The Mirror-Neuron System

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Definition

• Discharge both when the monkey does a particular action and when it observes another individual (monkey or human) doing a similar action (Di Pellegrino et al. 1992)
Monkey
원숭이 두뇌
F5 Mirror Neurons: Basic Properties

- Biological effectors (Hand or Mouth)
- Objects

Interaction

Mirror Neuron Triggering

- An Object Alone
- Mimicking Action without Object
- Agent Alone
F5 Mirror Neurons: Basic Properties

- Object significance → No influence
- Large degree of generalization
  - 동일한 행동이라면 (인간이건 원숭이건)
  - 거리에도 영향을 받지 않음
- Reward → No influence
- Visual vs. Motor Properties
  - Strictly congruent (1/3)
  - Broadly congruent (2/3)
F5 Mouth Mirror Neurons
F5 Mouth Mirror Neurons

- 25% neurons → Mirror neuron property
- Ingestive mirror neurons (80%)
  - Grasping food with the mouth
  - Braking it or sucking
- Communicative mirror neurons
  - Visual: Lip smacking
  - Motor: Ingestive actions
Evolutionary Perspective

Communicative Gestures

Evolution?

Ingestive Actions
The Mirror-Neuron Circuit
Function of Mirror Neuron

• Imitation and Action Understanding

• MNS가 Action Understanding을 위한 유일한 통로라고는 말못함

• Imitation은 상당히 고차원적 인지 능력이며, MNS만으로 설명되어야함
Mechanism

• Step 1) See an action done by another
• Step 2) Activation of neurons for that action in the observer’s brain
  – Motor representation spontaneously generated during active action
Evidence

• MNS는 광범위한 영역과 관련이 있어 파괴하고 효과를 확인하는 것은 어려움

• 시각정보를 제거한 상황에서도 action의 meaning과 MNS 사이의 연관성이 있는가?
  - 단순히 visual feature에 activate 하는 건가?
  - 아니면 action의 의미에 activate 하는 건가?
Hearing Sounds, Understanding Actions: Action Representation in Mirror Neurons, Science 2002
• “I Know What You are Doing”, *Neuron*, 2001
Human
신경 생리학적 근거

EEG

TMS
TMS를 통해 알려진 점

• Intransitive meaningless movements → MNS activation

• Code for the movements forming an action
FARS Model