VISUAL ATTENTION

Chapter 6: Mechanisms, Influences, and the Physiology of Focus

MECHANISMS OF THE MIND

“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.”

William James, Principles of Psychology (1890)

THE CORE MECHANISM

1. **Selective Processing:** The visual system has limited capacity and must filter input to avoid overload.
2. **Modes of Attention:** Overt (shifting eyes) vs. Covert (shifting mind).

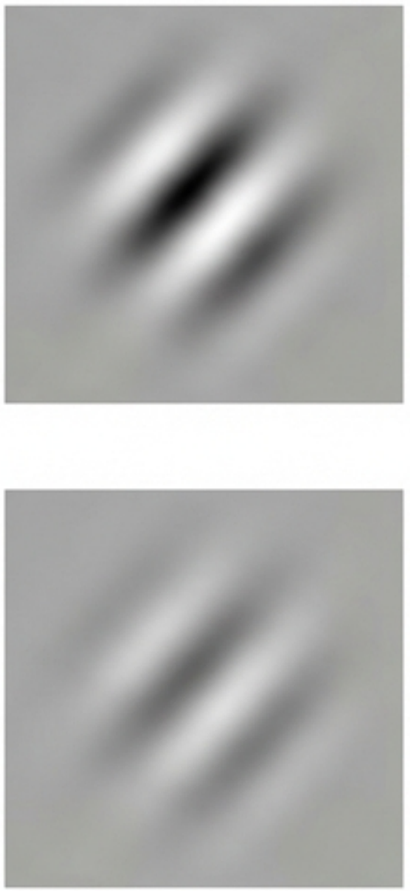
THE COCKTAIL PARTY EFFECT

The auditory system demonstrates our ability to filter. In Cherry's (1953) dichotic listening experiments, subjects could 'shadow' a message in one ear while remaining completely unaware of the content playing in the other ear.

EARLY MODELS OF BINDING

1. The Spotlight (Posner)

Attention operates like a zoom lens. Precueing speeds up processing.



2. Feature Integration Theory (Treisman)

Features (color, shape) are processed independently, then “bound” together by focused attention.

OVERT ATTENTION: THE NECESSITY OF SCANNING

Because high-acuity vision is limited to the fovea (the size of a thumb at arm's length), we must perform saccades—rapid, jerky eye movements—to scan these scenes for details like the 'white-headed birds' or specific faces.

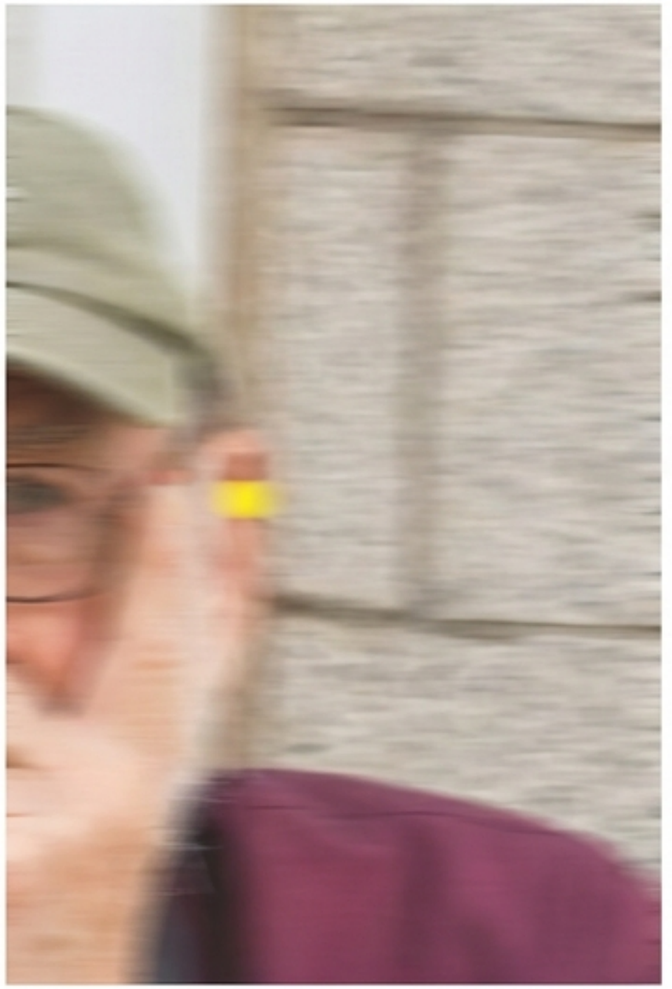
ANATOMY OF A GLANCE

Fixation (Pause)

Saccade (Movement)

Even when viewing a static object, the eye moves constantly—over 200,000 times a day—mixing overt looking with covert planning.

STABILIZING THE WORLD: COROLLARY DISCHARGE

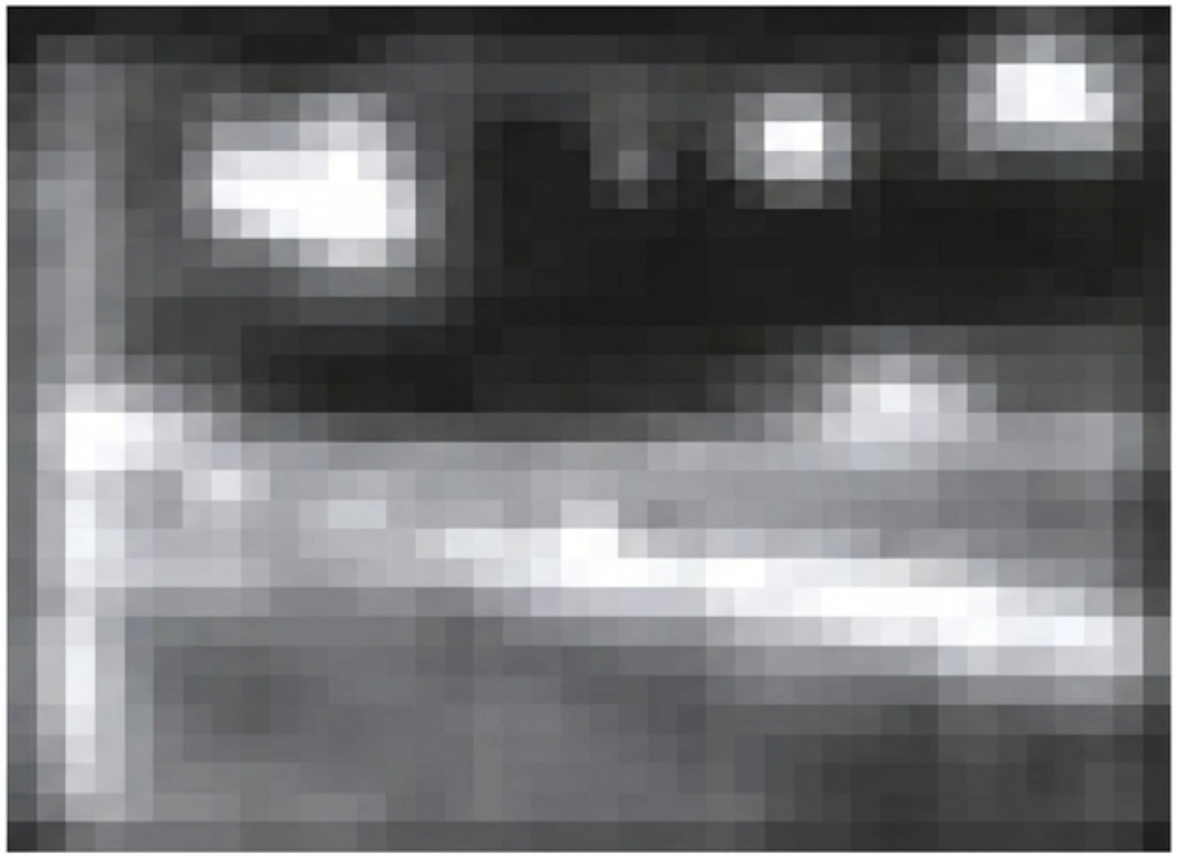


The Solution

The brain sends a motor signal to move the eye AND a copy (Corollary Discharge) to a comparator.

If the motion of the image matches the motion of the eye, the brain cancels the blur, resulting in a stable world.

INFLUENCE 1: VISUAL SALIENCE (BOTTOM-UP)



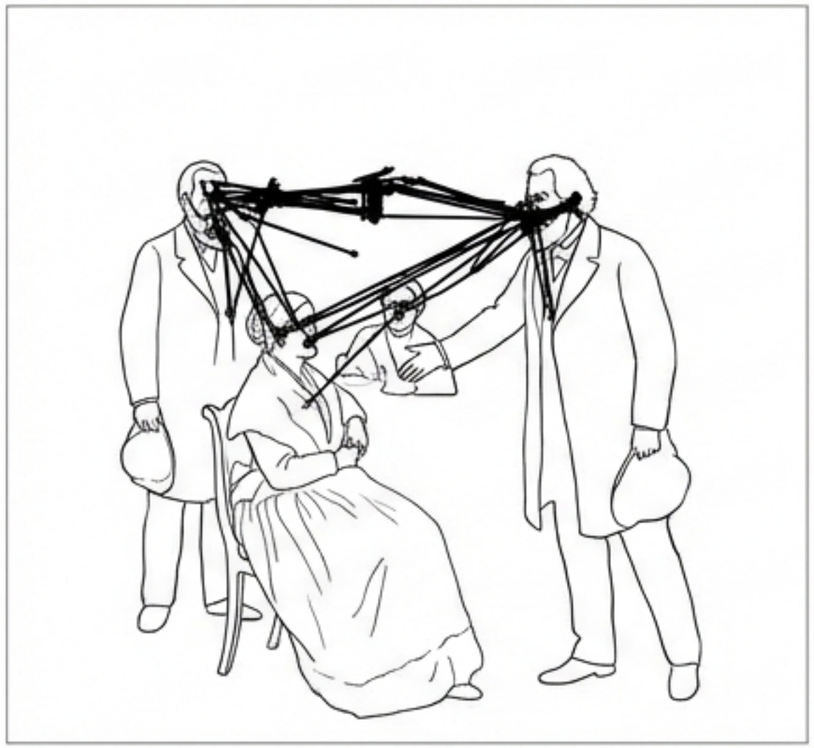
Salience is driven by the stimulus itself—contrast, color, and orientation. The heatmap on the right predicts the first few fixations based purely on these physical properties.

INFLUENCE 2: COGNITIVE GOALS (TOP-DOWN)

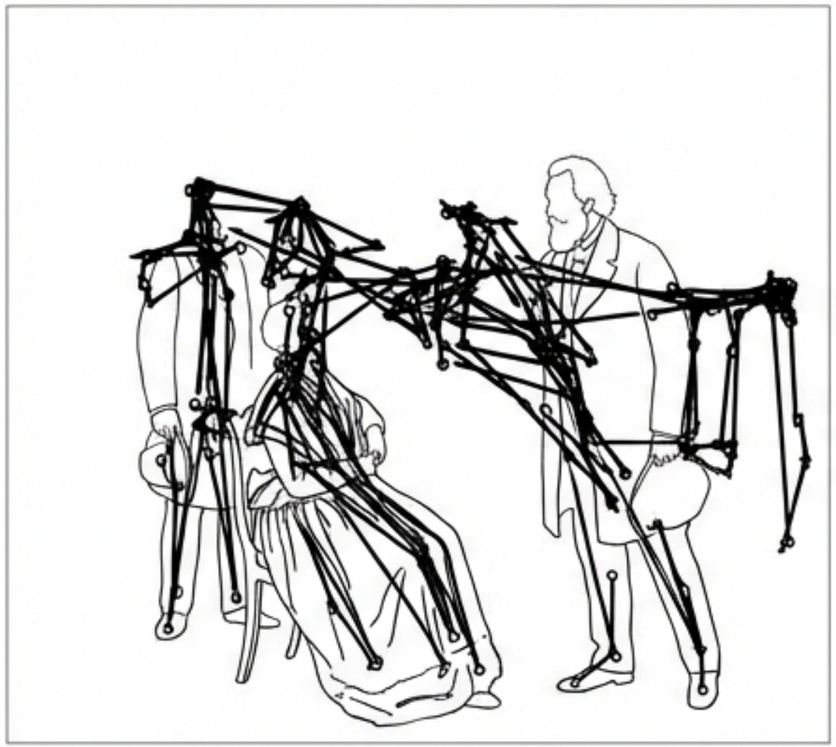
The Yarbus Experiment (1967).

Subjects viewed this painting while receiving different instructions. The resulting eye movements proved that we do not passively see; we actively interrogate the scene based on our internal goals.

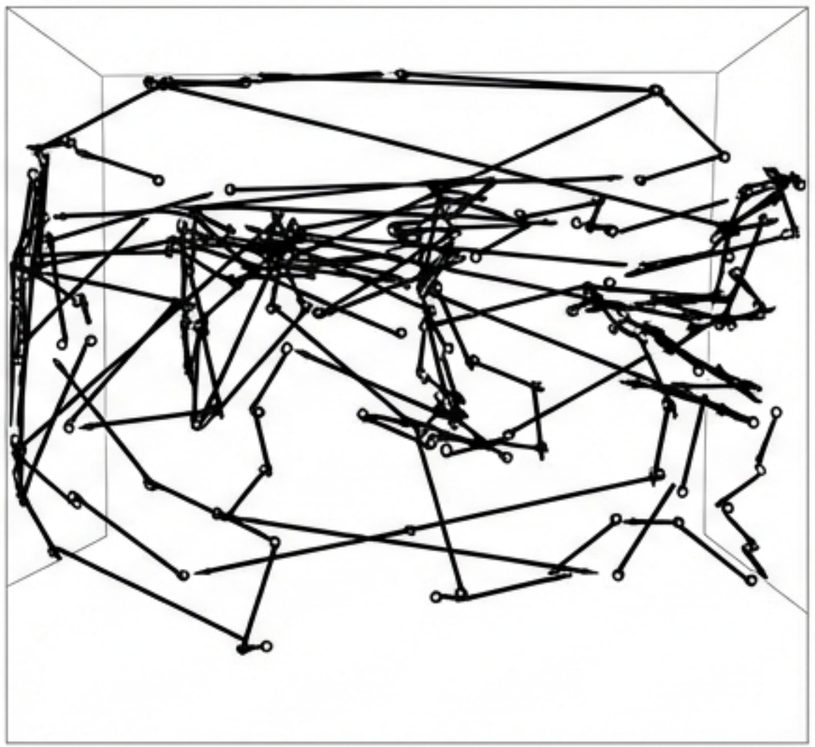
YARBUS DATA: TASK SHAPES PERCEPTION



Task: Estimate Ages



Task: Remember Clothes



Task: Remember Positions

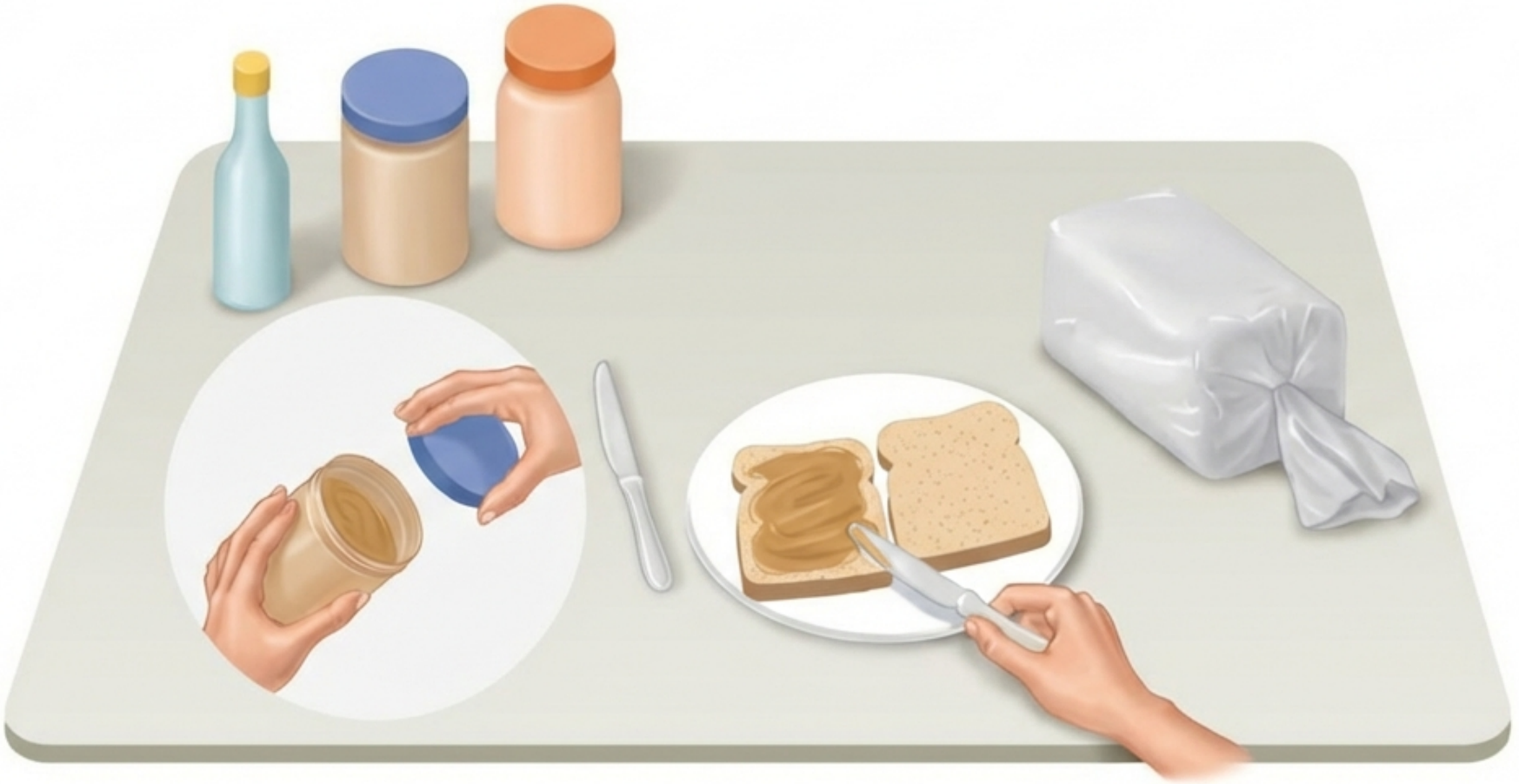
INFLUENCE 3: SCENE SCHEMAS

We possess mental templates (‘schemas’) of typical environments.

Viewers fixate significantly longer on the printer than the pot because it violates the kitchen schema.

Attention is grabbed by the incongruous.

INFLUENCE 4: TASK DEMANDS



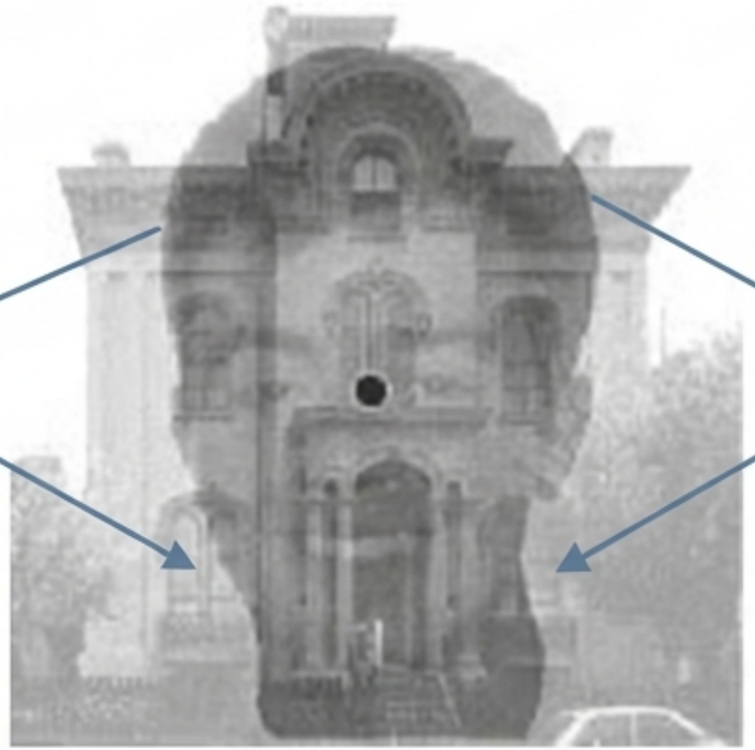
The ‘Just in Time’ Strategy. Eye movements precede motor actions by a fraction of a second. We look at the jar before we reach for it, and the knife before we pick it up. Vision is predictive.

ATTENTION ALTERS APPEARANCE

Carrasco (2004) demonstrated that when attention is cued to a specific location, the object there is perceived as having higher contrast than an identical object elsewhere. Attention literally *boosts* the signal strength of perception.

PHYSIOLOGY: ATTENTION TO OBJECTS

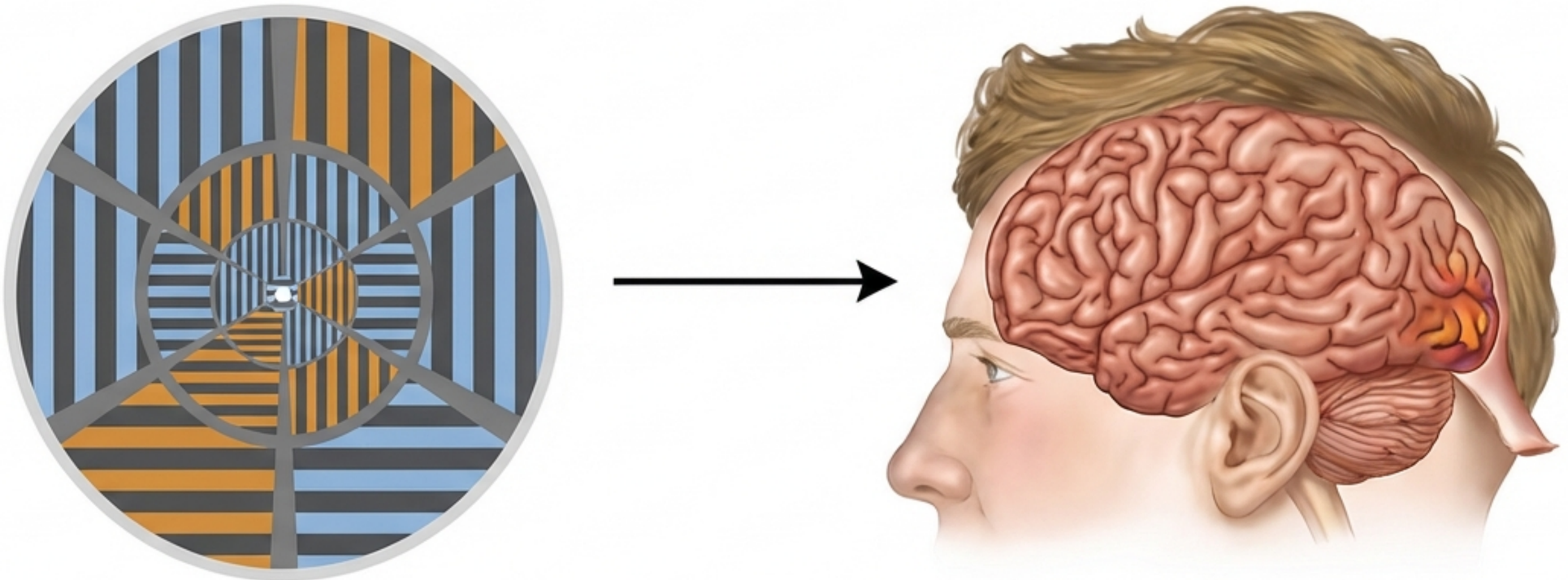
Attend to Face:
Activates Fusiform Face Area (FFA)



Attend to House:
Activates Parahippocampal Place Area (PPA)

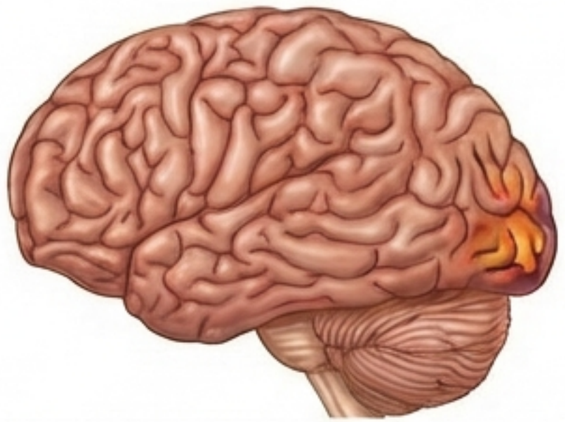
Attention modulates neural firing based on object category, even when the retinal image is identical.

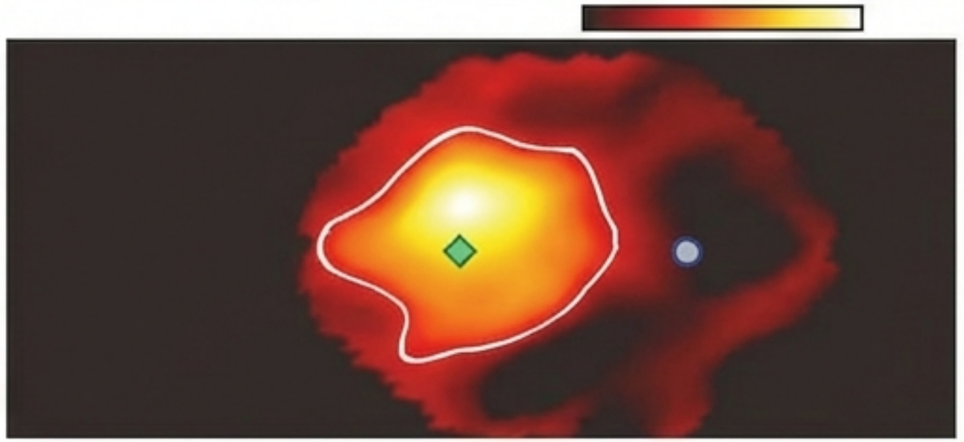
PHYSIOLOGY: SPATIAL ATTENTION MAPS



Datta & DeYoe (2009): Covert attention creates a topographic ‘hot spot’ in the visual cortex. Researchers can predict where a subject is attending just by reading their brain map.

TOPOGRAPHIC MAPPING OF FOCUS





Specific points in the visual world map physically to specific points on the brain's surface.

NEURAL PLASTICITY: SHIFTING RECEPTIVE FIELDS

Womelsdorf (2006): Neurons are not static. When a subject shifts attention, the receptive field of a neuron physically shifts toward the attended location. The brain ‘leans in’ to process the signal better.

INATTENTIONAL BLINDNESS

We look, but we do not see.

Simons & Chabris (1999): 46% of observers missed the gorilla when focused on counting basketball passes. Engagement in a difficult task renders us blind to salient, visible stimuli.

CHANGE BLINDNESS

Image A

Image B

Can you spot the difference? (Look at the sign in the lower left and the reflection in the sunglasses).

We assume the world is stable, so we do not constantly update our mental cache of the scene.

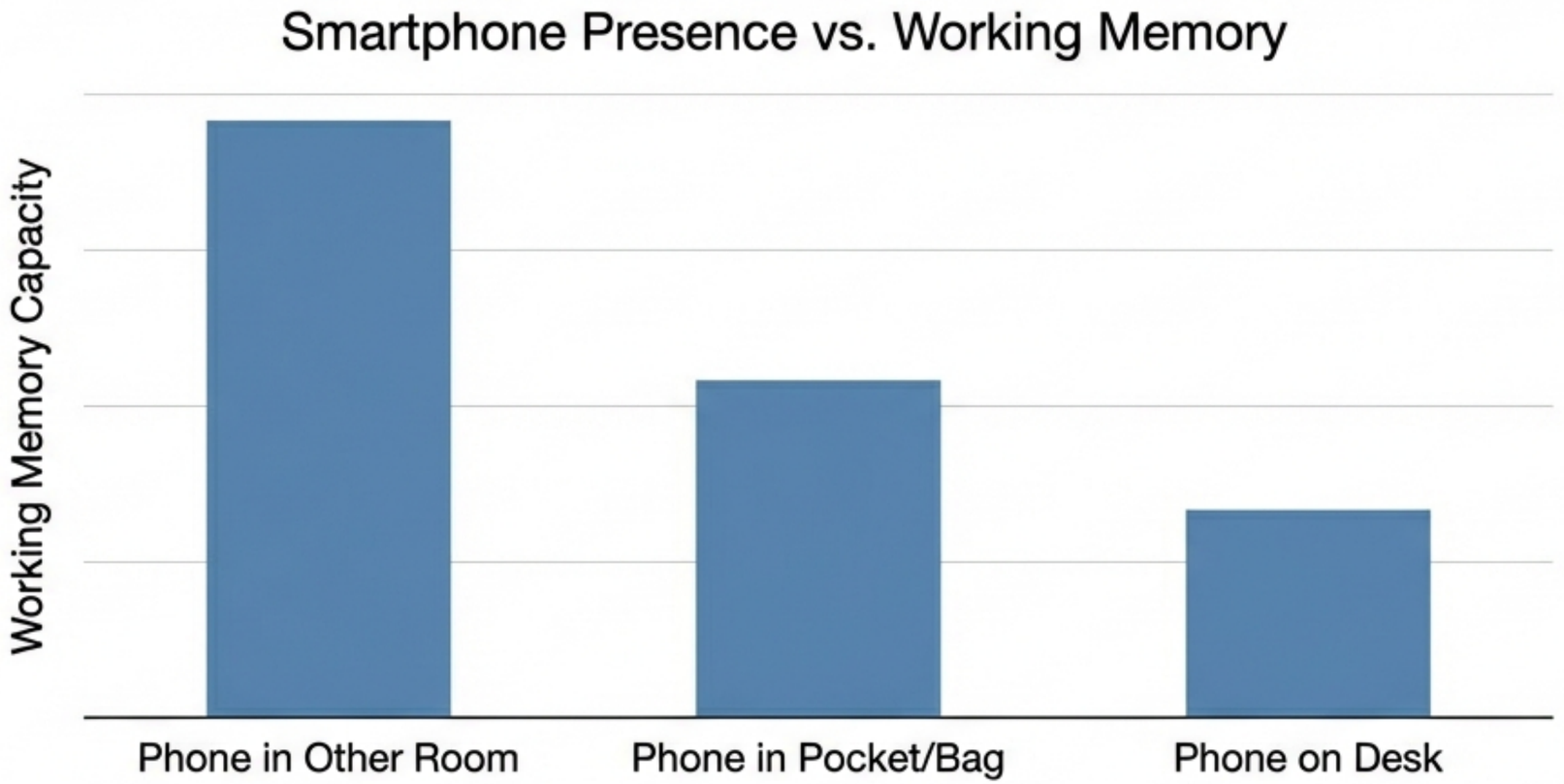
THE COST OF DISTRACTION

- 80% of crashes involve inattention 3 seconds prior.

- Cell phone use doubles missed red lights.

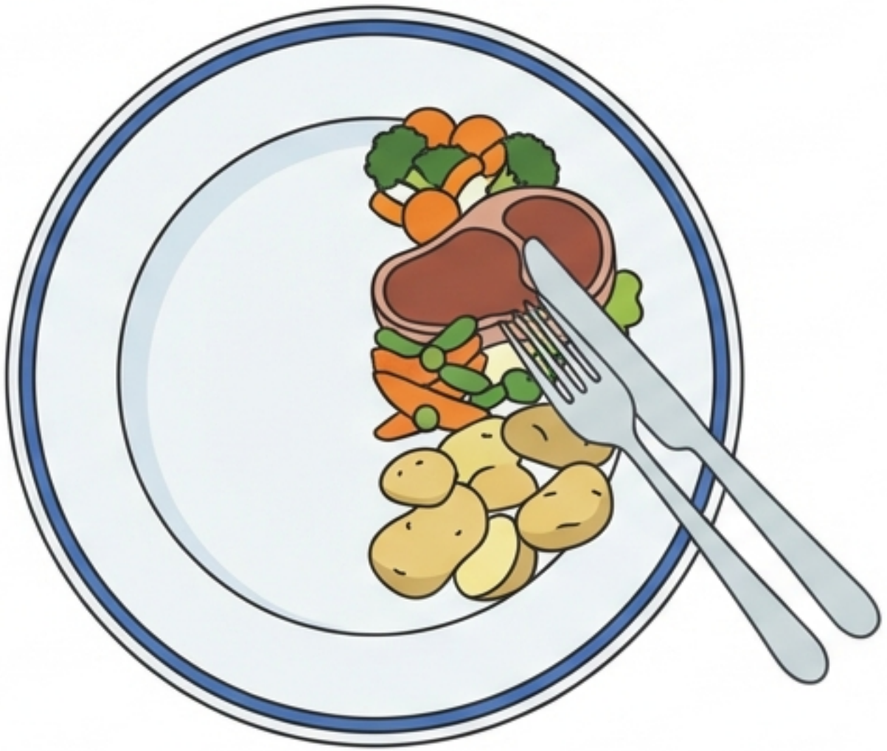
- Cognitive Load: The danger isn't occupying your hands; it is occupying your mind.

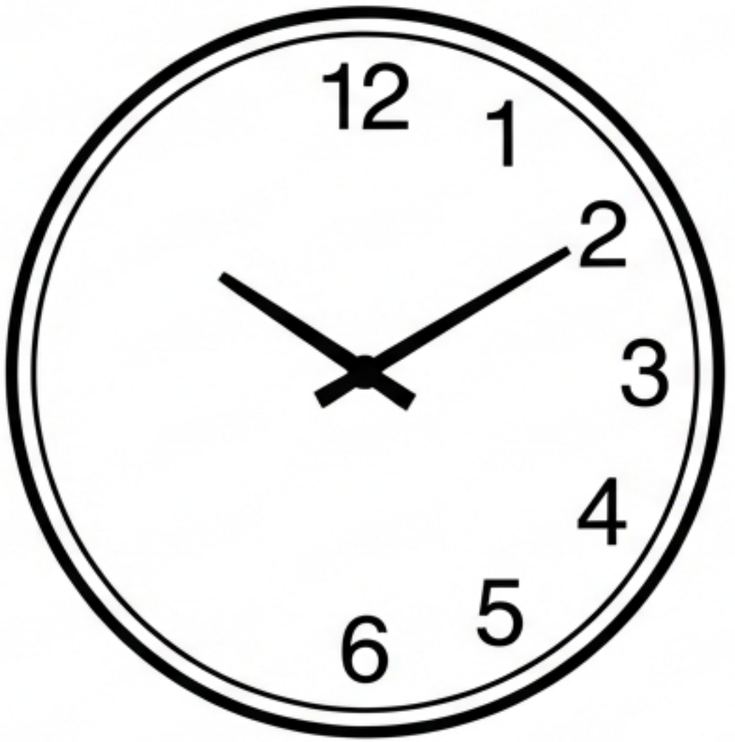
THE ‘BRAIN DRAIN’ OF PRESENCE



Ward (2017): The mere presence of a smartphone, even if turned off, reduces cognitive capacity. Separation is the only effective strategy.

DISORDERS: SPATIAL NEGLECT





Damage to the parietal lobe (usually right side) causes the patient to ignore the left half of the world—including their own memory and imagination (Bisiach & Luzzatti).

DISORDERS: SORS: EXTINCTION

Left Stimulus	Right Stimulus	Simultaneous
		
Seen	Seen	Left Extinguished

Competition: A stimulus on the good side “extinguishes” awareness of the stimulus on the affected side.

DEVELOPMENTAL DIMENSION

Infant Attention

Learning names requires “Sustained Attention” (>3 seconds).

Joint Attention

Joint Attention

Learning is social; parent and child looking at the same object.

The Eye Tracking Insight

Head-mounted cameras reveal that when learning names,

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infants look at the object, not the parent’s face.

PERCEPTION TO ACTION

Attention is the mechanism that binds perception to awareness, transforming a chaotic flood of sensory data into a coherent, navigable reality.