



# How Minds Work

# Global Workspace Theory

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# Global Workspace Theory

- A Theory of Consciousness
- A Theory of Cognition
- A Theory of Mind



# The Multiplicity of Mind

- Baars — The nervous system as a distributed parallel system of many different specialized processors
- Hofstadter — Codelets
- Jackson — Demons
- Minsky — Agents
- Ornstein — Small Minds



# The Theater Metaphor

- Stage — working memory
- Players — processors in working memory
- Spotlight — attention to the contents of consciousness
- Backstage — contexts
- Audience — all the other processors



# Vs. the Cartesian Theater

- Place in the brain, or mind, where “it all comes together”
- Fusion of sensory modalities, for example
- See Dennett’s *Consciousness Explained*
- Seems to require a homunculus
- Not to be confused with Baars’ theater metaphor



# The Stage

- Working memory
- Short term memory
- Limited capacity —  $7 \pm 2$
- Includes conscious contents



# The Players

- Each player is a processor
- Each is active
- Each is immediately available to consciousness
- Some are conscious, some not



# The Spotlight

- Mechanism for attention
- Shines on the content of consciousness
- Contents are a coalition of processors
- Not all players need be in the spotlight
- More later





# Backstage

- Contexts
- Each context a coalition of processors
- Contexts normally not conscious
- More later



# Audience

- All processors neither on stage nor backstage
- Some may be not currently active
- Some may be currently active but not in working memory
- Those not active will become active when their name is called, or when something of interest occurs
- Some will understand the language of a player in the spotlight, some won't

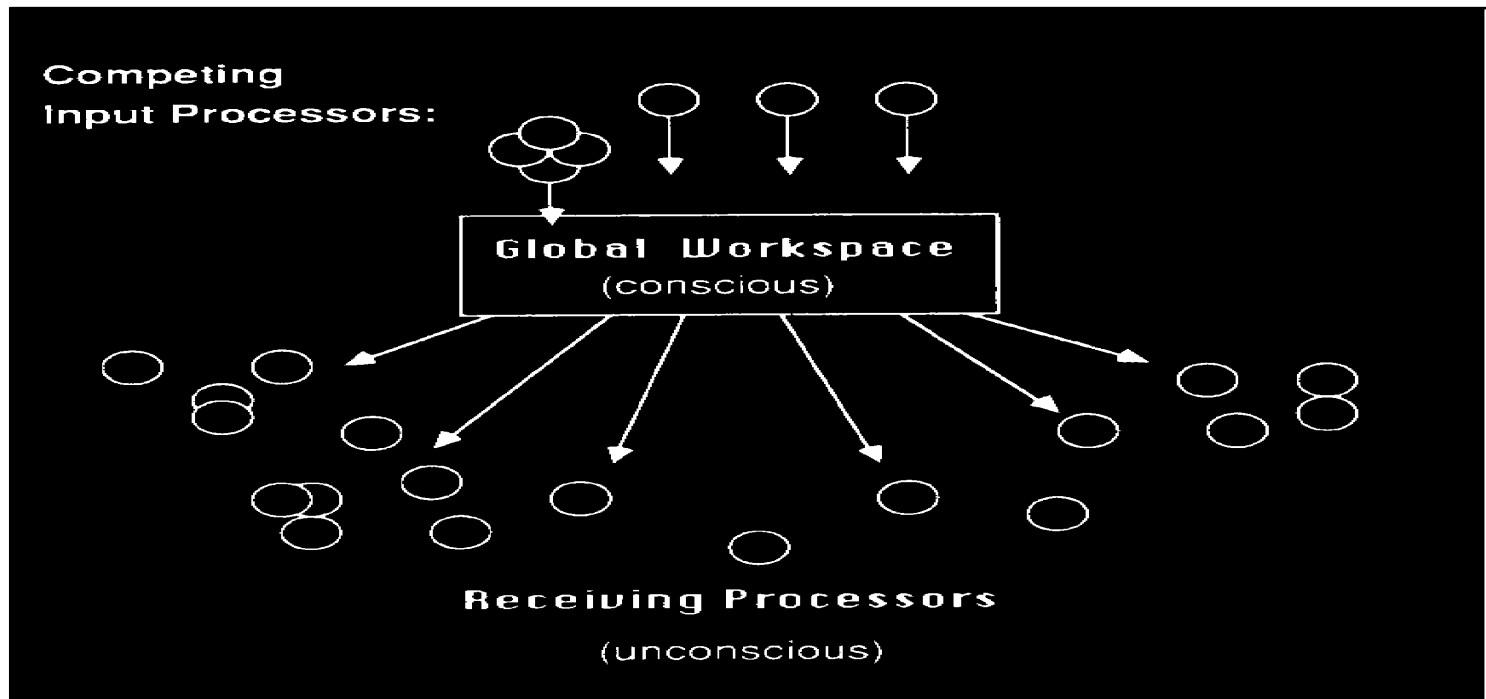


# Consciousness

- What's in the spotlight
- Limited capacity
- Coalition of codelets
- Message from these codelets broadcast to all other codelets
- “...serves to disseminate a small amount of information to a vast unconscious audience...”
- “The payoff for limited capacity seems to be vast access.”



# Global Workspace in Action



# What's in Consciousness

- Perception
  - Visual
  - Auditory
  - Other
  - Combinations
- Inner speech
- Visual imagery



# Tickets to the Spotlight

- Novelty
- Relevancy
- Informativeness
- Problems
- Inconsistency
- Violated expectations
- Whatever can't be dealt with by unconscious, automatic processors.



# Questions and Answers

- *Why consciousness?*  
To recruit other processors to help deal with situations that can't be handled automatically and subconsciously.
- *Why serial?*  
All processors must receive messages in their proper order to preserve causality.
- *Why limited capacity?*  
Long messages are hard for small processors to deal with.



# Contexts

- Unconscious contexts shape conscious experience
- Contexts—coalitions of processors
- Contexts include unconscious expectations  
unconscious intentions
- Similar to but not the same as
  - Frames
  - Scripts
  - Schemas
  - Semantic nets





# Types of Contexts

- Perceptual contexts
- Conceptual contexts
- Goal contexts
- Cultural contexts



# Perceptual Contexts

- “... shape and define conscious perceptual experiences.”
- Admiral Perry’s ships
- Gelb Effect—brightness from light attributed to surface color
- Upside down picture of the moon—craters are seen as mountains
- Hundreds of such effects are known



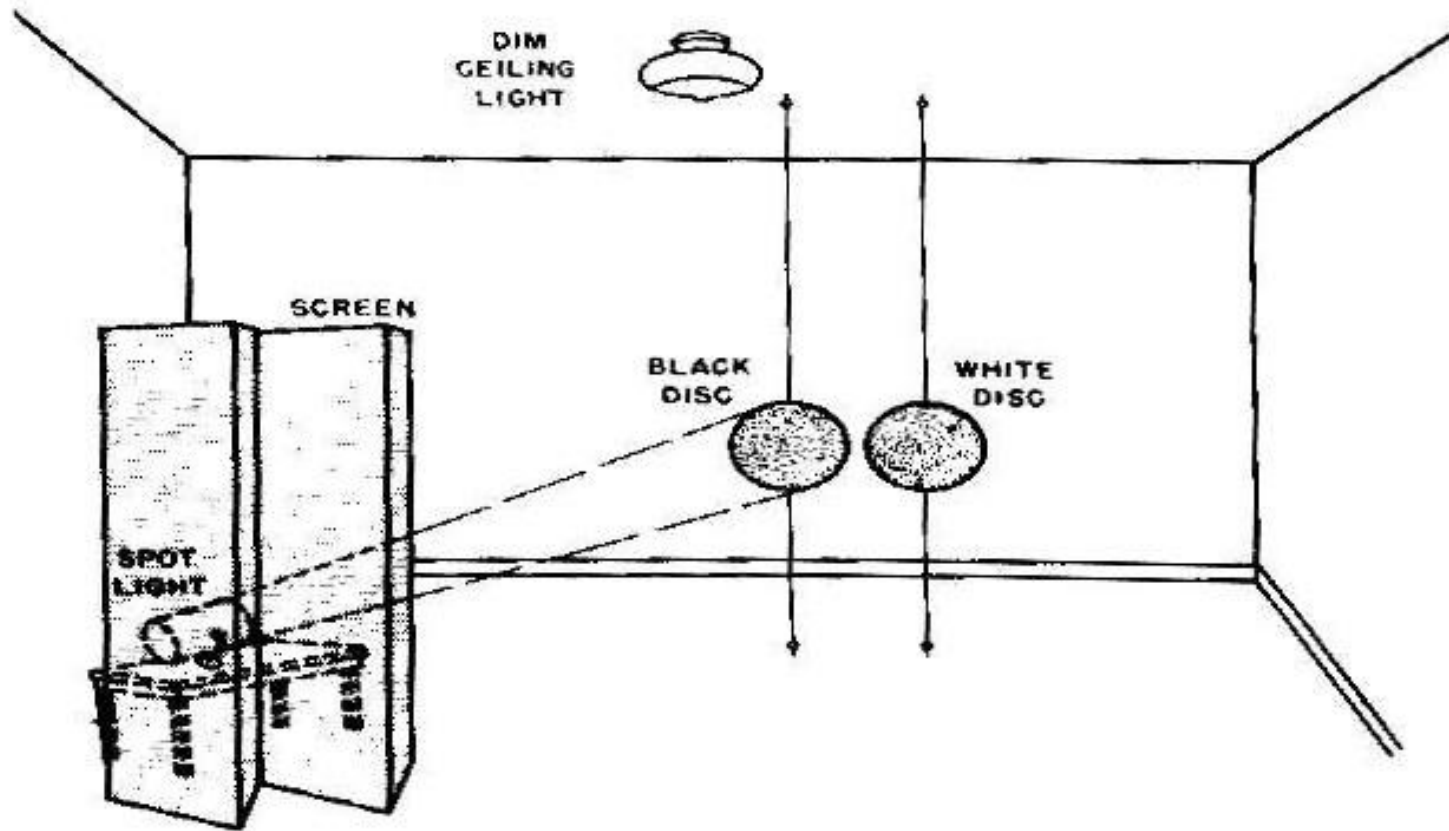


Fig. 12. Concealed illumination experiment. The person who does not know about the spotlight will judge the black and the white discs to have equal brightness. A small piece of paper thrust into the light beam, however, makes it obvious that the left disc is black.



# Craters or Domes



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HMW: Global Workspace Theory

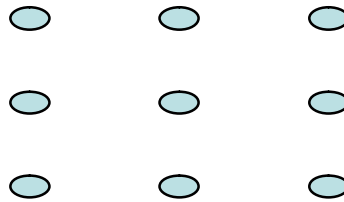
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# Conceptual Contexts

- Word disambiguation
  - bank<sub>1</sub> vs.. bank<sub>2</sub>
  - “set” in the OED—75,000 words
- Humor results from a sudden change in conceptual contexts
- Stable presuppositions
  - Newtonian vs. Einsteinian mechanics
  - Darwin’s theory
  - A generation must die off
- Business people talk of paradigm shifts



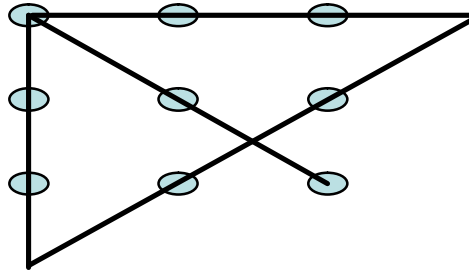
# Four Lines Puzzle



**Cover the nine dots  
with four straight line segments  
drawn without lifting your pencil.**



# Four Lines Puzzle Solution



**Requires a paradigm shift  
to allow lines outside  
of the conceptual boundary  
of the original dots.**



# Goal Contexts

- Hungry, eat, go back to work—sequence of two goal contexts
- Fire alarm while eating—new goal context
- Hierarchy of goal contexts
- Dinner with a potential customer—more than one goal context simultaneously
- Hidden agendas—often hidden from ourselves
- Intentions





# Cultural Context

- Our roles in this classroom situation
- Much is unconscious
- Deviation from expected role draws attention (consciousness)
- Expectations



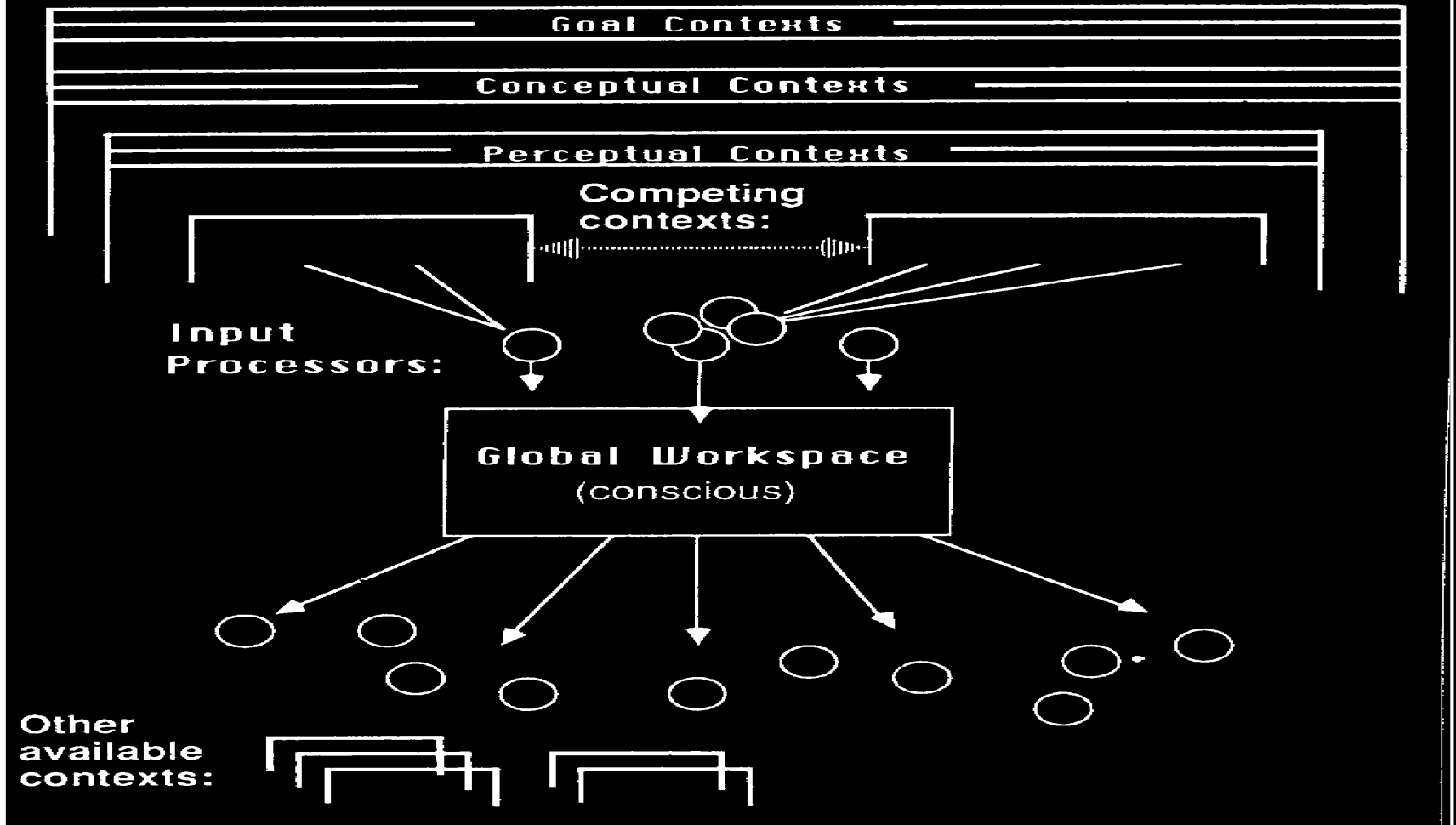
# Reality

- The world doesn't come labeled and bar-coded
- We each create our own objects, our own concepts, our own reality
- “... many different contexts interact to create a single conscious interpretation of reality.”



# Contexts at work

## The Dominant Context Hierarchy:



# Metacognition

- Thinking about thinking
- Voluntary attention requires metacognition
- Self-monitoring (mindfulness)
- Skepticism



# Voluntary Action

- James' ideomotor theory
- "... conscious goal images without effective competition serve to organize and trigger automatically controlled actions."
- Unconscious systems monitor and edit conscious goals
- "... voluntary action is tacitly edited action."
- Free will ??????



# Learning

- Developing contexts that cause us to experience the same reality in new and different ways
- To learn anything we merely pay attention to it



# More of the Theory

- Self
- Attention—as a control mechanism for consciousness
- And much more



# Consciousness is Functional

- A device for allocating resources
- Trade-off between organization and flexibility
- Organization for routine situations
- Flexibility in the face of novel conditions
- Consciousness helps to optimize this trade-off





# Some specific functions

- Dealing with ambiguities, as in language
- Adapting to novel, significant events
- Monitoring and editing conscious content
- Conscious goals recruit help in carrying out mental or physical actions
- Voluntary control of attention
- Making decisions that are problematic for our unconscious systems
- Partial matching of conscious content allows analogical reasoning
- Conscious imagery and inner speech allow metacognitive reflection and control
- Self-system maintains stability under changing internal and external conditions



# Readings

- Read about Global Workspace Theory in
  - Baars, B. J. 1988. *A Cognitive Theory of Consciousness*. Cambridge: Cambridge University Press.
  - Baars, B. J. 1997. *In the Theater of Consciousness*. Oxford: Oxford University Press.



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