

The Mirror-Neuron System

Annual Review of Neuroscience
vol. 27, pp. 169-192, 2004

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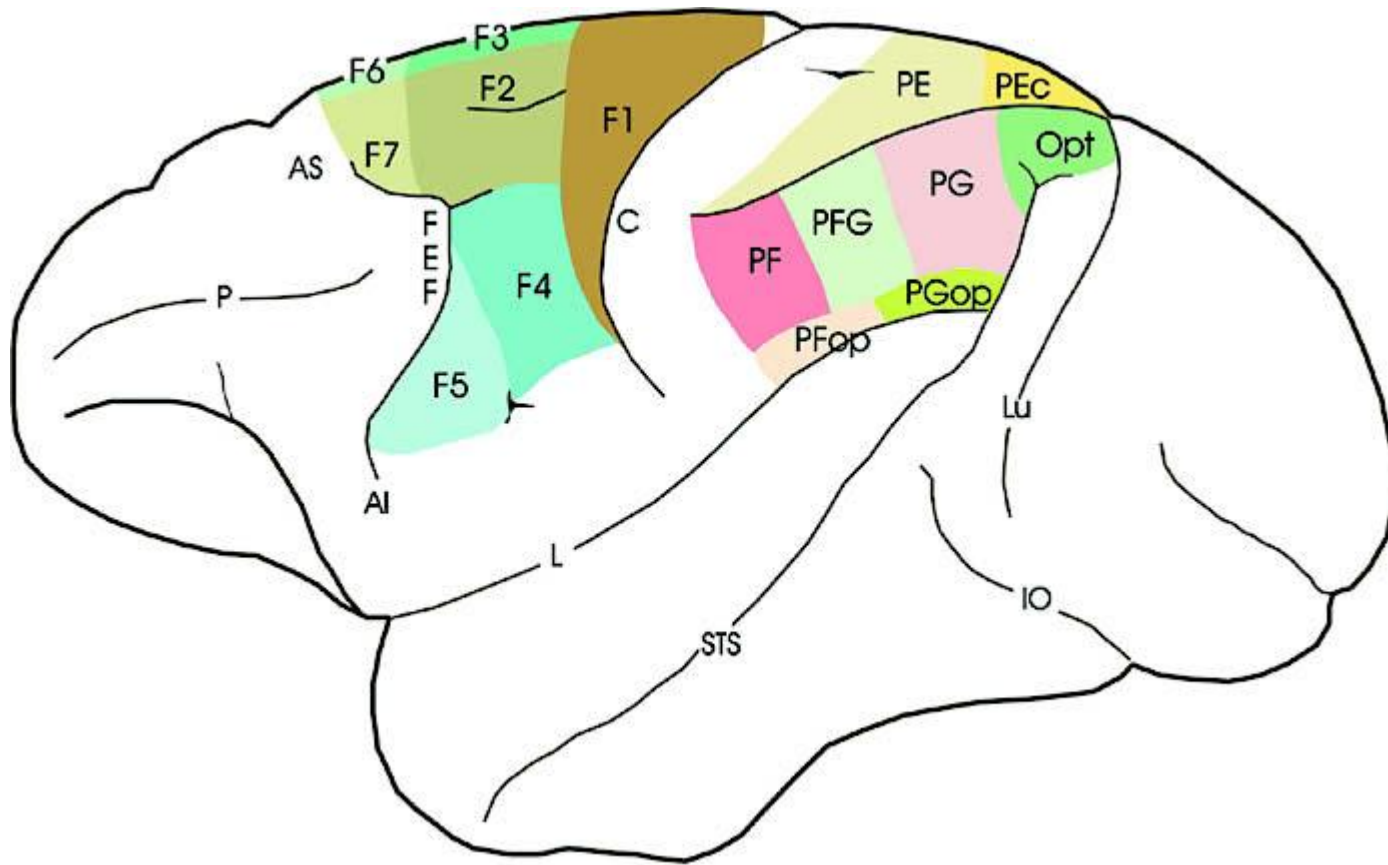
Definition

- 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)

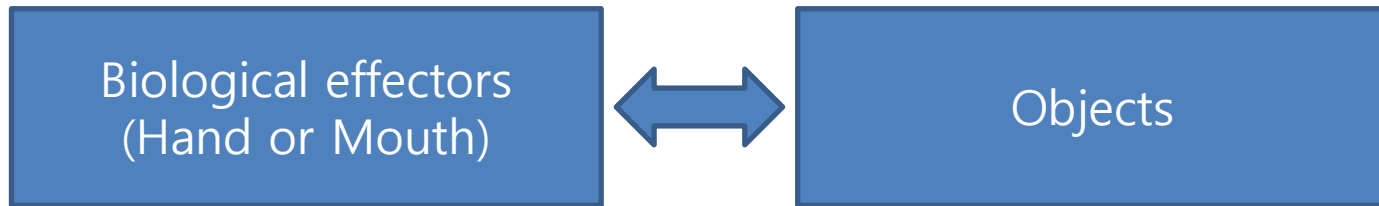
Monkey



원숭이 두뇌



F5 Mirror Neurons: Basic Properties



Interaction



Mirror Neuron Triggering

~~An Object Alone~~

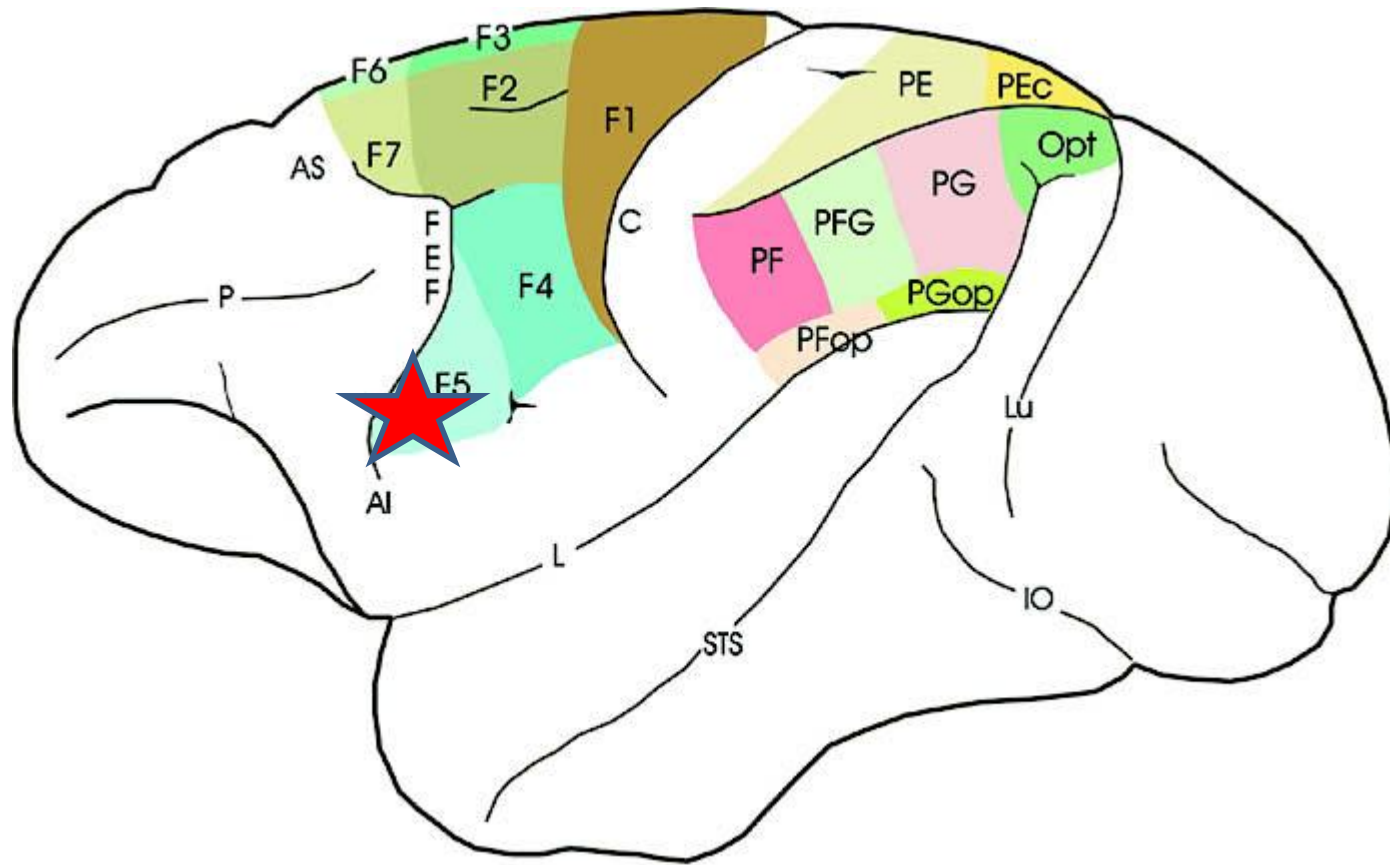
~~Mimicking Action
without Object~~

~~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

Function of Mirror Neuron

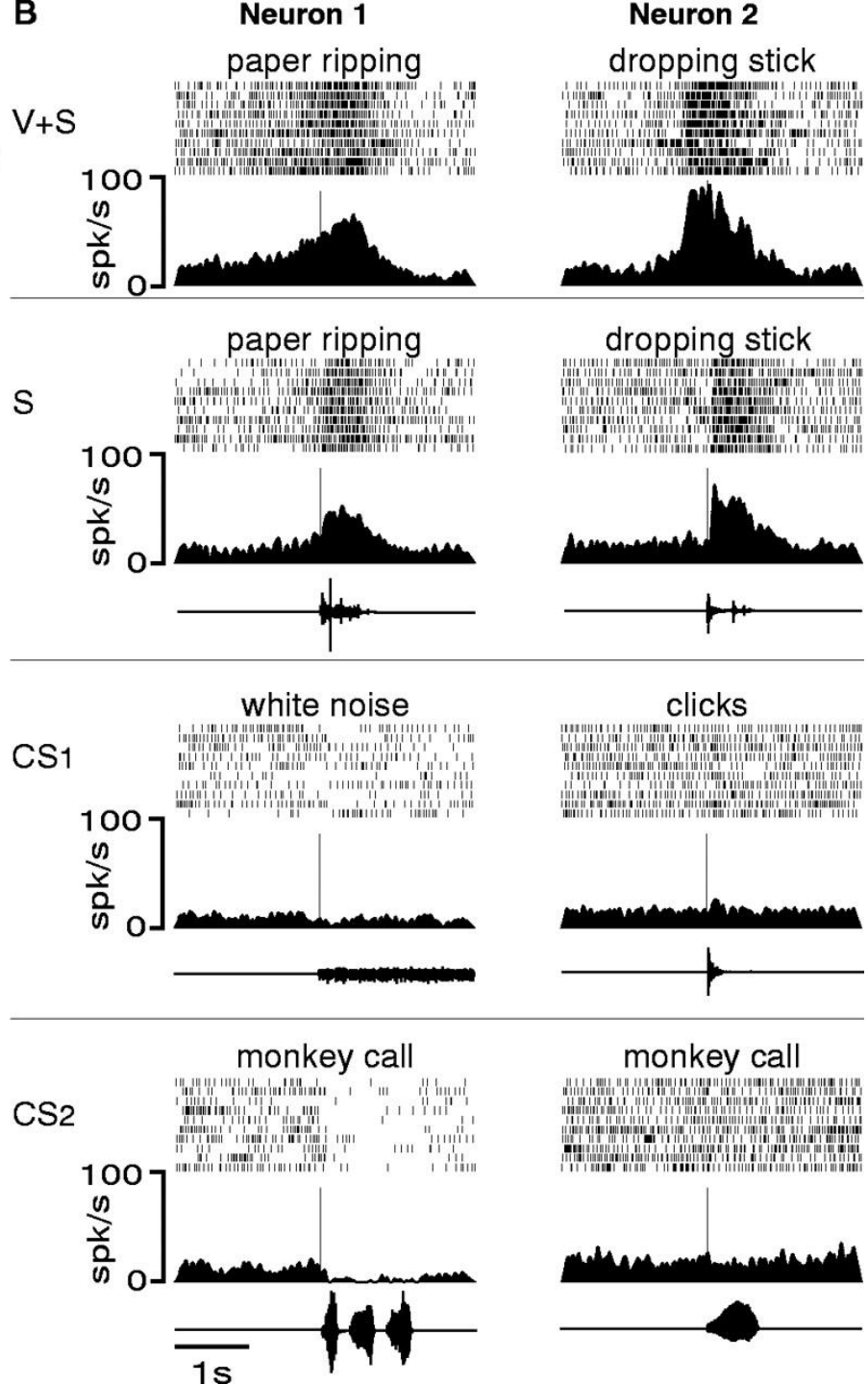
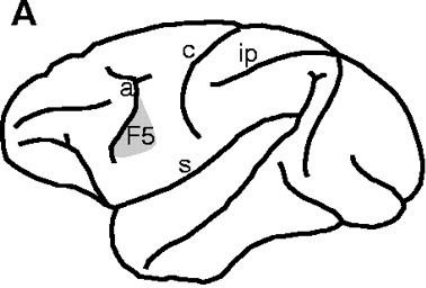
- Imitation and Action Understanding
- MNS가 Action Understanding을 위한 유일한 통로라고는 잘못함
- Imitation은 상당히 고차원적 인지 능력이며, MNS만으로 설명어려움

Mechanism

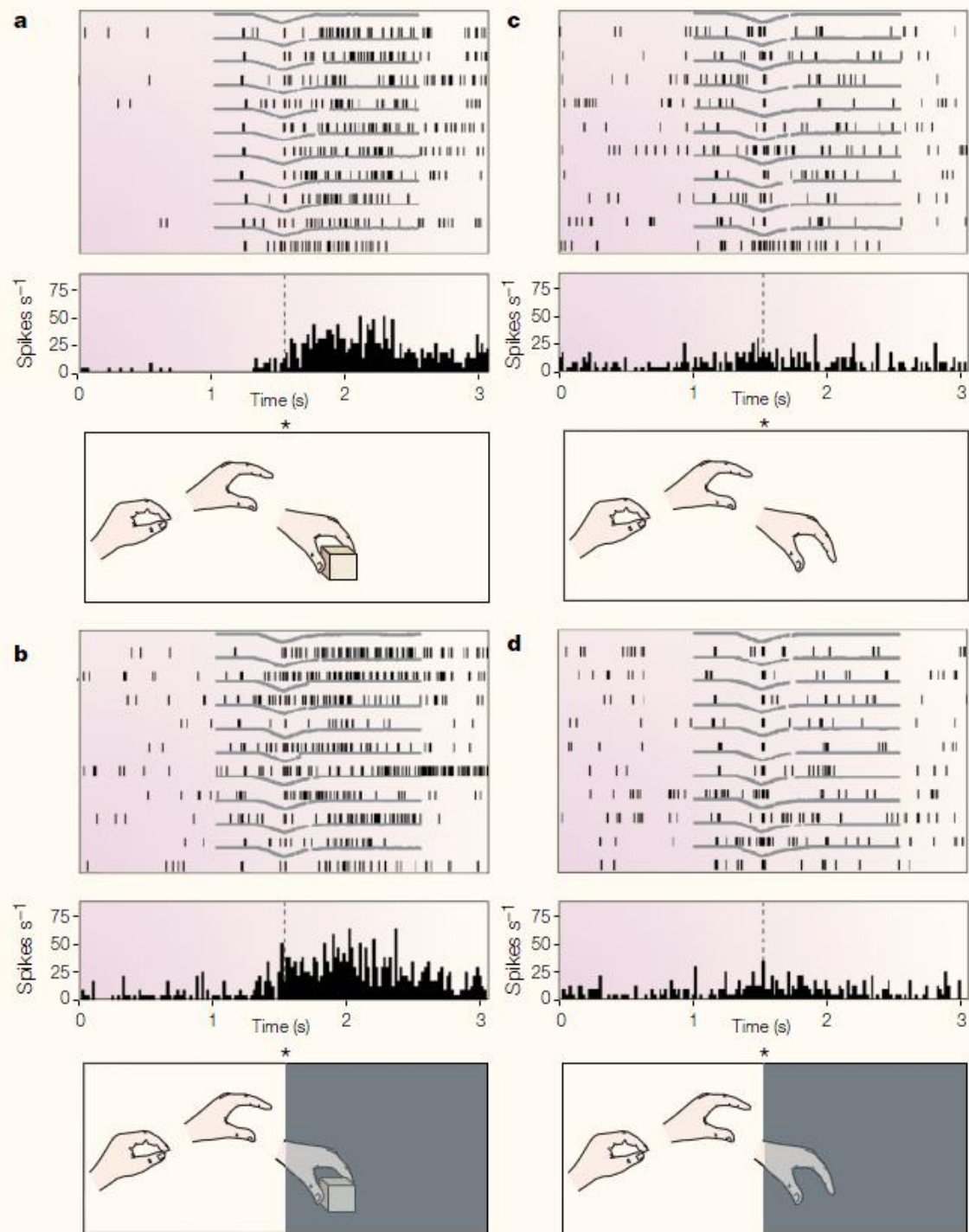
- Step 1) See an action done by another
- Step 2) Activation of neurons for that action in the observer's brain
 - Motor representation spontaneously generated during active action

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?



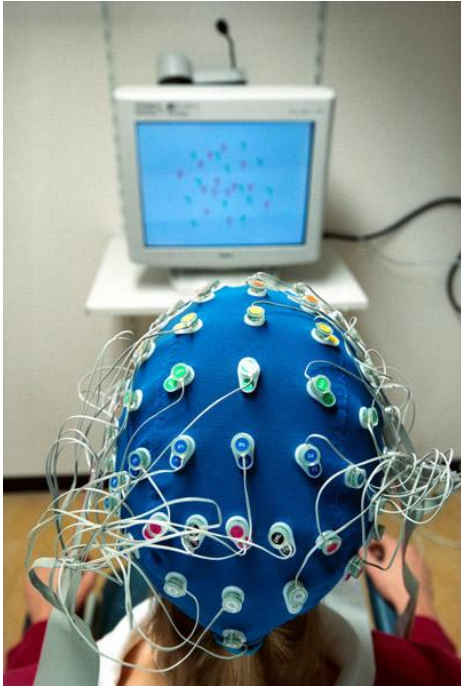
Hearing Sounds,
Understanding
Actions: Action
Representation in
Mirror Neurons,
Science 2002



- "I Know What You are Doing", *Neuron*, 2001

Human

신경 생리학적 근거



EEG



TMS

TMS를 통해 알려진 점

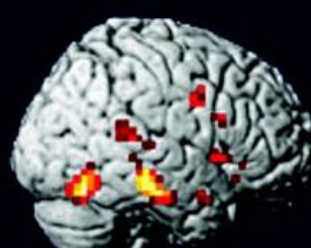
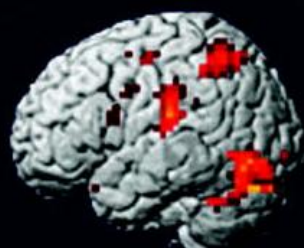
- Intransitive meaningless movements → MNS activation
- Code for the movements forming an action

BITING

ORAL COMMUNICATIVE ACTIONS



MAN



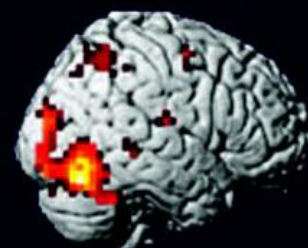
**MAN
(LIPREADING)**



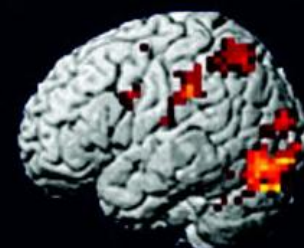
MONKEY



**MONKEY
(LIP SMACKING)**



DOG



**DOG
(BARKING)**



FARS Model

