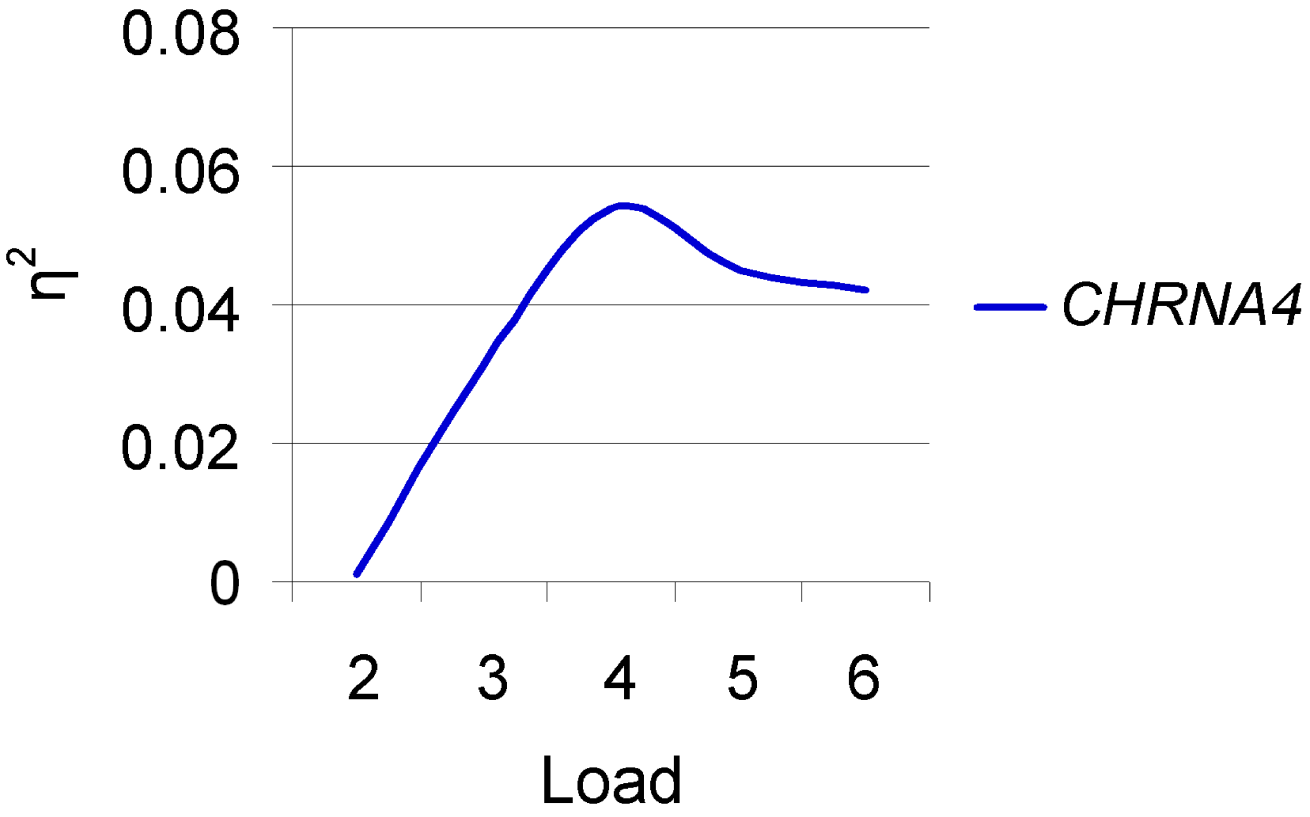
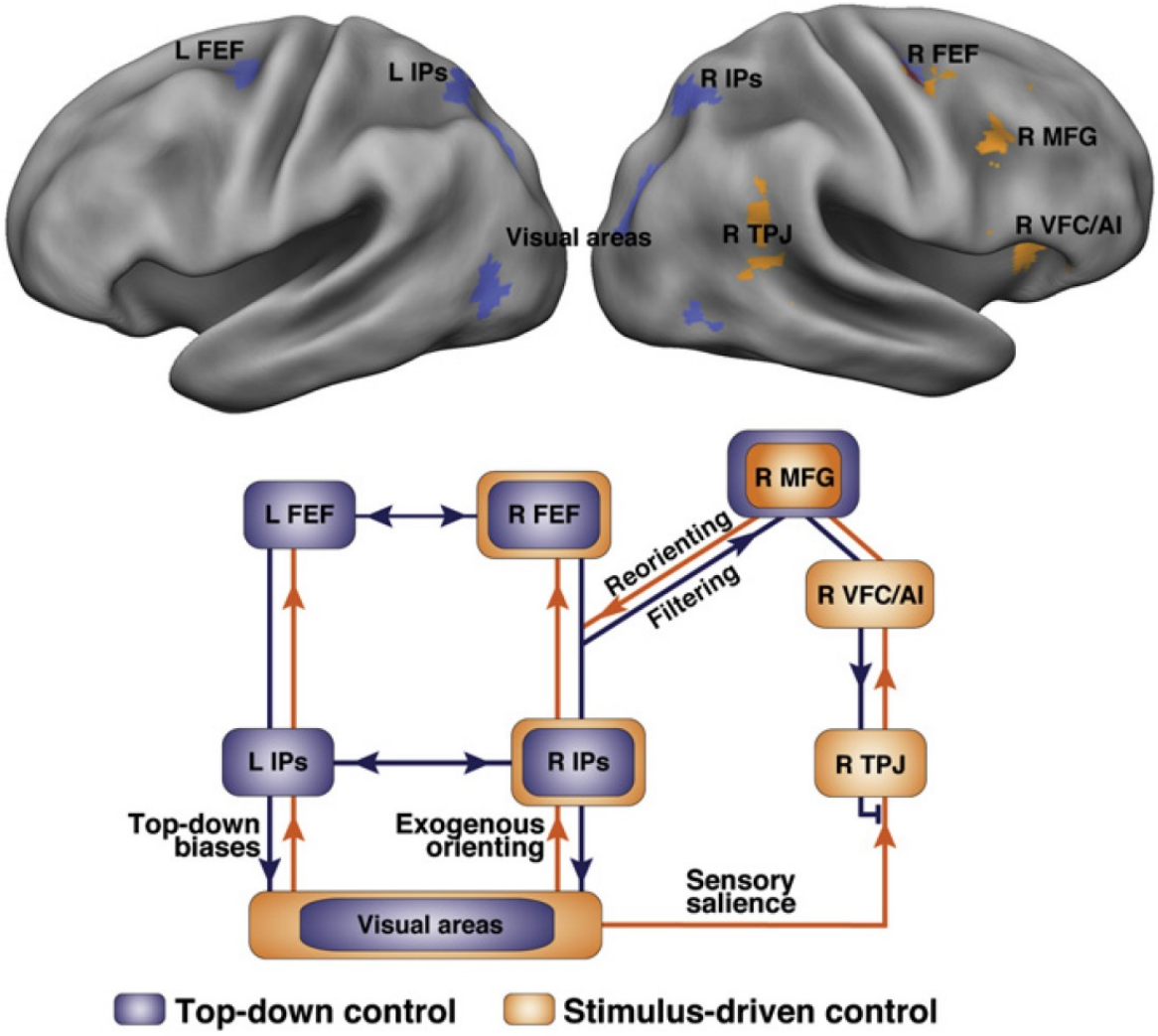


Espeseth et al, PLoS ONE, 2010

Focused attention and its reorienting

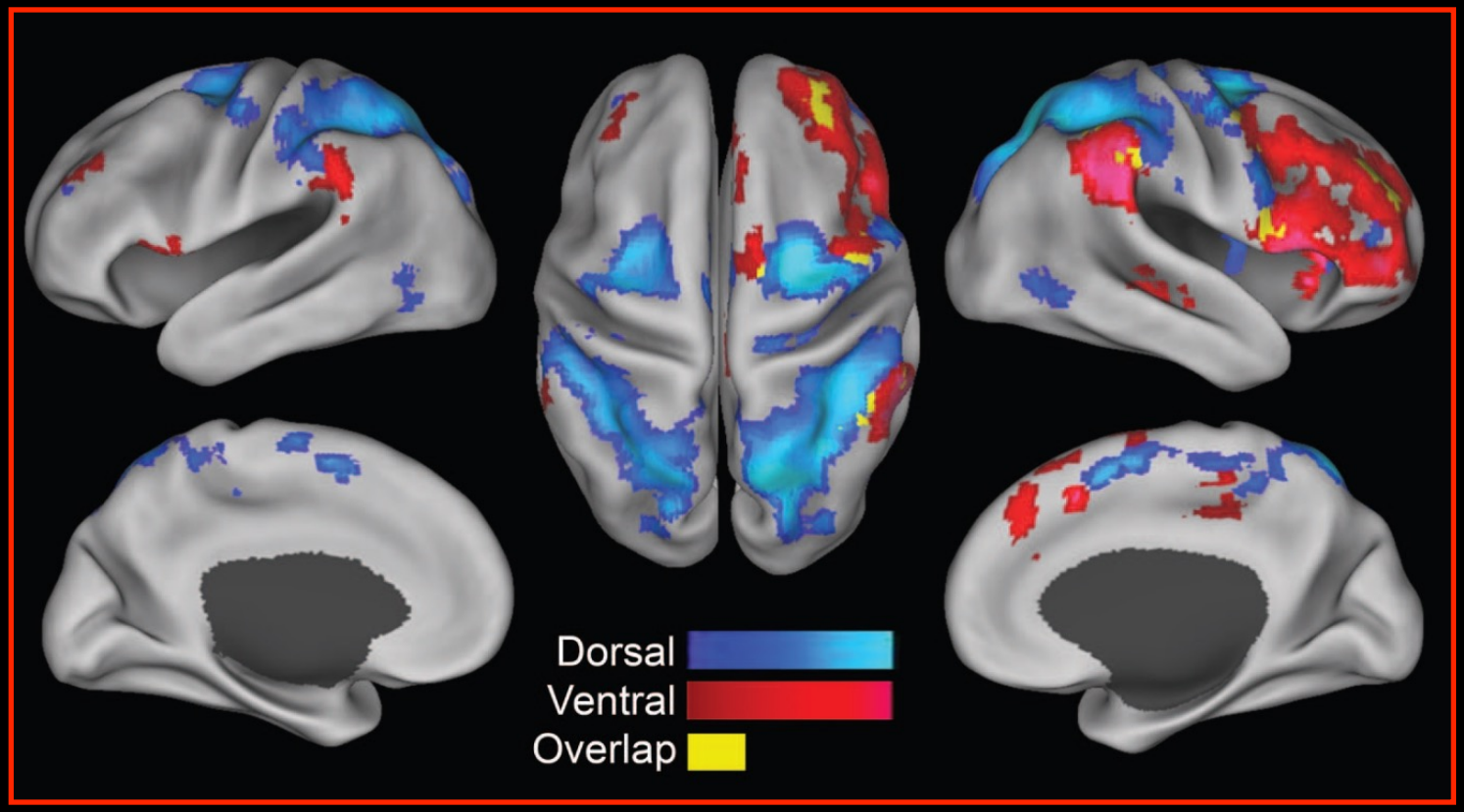
From Corbetta et al. (2008)

Top-down vs stimulus-driven control



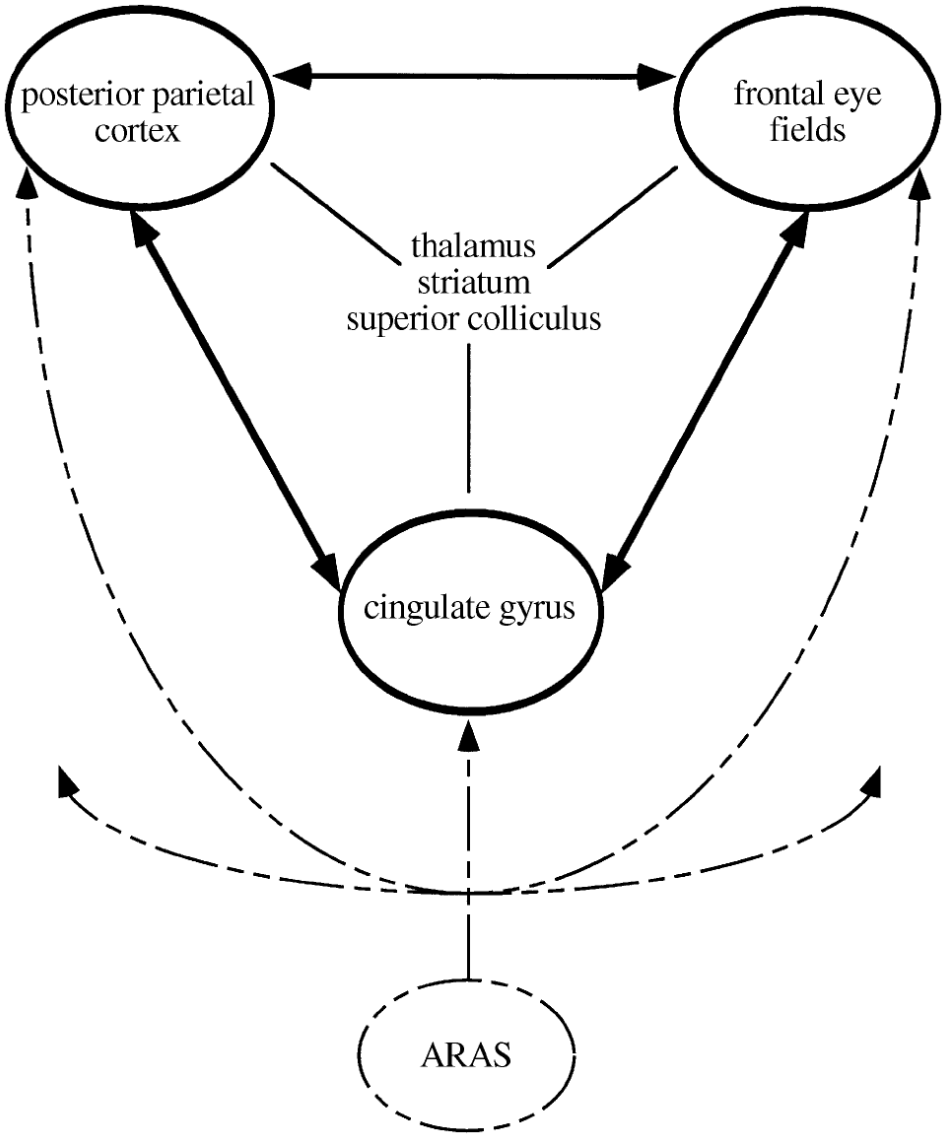
From Corbetta et al. (2008)

Resting state networks



From Fox et al. (2006)

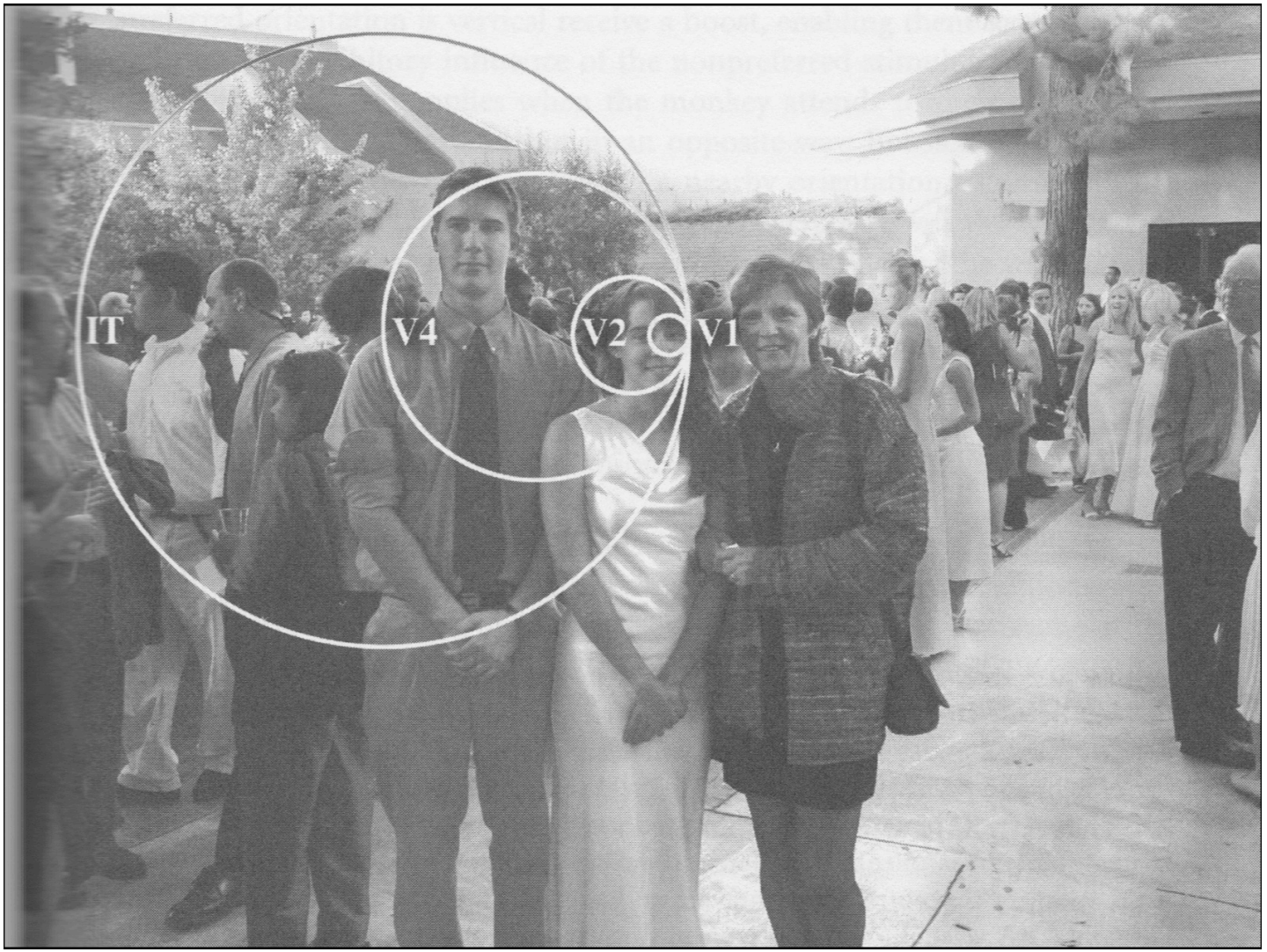
Mesulam's large-scale distributed network model



Mesulam, 1999

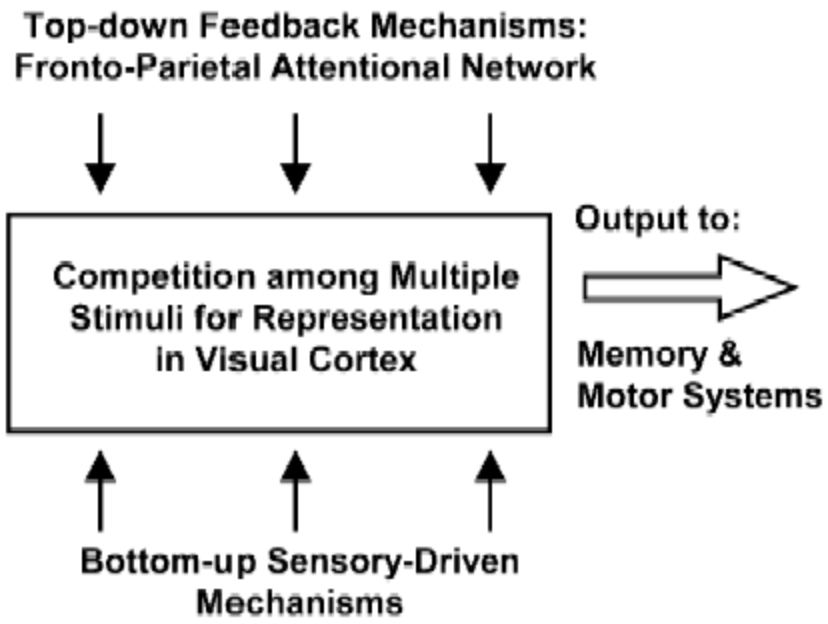
The biased competition model of attention

Why do we need attention?



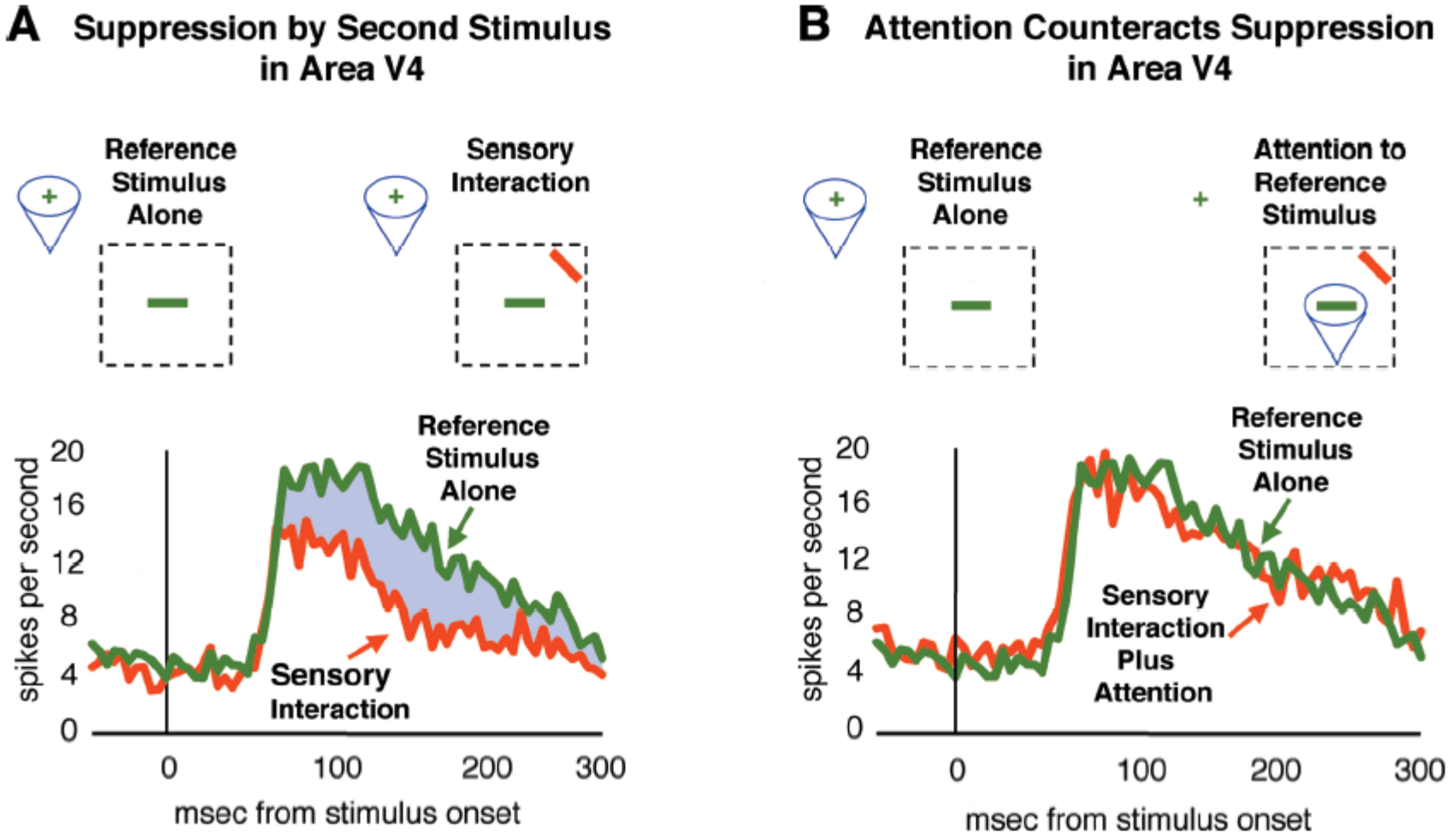
Koch, 2004

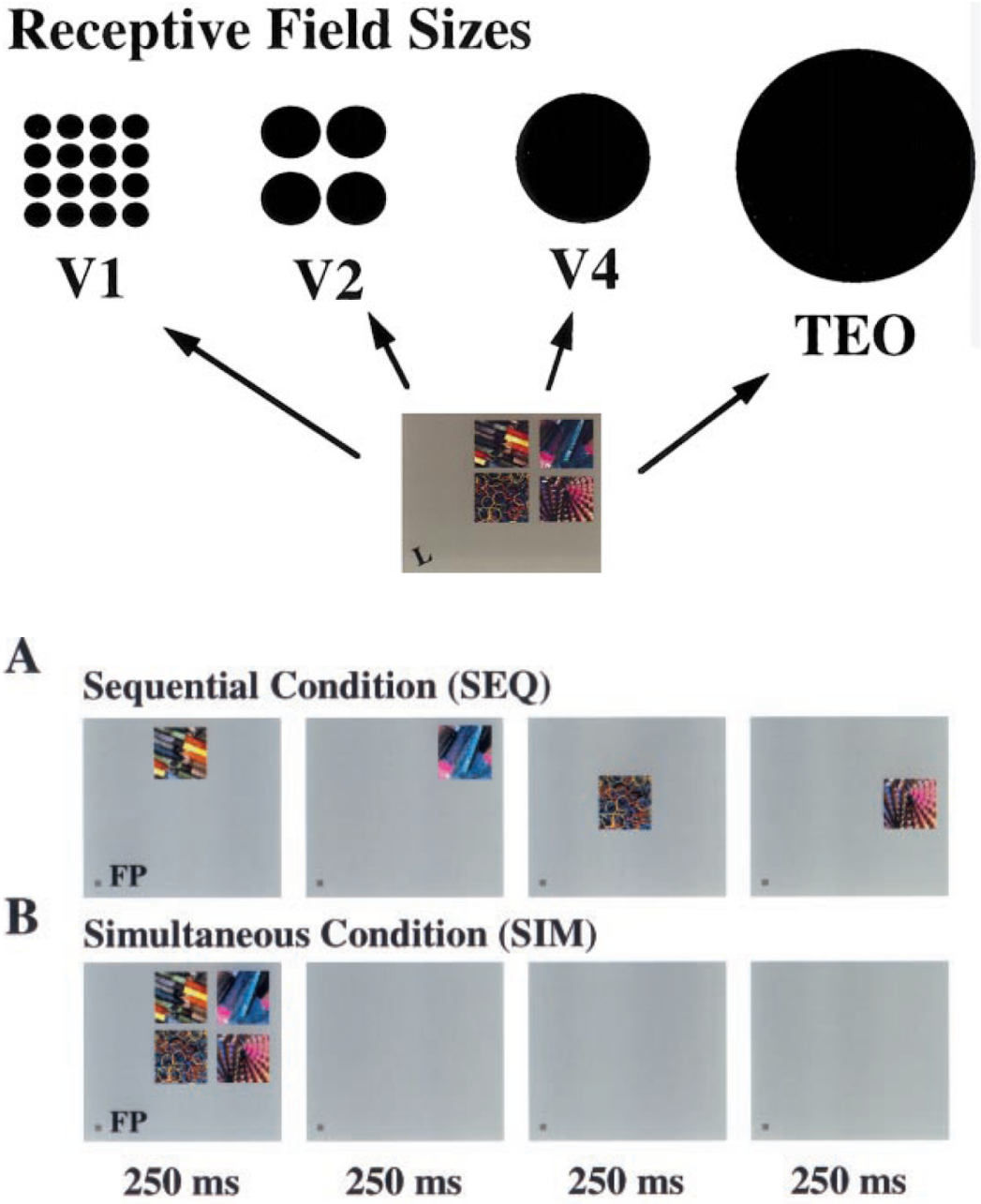
The biased competition model of attention

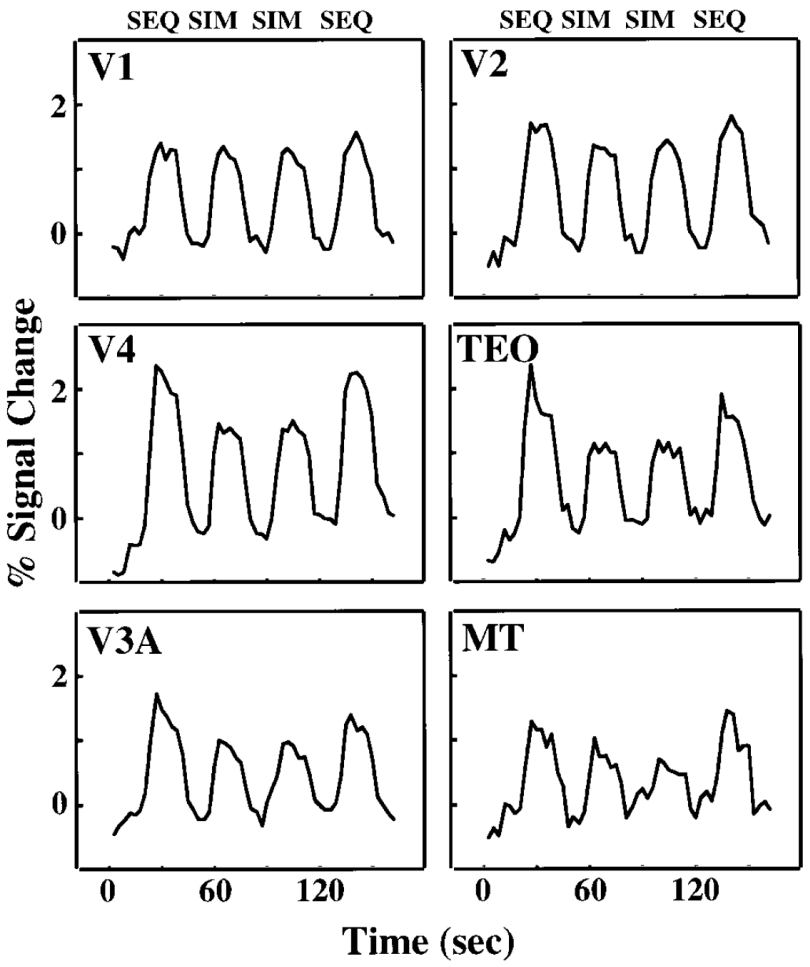


Biased Competition Model (BCM) - predictions

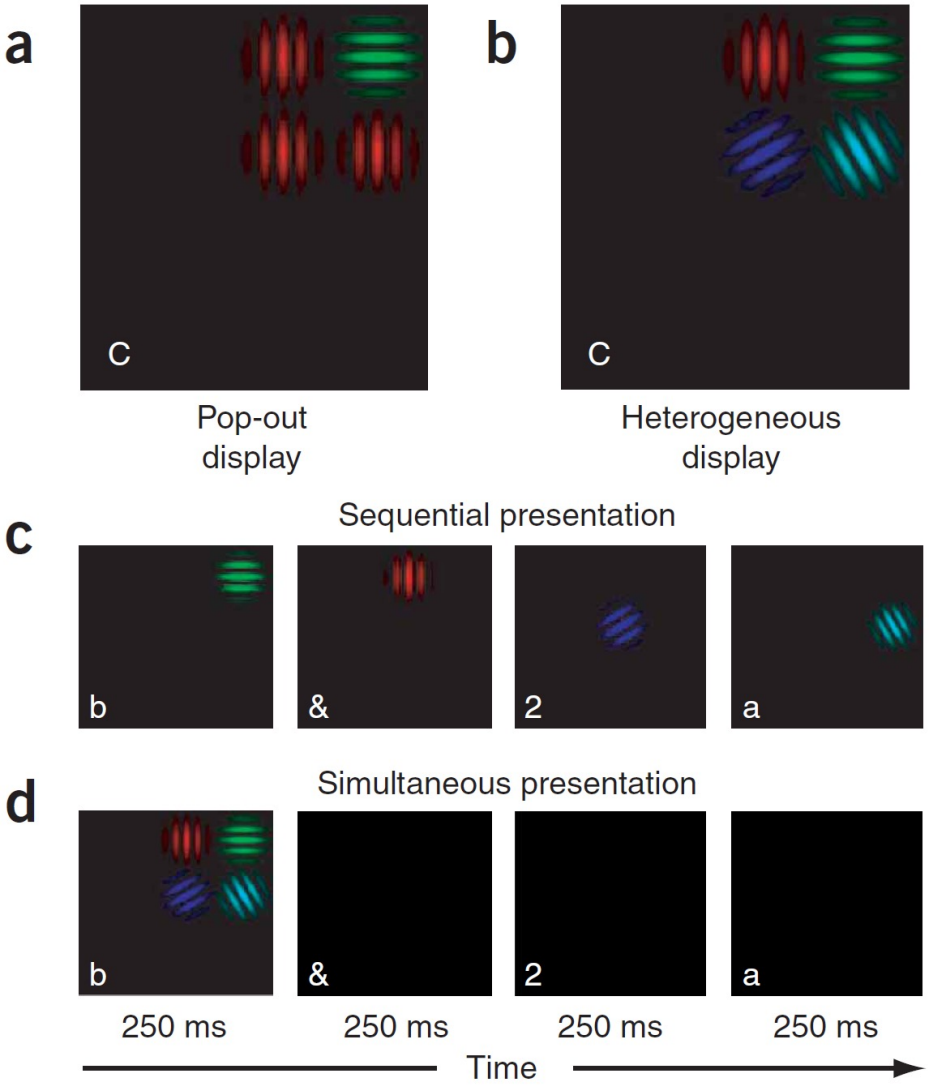
- Objects *compete* for neural representation
- Competition is greatest at the level of the *receptive field*
- Competition can be biased by *top-down* and *bottom-up mechanisms*
- Top-down biases are not only specific to a location, but also to an object feature
- Top-down biasing signals are generated in *frontal* and *parietal* cortex
- Competition is integrated across systems

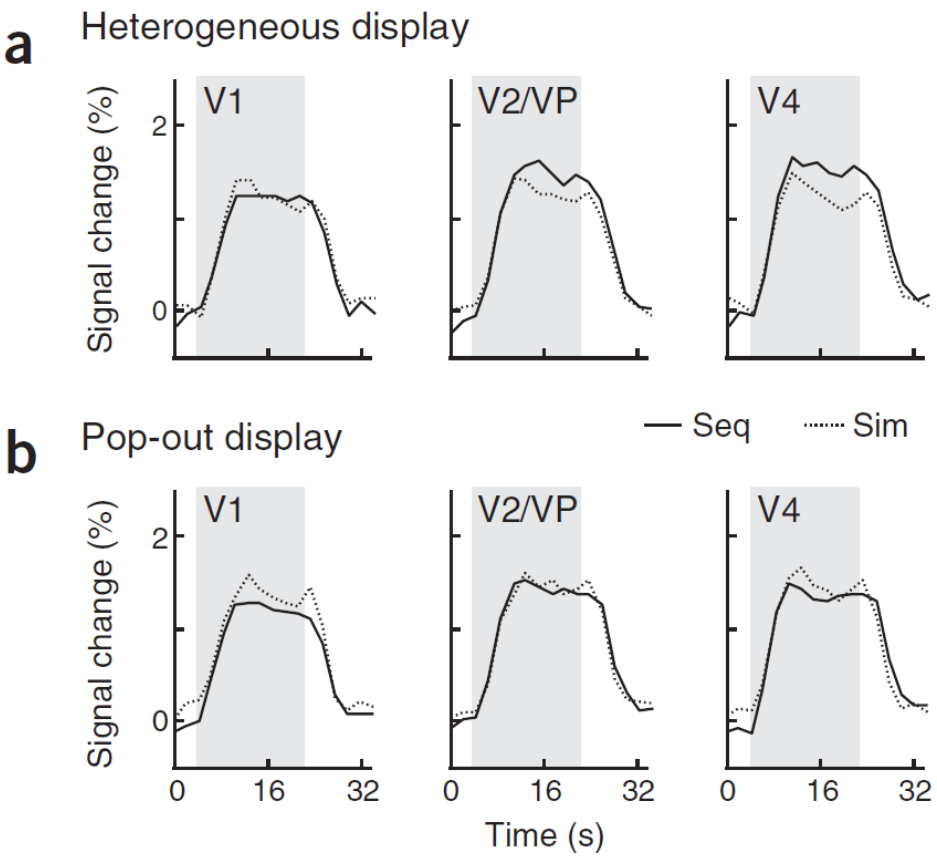

A
Suppression by Second Stimulus in Area V4
Reference Stimulus Alone
Sensory Interaction
Reference Stimulus Alone
Sensory Interaction
spikes per second
20
16
12
8
4
0
0
100
200
300
msec from stimulus onset
B
Attention Counteracts Suppression in Area V4
Reference Stimulus Alone
Attention to Reference Stimulus
Reference Stimulus Alone
Sensory Interaction Plus Attention
spikes per second
20
16
12
8
4
0
0
100
200
300
msec from stimulus onset





Kastner et al. Science1998





Beck & Kastner, *Nat Neurosci*. 2005

Neuron, Vol. 22, 751–761, April, 1999, Copyright ©1999 by Cell Press

Increased Activity in Human Visual Cortex during Directed Attention in the Absence of Visual Stimulation