CRASH COURSES IN EXPERIMENTAL DESIGNS IN POLITICAL AND SOCIAL SCIENCES

EXPERIMENTAL AND COGNITIVE ECONOMICS VS. POLITICAL SCIENCE

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A. EXPERIMENTAL ECONOMICS VS. POLITICAL SCIENCE

Aim. To run an experiment and to highlight the differences between experimental economics and experimental political science.


Readings


Blogs, Videos and Websites
Labsi Experimental Economics Laboratory
http://unisi.labsi.org
EXPERIMENTAL ECONOMICS
EXPERIMENTAL ECONOMICS

PROS

“Would it not be better to leave laboratory experiments to psychologists who are trained to run them properly? Nobody doubts that we have a great deal to learn from psychologists about laboratory technique and learning theory, but recent history would nevertheless suggest that the answer is a resounding no. Our comparative advantage as economists is that we not only understand the formal statements of economic theory, but we are also sensitive to the economic environments and institutions within which the assumptions from which such statements are deduced are likely to be valid. Just as chemists know not to mix reagents in dirty test tubes, so we know that there is no point in testing economic propositions in circumstances to which they should not reasonably be expected to apply.”

(Binmore 1999)

“Once models, as opposed to economies, became the focus of research the simplicity of an experiment and perhaps even the absence of features of more complicated economies became an asset. The experiment should be judged by the lessons it teaches about theory and not by its similarity with what nature might happen to have created.”

(Plott 1991)
CONS

The laboratory is not a socially neutral context, but is itself an institution with its own formal or informal, explicit or tacit, rules. Human agency takes place within a socio-economic world that is structured in the sense that it consists of internally-related positions and systems. Experimentation in economics is likely to be of limited value, save for situations – such as auctions – that exist in conditions of relative isolation and are characterized by low internal complexity.

(Siakantaris 2000)

- experimental situations often project a game-like atmosphere in which a ‘subject’ may see himself as ‘matching wits’ against the experimenter
- experimental subjects are cast in roles and they can act in accordance with his (mis)perceptions of these roles
- experiments have too short horizons (real world lasts many years and many trials)
- human beings are capable to control their behavior through the implementation of abstract rules

(Cross 1994)
# DATA SOURCES

**HOW?**

- Happenstance (uncontrolled conditions - ongoing processes)
- Experimental (controlled conditions - deliberately created)

**WHERE?**

- Field (naturally occurring environment)
- Laboratory (artificial environment)

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**EXPERIMENTAL ECONOMICS**

LABORATORY (artificial environment) + EXPERIMENTS (controlled *ad hoc* conditions)
PURPOSES OF EXPERIMENTS (WHY?)

1) Test of Behavioral Hypotheses.
   by constructing a laboratory environment that satisfies as many of the
   structural assumptions of a particular theory, it is possible to verify its
   behavioral implications

2) Theory Stress Tests
   to examine the sensitivity of a theory to violations of obviously
   unrealistic assumptions

3) Searching for Empirical Regularities
   heuristic experiments to discover and document stylized facts
   (Davis-Holt 1994)

   a) Speaking to Theorists
   b) Searching for Facts
   c) Whispering in the Ears of Princes
   (Roth 1986)
EXPERIMENTAL METHODOLOGY (HOW?)

1. PROCEDURAL REGULARITY
   to permit replications that the researcher and observers would accept as being valid
   - instructions
   - subject pool and methods of recruiting subjects
   - experimental physical environment
   - computerized or manual

2. MOTIVATION

Induced-value theory: use of a reward medium allows to induce pre-specified characteristics in experimental subjects and to make subjects’ innate characteristics largely irrelevant
- monotonicity: subjects prefer more reward medium to less and not become satiated
- salience: rewards are explicitly and unambiguously connected to the decisions made
- dominance: changes in subjects’ utility from the experiment come mainly from the reward medium and other subjective costs or benefits are rendered negligible by comparison, i.e. others’ reward
3. UNBIASEDNESS
Experiments should be conducted in a manner that does not lead participants to perceive any particular behavioral pattern as being correct or expected, unless explicit suggestion is a treatment variable - double blind setting

4. CALIBRATION
The design has to pre-specify and to cleanly separate the experimental predictions of alternative theories.

5. DESIGN PARALLELISM
Results established in the lab hold in other, especially non-lab, real-world situations where similar ceteris paribus conditions hold

“While laboratory processes are simple in comparison to naturally occurring processes, they are real processes in the sense that real people participate for real and substantial profits and follow real rules in doing so. It is precisely because they are real they are interesting” (Plott 1982)
PROFESSIONAL SUBJECTS, STUDENTS or WHAT?

Main Subjects pool - Undergraduate students

- readily accessible
- low opportunity costs
- steep learning curve
- they do not know much about experimenter’s hypothesis

PhD students
- unreliable subjects because they get interested in what are you doing and respond to their understanding of your topic rather than to incentives you have constructed

Classes or friends
- dominance or salience at risk, conflicts between personal, teaching and scientific aims
Professional subjects

- comparisons show that students are more adept at maximizing their profits and learning in the lab
- high opportunity costs
- pre-specified and innate characteristics are too strong
- when involved in laboratory markets they attempt to apply rules of thumb, which, valuable for dealing with uncertainty in the parallel natural market, are meaningless guides in the lab.

Controversial evidence

Burns (1985): professional wool buyers and students in a progressive auction (professionals apply familiar rules and not adjust to design requirements)

Dyer, Kagel, and Levin (1985): bidding behavior of students and construction workers (no difference)

Dejong et al (1988): Businessmen and students in sealed-offer markets (same profits, but higher variance for businessmen)

What about gender, age, risk attitude, experience?
Weak institutions ← Individual choice Bargaining Games Oligopoly Markets Strong institutions

Social psychology

1900
Cognitive psychology

1950
RAND
Chamberlin
Fouraker and Siegel Princeton

1960
Suppes and Atkinson
Luce
Roth
Friedman and Hoggatt
Selten
Plott
Battalio and Kagel

1970
Common methodology, general acceptance, new applications, new sites around the world

1980

1990
Nobel Prize in Economics 2002
INDEX

a) **public goods**
   cooperation vs. selfishness (social dilemmas, free-riding, institutions) - what improves cooperation (thresholds, learning)

b) **coordination problems**
   experiments with overlapping generations - coordination games with Pareto ranked equilibria - decentralized matching environments

c) **bargaining experiments**
   agreements - causes of disagreements and costly delays - bargaining protocol and preplay communications

d) **industrial organization**
   trading institutions centralized and decentralized - monopoly regulation and potential entry - market structure and market power - collusion factors - product differentiation and multiple markets

e) **experimental asset markets**
   informational efficiency of markets - state-contingent claims and bubbles - learning and dynamics of adjustment paths - investment and public policy

f) **auctions**
   symmetric independent private-values models - common value auctions - collusion

g) **individual choice behavior**
INDIVIDUAL CHOICE BEHAVIOR

1. JUDGMENT

A. Calibration
   1. Scoring Rules
   2. Confidence Intervals

B. Perception and Memory Biases

C. Bayesian Updating and Representativeness
   1. Underweighting on Likelihood Information (Conservatism)
   2. The Law of Small Numbers and Misperceptions of Randomness

D. Confirmation Bias and Obstacles to Learning

E. Expectations Formation

F. Iterated Expectations and the Curse of Knowledge
   1. False Consensus and Hindsight Bias
   2. Curse of Knowledge

G. The Illusion of Control
INDIVIDUAL CHOICE BEHAVIOR
2. CHOICE UNDER RISK AND UNCERTAINTY

A. Mounting Evidence of Expected Utility Violation (1965-1986)
   The Allais Paradoxes, Process Violations, Prospect Theory, Elicitation Biases

B. Generalizations of Expected Utility and Recent Tests
   Predictions of Generalized EU Theories, Empirical Studies Using Pair-wise Choices and Measuring Indifference Curves, Cross-Species Robustness: Experiments with Animals

C. Subjective Expected Utility
   The Ellsberg Paradox, Conceptions of Ambiguity

D. Choice over Time

E. Description Invariance
   Framing Effects, Lottery Correlation, Regret, and Display Effects

F. Procedure Invariance and Endowment Effect
   Preference Reversal, Endowment Effects, Some Psychology and Implications
EXPERIMENTAL POLITICAL SCIENCE
Harold Gosnell (1926) (voter registration and turnout in 1925 Chicago elections) - Hartmann (1936-37)

Moore and Callahan (1943) similar field experiments

Eldersveld (1956) first lab experiment in the *American Political Science Review* on propaganda and voting behavior

Riker (1967) “Bargaining in a Three-Person Game” *American Political Science Review*

Plott (1967) “A notion of equilibrium and its possibility under majority rule” *AER*

Journal “Experimental Study of Politics” (1970)
Experimental methods

- **Surveys** – phone, in-person or web-based opinion surveys

- **Laboratory** – controlled and artificial setting (web-based and virtual included)

- **Field** – in naturally occurring setting
Economics vs Politics

A) STYLIZATION

Context-free environments vs. descriptively realistic scenarios
Economics vs Politics

B) MONETARY INCENTIVES

- Induced-value theory: use of a reward medium allows to induce pre-specified characteristics in experimental subjects and to make subjects’ innate characteristics largely irrelevant.

- In some experiments, it is as if subjects take into the lab the preferences applied to real choices and stick to them with high probability. These biases or inclinations may tend to override the incentives effect.
Economics vs Politics

C) DECEPTION

- provision of information that actively misled subjects regarding some aspect of the study
- an explicit mis-statement of fact
- to give subjects misleading or erroneous information

Ob.: To maintain a reputation in order to make subjects motivated by the induced monetary rewards rather than by psychological reactions to suspected manipulation
Topics

Cambridge Handbook (2011)

Index

- Decision making
- Vote Choice, Candidate Evaluations, and Turnout
- Interpersonal relations
- Identity, Ethnicity, and Politics
- Institutions and Behavior
- Elite Bargaining
Much of what political scientists claim to know about citizens’ political beliefs and attitudes is based on **verbal self report**

But citizens can only verbalize thoughts and behavioral intentions that they are aware of (Lodge, Taber and Verhulst 2011)

The reliance on explicit measure of political attitudes and behaviors is problematic, as these measures assume people have direct access to their ‘true’ beliefs or attitudes and are willing and able to accurately report them (Wittenbrink 2007)
Behavioral Economics

Pars destruens

Cognitive Biases
Heuristics

Noisy information
Overconfidence

Pars construens

Dual Process Theories
Information Processing

Imitation
Informational Cascades
Cognitive Biases

- **Representativeness**
  Probability assessment of a state of the world is based on the degree to which the evidence is perceived as similar to or typical of the state of the world (people tend to rely too heavily on small samples and too little on large samples)

- **Overconfidence**
  (Psych) over-optimism about the individual’s ability to succeed in his/her endeavors
  (Economics) to overweight the importance of private information with respect to public information
Dual process theories

- Attention orienting as a dual processing activity (Cohen 1993, Birnboim 2003)

- **Selective attention** is defined as "control of information processing so that a sensory input is perceived or remembered better in one situation than another according to the desires of the subject" (Schneider and Shriiffin 1977, p. 4)

- This selection process operates according two different patterns: automatic detection and controlled search
Automatic Detection

- **Automatic detection** works in parallel, is independent of attention, difficult to modify and suppress once learned.

- **Controlled search** is a serial process that uses short-term memory capacity, is flexible, modifiable and sequential.
THINKING, FAST AND SLOW

DANIEL KAHNEMAN

WINNER OF THE NOBEL PRIZE IN ECONOMICS
KAHNEMAN’S PROJECT

To explore the systematic biases that separate the beliefs that people have and the choices they make from the optimal beliefs and choices assumed in rational-agent economic models

intuitive judgment and choice vs.
preferences and attitudes

Model of judgment heuristics

Key principles

- reasoning is done deliberately and effortful
- intuitive thoughts come spontaneously to mind without search, computation or effort
- most judgments and most choices are made intuitively
- rules that govern intuition are generally similar to the rules of perception
**PROCESS**

**CONTENT**

**PERCEPTION**
- Fast
- Parallel
- Automatic
- Effortless
- Associative
- Slow-learning
- Emotional

**INTUITION**
- System 1

**REASONING**
- System 2
- Slow
- Serial
- Controlled
- Effortful
- Rule-governed
- Flexible
- Neutral

**Percepts**
- Current stimulation
- Stimulus-bound

**Conceptual representations**
- Past, Present and Future
- Can be evoked by language
The perceptual system and the intuitive operations of System 1 generate **impressions** of the attributes of objects of perception and thought. These impressions are not voluntary and need not be verbally explicit.

In contrast, **judgments** are always explicit and intentional, whether or not they are overtly expressed. Thus, System 2 is involved in all judgments, whether they originate in impressions or in deliberate reasoning.

**Difference in effort** provides the most useful indications of whether a given mental process should be assigned to System 1 or System 2.

**Intuitive judgments** occupy a position—perhaps corresponding to evolutionary history—between the automatic operations of perception and the deliberate operations of reasoning.
## SYSTEMS 1 AND 2 ACTIVITIES

<table>
<thead>
<tr>
<th>SYSTEM 1</th>
<th>SYSTEM 2</th>
</tr>
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<tbody>
<tr>
<td>Detect that one object is more distant than another</td>
<td>Focus attention on the clowns in the circus</td>
</tr>
<tr>
<td>Complete the phrase “bread and…”</td>
<td>Focus on the voice of a particular person in crowded and noisy rooms</td>
</tr>
<tr>
<td>Make a “disgust face” when shown a horrible picture</td>
<td>Maintain a faster walking speed than is natural for you</td>
</tr>
<tr>
<td>Detect hostility in a voice</td>
<td>Monitor the appropriateness of your behavior in a social situation</td>
</tr>
<tr>
<td>Answer to 2+2=?</td>
<td>Tell someone your phone number</td>
</tr>
<tr>
<td>Drive a car on an empty road</td>
<td>Park in a narrow space</td>
</tr>
<tr>
<td>Find a strong move in chess (if you are a chess master)</td>
<td>Compare two washing machines for overall value</td>
</tr>
<tr>
<td>Understand simple sentences</td>
<td>Check the validity of a complete logical argument</td>
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</table>
The capabilities of System 1 include human skills that we share with other animals.

People are born prepared to perceive the world around us, recognize objects, orient attention, avoid losses, and fear spiders.

Other activities are learnt by System 1 by making associations between ideas (such as the master chess player).

Many activities of System 1 are completely involuntary while others, such as chewing, are susceptible of voluntary control but normally run on automatic pilot (accessibility).

System 2 is tuned to pay attention and has some ability to change the way system works by programming the normally automatic functions of attention and memory.

When you rent a car in UK you should pay attention to drive on the left side of the road.
ACCESSIBILITY AND CONTEXT

ABC

1234
ACCESSIBILITY AND EXPECTATIONS

- **Expectations** (conscious or not) are a powerful determinant of accessibility.

- Ambiguity and uncertainty are suppressed in intuitive judgment as well as in perception.

- It is different to see the two versions in close proximity or separately because observers will not spontaneously become aware of the alternative interpretation.

- Doubt is a phenomenon of System 2, an awareness of one’s ability to think incompatible thoughts about the same thing.

Klein (1998) experienced decision makers working under pressure (e.g., firefighting company captains) rarely need to choose between options because, in most cases, only a single option comes to mind.
BERNOULLI’S ERROR

- **Perception** is *reference-dependent*: the perceived attributes of a focal stimulus redirect the contrast between that stimulus and a context of prior and concurrent stimuli.

- Immersing the hand in water at 20°C will feel pleasantly warm after prolonged immersion in much colder water, and pleasantly cool after immersion in much warmer water.

- In contrast, **standard economics** assumes that the utility of decision outcomes is determined entirely by the final state of endowment, and is therefore *reference-independent*.

- Kahneman defines **Bernoulli’s error** the proposition that decision makers evaluate outcomes by the utility of final asset positions which has been retained in economics for almost 300 years.
MÜLLER–LYER ILLUSIONS
COGNITIVE AND VISUAL ILLUSIONS

- System 1 sees that the bottom line is longer than the top line.

- System 2 realizes from measurement in the second slide that the lines are equally long.

- But if you look again at the first slide the bottom line appears longer.

- There is no way to prevent System 1 from generating a wrong impression because it operates automatically and cannot be turned off at will.

- Biases cannot be avoided because System 2 have no clue to the error and is to slow and inefficient to serve as a substitute for System 1 in making routine decisions.

- Solution: learn to recognize situations in which mistakes are likely and to monitor them.
ADD TASK
ADD–3 EXERCISE

4521
PUPIL SIZE

- The changing size of your pupils is a faithful record of how hard you worked

- Pupils’ sizes are sensitive indicators of mental effort

- More the effort is hard more they dilate but with an inverted V

- Add-1 causes a larger dilation then the task of holding seven digits for immediate recall

- Add-3 in the first 5 seconds the pupil dilates by about 50% of its original area and heart rate increases by about 7 beats per minute. This is as hard as people can work and they give up. When exposed to more digits their pupils stopped dilating or actually shrank
SYSTEM 1’S QUICK RESPONSES

- Pupils offer an index of the current rate at which mental energy is used
- System 2 have limited capacity and this capacity is allocated second by second to other tasks
- You cannot allocate attention to others (the invisible gorilla)
- But orienting and responding quickly to threats or promising opportunities improves the chance of survival
- System 1 takes over in emergencies and assign total priority to self-protective actions
SELF-CONTROL

- System 1 has more influence on behavior when System 2 is busy.

- People who are cognitively busy are also more likely to make selfish choices, use sexist language and make superficial judgments in social situations.

- Add-3 loosens the hold on System 2 on behavior as few drinks or a sleepless night.

- Too much concern about how well one is doing in a task sometimes disrupts performance by loading short-term memory with pointless anxious thoughts (fast and frugal).

- Self-control requires attention and effort and is a task of System 2 who monitor and control thoughts suggested by System 1.
“it is natural for System 1 to generate overconfidence judgments, because confidence is determined by the coherence of the best story you can tell from the evidence at hand.” (p. 194)

“The most coherent stories are not necessarily the most probable, but they are plausible, and the notions of coherence, plausibility, and probability are easily confused by the unwary.” (p. 159)

“System 2 is not impressively alert. (...) Its laziness is an important fact of life, and the observation that representativeness can block the application of an obvious logical rule is also of some interest.” (p. 164)
THE ORIGIN OF BIASES

System 1 detects simple relations (i.e. “they are all like”) and integrate information about one thing at a time but it does not deal with multiple distinct topics at once.

System 2 follow rules, compare objects on several attributes and make deliberate choices between options, adopt “task sets”, i.e. program memory to obey an instruction that overrides habitual responses.

But people are overconfident and prone to place too much faith in their intuitions because they find cognitive effort mildly unpleasant and avoid it as much as possible.
System 1 collects all the properties of automaticity and heuristic processing as discussed by literature on bounded rationality (Simon) and heuristics (Kahneman and Tversky).

System 1 is fast, automatic, effortless, largely unconscious, associative and difficult to control or modify.

The perceptual system and the intuitive operations of System 1 generate non voluntary impressions of the attributes of objects and thought.
System 2 encompasses the processes of analytic intelligence, traditionally studied by information processing theorists.

System 2 is slower, serial, effortful, deliberately controlled, relatively flexible and potentially rule-governed.

In contrast with System 1, System 2 originates judgments that are always explicit and intentional, whether or not they are overtly expressed.
Gaze Direction and Dual Systems

“Gaze Bias Parallels Decision Making in Binary Choices under Uncertainty” Alessandro Innocenti, Alessandra Rufa, Jacopo Semmoloni (JNEP 2010)

- System 1 and System 2 are evolutionary products
- People heterogeneity as the result of individually specific patterns of interaction between the two systems
- If eye movements and attention shifts are tightly tied, gaze direction could represent a signal of how automatic and immediate reactions to visual stimuli are modified or sustained by conscious and rational processes of information collecting
Informational cascades

- Informational cascade - model to describe and explain herding and imitative behavior focusing on the rational motivation for herding (Banerjee 1992, Bikhchandani et al. 1992)

Key assumptions

- Others’ actions/decisions but not information are publicly observable
- Private information is bounded in quality
- Agents have the same quality of private information
Consider two restaurants named "A" and "B" located next to one another.

According to experts and food guides A is only slightly better than B (i.e. the prior probabilities are 51 percent for restaurant A being the better and 49 percent for restaurant B being better).

People arrive at the restaurants in sequence, observe the choices made by people before them and must decide where to eat.

Apart from knowing the prior probabilities, each of these people also got a private signal which says either that A is better or that B is better (of course the signal could be wrong).
Suppose that 99 of the 100 people have received private signals that B is better, but the one person whose signal favors A gets to choose first.

Clearly, the first chooser will go to A. The second chooser will now know that the first chooser had a signal that favored A, while his or her own signal favors B.

Since the private signals are assumed to be of equal quality, they cancel out, and the rational choice is to decide by the prior probabilities and go to A.
The restaurant example

- The second person thus chooses A regardless of her signal.
- Her choice therefore provides no new information to the next person in line: the third person's situation is thus exactly the same as that of the second person, and she should make the same choice and so on.
- Everyone ends up at restaurant A even if, given the aggregate information, it is practically certain that B is better (99 people over 100 have private signal that is the case).
- This takes to develop a “wrong” information cascade, i.e. that is triggered by a small amount of original information followed by imitations.
What is wrong?

- A is chosen although almost all people receive private signal that B is better than A and there is no clear prior evidence that A is better than B (51% vs. 49%)

- If the second person had been someone who always followed her own signal (overconfident), the third person would have known that the second person's signal had favored B. The third person would then have chosen B, and so everybody else

- The second person's decision to ignore her own information and imitate the first chooser inflicts a negative externality on the rest of the population

- If she had used her own information, her decision would have provided information to the rest of the population, which would have encouraged them to use their own information as well
Model’s key features

- People get private information ("signals") and can also observe public information.
- Public information is the history of all the actions (not information) of predecessors.
- People are rational because they are assumed to update their prior probabilities by using Bayes’ rule to process the public and private information they possess.
- An individual herds on the public belief when his action is independent of his private signal.
- If all agents herd there is an informational cascade that may be both “wrong” or “right”.
Heuristics and biases in cascades

- The theory of informational cascades assumes that decision makers behave rationally in processing all the available information.

- Experimental evidence points out cognitive biases:
  
  1. One third of the subjects exhibit a tendency to rely on the mere counting of signals (Anderson-Holt 1997)
  2. Subjects’ overconfidence consistently explains the deviations from Bayes’ rule (Huck-Oechssler 2000, Nöth-Weber 2003, Spiwoks et al. 2008)
Experimental setting

Subject monitor

P&T Infrared Camera

u(t)

H(s)

Subject

Operator monitor

Software
ET-6000
Data analysis and record
Stimulus generator

Controller

y(t)

RS232
Two events - Square and Circle - may occur with equal probability.

For each session, 9 subjects (students) were arranged in a pre-specified order and asked to predict the state with a monetary reward for a correct prediction.

Each subject observes:

- an independent and private signal (Private Draw) which has a 2/3 chance of indicating the correct event
- the predictions (Previous Choices) made by the subjects choosing previously that are public information
Bayesian learning

- HP: rational subjects process information according to Bayes’ rule and predict the event indicated as more probable by the combination of private signals and publicly known predictions.

- This implies that the choice of the first decision maker reveals the private signal he has drawn.

- For example, if he chooses A, later decision makers will infer that he has observed the signal $a$.

  $[\Pr(a|A) = 2/3 > \Pr(a|B) = 1/3]$
Bayesian learning

- If the second decision maker observes the same private signal $a$ he will predict accordingly.

- If she receives the other signal $b$, he will assign a 50% probability to the two events and both predictions will be equally rational.

- If the second decision maker chooses A, the third decision maker will observe two previous choices of A. If her private signal is $b$, it will be rational to ignore this private information and to predict A as the previous choosers (information cascade).
If \((a,b)\) indicates the numbers of signals \(a\) and \(b\) received or inferred, Bayes’ rule imposes:

\[
\Pr(A|a,b) = \frac{\Pr(a,b|A) \Pr(A)}{\Pr(a,b|A) \Pr(A) + \Pr(a,b|B) \Pr(B)}
\]

In the example, the third decision maker observes two signals \(a\) inferred and receives one signal \(b\) received and the expression above gives:

\[
\Pr(A|a,b) = \frac{(2/3)^2(1/3)(1/2)}{(2/3)^2(1/3)(1/2) + (1/3)^2(2/3)(1/2)} = \frac{2}{3}
\]
Bayesian learning

- Being signals balanced \[ \Pr(A|a) = \Pr(B|b) = 2/3 \], the difference between the number of signals \( a \) and \( b \) inferred or observed determines the more probable event.

- In this simplified case, Bayes’ rule corresponds to a very simple and intuitive counting heuristic, which is easily computable by all subjects.

- In the example above, the third decision maker has to count two previous choices over his/her only one private signal to determine her choice of A as rational
Private draw - PD (right)
Previous choices - PC (left)
Private signal - PD (left)
Previous choice - PC (right)
### Experimental design

<table>
<thead>
<tr>
<th>Session</th>
<th>Treatment</th>
<th>Participants (women + men)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(PD left - PC right)</td>
<td>9  (4 + 5)</td>
</tr>
<tr>
<td>2</td>
<td>(PD left - PC right)</td>
<td>9  (5 + 4)</td>
</tr>
<tr>
<td>3</td>
<td>(PD left - PC right)</td>
<td>9  (6 + 3)</td>
</tr>
<tr>
<td>4</td>
<td>(PC right - PD left)</td>
<td>9  (4 + 5)</td>
</tr>
<tr>
<td>5</td>
<td>(PC right - PD left)</td>
<td>9  (5 + 4)</td>
</tr>
<tr>
<td>6</td>
<td>(PC right - PD left)</td>
<td>9  (5 + 4)</td>
</tr>
<tr>
<td>7</td>
<td>(PD left - PC right)</td>
<td>9  (3 + 6)</td>
</tr>
<tr>
<td>8</td>
<td>(PD left - PC right)</td>
<td>9  (5 + 4)</td>
</tr>
<tr>
<td>9</td>
<td>(PD left - PC right)</td>
<td>9  (4 + 5)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>81 (41+40)</td>
</tr>
</tbody>
</table>

Participants: 81   Mean age: 22.4 Years
Experimental variables

- First Fixations

- **Total number of fixations** (Fixations = gazing at region of interest –ROI- for at least 200 milliseconds)

- **Relative time spent fixating ROI** (relative time = time in a ROI divided by the total time spent on a task)

- Sequence of last fixations
Subjects’ types

- **BAYESIAN** - the equal probability of the two states implies that the optimal Bayesian decision rule is to predict the state which obtains the greatest number of observed (Private draw) and inferred signal (Previous choices).

If subjects **choose differently** from what implied by Bayesian update:

- **OVERCONFIDENT** - if subject’s choice is equal to his Private draw
- **IRRATIONAL** - if subject’s choice is not equal to his Private draw
## Results

<table>
<thead>
<tr>
<th>Order of choice</th>
<th>Bayesian</th>
<th>Overconfident</th>
<th>Irrational</th>
</tr>
</thead>
<tbody>
<tr>
<td>1\textsuperscript{st}</td>
<td>6</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2\textsuperscript{nd}</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3\textsuperscript{rd}</td>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4\textsuperscript{th}</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5\textsuperscript{th}</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6\textsuperscript{th}</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7\textsuperscript{th}</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>8\textsuperscript{th}</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>9\textsuperscript{th}</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Total (first chooser excluded)</td>
<td>51</td>
<td>16</td>
<td>5</td>
</tr>
</tbody>
</table>
### First fixations

<table>
<thead>
<tr>
<th></th>
<th>Private Draw</th>
<th>Previous Choices</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Latency of first fixations</td>
<td>N. of first fixations</td>
<td>%</td>
<td>N. of first fixations</td>
<td>%</td>
</tr>
<tr>
<td>Bayesian</td>
<td>0.306 sec</td>
<td>27 (13L+14R)</td>
<td>52.9</td>
<td>24 (13L+11R)</td>
<td>47.1</td>
</tr>
<tr>
<td>Overconfident</td>
<td>0.412 sec</td>
<td>13 (6L+7R)</td>
<td>81.2</td>
<td>3 (1L+2R)</td>
<td>18.8</td>
</tr>
<tr>
<td>Irrational</td>
<td>0.191 sec</td>
<td>3 (2L+1R)</td>
<td>60.0</td>
<td>2 (0L+2R)</td>
<td>40.0</td>
</tr>
<tr>
<td>Total</td>
<td>0.321 sec</td>
<td>43 (21L+22R)</td>
<td>46.8</td>
<td>25 (14L+15R)</td>
<td>53.2</td>
</tr>
</tbody>
</table>

- Overconfident subjects allocated their initial attention to private draw in 81% of the cases, and exhibited a longer average reaction time (0.412 sec.) and a shorter average duration of first fixation (0.523 sec).
Only irrational subjects were significantly more inclined to look at private draw (47.1%) than at former choices (22.6%).
First fixations by side

<table>
<thead>
<tr>
<th></th>
<th>PRIVATE DRAW (PD)</th>
<th></th>
<th>FORMER CHOICES (FC)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LEFT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>N.</td>
<td>Tot.</td>
<td>%</td>
<td>N.</td>
</tr>
<tr>
<td>BAYESIAN</td>
<td>8</td>
<td>14</td>
<td>57.1</td>
<td>20</td>
</tr>
<tr>
<td>OVERCONFIDENT</td>
<td>5</td>
<td>9</td>
<td>55.6</td>
<td>9</td>
</tr>
<tr>
<td>IRRATIONAL</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>14</strong></td>
<td><strong>24</strong></td>
<td><strong>58.3</strong></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>

- No statistically significant difference between left and right orientation of the screen was detected and the pattern of first fixations across subjects’ types.
No gaze cascade effect: observers gaze was not increasingly directed towards the chosen signal
Likelihood by types

Fig. 2 Likelihood that subjects look at the chosen signal as a function of time until decision (by subjects' types)
Findings

- Overconfident subjects allocate the first fixation (initial attention) towards private draws and take more time than others to decide if the private signal is on the right or the left of the screen.

- Bayesian subjects allocate their initial attention to both kinds of information without exhibiting any particular bias.

- No evidence of the gaze cascade effect.
Interpretation

- In terms of the Dual Process theory, our findings support the hypothesis that automatic detection, as inferred from gaze direction, depends on cognitive biases.

- The heuristic and automatic functioning of System 1 orients attention so as to confirm rather than to eventually correct these biases.

- The controlled search attributable to System 2 does not significantly differ across subject types.
“Highly accessible impressions produced by System 1 control judgments and preferences, unless modified or overridden by the deliberate operations of System 2.” (Kahneman and Frederick 2002)

System 1 → orienting choice

System 2 → reinforcing choice
Heuristic processes of System 1 select the aspect of the task on which attention is immediately focused.

Analytic processes of System 2 derive inferences from the heuristically-formed representation through subsequent reasoning.

This dual account of attention orienting may explain the emergence of cognitive biases whenever relevant information is neglected at the heuristic stage for various reasons (overconfidence, noisy and redundant information, information overload).
Back to Political Science

- Pervasive effects of unconscious thoughts, feelings and behaviors on attitude formation, opinions, decisions

- Most of our daily life is experienced unconsciously, outside awareness

- Political scientists are interested in behavioral variables such as voting, contributing, bargaining, but they rely on verbalized intentions (surveys) and not on observed behaviors
Back to Political Science

- Dual theories -> both conscious and unconscious processes are continuously at work, not only when people make snap judgments but even when are asked to weigh pros and cons before forming a political opinion or voting

- Lab and field experiments (virtual simulations too) allow to incorporate unconscious cognition into models of political beliefs challenging the extant understanding of mass beliefs
Research areas in the lab

- **online information processing** – people form impressions of persons, events, or issues spontaneously and without awareness by extracting the affective value of the message.

- **implicit attitudes** – most attitudes are latent constructs, they cannot be directly observed but must be inferred from self-report or nonverbal responses such as reaction time (IAT).

- **unconsciously information processing** – perceptual threshold (60 and 100 milliseconds) anticipate subjective threshold – after which conscious processing is possible.
Aim: To provide an introduction to cognitive economics and its implications for political science.


Readings:


Blogs, Videos and Websites:
Nudge (official site)

Dan Ariely asks, Are we in control of our decisions? (17:27)
[http://www.youtube.com/watch?v=9X68dm92HVI](http://www.youtube.com/watch?v=9X68dm92HVI)
Cognitive economics is not a distinct subfield of economics but a school of thought based on the idea that the study of economic behaviour has to be founded on the interdisciplinary approach of cognitive sciences.

The research field of Cognitive Science is formed by the intersection of a variety of different disciplines including cognitive psychology, philosophy of mind, linguistics, artificial intelligence and neuroscience.

The field of cognitive economics is the analysis of the mental and cognitive processes through which the economic agent collects, processes, interprets and uses information and knowledge to make economic choices.

Its main object is to open the black-box containing all the processes through which preferences are formed and are translated into choices.

Cognitive economics departs from behavioral economics, whose methodology is based on the analysis of the effectively exhibited behaviors, which is consonant with the axiom of revealed preferences and allows ignoring the mental processes leading to decisions or judgments.
NEUROECONOMICS

Neuroeconomics is a sub-field of cognitive economics.

Studies how the brain interacts with the environment to produce economic behavior.

Neuroeconomics is the grounding of microeconomics in details of neural functioning.

While the revealed preferences approach has deliberately avoided trying to discover the neural determinant of choices, neuroscience is beginning to allow direct measurement of thoughts and feelings.

Methodologically, neuroeconomics is not intended to test economic theory in a traditional way - particularly under the view that utilities and beliefs are only revealed by choices - but to establish the neural circuitry underlying economic decisions, for the eventual purpose of making better predictions.
Dr., I've never seen anything like it. All the rational regions have shut down!
BASIC PRINCIPLES

- Much of the brain is constructed to support automatic processes which are faster than conscious deliberation and which occur with little or no awareness or feeling of effort.

- Economic behavior is under the pervasive and often unrecognized influence of finely tuned affective (emotion) systems that are localized in particular brain region.

- If affective systems are damaged or perturbed by brain damage, stress, imbalances in neurotransmitters, alcohol or “the heat of the moment” the deliberative system generally is not capable of getting the job done.

- Many behaviors that are clearly established to be caused by automatic or affective systems are interpreted by human subjects, spuriously, as the product of cognitive deliberation.

- The deliberative system, which is the system that is responsible for making sense of behavior, does not have perfect access to the output of the other systems, and exaggerates the importance of processes it understands when it attempts to make sense of the body’s behavior.
TOOLS

- Animal studies
- Human studies
- Lesion studies (i.e., studies of patients with deficits that follow specific brain damage)
- Single neuron measurement (non-human mammals)
- Eye-tracking
- Measuring hormone levels
- Physiological activations (Heart rate, Skin conductance level, Blood pressure, Finger temperature, Respiratory rate)
- Transcranial magnetic stimulation (TMS)
- Imaging of brain activity
  - Electro-encephalogram (or EEG)
  - Positron emission topography (PET)
  - Functional magnetic resonance imaging (fMRI)
EEG
PET
Comparison of people performing different tasks (experimental + control task) by observing the images of the regions of the brain that are differentially activated by the experimental task.

- **Electro-encephalogram (or EEG)** uses electrodes attached to the scalp to measure electrical activity synchronized to stimulus events or behavioral responses known as Event Related Potentials, or ERPs. (poor spatial resolution but unobtrusiveness and portability)

- **Positron emission topography (PET)** scanning measures blood flow in the brain, which is a reasonable proxy for neural activity, since neural activity in a region leads to increased blood flow to that region. (poor temporal resolution for stochastic lag of blood, i.e. flow)

- **Functional magnetic resonance imaging (fMRI)**, which tracks activity in the brain proxied by changes in blood oxygenation - neural processes are thought to occur on a 0.1 millimeter scale in 100 microseconds (msec) (the spatial and temporal resolution of a typical scanner is only 3 millimeters and about two seconds)
Functional Magnetic Resonance Imaging (fMRI)

- Uses strong magnetic fields to create images of biological tissue
  - Measures hemodynamic signals related to neural activity
    - Blood Oxygenation Level Dependent (BOLD) contrast
    - MR signal of blood is dependent on level of oxygenation
    - Changes in deoxyhemoglobin
  - Blood flow in the brain implies function
    - Studies have shown regional brain activity when exposed to cues (Huettel et al. 2004)

Source: UC Irvine Center for Functional Onco-Imaging
Why is fMRI so exciting?

- Non-invasive
- Better temporal resolution
- Good and improving spatial resolution
- Can be used in conjunction with other methods

Source: MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging Visiting Fellowship Program in fMRI, 2005
BASIC FACTS ABOUT THE BRAIN

The brain is divided into two halves and each half is divided into four lobes: frontal, parietal, occipital and temporal.

Regions of these lobes are interconnected and create specialized “circuits” for performing various tasks.

What do each of these lobes do?

**Frontal Lobe** - associated with reasoning, planning, parts of speech, movement, emotions, and problem solving

**Parietal Lobe** - associated with movement, orientation, recognition, perception of stimuli

**Occipital Lobe** - associated with visual processing

**Temporal Lobe** - associated with perception and recognition of auditory stimuli, memory, and speech
The human brain is a primate brain with more neocortex. The fact that many human and animal brain structures are shared means that human behavior generally involves interaction between “old” brain regions and more newly-evolved ones.
TRIUNE DIVISION OF BRAIN
Paul MacLean (1990)

- "reptilian brain," which is responsible for basic survival functions, such as breathing, sleeping, eating

- "mammalian brain," which encompasses neural units associated with social emotions

- "hominid" brain, which is unique to humans and includes much of our oversized cortex—the thin, folded, layer covering the brain that is responsible for such "higher" functions as language, consciousness and long-term planning
THE “NEW” REGIONS

**Prefrontal cortex** – the executive region because it draws inputs from almost all other regions and plan actions. The prefrontal area is the region that has grown the most in the course of human evolution and which, therefore, most sharply differentiates us from our closest primate relatives.

THE “OLD” REGIONS

**Limbic System** as the main area involved with emotions

- **Amygdala** play an important role on the mediation and control of major affective activities like friendship, love and affection, on the expression of mood and, mainly, on fear, rage and aggression. It is also the center for identification of danger.

- **Hippocampus** is particularly involved with memory phenomena, specially with the formation of long-term memory (the one that, sometimes, lasts forever).

- **Hypothalamus** is involved in the so-called motivated behaviors, like thermal regulation, sexuality, combativeness, hunger and thirst. It is also believed to play a role in emotion.
Limbic System

- Thalamus
- Cingulate Gyrus
- Striatum
- Corpus Callosum
- Hypothalamus
- Pons
- Spinal Cord
- Hippocampal Formation
- Amygdala
- Cerebellum
- Cingulate Gyrus
Controlled processes
- conscious and introspectively accessible
- tend to be serial and to use a step-by-step logic
- tend to be invoked deliberately by the agent when her or she encounters a challenge or surprise
- are often associated with a subjective feeling of effort

Automatic processes
- operate outside of conscious awareness
- tend to operate in parallel
- are often associated with a feeling of effort
- people often have surprisingly little introspective access to automatic choices
- Ex. a face is perceived as ‘attractive’, or a verbal remark as ‘sarcastic’, automatically and effortlessly

Cognitive processes
- those that answer true/false questions
- to influence behavior the cognitive system must operate via the affective system

Affective processes
- those that motivate approach/avoidance behavior.
- include emotions such as anger, sadness, and shame, as well as "biological affects" such as hunger, pain, and the sex drive.
AUTOMATIC PROCESSES

Key principles

- **Parallelism**  much of the brain's processing involves processes that unfold in parallel and are not accessible to consciousness

- **Plasticity**  the brain undergoes physical changes as a result of these processes: when signals are repeatedly conveyed from one neuron to another, the connections between those neurons strengthen (Hebb 1949). Information processing is unlikely to be reversible because the physiological processes that produce learning are themselves not reversible

- **Modularity**  it draws upon multiple modules specialized to perform specific functions: neurons in different parts of the brain have different shapes, structures and functions

- **Specialization**  when the brain is confronted with a new problem it initially draws heavily on diverse modules, including, often, the prefrontal cortex, but over time, activity becomes more concentrated in modules that specialized in processing relevant to the task
AFFECTIVE PROCESSES

Key Principles

- **Homeostasis** Affective system involves detectors that monitor when a system departs from a 'set-point' and mechanisms that restore equilibrium when such departures are detected (it is highly attuned to changes in stimuli rather than their levels). Some of these mechanisms do not involve deliberate action.

- **Raw motivation** Economists usually view behaviour as a search for pleasure. Neuroscience and other areas of psychology show that the motivation to take an action is not always closely tied to hedonic consequences (liking vs. wanting systems).

- **Competition** Affective system often plays as if the decision maker is of "two minds". It drive us in one direction and cognitive deliberations in another.

- **Erroneous sense-making** Since quadrant I often does not have conscious access to behavior in the other quadrants, it is often tends to over attribute behavior to itself, i.e. to a deliberative decision process.
MAIN FINDINGS

- Decision making is **not a unitary process**—a simple matter of integrated and coherent maximization—because it is driven by the interaction between automatic and controlled processes.

- The extent to which **intertemporal choice** is generated by **multiple systems with conflicting priorities** is consequently the most debated issue within neuroscience. Most evidence favors a multiple systems perspective.

- Neuroscientific research on **social preferences** is supportive of a **dual-systems account**, also with regard to how self-interest and fairness concerns interact to influence behavior.

- Social science is intertwined with psychology by inspiring models increasingly grounded in psychological reality and by addressing debates on if multiple systems operate **sequentially or in parallel** to influence behavior.
DESCARTES' ERROR

ANTONIO DAMASIO

'A TOUR DE FORCE OF SHEER REFLECTIVE IMAGINATION'
TIMES LITERARY SUPPLEMENT
REVISED EDITION WITH A NEW PREFACE
HOW EMOTIONS AFFECT DECISION-MAKING

- Spotlight of information processing - to focus attention on certain kinds of information (Boyer 1991)

- To encode and recall information – affect-as-information mechanism (Slovic et al. 2002)

- Motivator by influencing approach-avoidance tendencies and effort to process information (Zeelenberg-Pieters 2006)

- To provide a common currency for experiences in judgment and decisions, just as money for goods (Cabanac 1992)

- Driving decision-making in complex and conflicting choices markers can help decide - **somatic marker** (Damasio 1994)
SOMATIC MARKER

Somatic markers are associations between reinforcing stimuli that induce an associated physiological affective state, that produce a net somatic state.

Somatic states can be induced from
(1) primary inducers
(2) secondary inducers.

*Primary inducers* are innate or learned stimuli that induce pleasurable or aversive states. Once present in the immediate environment, they automatically and obligatorily elicit a somatic response.

*Secondary inducers* are entities generated by the recall of a personal or hypothetical emotional event, i.e., “thoughts” and “memories” of the primary inducer, which elicit a somatic response.

This state biases our decision of how to act, or unconsciously, via the brainstem and ventral striatum, or consciously, engaging higher cortical cognitive processing.

Damasio proposes that somatic markers direct attention towards more advantageous options, simplifying the decision process.
According to Damasio, two distinct pathways reactivate somatic marker responses.

In the first pathway, emotion can be evoked by the changes in the body that are projected to the brain—called the “body loop” (to see a snake).

In the second pathway, cognitive representations of the emotions can be activated in the brain without being directly elicited by a physiological response—called the “as-if body loop”. (imagine and encounter with a snake).

The brain can anticipate expected bodily changes, which allows the individual to respond faster to external stimuli without waiting for an event to actually occur.
SOMATIC MARKER AND DECISION-MAKING

Somatic marker hypothesis explains because a defect in emotion causes an impaired ability to make “good” decision making.

To assess the value of the available choices available in complex and conflicting tasks, cognitive processes may become overloaded and unable to help us decide.

In dual system theory System 1’s impressions cannot be modified or confirmed by System 2.

In terms of affect heuristic (Slovic et al. 1982) “the answer to an easy question (How do I feel about it?) serves as an answer to a much harder question (What do I think about it?)” (Kahneman, *Thinking fast and slow* p. 139)

In this way, people’s emotional evaluation of outcome, and the bodily states and the approach and avoidance tendencies associated with them, play a central role in guiding decision-making.
When making decisions in the future, these physiological signals (or ‘somatic markers’) and its evoked emotion are consciously or unconsciously associated with their past outcomes and bias decision-making towards certain behaviors while avoiding others.

For instance, when a somatic marker associated with a positive outcome is perceived, the person may feel happy and motivate the individual to pursue that behavior.

When a somatic marker associated with the negative outcome is perceived, the person may feel sad and act as an internal alarm to warn the individual to avoid a course of action.

These situation-specific somatic states based on, and reinforced by, past experiences help to guide behavior in favor of more advantageous choices and therefore are adaptive.
Somatic markers are probably stored in the ventromedial prefrontal cortex
CONCLUSIONS

- The existence of specialized systems challenges standard assumptions about human information processing and suggests that intelligence and its opposite—bounded rationality—are likely to be highly domain specific.

- Brain is composed by systems evolving to perform specific functions. Our problem-solving capacity and our decision-making depends on being tailored to do certain tasks.

- Brain modules are highly specialized, i.e. there is a module controlling a person’s inference about what other people believe, feel or might do.

- Emotions play a fundamental role in explaining preferences and choices usually encompassed under the label of rationality.
CONCLUSIONS

Cognitive science raises doubts about the usefulness of some of the most common constructs that social scientists commonly use, such as risk aversion, time preference, egoism, altruism.

- These characteristics are not stable over time and consistent across activities but weakly correlated or uncorrelated across situations.

- Inconsistency derives from state-contingent preferences and choices are context-dependent.

- Intertemporal preferences are assumed to be constant for different types of choices.

- The modularity of the brain implies that different types of options activate different mixtures of neural system and different choices.