

14.127 Lecture 7 Part 2  
Crossroads of economics and cognitive  
science.  
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# Outline

1. Introduction
2. Definitions (two system model)
3. Methods
4. Current research
5. Questions raised by neuroscience.
6. General modeling framework

# 1. Introduction

- In an infinitely complex world, decision-makers need cognitive short-cuts.
- Humans are good at finding them (i.e., we are good at simplifying the world)
- Nobody has been able to build models (e.g., machines, algorithms) that generally predict the decisions that we make.
- Only domain specific models (e.g., chess, law of small numbers) have been successful.

# The rational actor model is the “best” model proposed to date.

- Precise theory (i.e., it makes quantitative predictions)
- Applicable to all problems that can be expressed with explicit payoff functions
- Comparative statics usually right

# Cognitive Science in Nutshell

No single framework exists

Many complementary and overlapping frameworks

## *Rough* survey of the cognitive science *fields*:

- Psychology (esp. cognitive psychology): how do people process and react to stimuli/information?
- Cognitive neuroscience: measuring and modeling brains
- Computational intelligence ('artificial intelligence'):
  1. intelligent machines
  2. computational modeling of human intelligence
- Linguistics: study of language

Each of these fields is less parsimonious than economics.

E.g., psychology has no organizing principle or model

Taken together, the cognitive sciences are spectacularly heterogeneous (relative to economics)

## 2. Definitions:

- Neocortex: rational (new mammalian) brain.
- Limbic system (Amygdala, Hippocampus, Hypothalamus...): emotional, affective (old mammalian) brain.
- Primitive (reptilian) brain: instincts, autonomic nervous system, basic survival.
- Neuron: brain cell.
- Synapse: juncture between neurons.
- Neurotransmitters (e.g., Dopamine (DA) and Serotonin).

# Dual process cognition

## Emotional system

- limbic
- fast
- parallel
- affective
- unconscious
- experiential
- associationist
- connectionist
- analogical

## Analytic system

- cortical
- slow
- serial
- logical
- conscious
- hypothetical
- creative
- forward-looking
- abstract

# 3. Methods

- Animal behavioral studies (e.g., addicting rats to cocaine)
- Studies of autists and children (Sally et al 2001).
- External physiological measurement (e.g., pupil dilation, voice tone, facial expression, skin conductance, heart rate)

# More methods...

Brain lesions, lobotomies, localized damage...

- e.g., experimental destruction of both amygdalas in an animal tames the animal, making it sexually inactive and indifferent to danger like snakes or other aggressive members of its own species
- e.g., humans with lesions of the amygdala lose affective meaning
- e.g., hippocampus removal prevents experiences from being encoded in long-term memory

# More methods

- EEG, PET, fMRI... (taking pictures of the *active* brain; e.g., McCabe, Houser, Ryan, Smith, and Trouard 2001).
- Neuron measurement (e.g., track high frequency dopamine release in animal models, Schultz et al)
- Brain stimulation (e.g., electrical stimulation of the amygdala elicits violence and aggressivity; at special loci, electrical brain stimulation is highly reinforcing)

# More methods

- Gene studies (using animal models, researchers can manipulate specific genes; using humans, researchers can study behavior in populations with specific genes like APOE)
- Computational brain models (e.g., neural nets)
- Read: Steve Pinker, How the mind works

## 4. Research:

McCabe et al (2001)

- Subjects play cooperation games against human subjects and computers.
- Subjects who attempt cooperation show greater prefrontal cortex activation when they play humans than when they play computers.
- Subjects who do not attempt cooperation show no differential activation.

Shiv, B. and Fedorikhin, A. (1999), "Heart and Mind in Conflict: Interplay of Affect and Cognition in Consumer Decision Making," *Journal of Consumer Research*, Vol. 26 (December 1999), 278-282.

- Cognitive/deliberative mental processing resources manipulated by having people keep a 2-digit or 7-digit number in mind as they walk from one room to another
- On the way, subjects face choice between piece of cake or fruit-salad

Free processing resources	% choosing cake
<b>High</b> (remember only 2 digits)	37%
<b>Low</b> (remember 7 digits)	59%