Psychophysical studies of visual object recognition

Neurobiology 230. Harvard College/GSAS 78454

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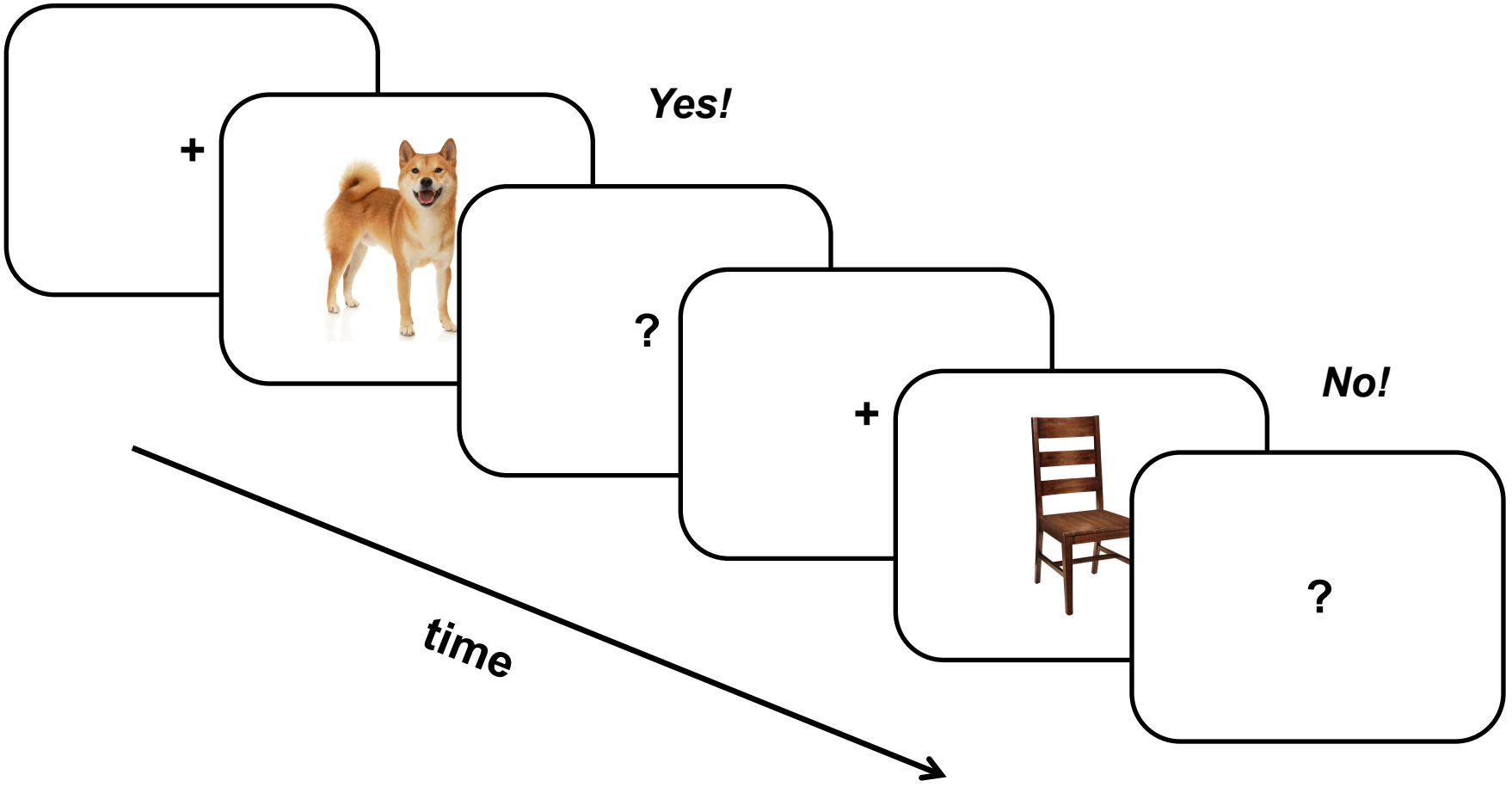
What is psychophysics?

Psychophysics is the study of the link between stimulus and perception and it quantitatively investigates the relationship between physical stimuli and the perception/ sensation/behavior they produce.

Example psychophysical experiment

Is the object an animate or inanimate object?



What do typical experiments measure?

Reaction time: The time taken by subjects to perform a task or make a judgment. Reaction time can give an indication (or at least the upper bound) or how long the necessary psychological (and neural) processes take.

Performance: The accuracy of performing a task. Performance is often inversely related to reaction time.

Threshold: Stimuli can be varied (e.g., presentation duration) to determine the threshold for detection or discrimination.

Gestalt laws

Law of closure

Law of similarity

Law of proximity

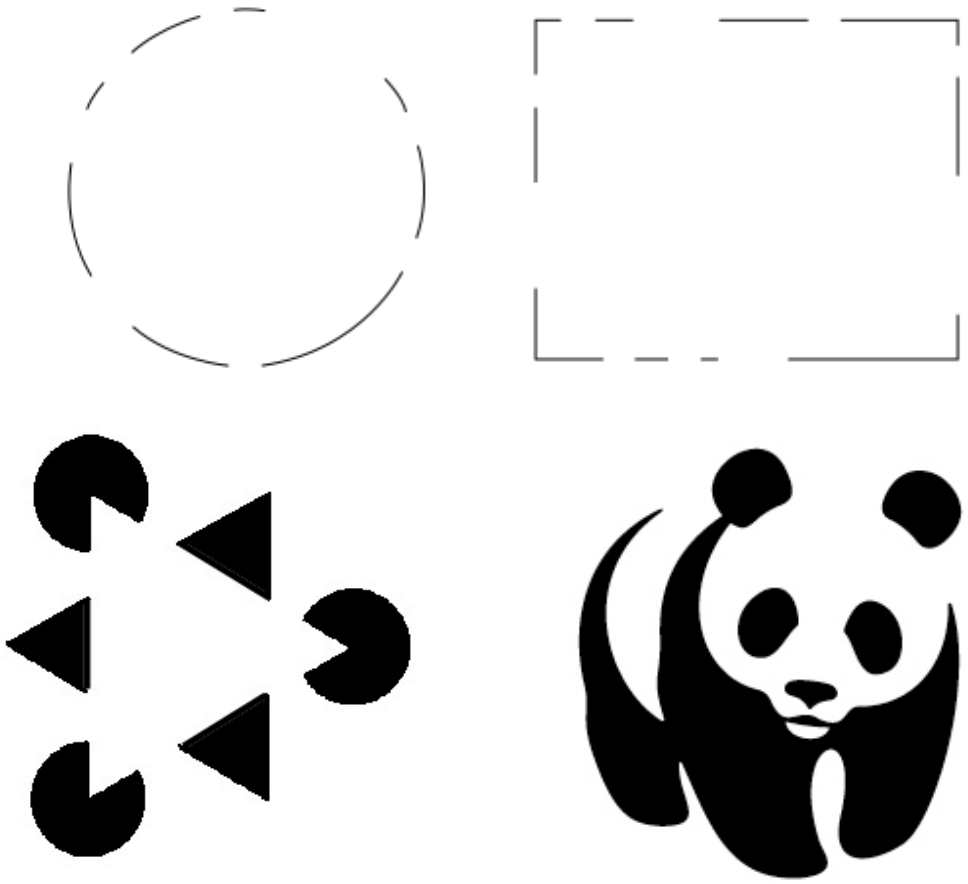
Law of symmetry

Law of continuity

Law of common fate

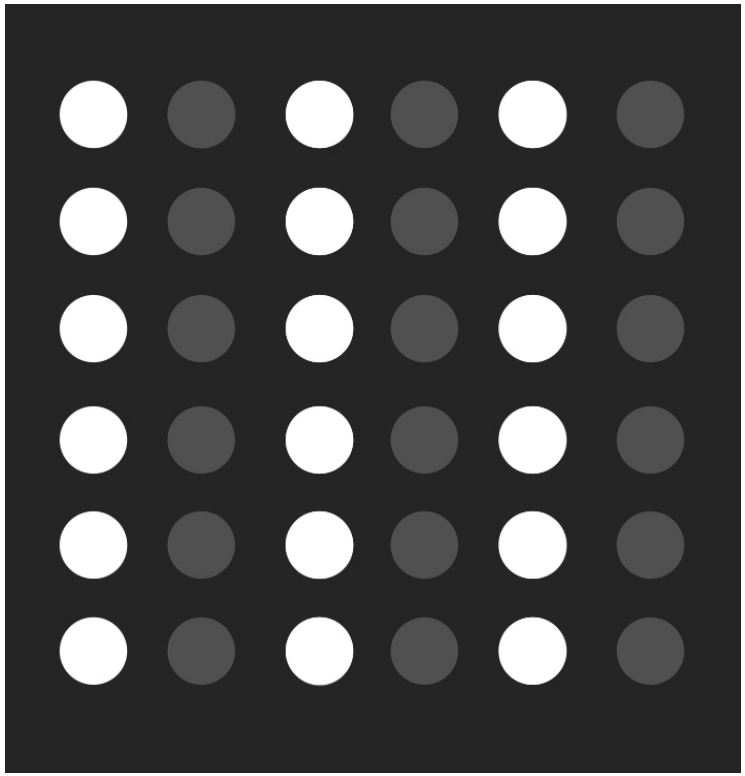
Law of closure

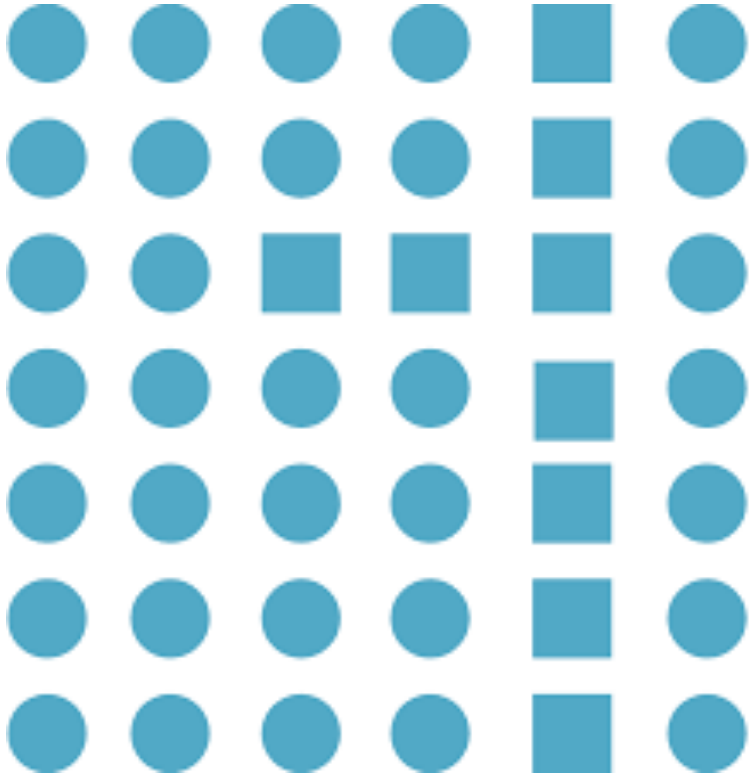
We perceive objects such as shapes, letters, pictures, etc., as being whole when they are not complete. Specifically, when parts of a whole picture are missing, our perception fills in the visual gap.



Law of similarity

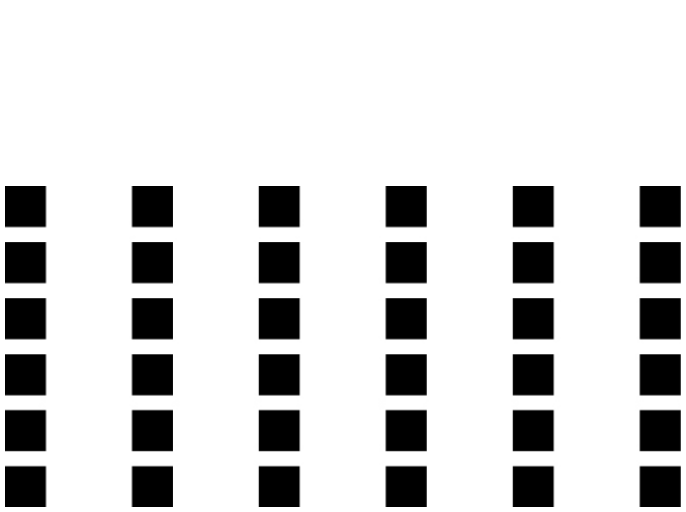
We group **similar** elements into collective entities or totalities. This similarity might depend on relationships of form, color, size, or brightness

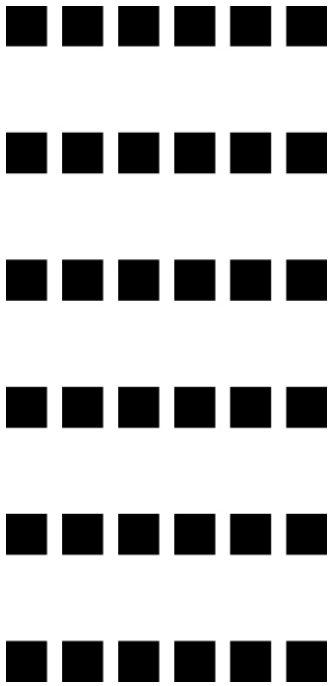




Law of proximity

We group objects that are **proximate** to each other (either spatially or temporally) tend to be grouped together.





Law of symmetry

We group elements that are **symmetrical** to each other tend to be perceived as a unified group.

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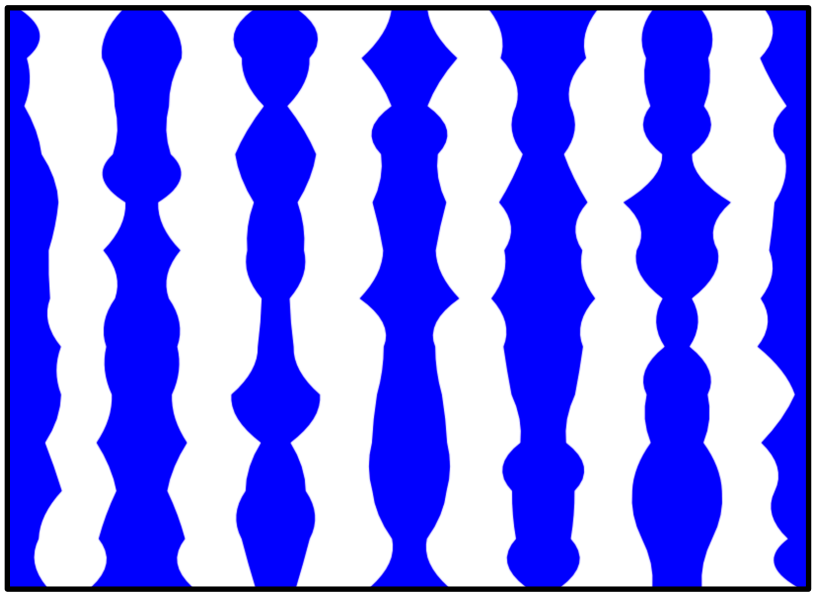
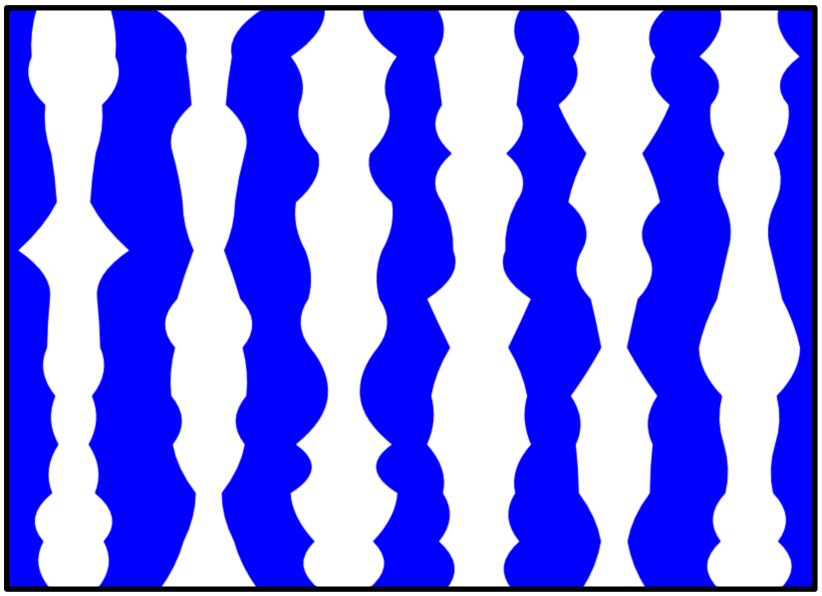
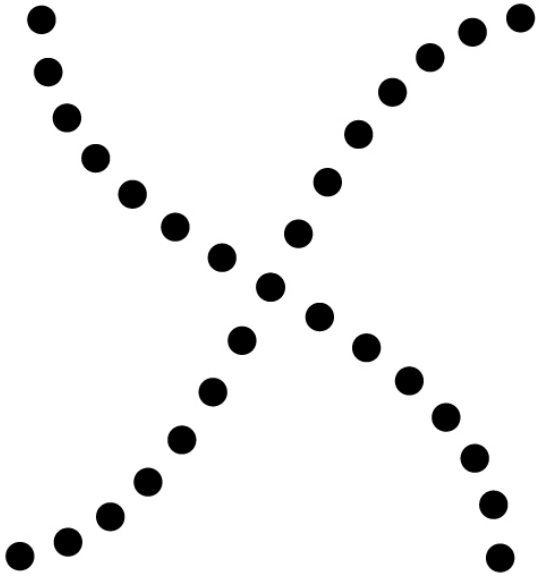
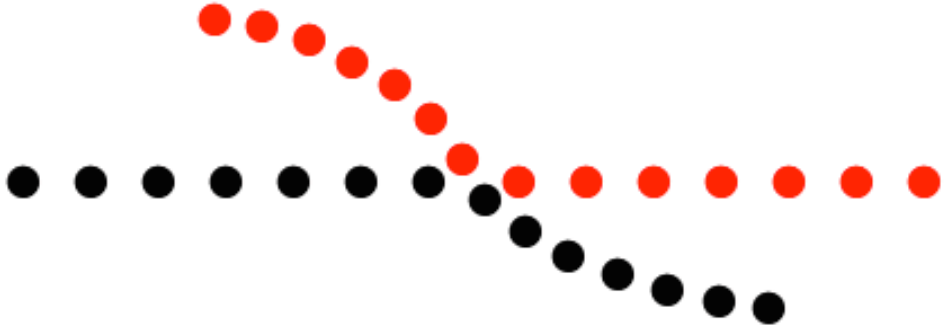




Law of continuity

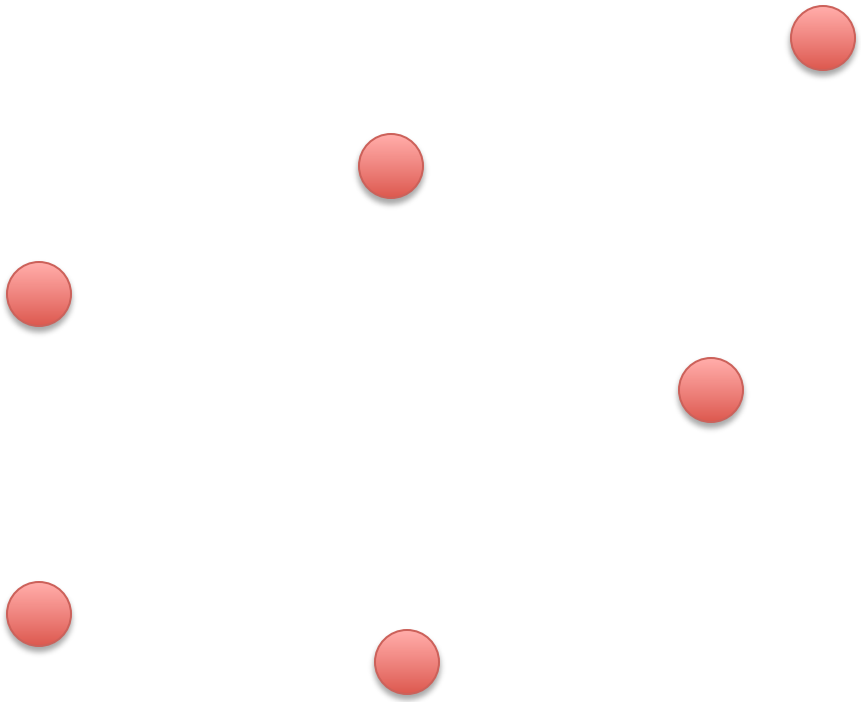
We perceive points that are connected by straight or curving lines are seen in a way that follows the smoothest path.





Law of common fate

We perceive elements with the same moving direction as a collective unit.



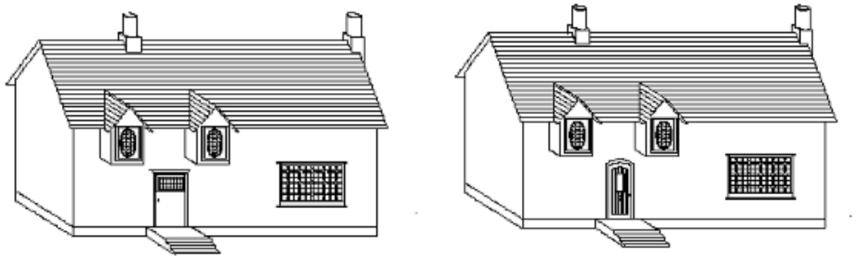
Hollistic process of face perception

Part-whole effect

Inversion effect

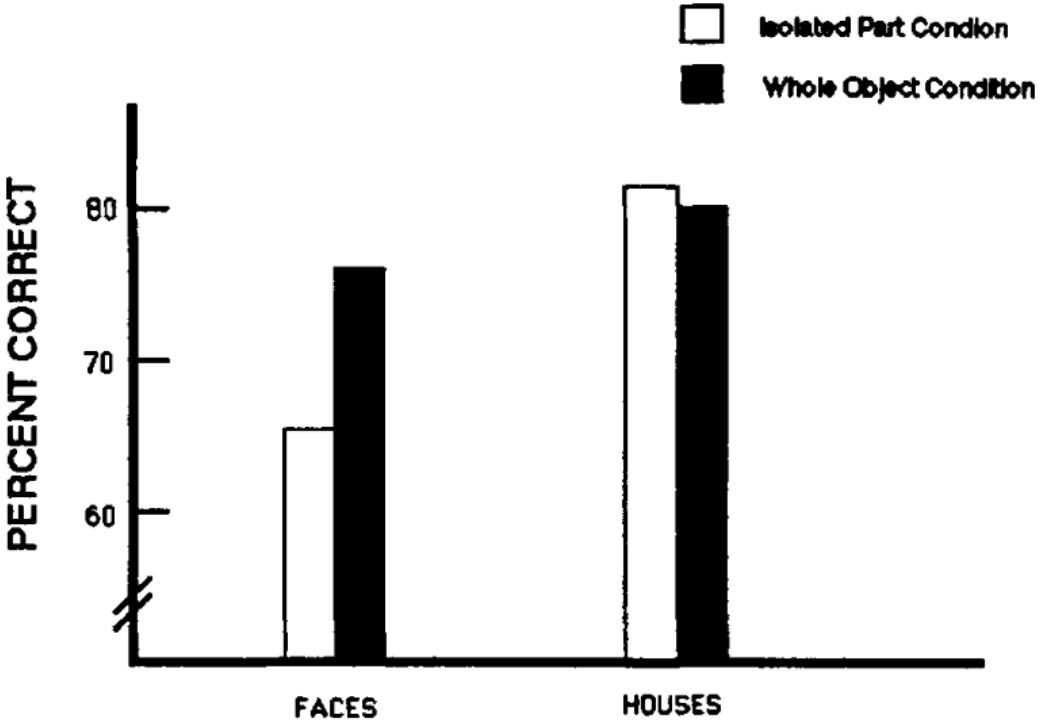
Composite face effect

Parts vs wholes effect in face perception

	Faces	Houses
Parts		
Whole		

Tanaka & Farah (1993)

Parts vs wholes effect in face perception



Tanaka & Farah (1993)

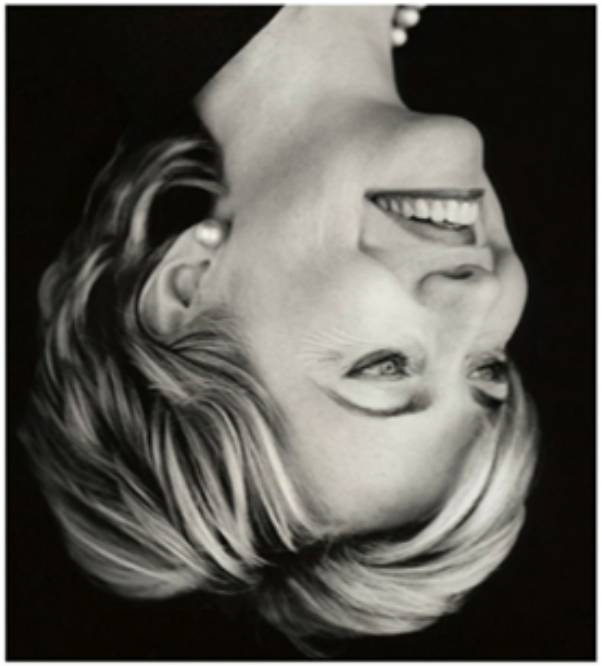
Part-whole illusion

McKone et al (2013)

Part-whole illusion

McKone et al (2013)

Inversion effect



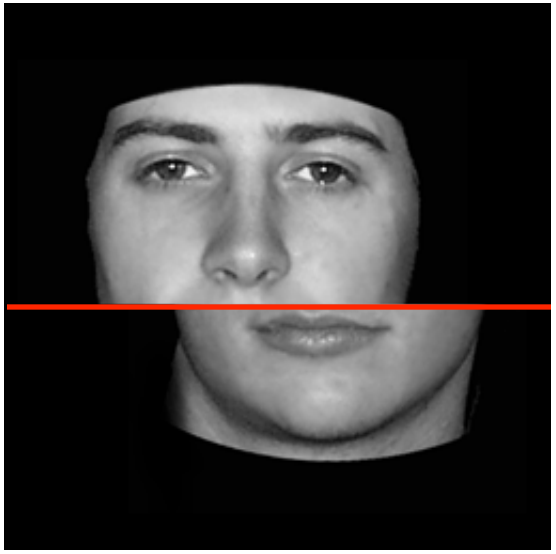
Inverted

McKone et al (2013)

Composite face effect

A

B



Composite face effect

Properties of object recognition

Invariant object recognition

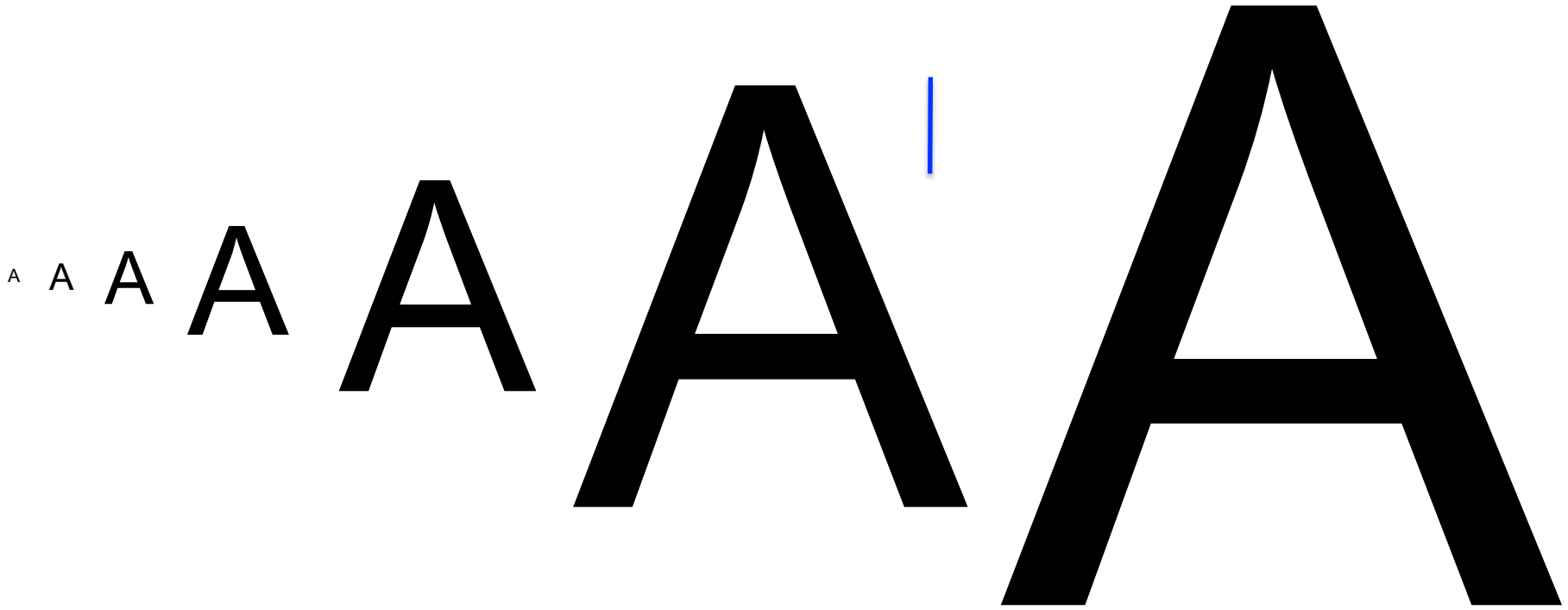
Speed of visual recognition

Recognition from minimal features

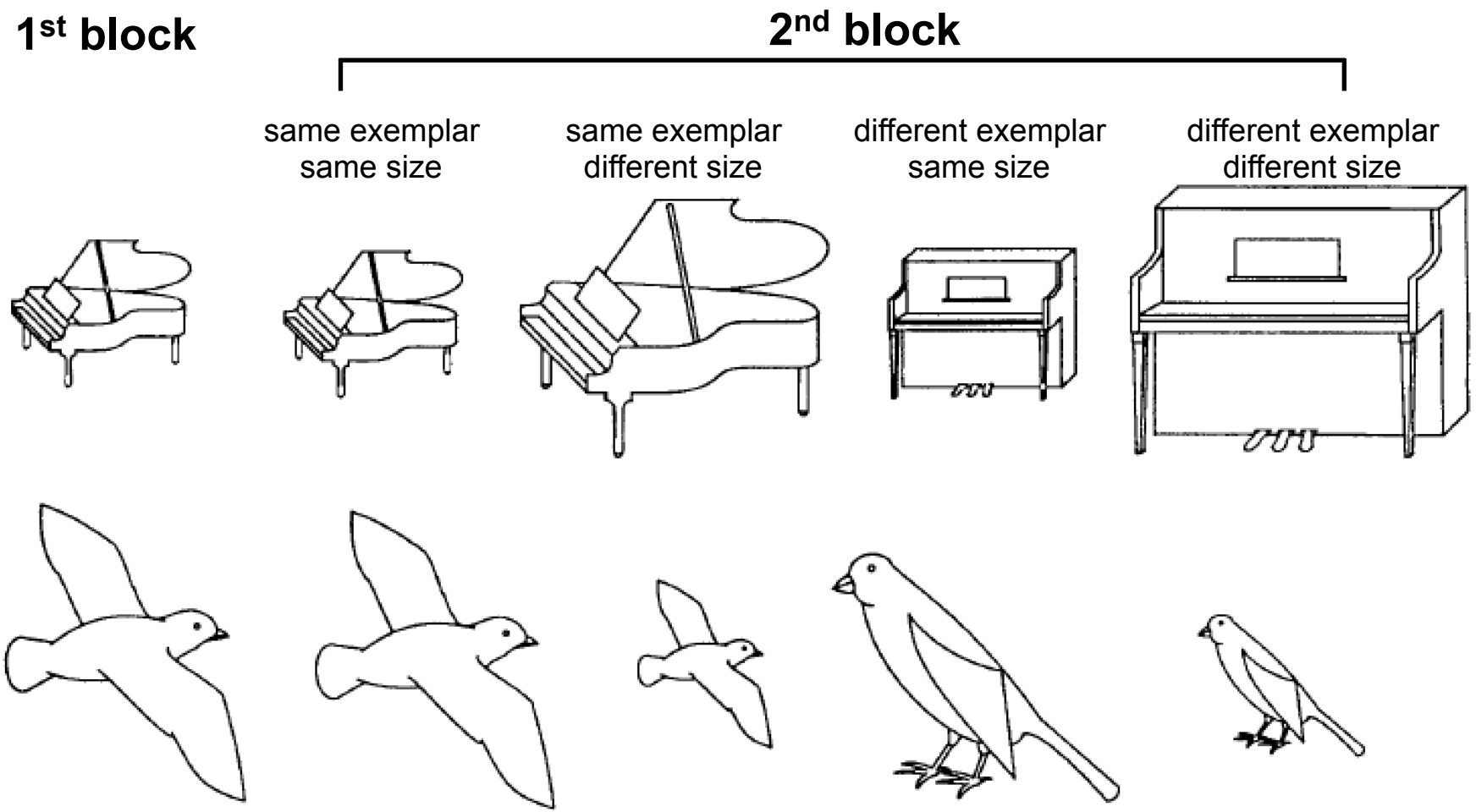
The value of experience

Invariant recognition

Scale/size tolerance

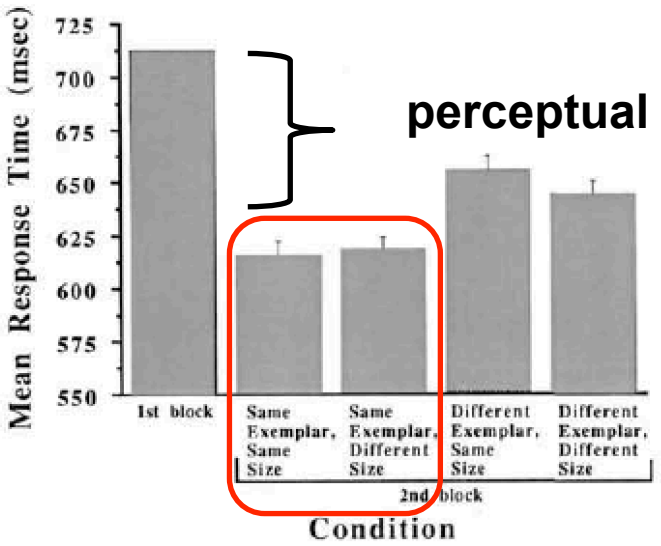


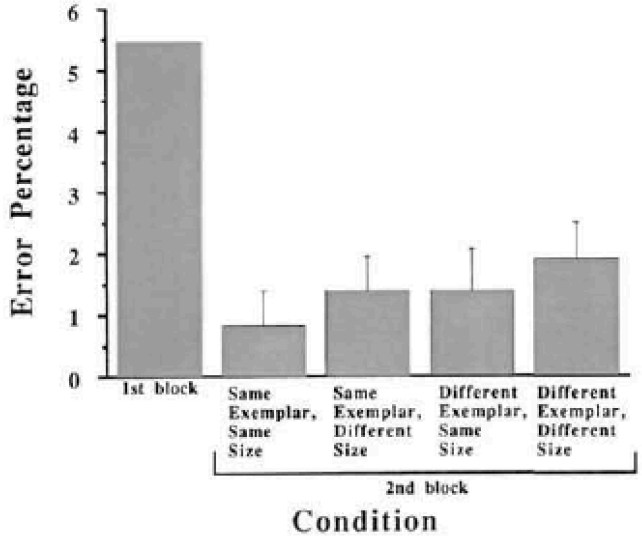
Size invariance in visual object priming



Biederman & Cooper (1992)

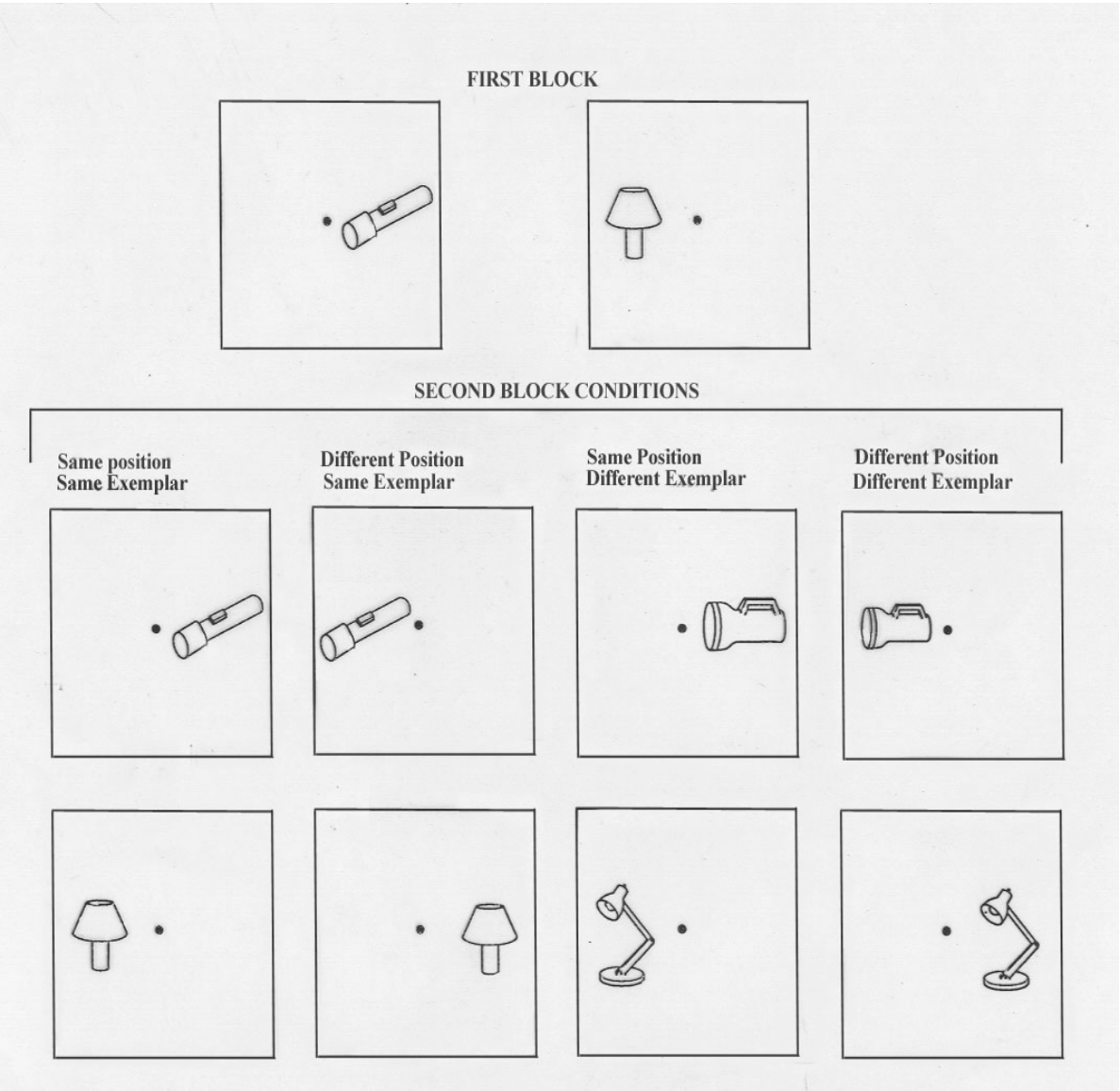
Size invariance in visual object priming





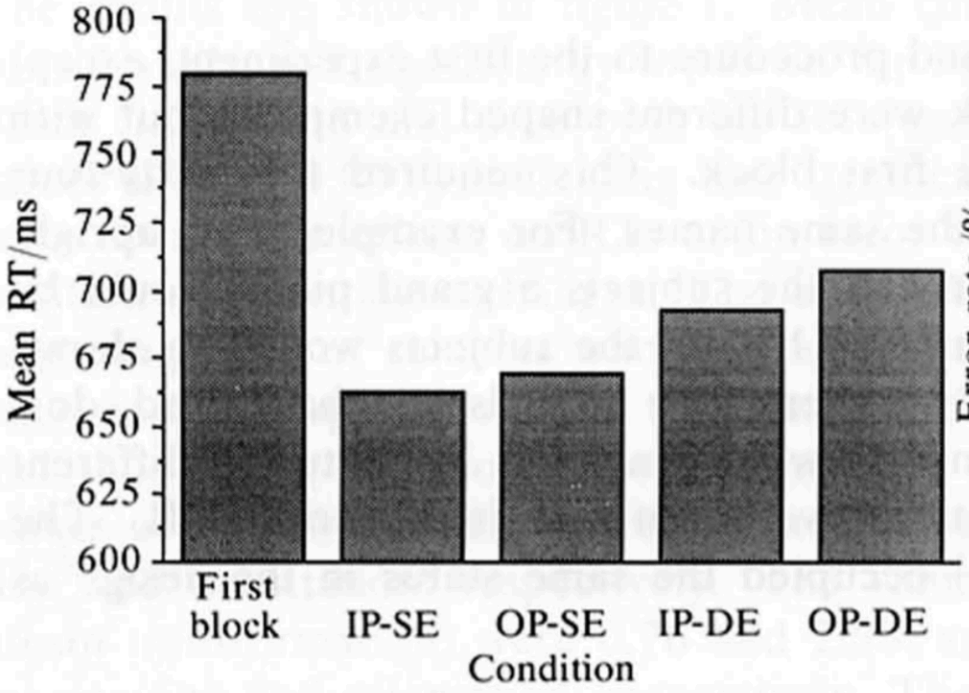
Biederman & Cooper (1992)

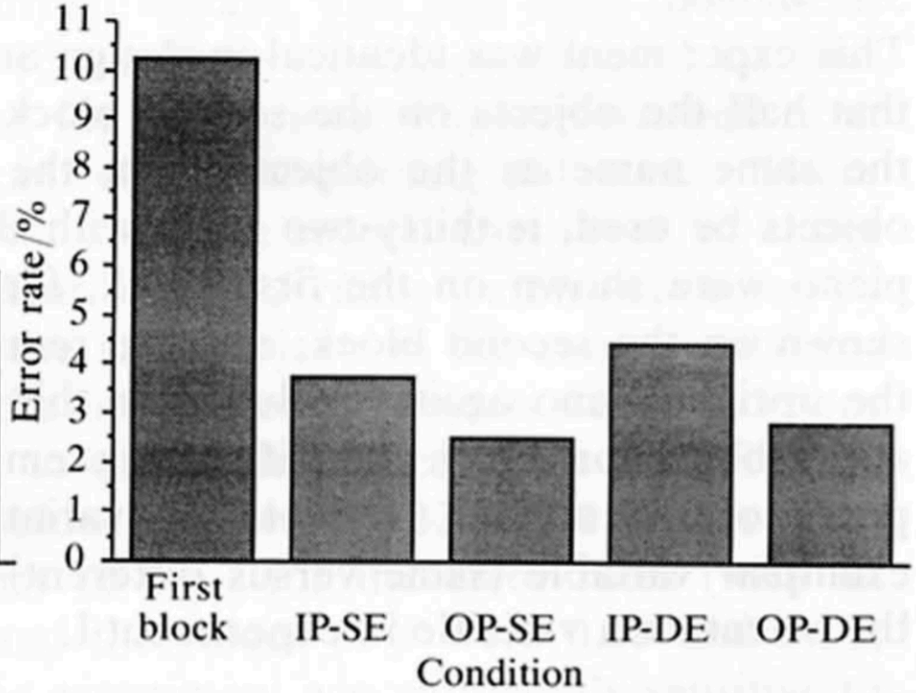
Position invariance in visual object priming



Biederman & Cooper (1991)

Position invariance in visual object priming





Biederman & Cooper (1991)

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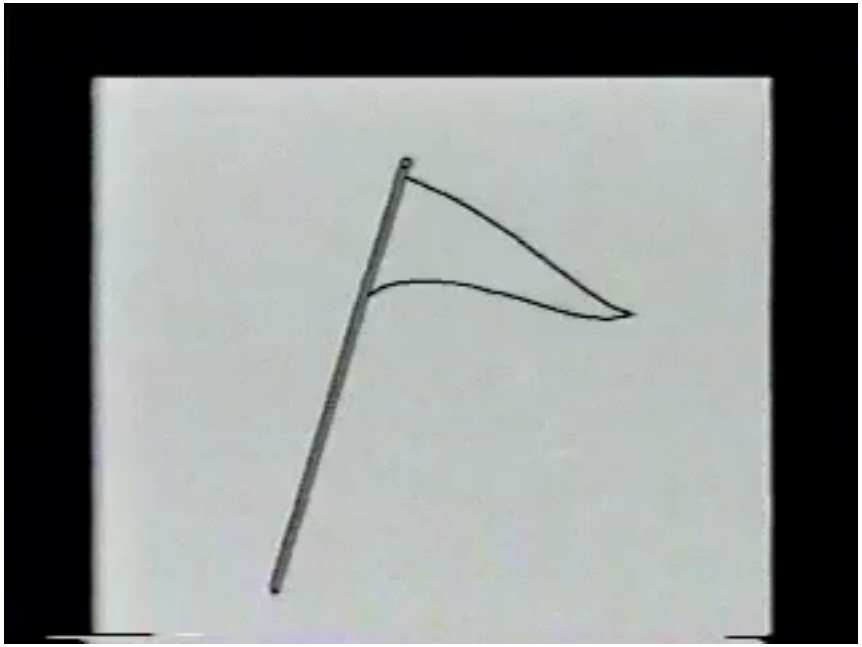
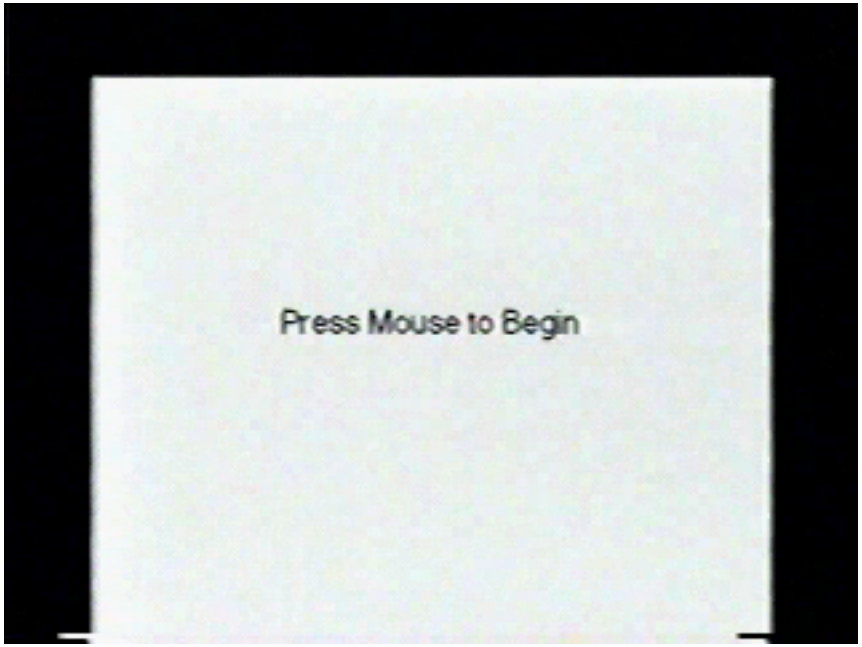
RSVP (Rapid Serial Visual Presentation)

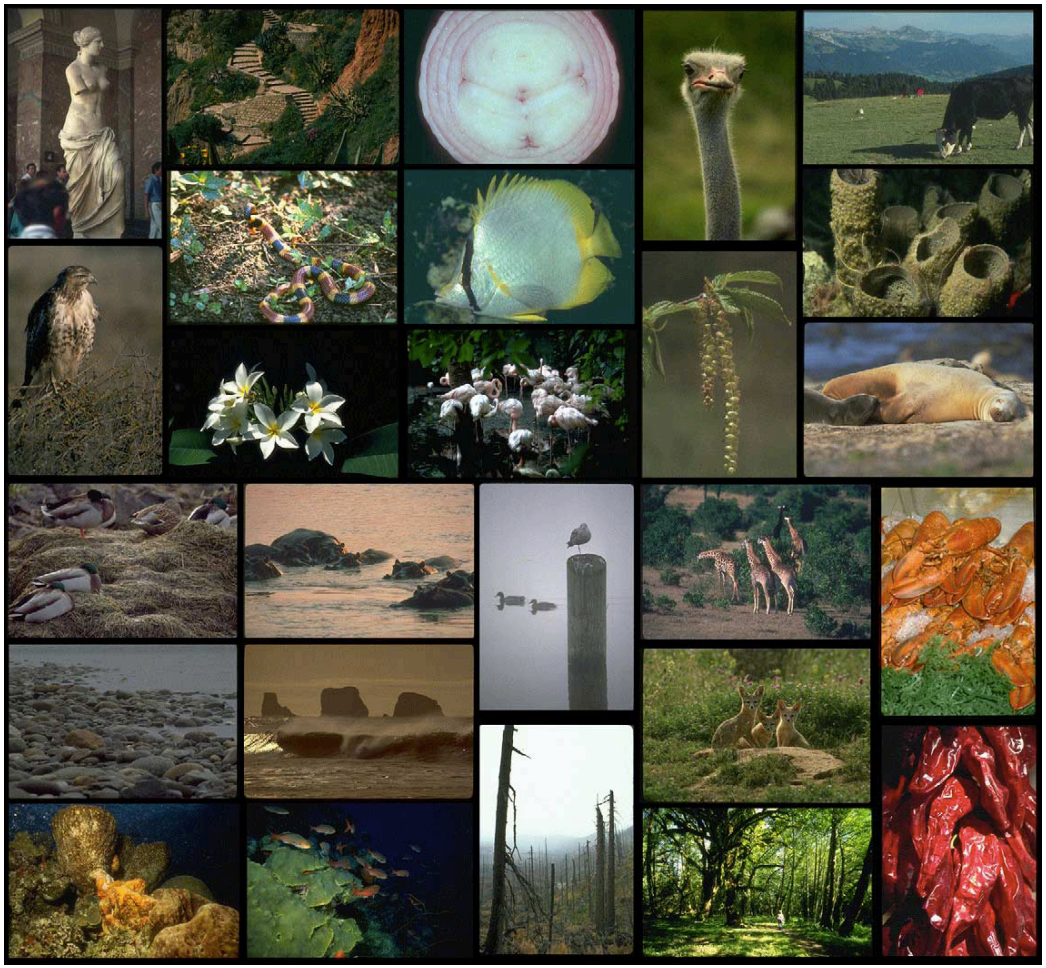


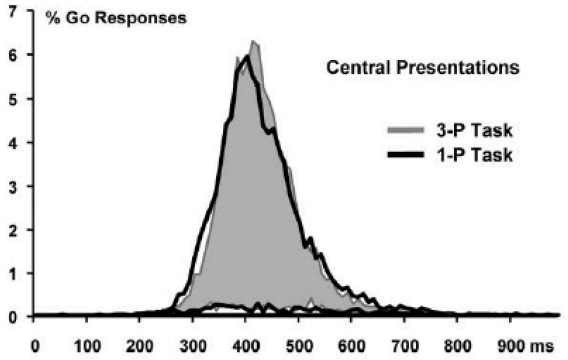


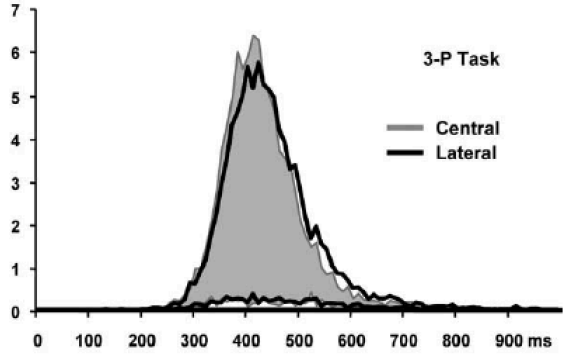
Irving Biederman

Probing the timing of the visual system

Go- no go animal categorization task







Fize et al. (2005)

Properties of object recognition

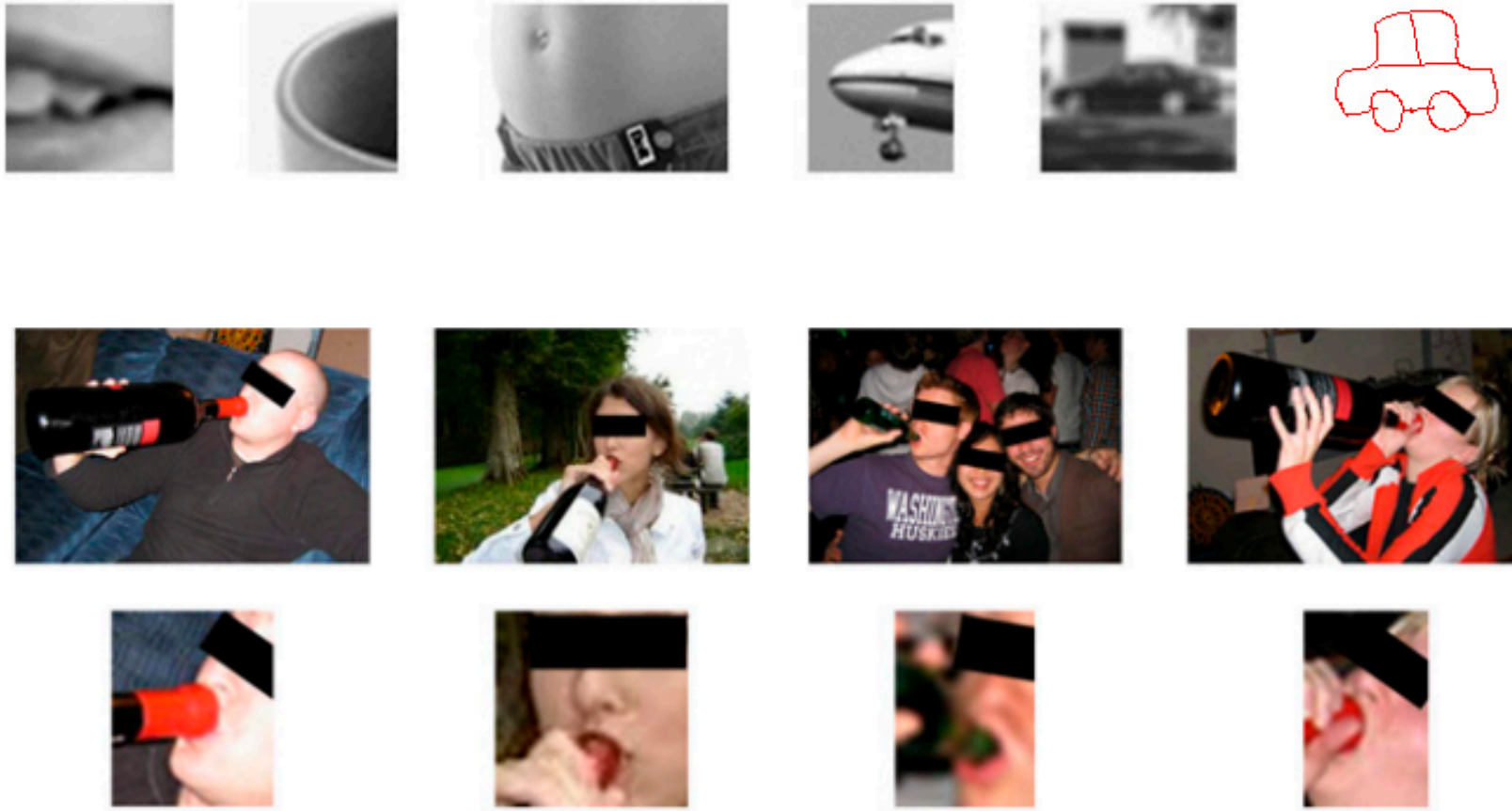
Invariant object recognition

Speed of visual recognition

Recognition from minimal features

The value of experience

Object recognition from minimal features



Shimon et al (2016)

MIRCs: MInimal Recognizable Configurations

Shimon et al (2016)

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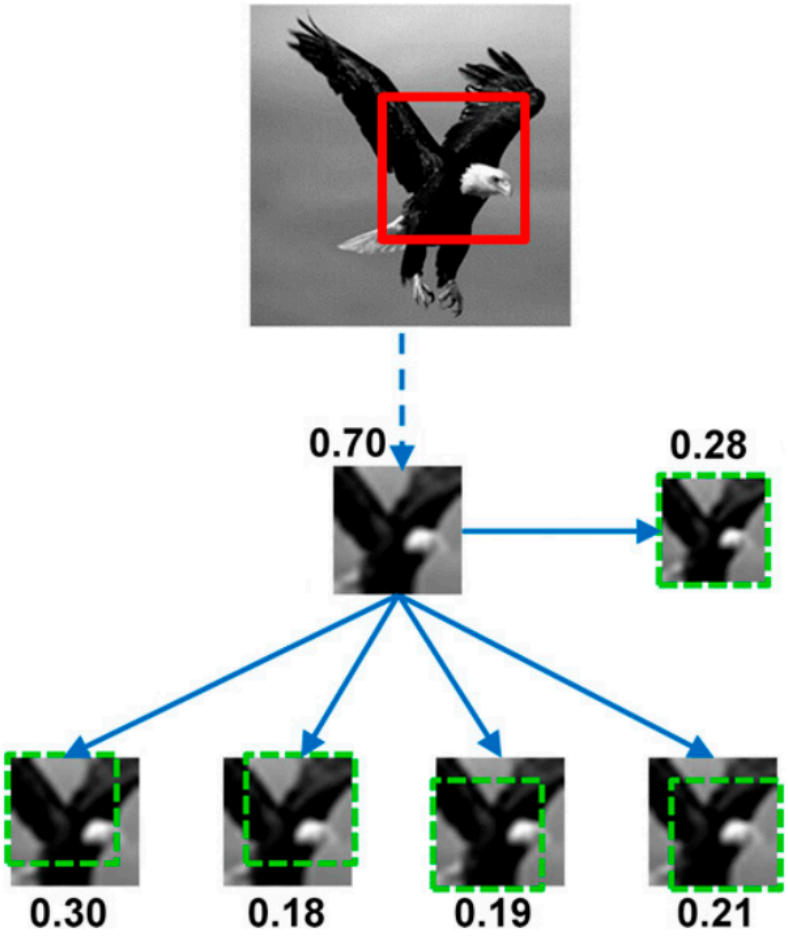
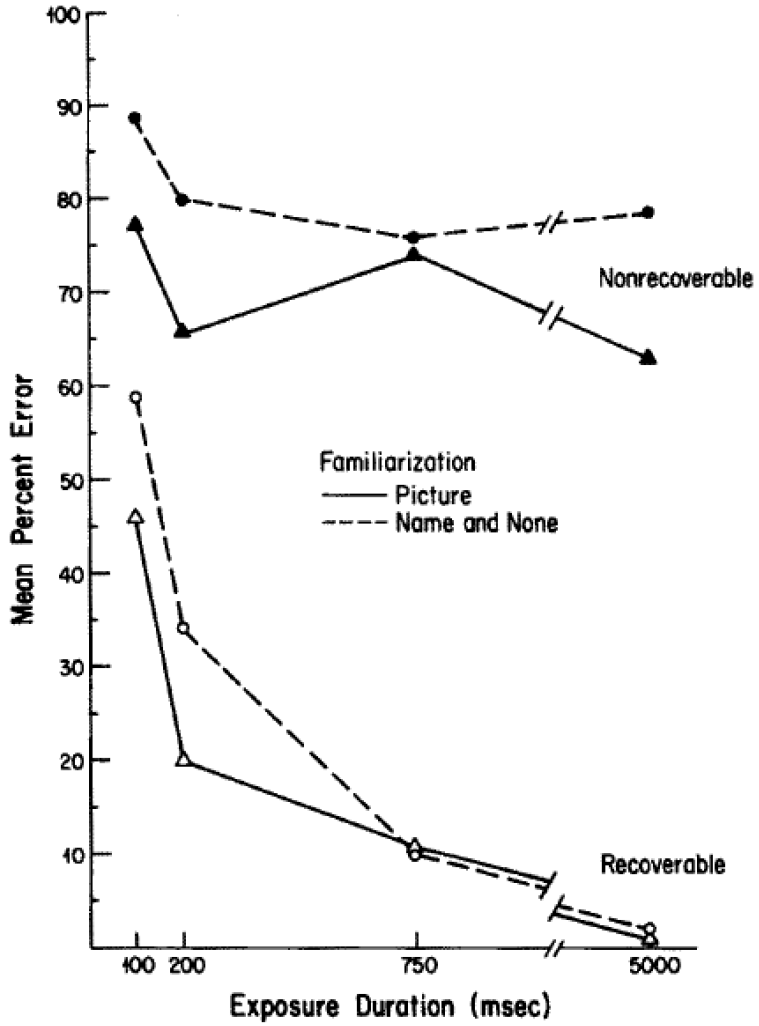


Shimon et al (2016)

Diagnostic features at the part-level

Non-recoverable



Biederman (1987)

Properties of object recognition

Invariant object recognition

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Recognition from minimal features

The value of experience

Visual recognition depends on experience

Waterfall illusion

http://www.michaelbach.de/ot/mot-adapt/index.html