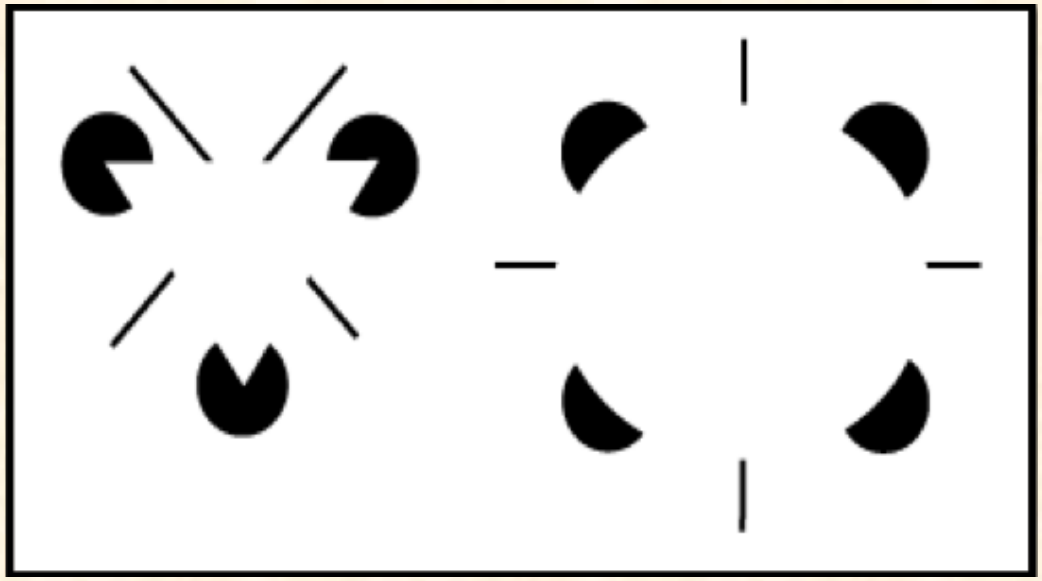
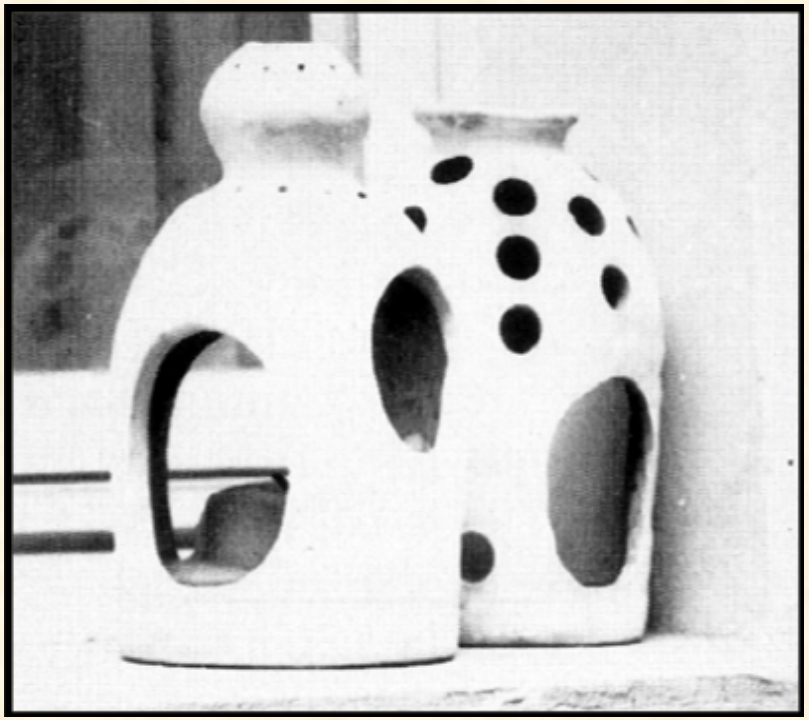
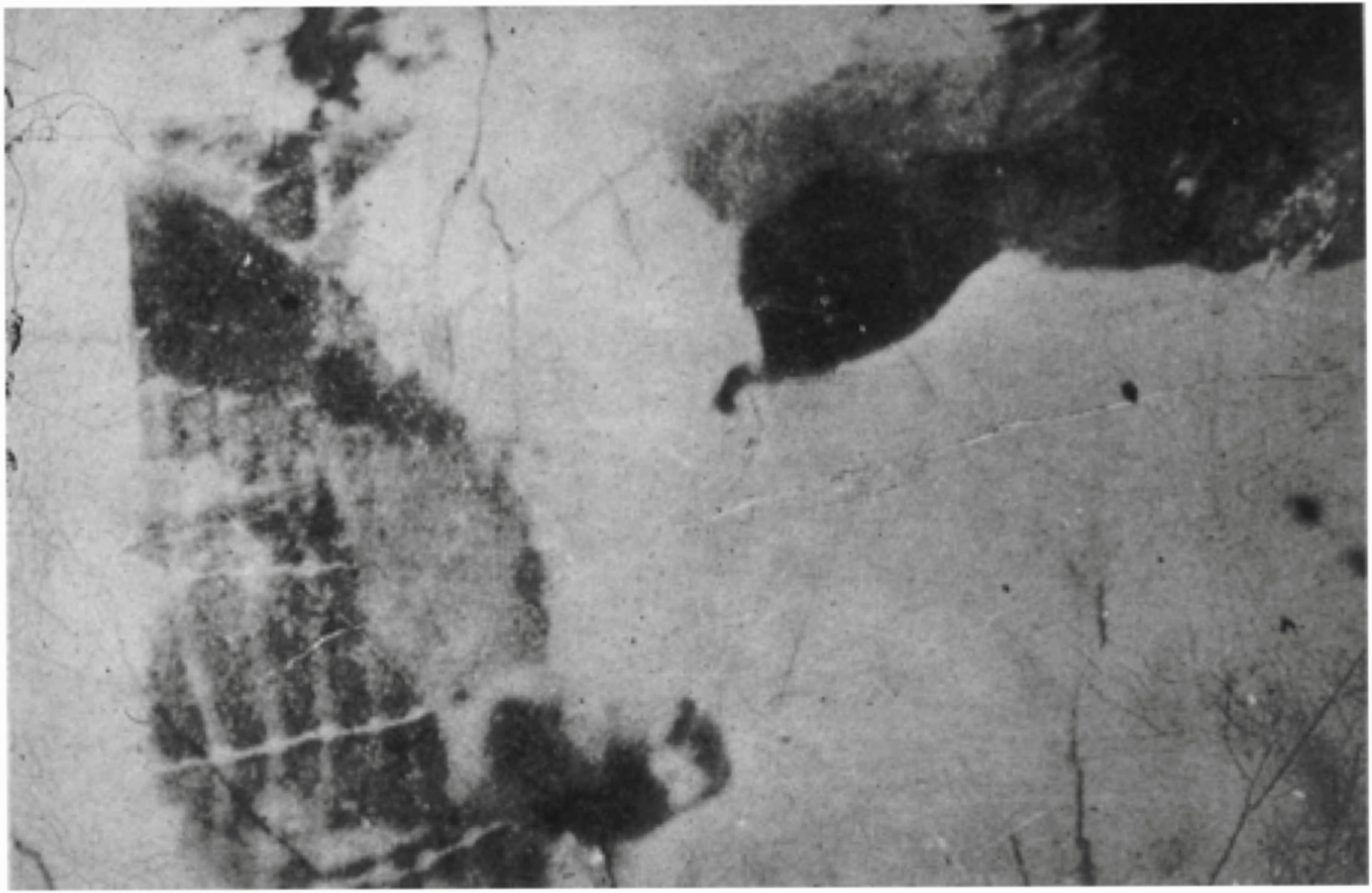
perception: inferential process

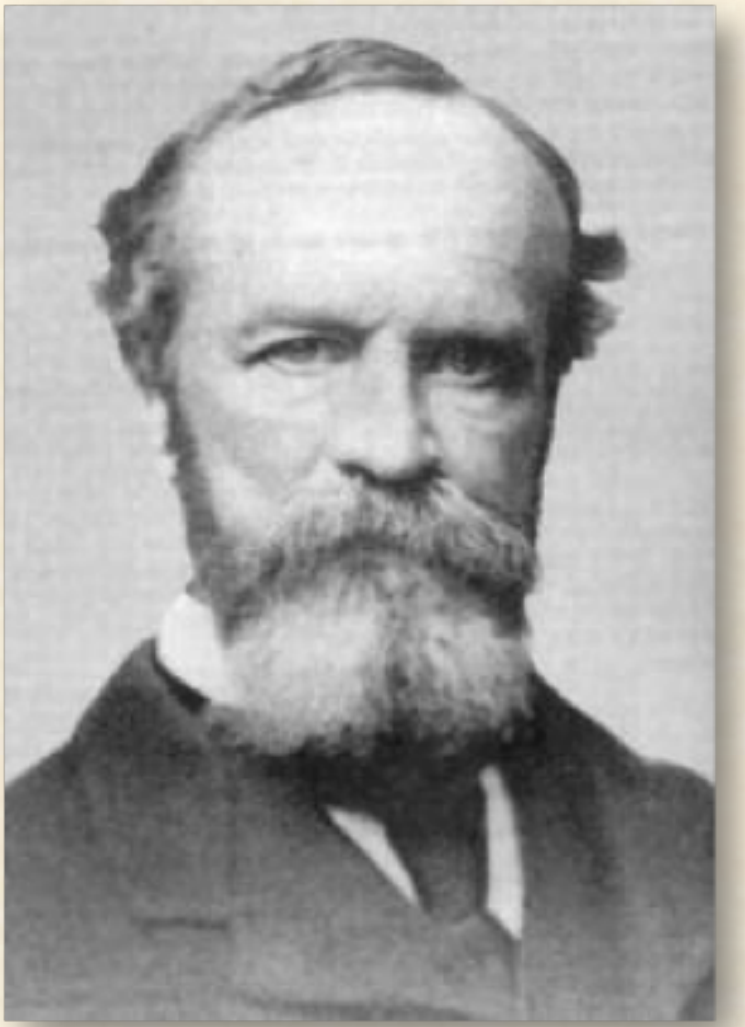




perception: inferential process



attention: W. James (1890)

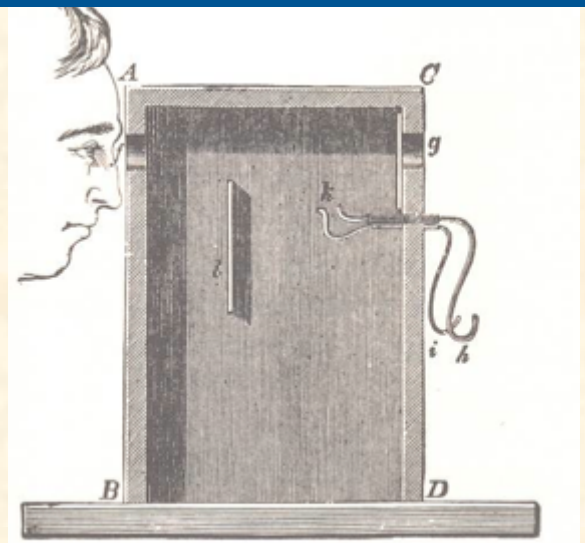


"Everyone knows what attention is.
It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought.

Focalization, concentration of consciousness are of its essence.

It implies withdrawal from some things in order to deal effectively with others…"

covert attention: von Helmholtz (1867)



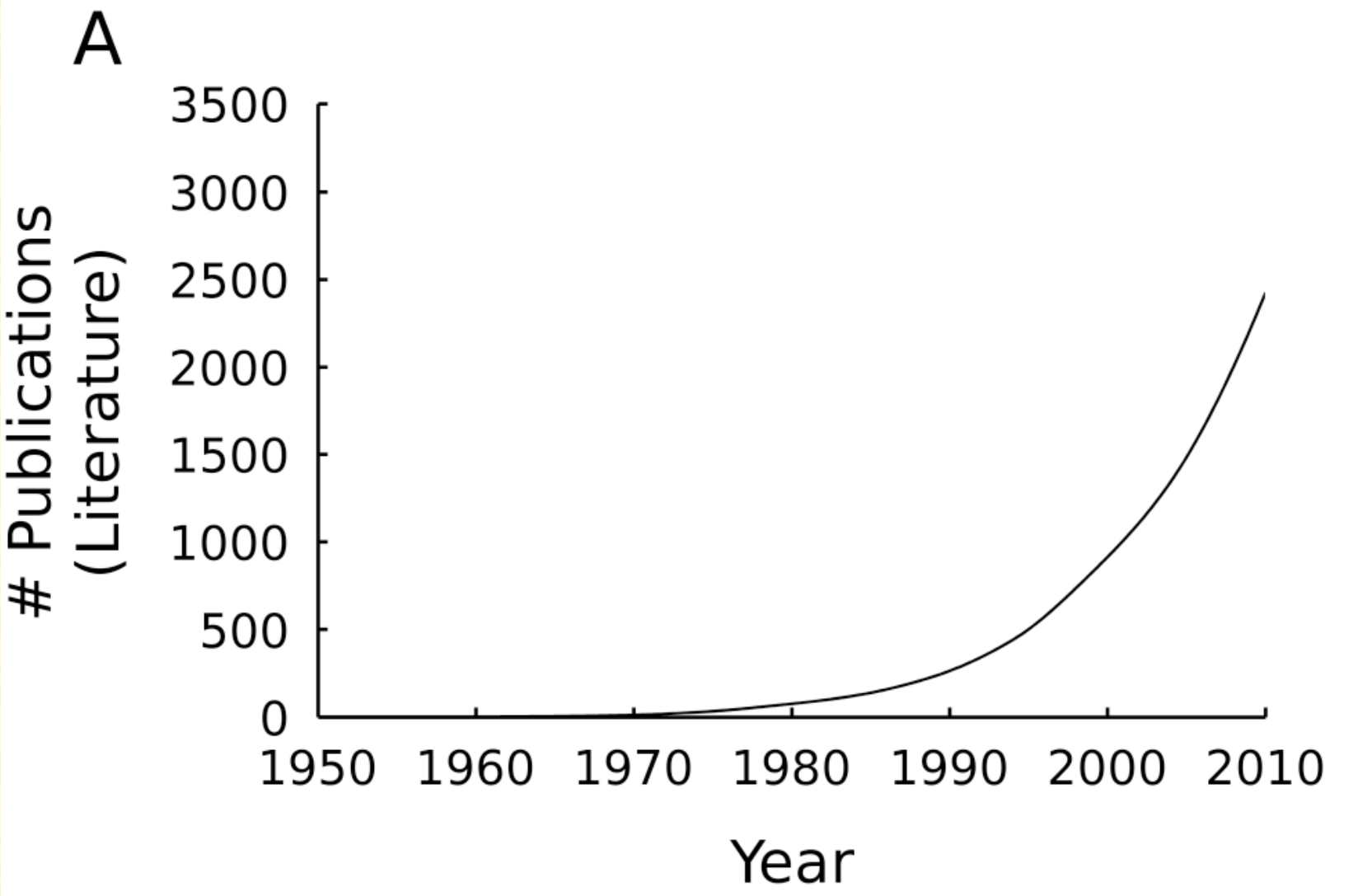
"It is a curious fact that the observer may be gazing steadily at the two pinholes and holding them in exact coincidence, and yet at the same time he can concentrate his attention on any part of the dark field he likes, so that when the spark comes, he will get an impression about objects in that particular region only.

In this experiment the attention is entirely independent of the position and accommodation of the eyes, or indeed, of any known variations in or on the organ of vision.

Thus it is possible, simply by a conscious and voluntary effort, to focus the attention on some definite spot in an absolutely dark and featureless field."

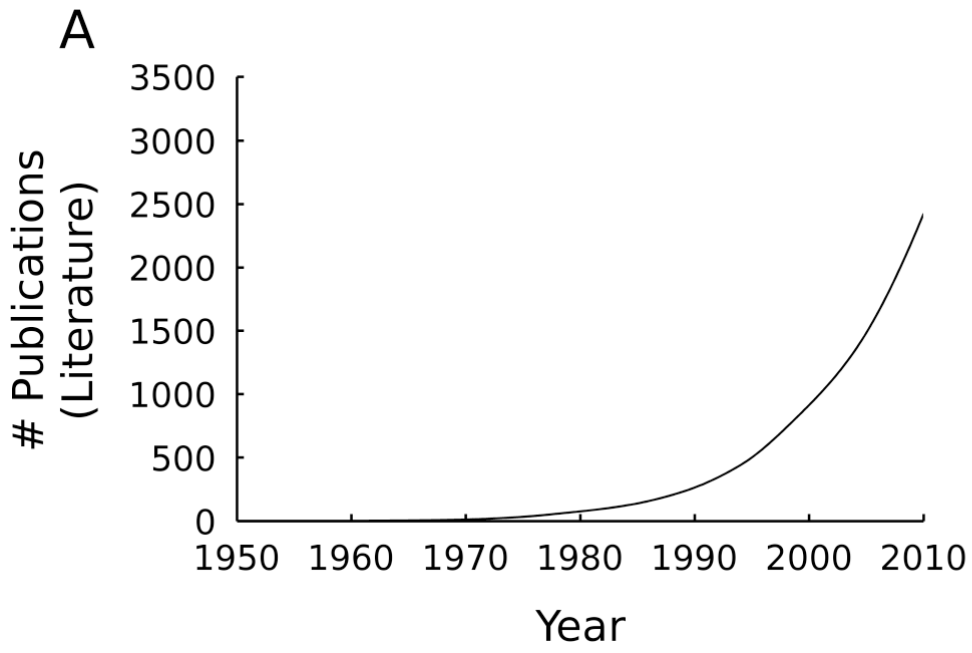
Physiological Optics, 1867, Vol 3, *p. 455*

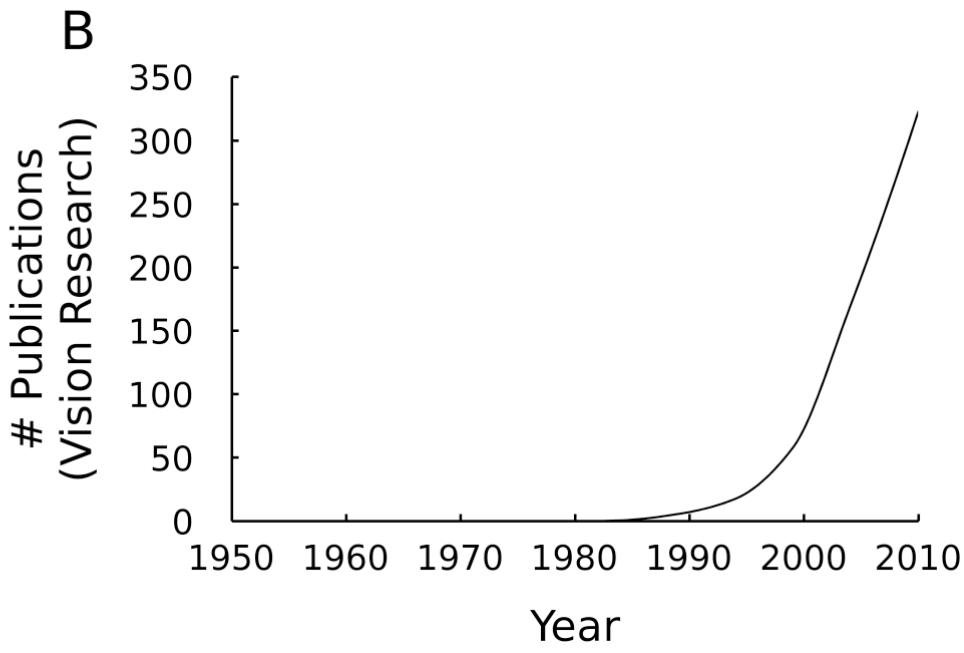
Publications on “Visual attention”



Carrasco (Vision Research, 2011) Visual attention: The past 25 years

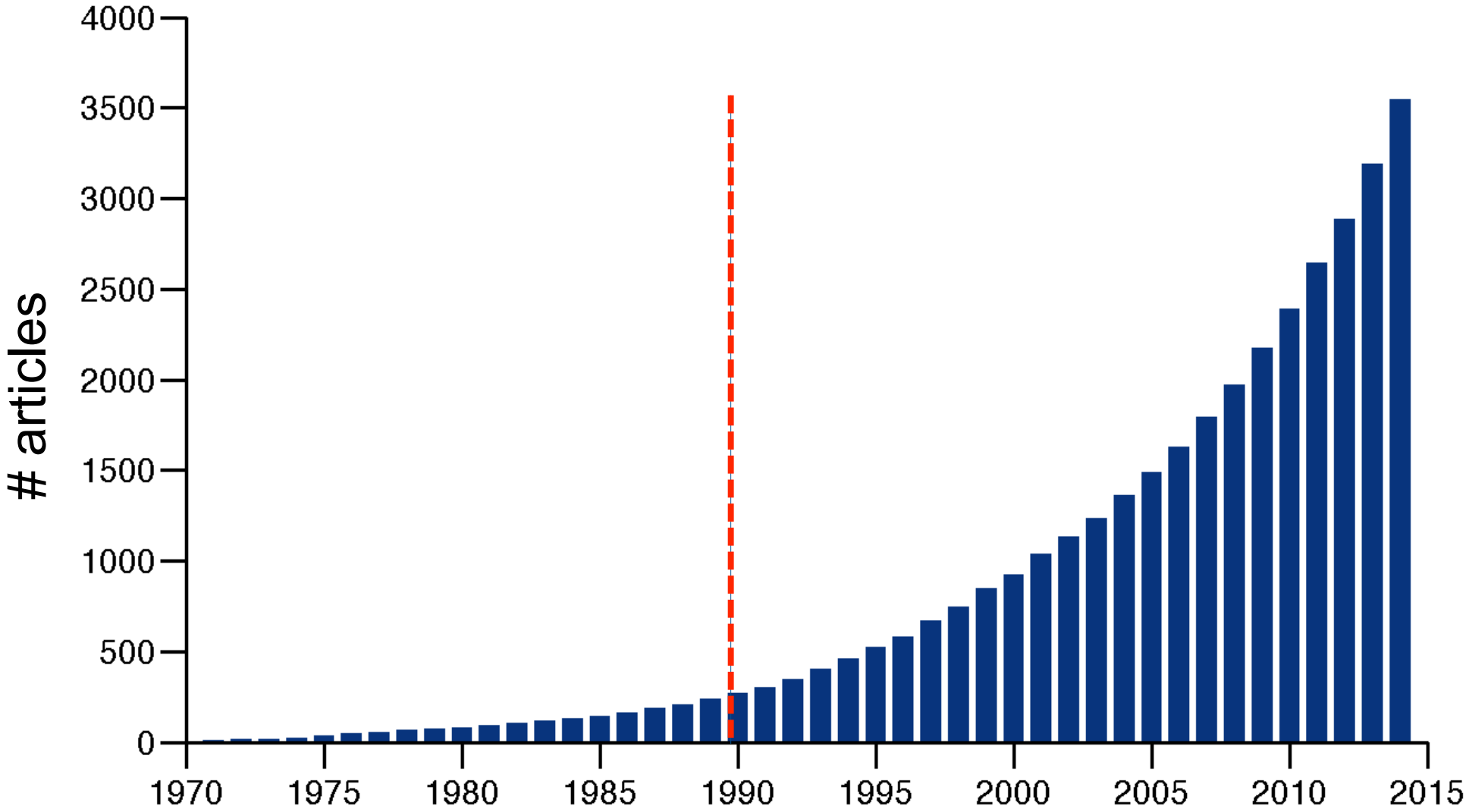
Publications on “Visual attention”





Carrasco (Vision Research, 2011) Visual attention: The past 25 years

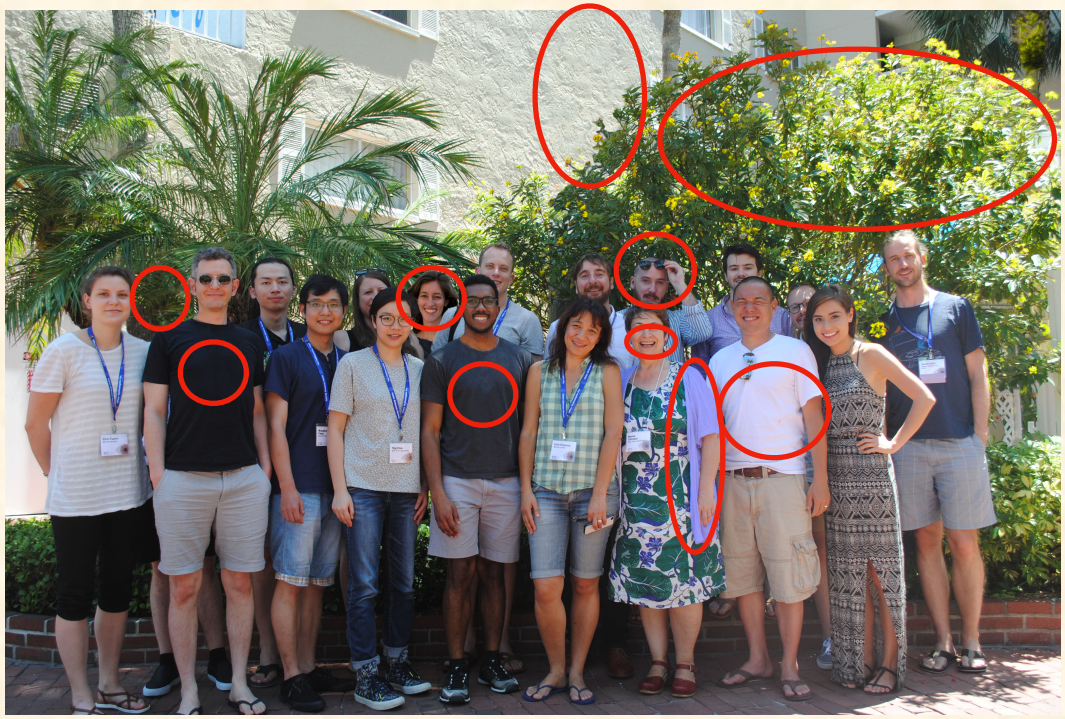
visual attention : number of articles per year



Carrasco & Barbot, 2015

cocktail party phenomenon

cocktail party phenomenon



Aude Oliva & George Alvarez, 2006

original image

final image

original

final

Capacity limitation

- As visual information traverses the successive cortical areas of the ventral visual stream, the size of receptive fields increase.
- Neurons in higher order areas with large receptive fields have to deal with many visual stimuli that appear simultaneously within their receptive fields.

selective attention

- the amount of information coming down the optic nerve –estimated to be in the range of 10^8 ~ 10^9 bits per second– far exceeds what the brain is capable of fully processing and assimilating into conscious experience

C Koch 2004

  - Selective attention (processing input preferentially) is the natural strategy for dealing with this bottleneck

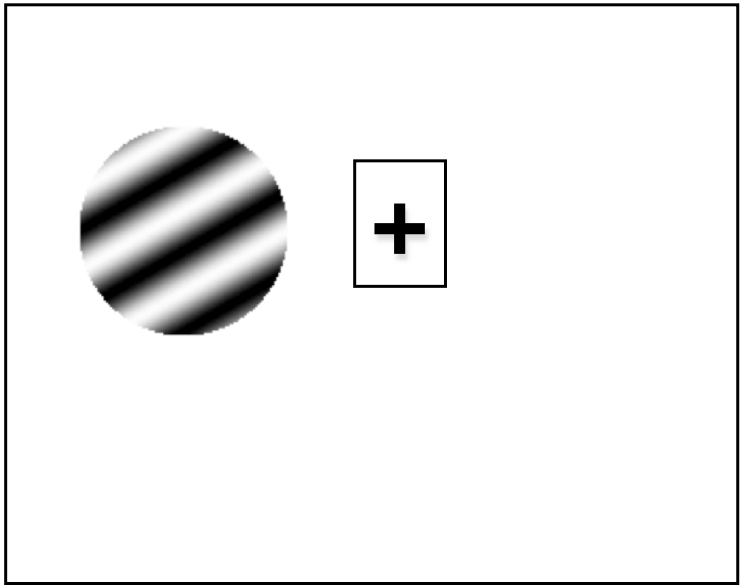
limited resources and bioenergetic cost

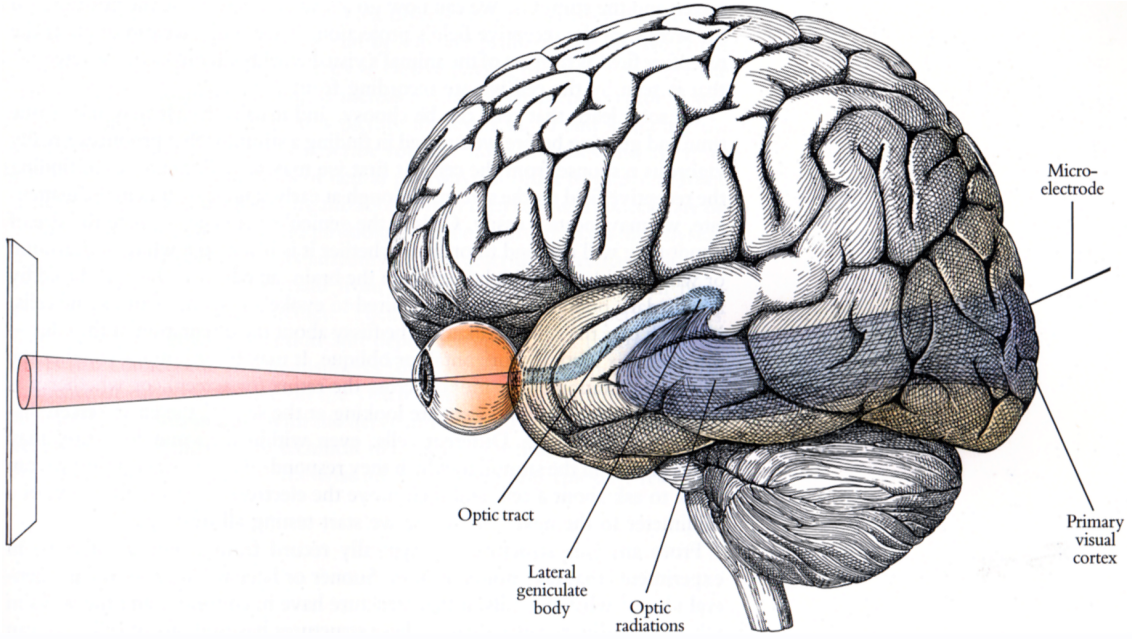
- the high-energy cost of neuronal activity involved in cortical computation limits our ability to process information
  - constant overall energy consumption available to the brain
  - neuronal metabolic cost depends on the spike rate; the cost of a single spike is high
  - average discharge rate of active neurons determines how many neurons can be active concurrently: ~1%
- the brain needs machinery to allocate energy according to task demand: attention

Lennie, Curr Bio 2003

Visual attention

selective process - priority in processing	
overt attention -	head and eye movements
covert attention -	monitor the environment; informs eye movements





Attention – key role in perception

- 1980s and early 90s:
  - necessary for effortful processing
  - ‘glue’ that binds simple features into an object
  - what attention does?
  - what processes does it affect?

Attention – key role in perception

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  - necessary for effortful processing
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  - what attention does?
  - what processes does it affect?

- last decades, effects of attention on perception:
  - psychophysics
  - single-unit recording
  - neuroimaging
  - neurostimulation
  - computational modeling

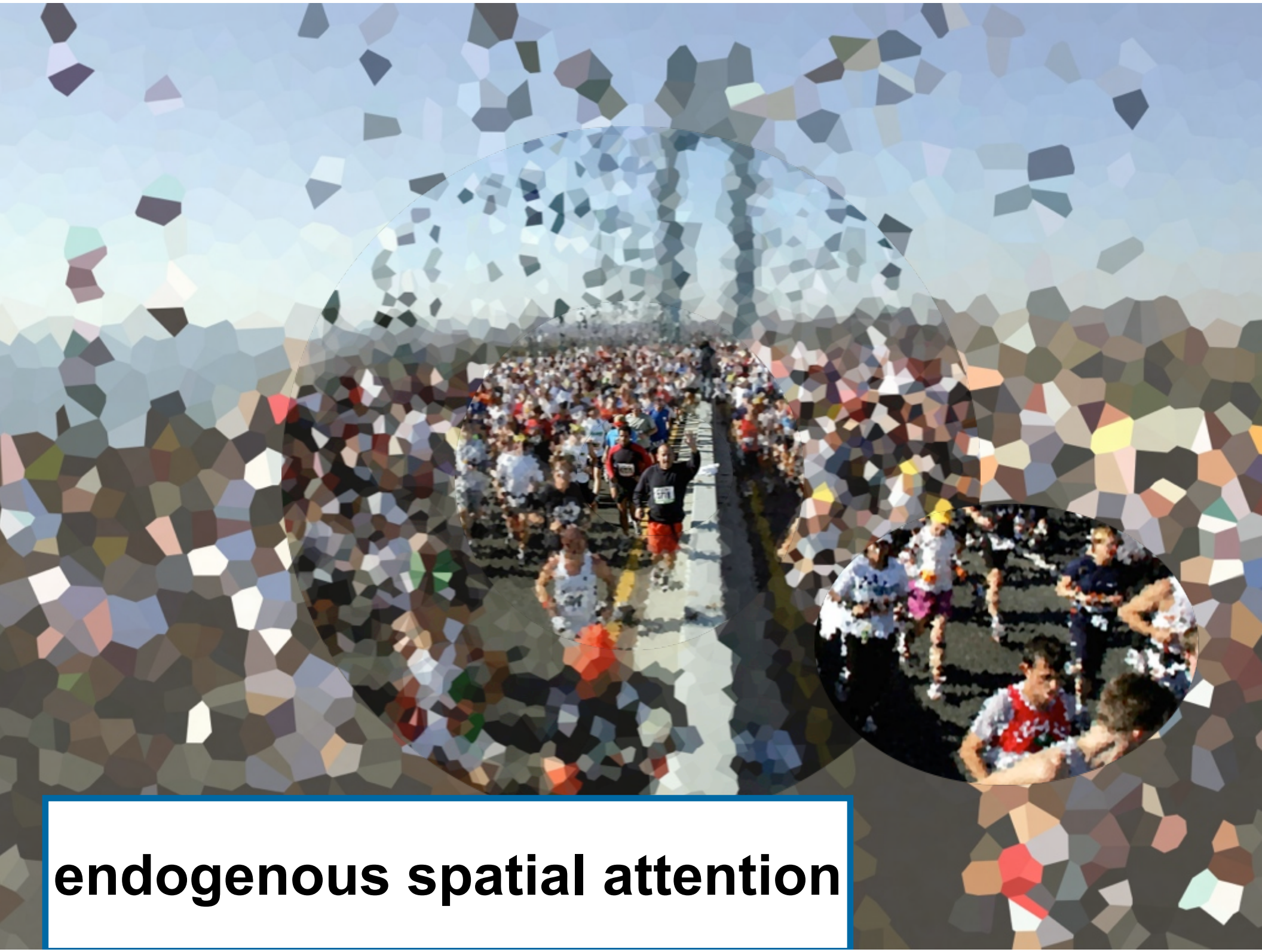
visual attention: selective processing of info

- **covert attention**
  - **spatial: exogenous and endogenous**
  - feature-based
  - temporal attention

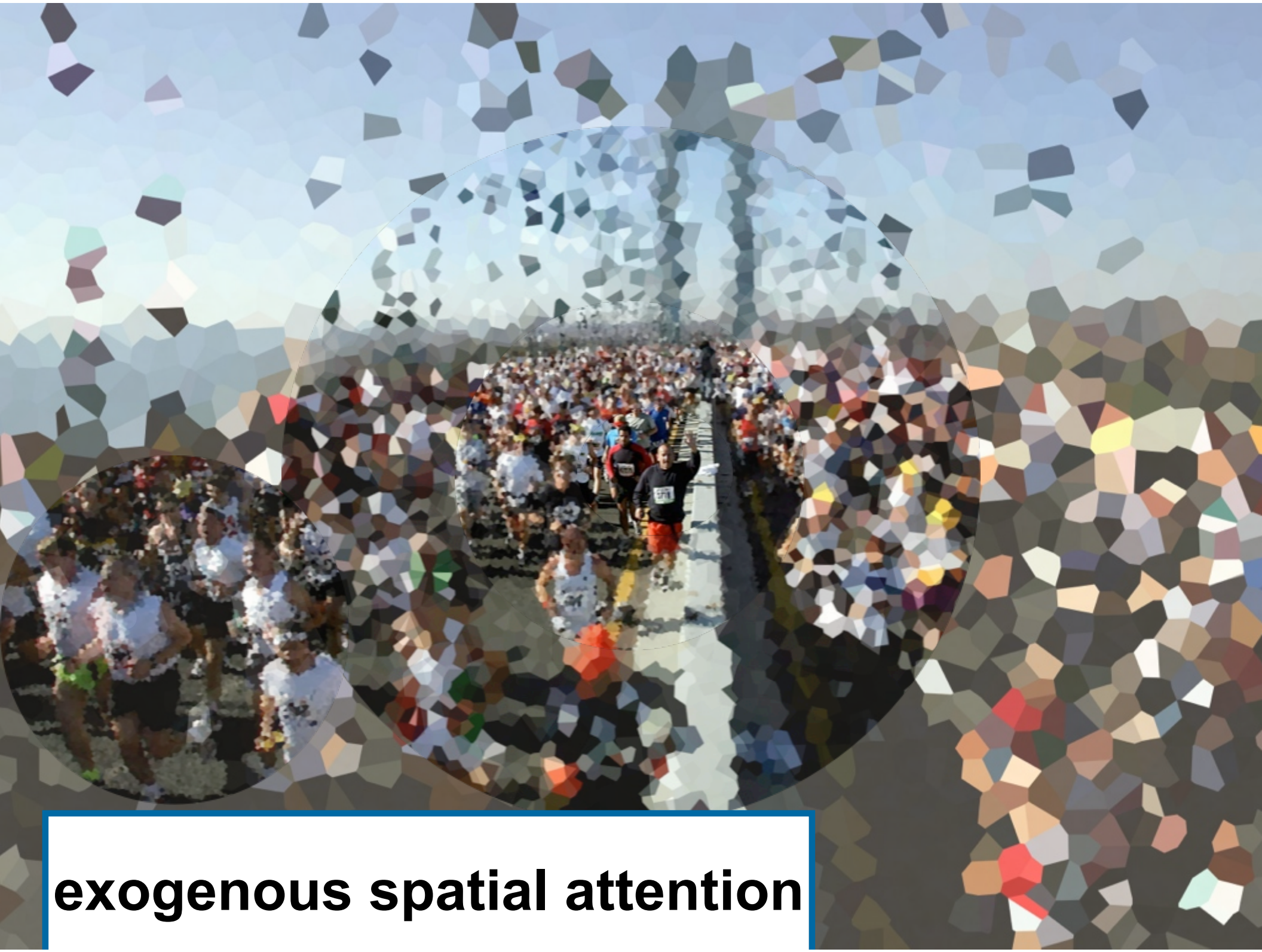
visual attention: selective processing of info

- **covert attention**
  - **spatial: exogenous and endogenous**
  - feature-based
  - temporal attention
- interactions of covert and overt attention
  - presaccadic attention; remapping; microsaccades


ITALIA
COLIN



endogenous spatial attention



exogenous spatial attention

endogenous	exogenous
voluntary	involuntary
goal driven	stimulus driven
flexible (scales with cue validity)	automatic
sustained: ~300 ms…	transient: peaks ~100 ms
cortical (and subcortical)	cortical and subcortical

most cases, similar perceptual consequences

endogenous and exogenous attention

- improve visual discriminability
  - contrast sensitivity
  - spatial resolution
  - motion
  - visual search
- modulate subjective appearance
- speed information accrual (SAT methodology)

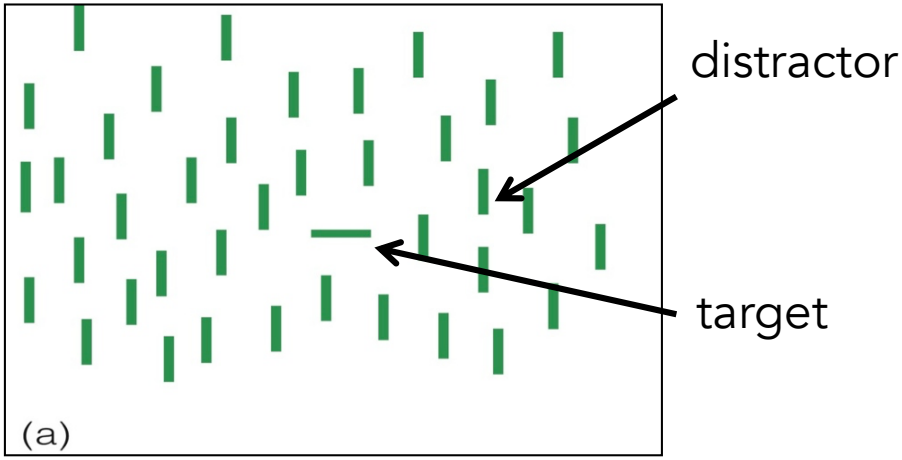
reviews: Carrasco, VisRes 2011; Oxford Handbook of Attention 2014
Anton-Erxleben & Carrasco, Nature Rev Neurosci 2013
Carrasco & Barbot, CSH 2015

to investigate covert attention

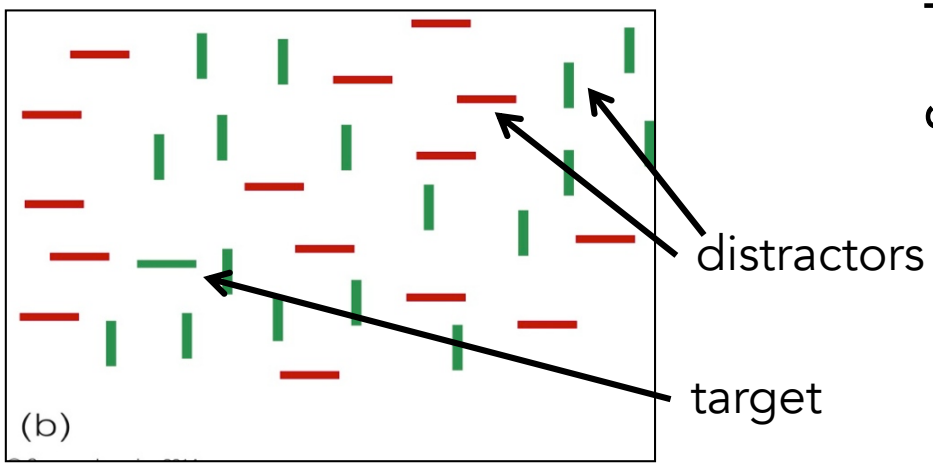
- Construct (~ to other constructs in cognition)
  - definition
  - operationalization
    - how to avoid circularity (visual search features vs conjunctions example)

FIT - visual search (cartoon example)

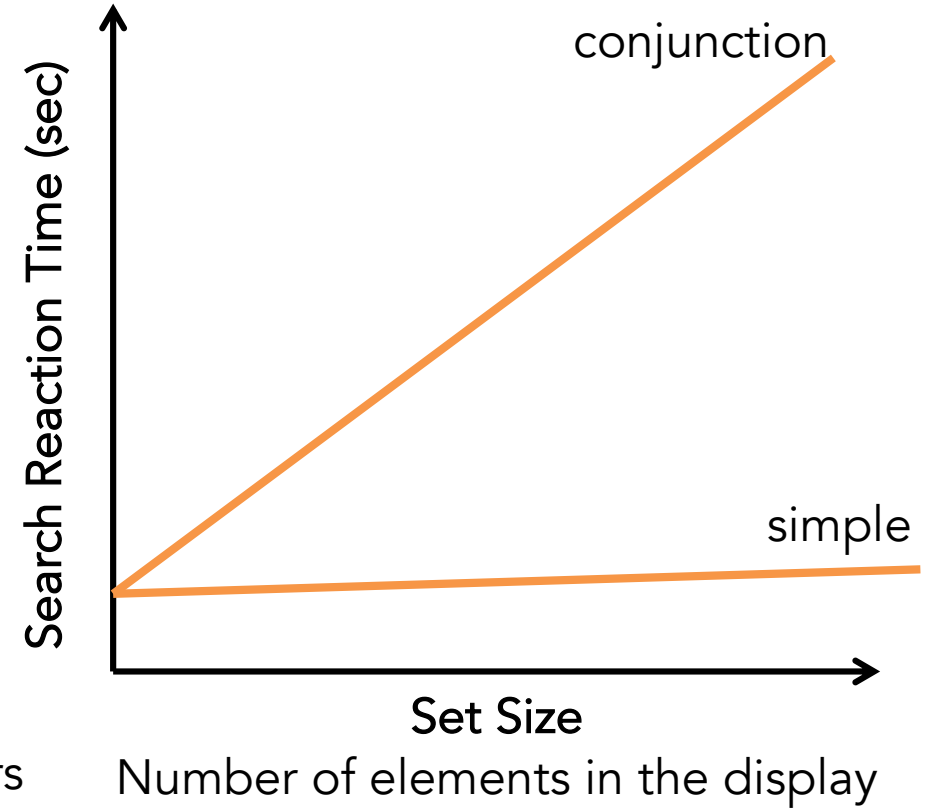
Feature ('Pop-out') search:
"Find the horizontal line"



Conjunction search:
"Find the green horizontal line"



Result: slower when searching for a conjunction of features

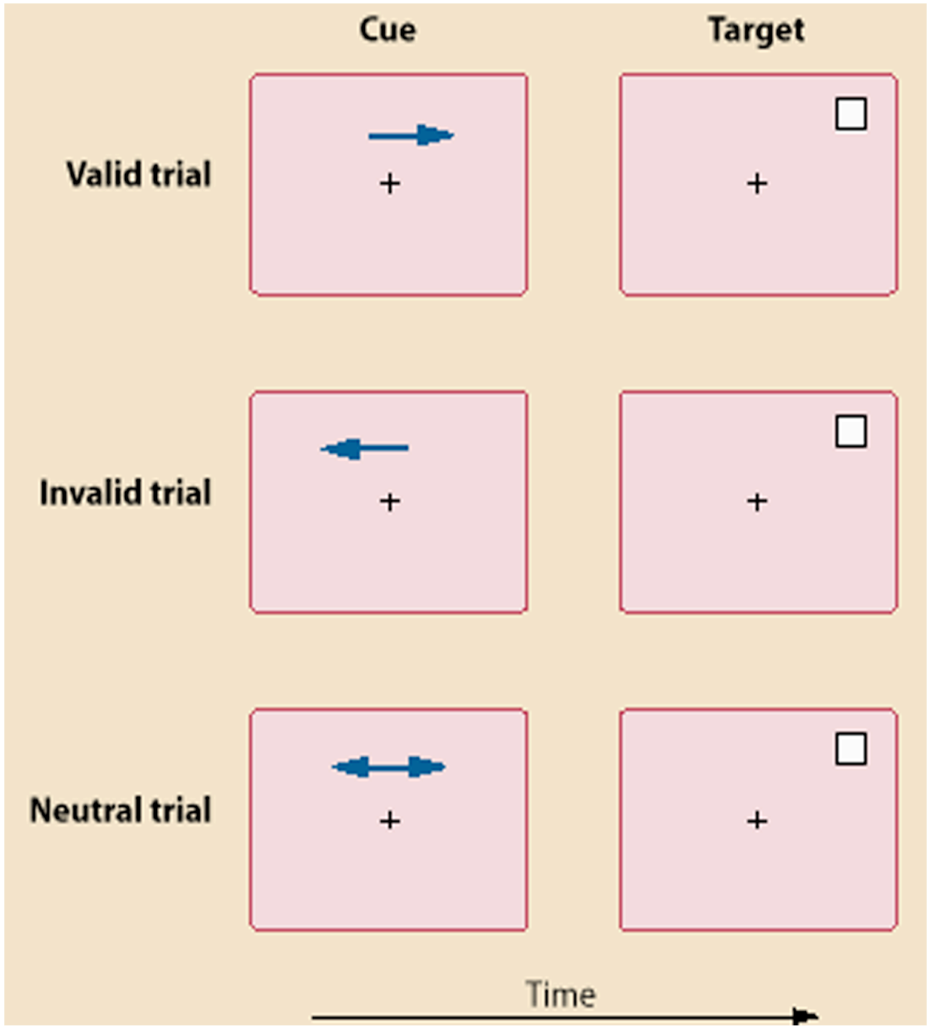


to investigate covert attention

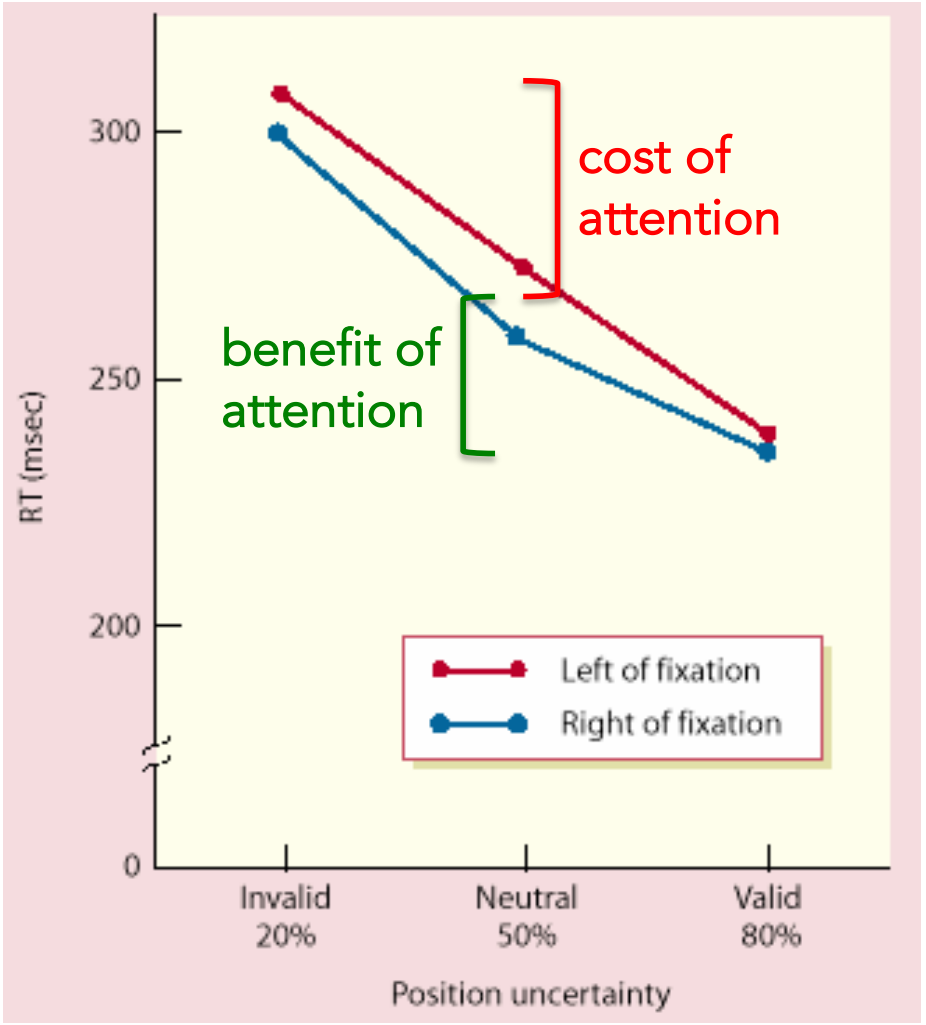
- Construct (~ to other constructs in cognition)
  - definition
  - operationalization
    - how to avoid circularity (visual search features vs conjunctions example)
- keep both the task and stimuli constant across conditions while manipulating attention
- monitor observers' eyes
- cues should convey only information that is orthogonal to the task
    - Posner detection task example

Posner's detection protocol

Press the button as soon as you detect a square"



Valid cues speed RT and invalid cues slow RT



Posner, Nissen, Ogden (1978)