

Ch 16. The Problem of Consciousness

Cognitive Neuroscience: The Biology of the Mind, 2nd Ed.,
M. S. Gazzaniga, R. B. Ivry, and G. R. Mangun, Norton, 2002.

Summarized by
S.-H. Kim, and B.-T. Zhang
Biointelligence Laboratory, Seoul National University
<http://bi.snu.ac.kr/>

Introduction

Introduction – case of W. J.

- After split –brain surgery
 - ◆ Each half of the brain behaved **independently** of the other
 - Left hemisphere does not know what is going on in the right one, and vice versa
 - ◆ Each half functioned outside the realm of the other
 - Each could learn, remember, emote, and carry out planned activities

Understanding Consciousness

- Consciousness
 - ◆ What makes us uniquely human
 - Self-reflection
 - Think about thinking
 - Know that I know
- What is consciousness precisely?
 - ◆ No satisfactory definition so far
 - ◆ A hotly debated topic ever since human have been debating

Contents

- Philosophical Perspectives
- Conscious vs. Unconscious Processing
 - ◆ The Extent of Subconscious Processing
 - ◆ Gaining Access to Consciousness
- Neurons, Neuronal Groups, and Conscious Experience
- The Emergence of the Brain Interpreter in the Human Species

Philosophical Perspectives

Philosophical Perspectives

- Problem of consciousness
 - ◆ Mind-brain problem/Ontological problem
- Two different philosophies
 - ◆ **Dualism/Materialism**
 - ◆ Dualism
 - Mind and brain are two distinctive phenomena
 - ◆ Materialism
 - Both mind and body are physical mediums

Dualism

- Common premise
 - ◆ Conscious experience is nonphysical and beyond the scope of the physical science
- Various forms
 - ◆ Popular dualism
 - The idea that people are “ghosts in the machine”
 - ◆ Property dualism
 - Brain has unique nonphysical properties for mind
 - ◆ Interactionist property dualism
 - Mental phenomena affects brain and behavior

Materialism

- More typically supported than dualism now
 - ◆ With advances in cognitive neuroscience
- Various forms
 - ◆ Philosophical behaviorism
 - One cannot talk about inner experience at all
 - ◆ Reductive materialism
 - Mental state is identical with physical state in the brain
 - ◆ **Functionalism**
 - Equivalently functional → Equivalently human
 - Ex) Cog, a robot being built at MIT

Alternatives (1/2)

- Limitations of Dualism/Materialism
 - ◆ Dualism ignores biological findings
 - ◆ Materialism overlooks subjective experience
- Alternative
 - ◆ Searle (2000) - Biological naturalism
 - Unified approach
 - ◆ Pinker (1997) – How the mind works
 - Three issues in consciousness
 - **Sentience, Access to Information, Self-knowledge**

Alternatives (2/2)

- Three categories of consciousness by Pinker
 - ◆ Sentience
 - Subjective experience, phenomenal awareness, raw feelings, first-person tense
 - ◆ Access to information
 - The ability to report on the content of mental experience
 - Without knowing how the content was built up
 - ◆ Self-knowledge
 - Accurate information about the being itself
 - Change of level: Feeling pain → **Here I am**, feeling pain

Conscious vs. Unconscious Processing

Conscious vs. Unconscious Processing

- Mental processes
 - ◆ **Conscious** processes/awareness + **Unconscious** processes
 - ◆ Content (products) of mental life + internal operations to generate the contents
- Unconscious processes
 - ◆ Happens outside our consciousness realm
 - ◆ **Not knowing** of the stimulus, **respond** to the stimulus features

Unconscious Processing (1/2)

- Studies of blindsight
 - ◆ Patients with a **lesion in visual cortex** can respond to visual stimuli in the blind part of visual field
 - ◆ Supporting experiments
 - Weiskrantz et al. (1974)
: Preserved areas of vision for the patient with lesion in visual cortex
 - Wessinger et al. (1997)
: Involvement of the damaged primary pathway in blindsight

Unconscious Processing (2/2)

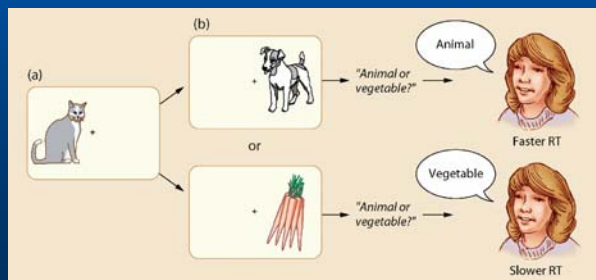
- Studies of visual neglect
 - ◆ Patients with **unilateral neglect** (ex. right hemisphere) cannot name stimuli entering the neglected visual field
 - ◆ But they **can judge** whether two visual stimuli in each field are the same or different
 - ◆ And they deny having seen the stimuli in the neglected left field
 - ◆ <Fig 16.4>

Extent of Subconscious Processing (1/6)

- Question
 - ◆ How sophisticated can the processing outside of conscious awareness be?
- Insight from the study of blindsight/neglect
 - ◆ Many cognition activities go on outside of the realm of conscious awareness
 - ◆ These unconscious processes happen at the level of the cortex

Extent of Subconscious Processing (2/6)

- Naïve answer
 - ◆ Quite complex information can be processed without conscious awareness
 - ◆ High-level information can be exchanged between processing systems outside consciousness



<Fig 16.5>

Extent of Subconscious Processing (3/6)

- Studies on the healthy brain
- Know-what, don't-know-how cases
 - ◆ Experiment of learning word pairs
 - Nisbett and Ross (1980)
 - Free association with the word, but subjects don't know how the word came across the mind
 - ◆ Solving the Hanoi Tower problem
 - Subjects can remember the events of solving process
 - But they don't know how the events become established in memory
 - <Fig 16.6>

Extent of Subconscious Processing (4/6)

- **Subliminal perception**

- ◆ Classical approach
- ◆ Subjects are **biased** in judging as a function of the **subliminal exposures**

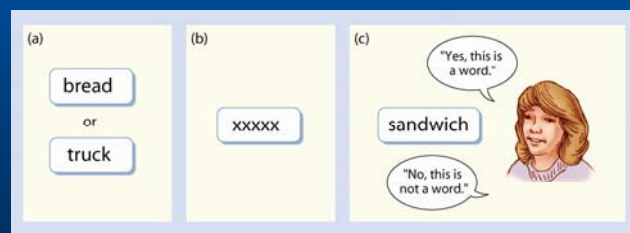


<Fig 16.7>

Extent of Subconscious Processing (5/6)

- **Masking paradigm**

- ◆ The brief presentation of a screen or a word followed by a masking stimulus
- ◆ Subliminally presented stimulus has **effects on** the response time of **semantically related words**

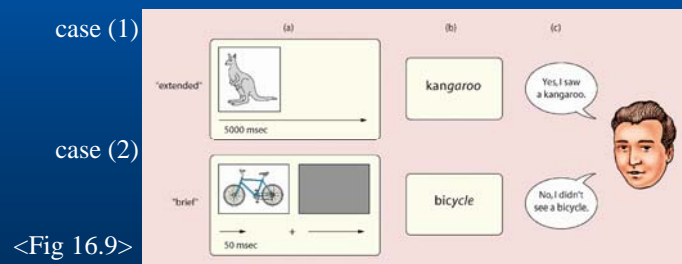


<Fig 16.8>

Extent of Subconscious Processing (6/6)

- Single **cross-form priming** Paradigm

- ◆ Picture to word priming
- ◆ Can occur **with awareness** → case (1)
or **without awareness** → case (2)



Gaining Access to Consciousness (1/3)

- Elusive boundary between conscious and unconscious area
- **Access-consciousness** by Steve Pinker
 - ◆ Evolutionary pressures to the Rise of Access-consciousness
 - Cost of Space, Cost of Time, Cost of Resources
 - ◆ Features of access-consciousness
 - Rich field of sensation we all live in
 - Capacity to move information in and out of awareness
 - Salience, emotional coloring and executive controller
 - Self-knowledge

Gaining Access to Consciousness (2/3)

- From **conscious to unconscious** Movement
 - ◆ From controlled processing to automatic processing
 - ◆ Expertise
 - Learning complex motor tasks such as driving a car
 - Complex cognitive tasks such as reading or writing
 - ◆ **Scaffolding to storage** framework
 - Petersen et al. (1998)
 - Steps
 - 1) Conscious practice → scaffolding process
 - 2) Memory being consolidated → storing process
 - 3) Brain involvement change → removal of the scaffolding

Gaining Access to Consciousness (3/3)

- Experiment on the expertise process
 - ◆ Verb generation task with PET techniques
 - Petersen et al. (1998)
 - Conscious processing uses **a much different network of brain regions** than does later unconscious processing
 - ◆ Progress of chess player from novice to master
 - Chabris and Hamilton (1992)
 - Novices examine the pieces and moves one by one separately
 - Masters view and play the board **as a series of groups or clumps** of pieces and moves
 - “Learned intuition”

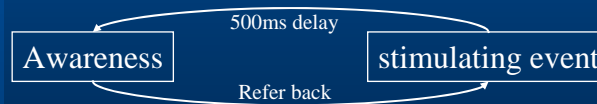
Neurons, Neuronal Groups, and Conscious Experience

Neurons, Neuronal Groups, and Conscious Experience (1/4)

- How the brain does its job
 - ◆ Newsome's finding 1
 - Area MT of monkey cortex (involved in motion detection)
 - Monkey's motion discrimination capacity was **predictable by** the response pattern of **a single neuron**
 - A single neuron in MT was **as sensitive as** the monkey in the visual display
 - **But a single neuron is surely with redundant property**
 - ◆ Newsome's finding 2
 - Microstimulation of the neurons in MT could tilt the direction of monkey's decision making
 - **Then it is the place where the decision is made?**

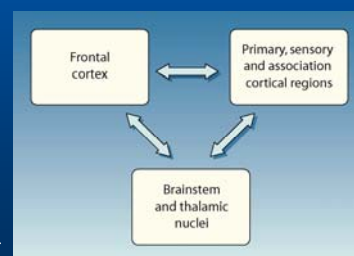
Neurons, Neuronal Groups, and Conscious Experience (2/4)

- The **Timing** of consciousness
 - ◆ Newsome's finding is believed **part of a neural loop** involved with perceptual discrimination
 - Then when do we become conscious of our thought, intentions, and actions?
 - ◆ **Backward referral hypothesis**
 - Libet et al. (1979)
 - About **neural time factors** in conscious/unconsciousness



Neurons, Neuronal Groups, and Conscious Experience (3/4)

- ◆ **Vital triangle**
 - Cotterill (1997)
 - Supports Libet's backward-referral hypothesis
 - Emphasis on the **various feed-forward and feed-back connections** that enable consciousness

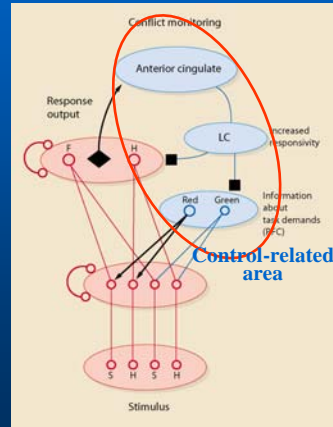


<Fig 16.12>

Neurons, Neuronal Groups, and Conscious Experience (4/4)

◆ Error detection and correction

- Then the ability to detect and correct errors?
 - ← Because beginning of the act **occurs sufficiently after** awareness of the intent
- The lateral prefrontal cortex is essential for corrective behavior (Blue components)



<Fig 16.13>

The Emergence of the Brain Interpreter in the Human Species

The Emergence of the Brain Interpreter in the Human Species (1/3)

● The Brain interpreter

◆ Sense of Conscious Unity

- We seem to be a **unified conscious agent** with a thread running through all things, having all worlds strung on it
- Then what is the specialized system to carry out the **interpretive synthesis**?

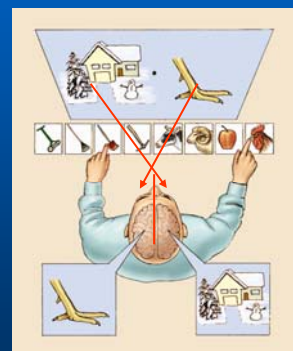
◆ Brain interpreter

- A system seeking explanations for internal and external events to produce appropriate behaviors
- Tied to our capacity to see **how contiguous events relate to one another**
- Exists only in the **left hemisphere**

The Emergence of the Brain Interpreter in the Human Species (2/3)

◆ Discovery of the brain Interpreter

- By Gazzaniga and Ledoux
- Using simultaneous concept test for **split-brain** patient
- Test steps:
 - 1) Patient shown two pictures exclusively was asked to choose associated ones
 - 2) He responded the correct ones of shovel and chicken
 - 3) And he explained his choosing of shovel **in the context of the left hemisphere**



<Fig 16.14>

The Emergence of the Brain Interpreter in the Human Species (3/3)

- That is, his **left hemisphere** observed and **interpreted the left hand's response** in the context of its own knowledge
- ◆ Responsibility of the brain interpreter
 - Catching up with all the products of activities operating outside the realm of awareness
 - By this, it allows for the formation of beliefs and provides the story line or narrative of our lives
- ◆ From an evolutionary perspective
 - What we mean by consciousness is **how we feel about our specialized capacities** like thinking, using language, etc.
 - Hence, consciousness is not another system, but related to our capacity to **assign feelings to mental activities**

Is Consciousness a Uniquely Human Experience (1/5)

- Question
 - ◆ If our conscious state has evolved as a product of our brain's biology...
 - ◆ Is it possible that our closest relatives might also possess this ability or a developing state of that?
- Theory of mind
 - ◆ **The term** coined by Premack and Woodruff (1978)
 - ◆ The ability **to represent and infer unobservable mental states** such as desires, intentions, and beliefs from the self and the others

Is Consciousness a Uniquely Human Experience (2/5)

- Two Approaches to the **primate theory of mind**
 - ◆ First, comparative biological approach
 - To compare different species' brains to those of humans
 - Proved to be difficult, except for the fact that the human prefrontal cortex is much larger in area than of others
 - ◆ Another, **comparative psychological approach**
 - To focus on the behavioral manifestation of the brain
 - Parallels the approach of psychologists studying development of **the theory of mind in children**
 - Tests the ability to **distinguish between the mental representation and the real world**

Is Consciousness a Uniquely Human Experience (3/5)

- Experiments about **primate theory of mind**
 - ◆ About understanding the connections between seeing and knowing
 - Povinelli and Eddy (1996)
 - Whether chimpanzees can appreciate that seeing what someone else sees conveys common information about the object

<Fig 16.16>



Is Consciousness a Uniquely Human Experience (4/5)

- Despite the great effort expended, the result failed to support the idea that chimpanzees have a theory of mind
- ◆ About emergence of conceptual knowledge of the self and the other
 - The result suggests that the chimpanzees are capable of self-recognition, understands how the eyes and internal states of attention are connected

<Fig 16.17>



Is Consciousness a Uniquely Human Experience (5/5)

- Conclusion
 - ◆ In the above experiments, the chimpanzees do not demonstrate conscious abilities as do growing children
 - ◆ Thus we can conclude that **chimpanzee theory of mind is much less advanced** than the human theory of mind
 - ◆ And perhaps the continued evolution of human, not chimpanzee, was due to the advanced theory of mind with which humans appear to be uniquely endowed

Left- and Right-Hemisphere Consciousness (1/2)

- Reduced capacity in the right hemisphere
 - ◆ As mentioned, right hemisphere **does not have the brain interpreter** to appreciate the feelings associated with mental states
 - ◆ Examples of Limited capacity for split-brain patients
 - Patients **without right-hemisphere language** were not able to make simple matching judgments above the level of chance
 - When a judgment of same-difference was required, the right hemisphere failed
 - ◆ Cases of Patients **with right-hemisphere language**
 - Even the patients with right-hemisphere language ability were **poor at making simple inferences** such as of causal relation

Left- and Right-Hemisphere Consciousness (2/2)

- In the task to infer the causal relation between two lexical elements and pick the answer from possible words, the patients could find a close lexical associate, but he could not make the inference that the words had some causal relationship
- Different role of each hemisphere
 - ◆ The right monitoring the world
 - The right hemisphere **deals mainly with raw experiences** in an unembellished way
 - ◆ The left differentiating the world
 - The left hemisphere is **labeling experiences, making inferences and carrying out a host of other cognitive activities**

Summary

- How the brain enables human conscious experience remains a great mystery of human knowledge
- Someone like Colin McGinn(1991) would say, if the mind is a biological device, there is no guarantee that it can conceive of the answer to every problem it can pose for itself
- But current research is illuminating the issues in consciousness, and the study of conscious experience is surely central to understanding the mind

Key Terms

Access-consciousness	dualism	mentalistic	Subjectivity
Backward referral hypothesis	functionalism	micro-stimulation	Subliminal perception
behaviorist	interpreter	qualia	sub-threshold
Blind-sight	Masking stimulus	Self-knowledge	Theory of mind
consciousness	materialism	Sentience	Unconscious processes

Thought Questions(1)

1. Given that the key premise of dualistic theories of consciousness is that conscious experience is beyond the realm of physical sciences, how can you reconcile this view with scientific investigation? If consciousness is nonphysical, then presumably it cannot be measured. If it cannot be measured, how can it be studied?
2. What if Searle is right? Should we toss out both dualism and materialism, ignoring the notion that consciousness is made up of many hierarchical components, and start over? Discuss your answer.
3. We know that with practice we get better at performing tasks (such as driving a car, or reading upside-down text) and often eventually perform the tasks unconsciously. But we also know it takes more than just to improve performance. What else is happening?

Thought Questions(2)

4. Since blindsight subjects have deficits in visual awareness, they are often held up as archetypal cases for consciousness investigations. What is wrong with this approach? Can studying unconsciousness in the damaged brain really tell us anything about consciousness in the intact, healthy brain? Explain your answer.
5. Can Libet be right? Do we actually live 500 msec in the past? If so, do we really control our actions, or are we just reacting and then interpreting our behavior afterward? How does this fit in with Gazzaniga's views on the left-brain interpreter that has been demonstrated in split-brain patients?