Behavioral Economics Lecture 2
Experimental Methodology in Behavioral Economics

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1. Economics as an Experimental Science

- "One possible way of figuring out economic laws…is by controlled experiments…. Economists [unfortunately]…cannot perform the controlled experiments of chemists or biologists because they cannot easily control other important factors. Like astronomers or meteorologists, they generally must be content largely to observe."

——Samuelson and Nordhaus, *Principles of Economics*, 12th ed., 1985

1. Economics as an Experimental Science

- “Economic theory, through a formal deductive system, provides the basis for experimental abstraction and the experimental design, but society in most cases carries out the experiment. ... Therefore, the economic researcher observes the outcome of society’s experiment or performance but has little or no impact on the experimental design and the observations generated. Thus, by the passive nature of the data, economic researchers are, to a large extent, restricted in their knowledge search to the process of nonexperimental model building. ... The experiment is outside the researcher’s control.”

——Judge et al. *Introduction to the Theory and Practice of Econometrics*,1988

1. Economics as an Experimental Science

- “Experimental economics is an ‘exciting new development’.”

——Samuelson and Nordhaus, *Principles of Economics*, 14th ed., 1992

1. Economics as an Experimental Science

- **The Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel 2002**

  - "Traditionally, economic theory has relied on the assumption of a "homo œconomicus", whose behavior is governed by self-interest and who is capable of rational decision-making. Economics has also been regarded as a non-experimental science, where researchers – as in astronomy or meteorology – have had to rely exclusively on field data, that is, direct observations of the real world."

1. Economics as an Experimental Science

- **The Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel 2002**

  - "During the last two decades, however, these views have undergone a transformation. Controlled laboratory experiments have emerged as a vital component of economic research and, in certain instances, experimental results have shown that basic postulates in economic theory should be modified. This process has been generated by researchers in two areas: cognitive psychologists who have studied human judgment and decision making, and experimental economists who have tested economic models in the laboratory. This year's prize is awarded to the innovators in these two fields: **Daniel Kahneman** and **Vernon Smith**."

1. Economics as an Experimental Science

Vernon L. Smith

2002 Nobel Laureate in Economics
George Mason University

"for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms."

1. Economics as an Experimental Science

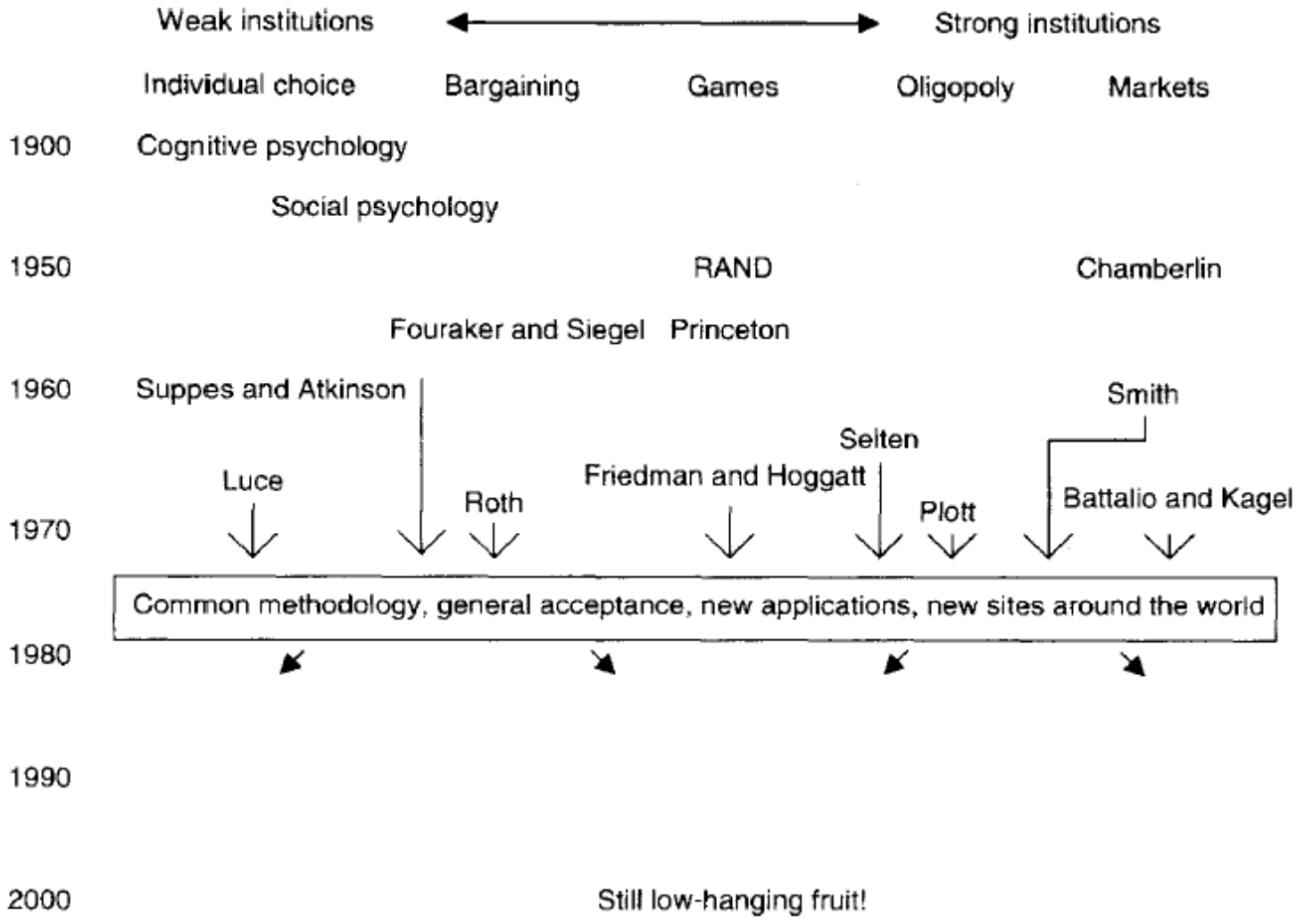
- Other Founding Fathers

Reinhard Selten
1994 Nobel Laureate in Economics
Professor at the University of Bonn

Charles Plott
Professor of CALTECH

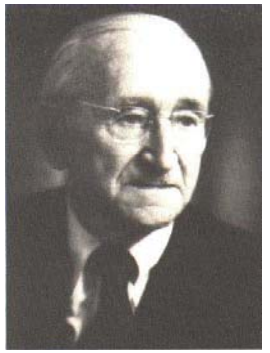
1. Economics as an Experimental Science

- Evolution of Experimental Economics.



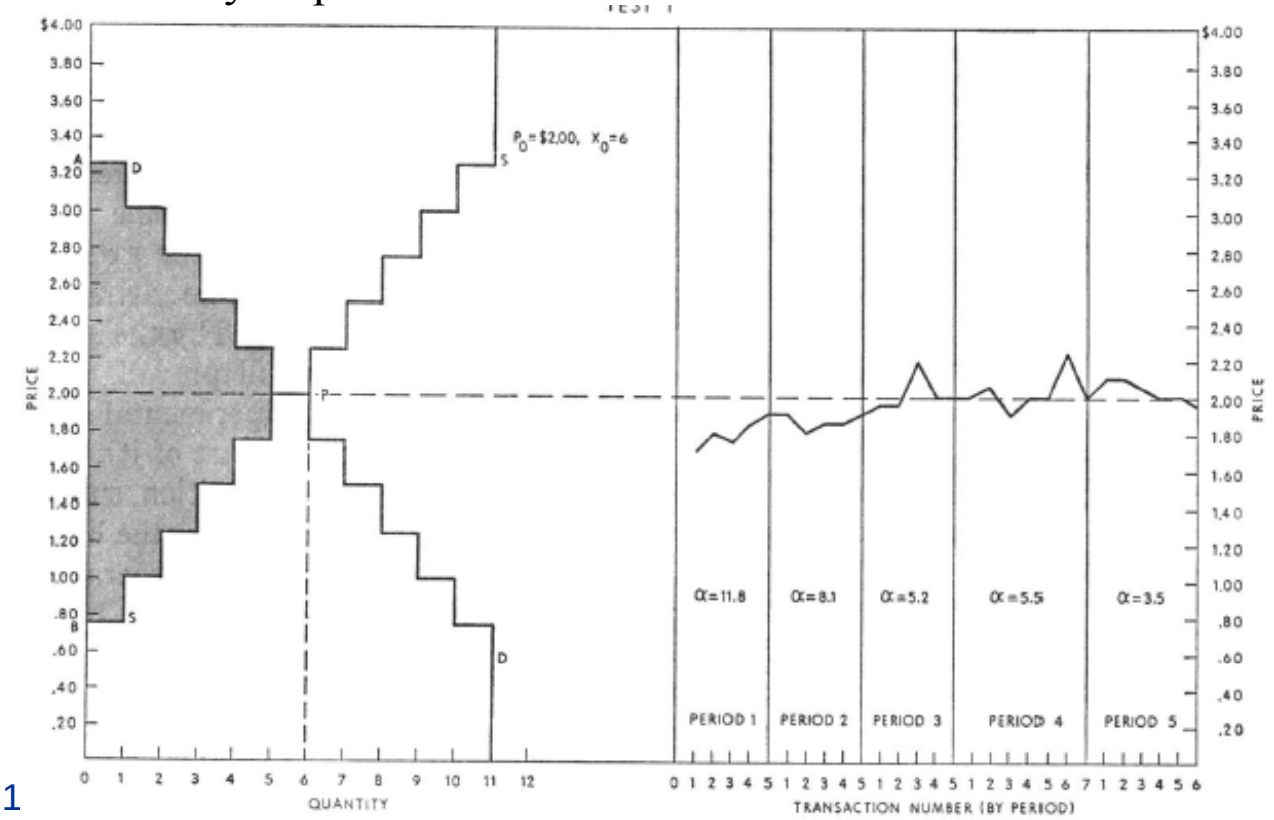
1. Economics as an Experimental Science

- V. Smith & the Hayek Hypothesis
  - Conditions of Competitive Equilibrium
    - Large number of buyers and sellers
    - Possess perfect or at least very good information about demand and supply
  - The most significant fact about this price system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action. (Hayek, 1945)
  - It would appear that, in asserting such a tendency, economists may have been led unconsciously to share their unique knowledge of the equilibrium point with their theoretical creatures, the buyer and sellers, who, of course, in real life have no knowledge of it whatever. (Chamberlin, 1948)



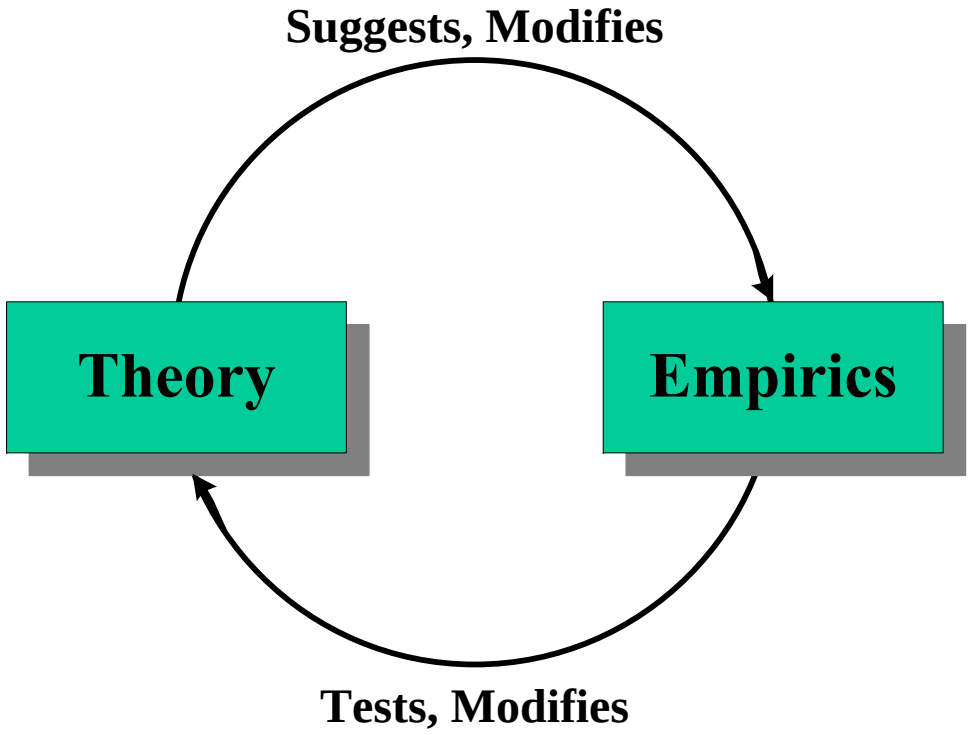
1. Economics as an Experimental Science

- V. Smith & the Hayek Hypothesis
  - Double Auction (Smith, 1962)
    - Public Bids and Asks
    - Stationary Repetition



1. Economics as an Experimental Science

- The Methodology of Scientific Research



1. Economics as an Experimental Science

- Data Sources

	Happenstance	Experimental
Field	Rate of Inflation	Income Maintenance Experiments Policy Experiments Donation Experiment
Laboratory	Discover of Penicillin	Laboratory Asset Markets Bargaining Experiments

1. Economics as an Experimental Science

- Complementary between Econometrics and Experimental Economics
  - LaLonde(1986)
  - The effectiveness of econometrical techniques
  - The experimental data allow more reliable inferences
  - In many cases happenstance data are adequate and cheap
  - Combine data from computer simulation, field and laboratory experiment

1. Economics as an Experimental Science

- Purposes of Experimental Economics
  - Test Theory
  - Which theories best fit data
  - Compare Institutions
  - Discover empirical regularities in areas for which existing theory has little to say.
  - Test Bed
  - Provide data on how to influence consumers, voters, and management
  - Influence Policymakers
  - Education

1. Economics as an Experimental Science

- Compare Institutions
  - Identical environment but varying market rules of exchange, to establish comparative properties of institutions.
  - Institutions are the rules of exchange, and these rules affect the information and incentives available to people participating in the market.
  - Institutions matter because information matters!

1. Economics as an Experimental Science

- Compare Institutions: Dynamic Auction vs. Posted Offer
  - One Sided Dynamic Auction: Buyers make repeated oral price bids for exchange of many units, one unit at a time.
    - Traders obtain sequential price observations as binding contracts are formed.
    - This is the way "country auctions" for livestock and machinery have historically been organized.

1. Economics as an Experimental Science

- One Sided Dynamic Auction

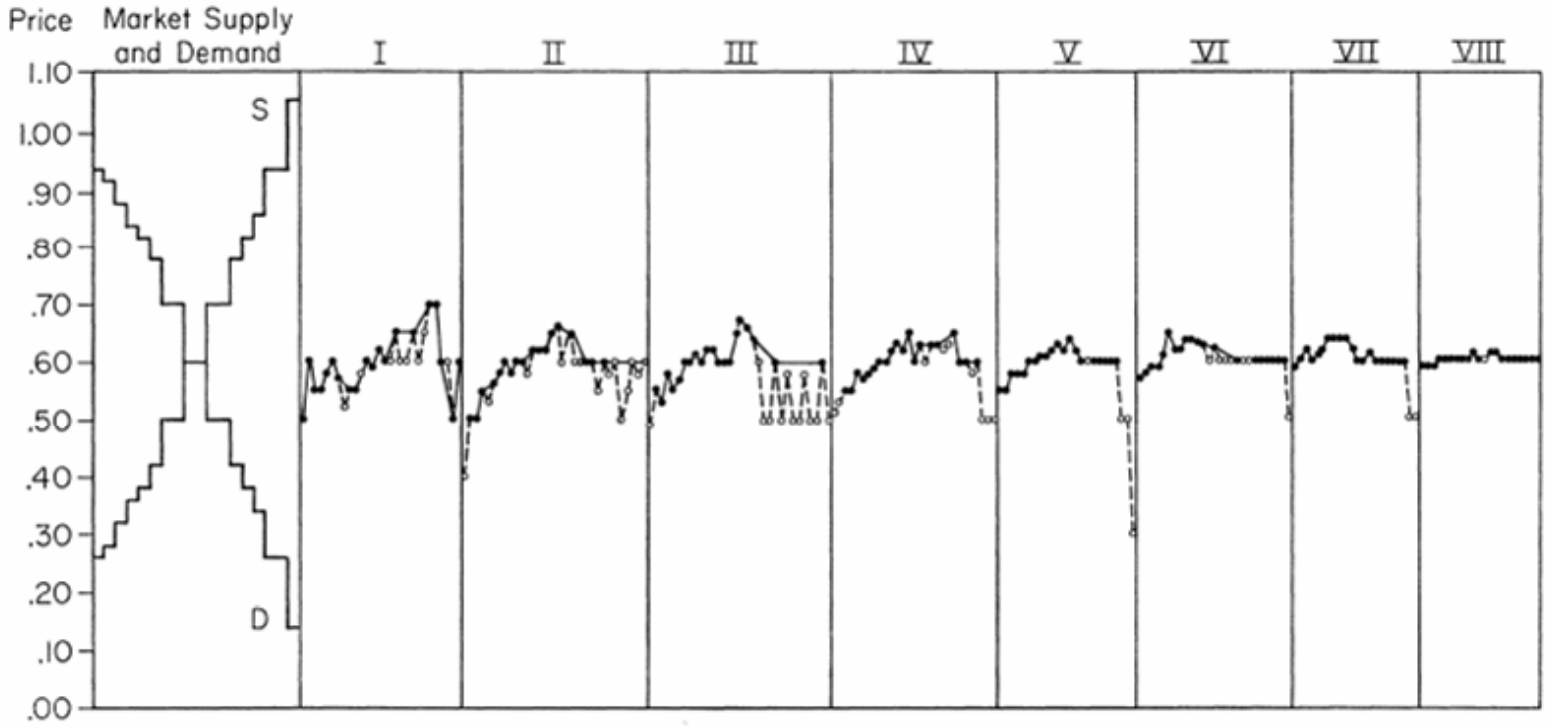


FIGURE 7

Sequences of bids and contracts. Experiment 4—(oral bid). ○ = unaccepted bid; ● = accepted bid (contract)

1. Economics as an Experimental Science

- Compare Institutions: Dynamic Auction vs. Posted Offer
  - Posted Offer: Sellers post price which cannot be changed within a period. Buyers respond by trading as many units as they like.
    - This is the typical organization of retail markets where there is a price commitment extending over several transactions.

1. Economics as an Experimental Science

- Posted Offer

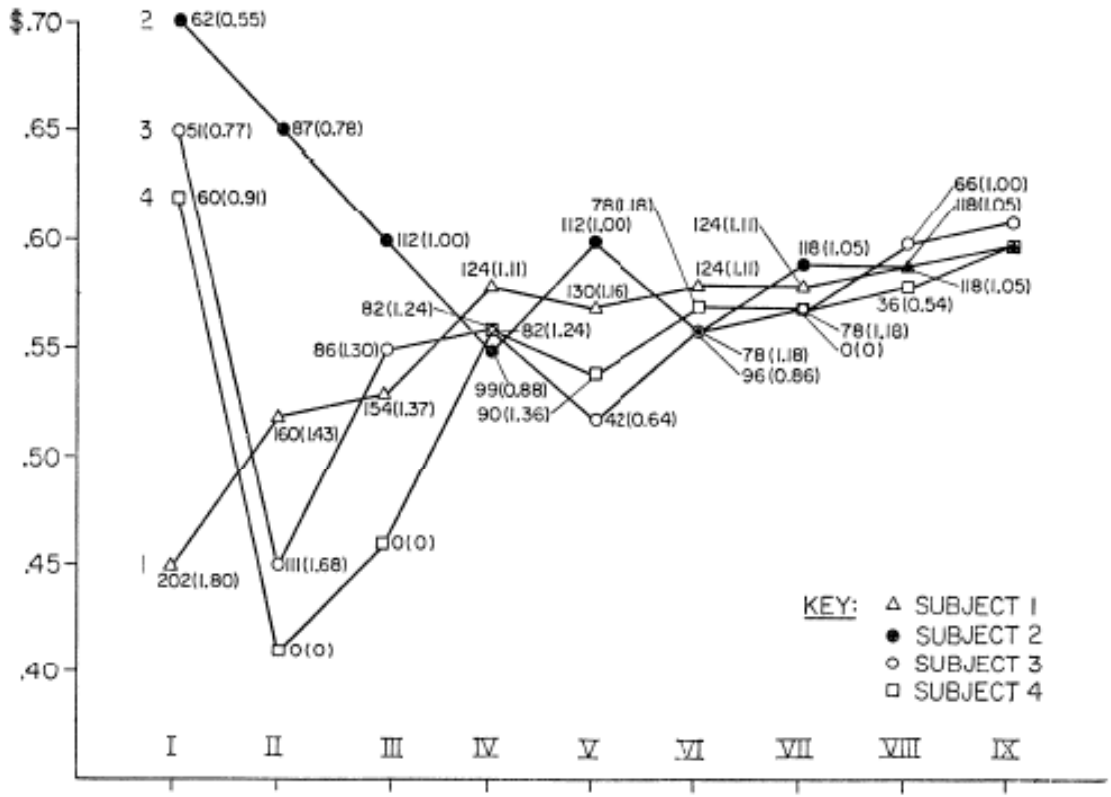


FIGURE 8

Buyer bids, profits, percentage of equilibrium profit by trading period. Experiment 1.

1. Economics as an Experimental Science

- Compare Institutions: What Have We Learned?
  - Institutions matter! When selling identical items, posted offer retail pricing converges to equilibrium more slowly and erratically than oral auction markets.
  - Market fundamentals are identical. In one people get rich, while in the other economy is volatile and struggles to thrive.

1. Economics as an Experimental Science

- Test Theory & Discriminate between Theories.
  - Compare a theory's message or outcome implications with experimental observations.
  - Example: Dictator Games

1. Economics as an Experimental Science

- Test Theory: Duhem-Quine Thesis
  - One can always rescue a theory from an anomalous observation by ex post hoc recourse in imaginative and persuasive auxiliary hypotheses.
  - This thesis denies the possibility of direct falsification of any specific testable implication of a theory.
  - Vernon Smith: Philosophers exaggerated the significance of the Duhem-Quine problems. Experimental economists do new experiments to test the auxiliary hypotheses. If they are not testable, it's preeminently your critic's problem.

1. Economics as an Experimental Science

- Test Theory: Flat Maximum
  - Harrison(1992) questioned falsifying observations in experimental economics as due to a postulated lower opportunity cost of deviating from theoretical optimality.
  - Smith and Walker (1993) offered a review of studies testing this proposition. The results show:
    - Money does matter;
    - Factors besides money also matter;
    - Many anomalies do not disappear by escalating payoffs;
    - Inadequate attention has been given to modeling the possible relationship between the performance of a theory and the motivation of decision makers.

1. Economics as an Experimental Science

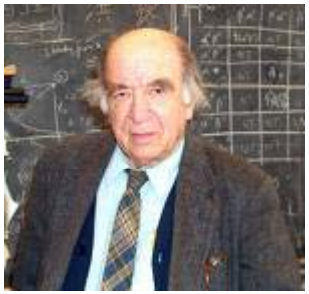
- Test Theory: Theory Failure
  - Explore the causes of a theory's failure.
    - "Establishing the anatomy of failure is essential to any research concerned with modifying the theory " -Vernon Smith
  - Establish empirical regularities as a basis for new theory.
    - Theories rely on simplified assumptions; Experiments make the study of complex environments possible.

2. Methodology of Economics Experiments

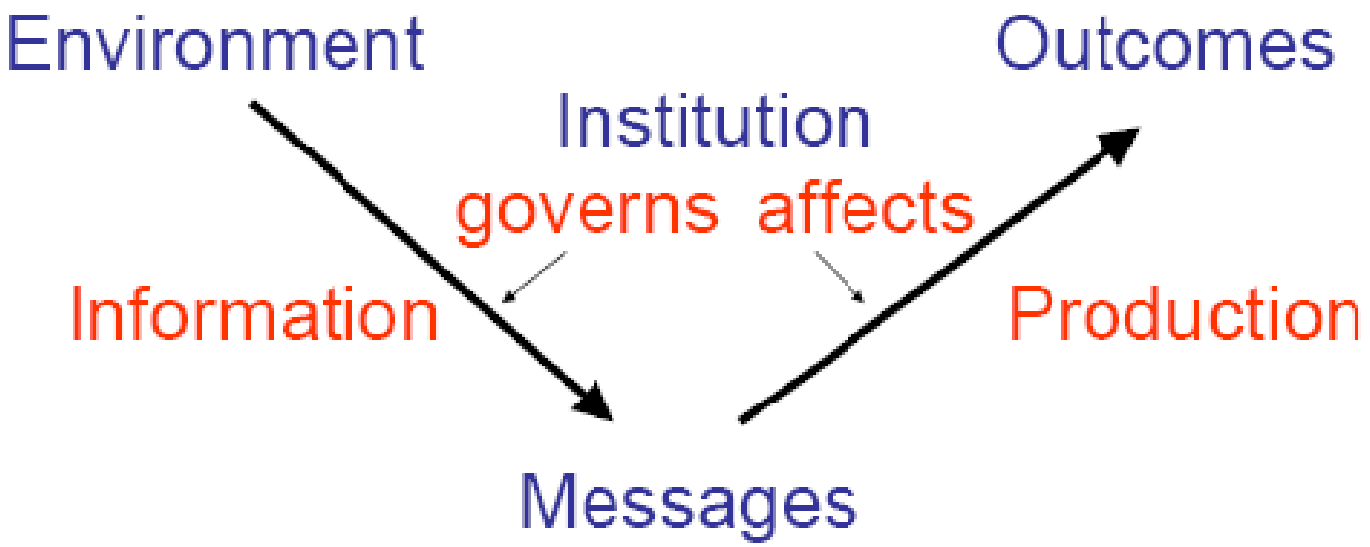
- Realism and Models
  - Design the laboratory environment to resemble as closely as possible a real-world environment.
  - Design an experiment that replicates as closely as possible the assumptions of a formal model.
  - The correct answer is *neither*.
    - Example: Financial Market
  - Simplicity enhances control.

2. Methodology of Economics Experiments

- Control: Key Concept of Experiment
  - Economic Agents and Economic Institution (Hurwicz, 1972)
  - Smith(1982): Environment
    - Preferences, technology, and initial endowments
    - Controlled by using monetary rewards
  - Smith(1982): Institution (rules of the game)
    - Possible actions
    - Sequence of actions
    - Information conditions
    - Experiments usually define an extensive or normal form game
    - Framing (language, story)

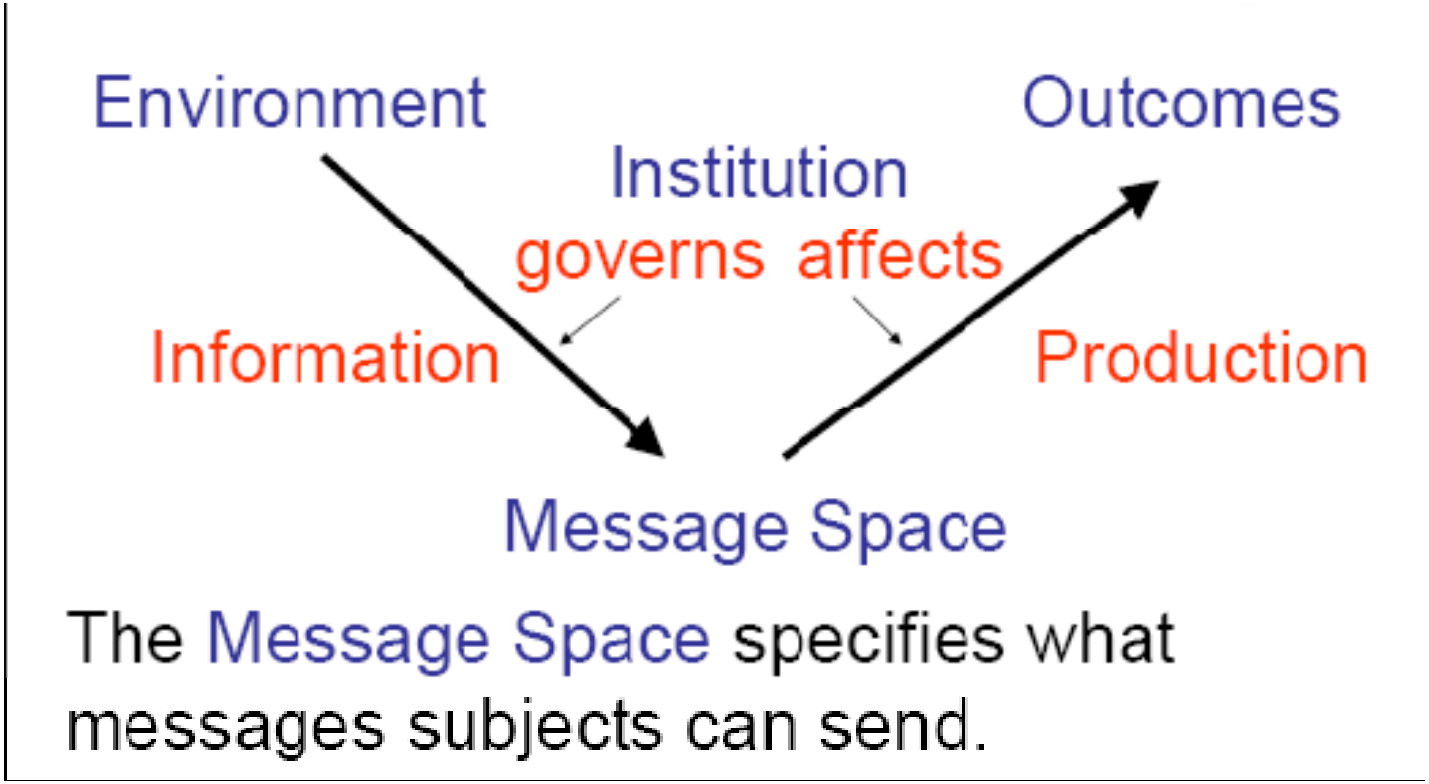


2. Methodology of Economics Experiments



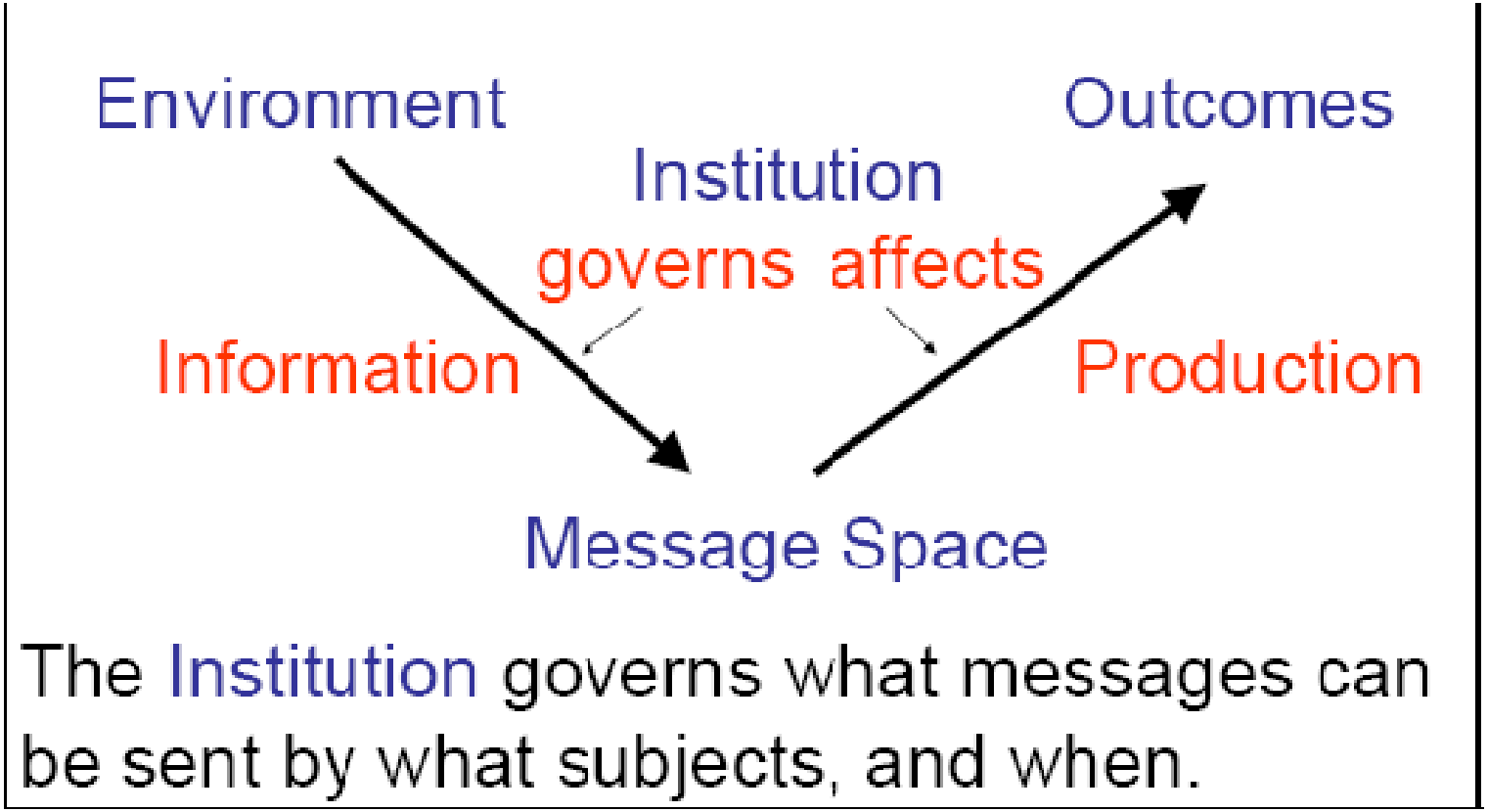
The Environment specifies subjects' preferences over outcomes.

2. Methodology of Economics Experiments



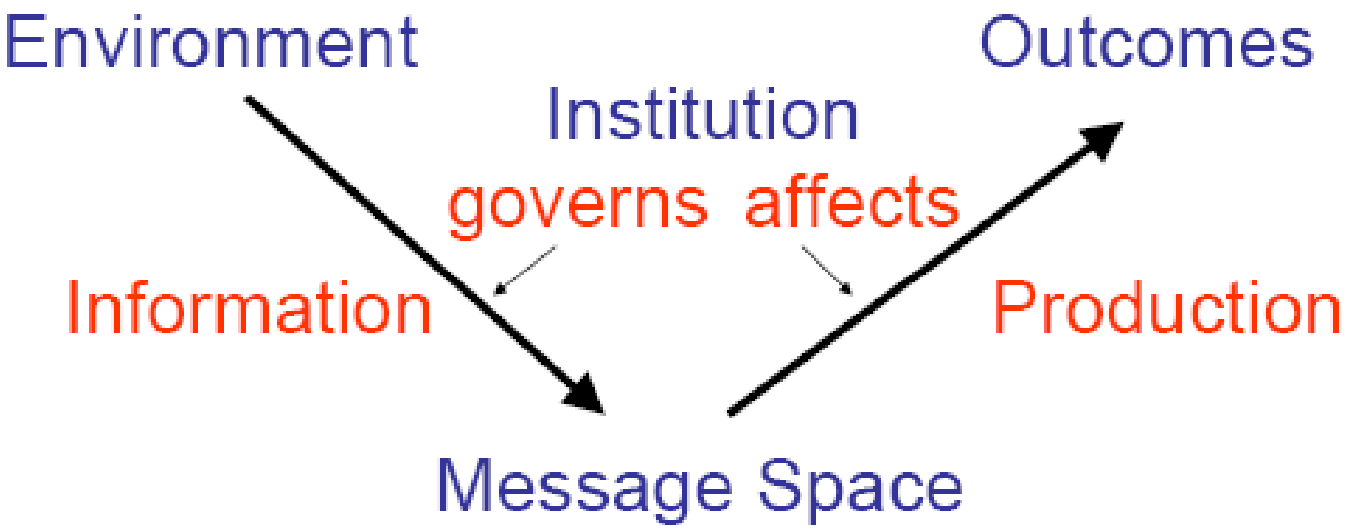
The Message Space specifies what messages subjects can send.

2. Methodology of Economics Experiments



The Institution governs what messages can be sent by what subjects, and when.

2. Methodology of Economics Experiments



The Institution also determines how messages affect outcomes.

2. Methodology of Economics Experiments

The Experimenter then **controls** for the **environment** and **institution** and **observes** subject **messages** and **outcomes**.

Vernon Smith, "Microeconomic Systems as an Experimental Science," American Economic Review, (72)1982, pp. 923-955.

2. Methodology of Economics Experiments

- Control: Key Concept of Experiment
  - Experimenter knows what is exogenous and what is endogenous
    - Few unobservable variables
    - No causality problems: Treatments allow implementation of the ceteris condition
    - Facilitates analysis: no sophisticated econometrics necessary
  - Experimenter controls information conditions
    - Important for study of, e.g., asymmetric info games
  - Experimenter knows the theoretical equilibrium
    - Equilibrium and disequilibrium can explicitly observed
    - Quick and sticky adjustment can be observed and examined

2. Methodology of Economics Experiments

- Control: Key Concept of Experiment
  - Evidence is replicable
    - Experimenter controls the conditions under which evidence is generated
    - Those who question results can replicate the experiment

2. Methodology of Economics Experiments

- Financial Incentives
  - Paying subjects essential for economic experiments
    - What people say they would do in hypothetical circumstances does not necessarily correspond to what they actually do if actions have monetary consequences (e.g., Glaeser/Laibson/Scheinkman/ Soutter, C. (2000). Measuring Trust, The Quarterly Journal of Economics, Vol. 115, S. 811-841.)
  - Are you a fair person?
    - Do you help others who are in need?
    - Would you say, that you say what you mean?

2. Methodology of Economics Experiments

- Why Financial Incentives?
  - Cognitive cost of thinking carefully.
  - Many experiments are to test economic theory (maximize utility)→comparability
  - Reveal true preference
    e.g. willingness-to-pay for environmental good.
  - Who come to participate?
  - "Incentives" to the experimenter.
  - Why monetary incentives?
    - Easy to gauge
    - No satiation

2. Methodology of Economics Experiments

- Induced-Value Theory (Smith, 1976)
  - Monotonicity
    - Subject must prefer more reward medium to less, and not become satiated.
    - If $V(m, z)$ represents the subject's unobservable preferences over the reward medium (m) and everything else (z), then the monotonicity condition is that the partial derivative Vm exists and is positive for every feasible combination (m, z).
    - This condition seems easy to satisfy by using domestic currency as the reward medium.

2. Methodology of Economics Experiments

- Induced-Value Theory (Smith, 1976)
  - Salience
    - The reward Δm received by the subject depends on her action (and those of other agents) as defined by institutional rules that she understands. That is, the relation between actions and the reward implements the desired institution, and subjects understand the relation.

2. Methodology of Economics Experiments

- Induced-Value Theory (Smith, 1976)
  - Dominance
    - Changes in subjects' utility from the experiment come predominantly from the reward medium and other influences are negligible. This condition is the most problematic of the three since preferences V and "everything else" Z may not be observed by the experimenter. Dominance becomes more plausible if the salient rewards Δm are increased and if the more obvious components of z are held constant.
    - Privacy
    - Subject's effort to help the experimenter

2. Methodology of Economics Experiments

- Induced-Value Theory (Smith, 1976)
  - Example: Induced Preferences
    - U(x, y)
    - Using reward table, paymentΔm = U(x, y)
    - Induced Preference W(x,y)=V(m_0+U(x,y),z+Δz)
    - $$MRS^W = \frac{W_x}{W_y} = \frac{V_m U_x + V_z \Delta z_x}{V_m U_y + V_z \Delta z_y} = \frac{V_m U_x}{V_m U_y} = \frac{U_x}{U_y} = MRS^U$$
    - The Prespecified preferences = Induced Preferences

2. Methodology of Economics Experiments

- Parallelism
  - External Validity
  - Induction
  - Parallelism
    - Propositions about the behavior of individuals in the performance of institutions that have been tested in laboratory microeconomics apply also to nonlaboratory microeconomies where similar *ceteris paribus* condition holds.

2. Methodology of Economics Experiments

- Parallelism
  - General theories and models by definition apply to all special cases. Therefore, general theories and models should be expected to work in the special cases of laboratory markets. As models fail to capture what is observed in the special cases, they can be modified or rejected in light of experience. The relevance of experimental methods is thereby established.
    Laboratory processes are real processes in the sense that real people participate for real and substantial profits and follow real rules in doing so. (Plott, 1982)

2. Methodology of Economics Experiments

- Parallelism
  - Advice
    - Pay in cash
    - Find subjects whose opportunity costs are low and whose learning curves are steep
    - Simple economic environment to address the research issues
    - Avoid loaded words
    - Dominance wouldn't be achieved at the low level of reward
    - Privacy
    - Never deceive subjects

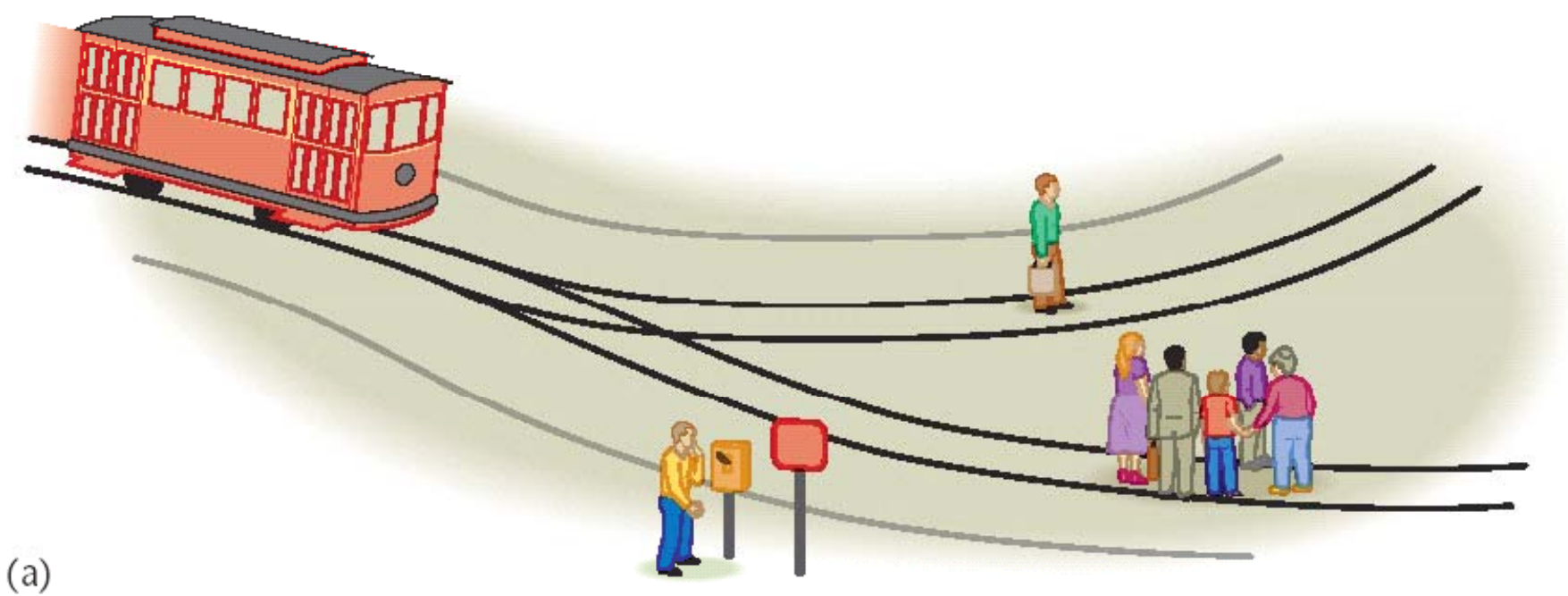
2. Methodology of Economics Experiments

- What Might Be Other Motives?
  - Boredom, e.g., creates game playing incentives
    - If you have pressed 22 times the x-button you like to see what happens if you press the y-button
  - Public information on all payoffs renders relative comparison motives important (envy, fairness)
  - Subjects want to help or hinder the experimenter (experimenter demand effects)
  - Potential solutions
    - Make reward sufficiently large
    - Avoid public information about payoffs
    - Do not give hints about the purpose of the experiment
    - Use a neutral language in the instructions

2. Methodology of Economics Experiments

- What Might Be Other Motives?
  - John Baron: Payoffs are useless when there is no right answer.
  - Examples: studies of judgment of fairness, moral judgments.

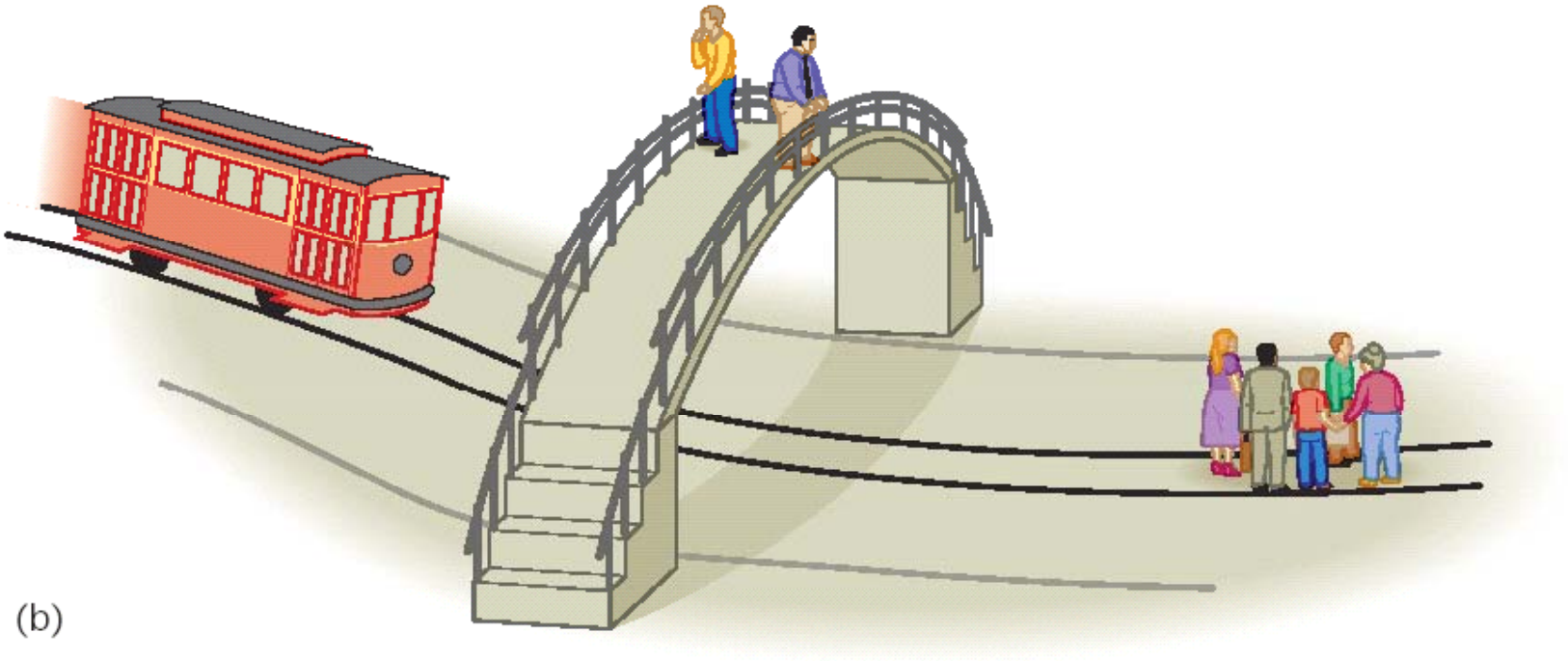
2. Methodology of Economics Experiments



(a)

- You see a runaway trolley car rushing down the tracks and know that the trolley will kill five people walking along the tracks who don't realize it is headed their way. There is a switch in front of you which would immediately divert the trolley to a different set of tracks. However, there is a man walking on those tracks who would be killed if you threw the switch. What do you do?

2. Methodology of Economics Experiments



(b)

- From a footbridge above the tracks, you see a runaway trolley car rushing toward five people walking along the tracks who don't realize it is headed their way. They will be killed if the trolley doesn't stop. But, there is a man near you on the bridge. If you push him off the bridge, he will topple onto the tracks, be killed, but stop the trolley. You have to decide whether to push him and save the five people or not push him and watch them die.

2. Methodology of Economics Experiments

- Instructions
  - Complete description of the game
    - Sequence of decisions
    - Interaction
    - Payoff consequences
  - Explain how you earn money
  - Control questions to check understanding
  - Neutral framing often helps understanding
    - Concrete framing (goods markets, labor market): Easy to understand, Problem(?): associations with real life?
    - Abstract framing: Avoids daily life associations, harder to understand.

2. Methodology of Economics Experiments

- Instructions: Burnahm, McCabe & Smith (2000)
  - Each subject's matched counterpart in bargaining is referred to as either "partner" or "opponent".

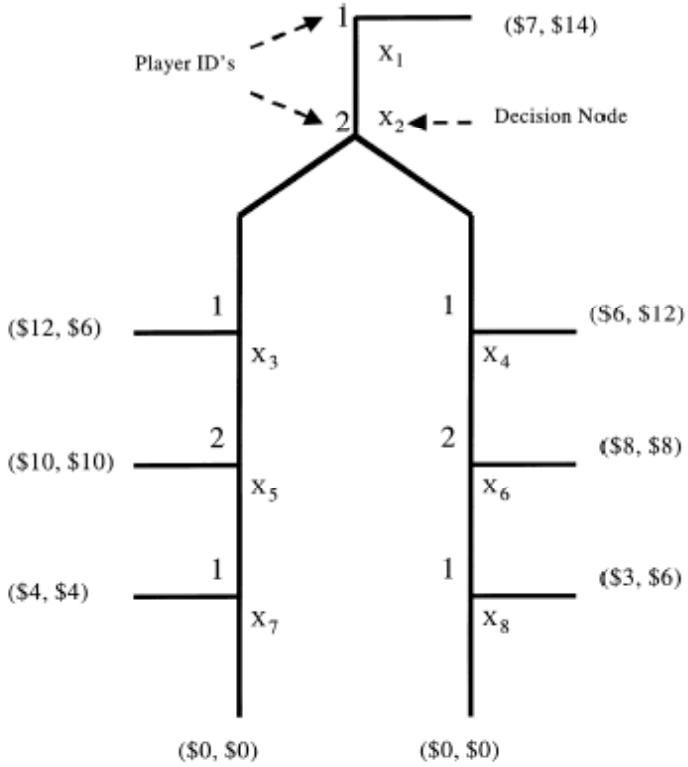


Fig. 2. Extensive form game tree.

2. Methodology of Economics Experiments

- Instructions: Burnahm, McCabe & Smith (2000)
  - Trustworthiness with "partner" is over twice that for "opponent", and this reinforces trust, although both trust and trustworthiness erode over time.

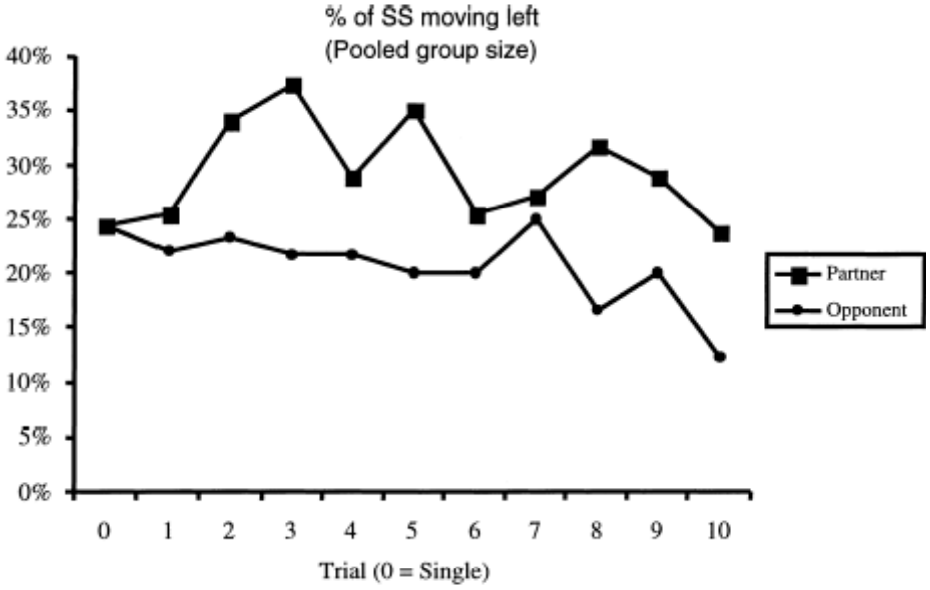


Fig. 7. Trust over time.

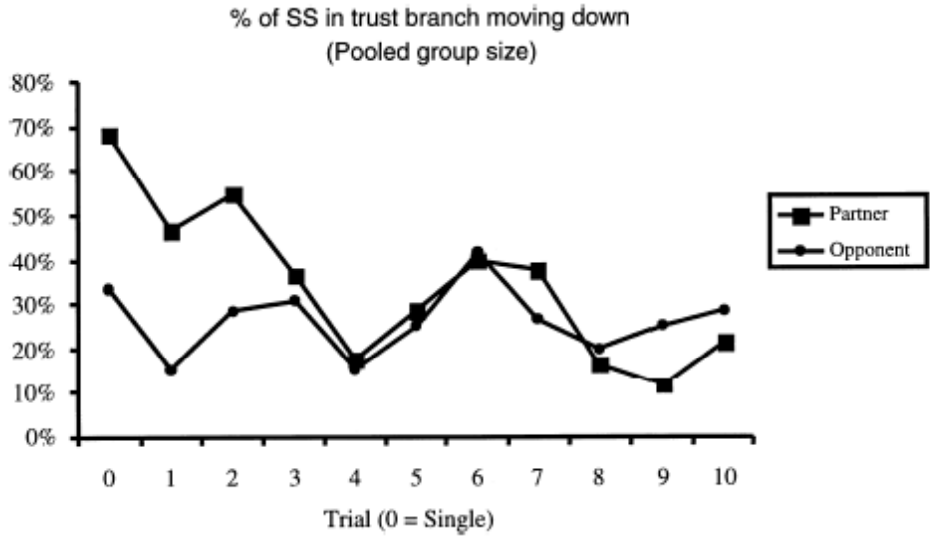


Fig. 8. Trustworthiness over time.

2. Methodology of Economics Experiments

- Deception
  - Purpose of deception in psychology:
    - Hide the real purpose of study (not necessarily deception)
    - Some situations are unlikely to arise naturally
    - Less costly (e.g. “human” partner might not be)
  - Economists: Never deceive subjects. Why?
    - Moral code among experimental economists
    - Reputation lost among subject pool
    - Eliminates chances of publishing study in an economics journal

2. Methodology of Economics Experiments

- Deception
  - Hertwig and Ortmann
    - Lack of trust toward experimenter—lose control, add noise in participants decisions.
  - Jamison, Karlan and Schechter (2008)
    - Effects on both selection and cooperation.
    - e.g. females are less likely to return after being deceived
    - Inexperienced females who trusted in the deception round kept more money in the dictator game in the subsequent round.
  - Very often, deception can be avoided by clever design.

2. Methodology of Economics Experiments

- Law Issue
  - In the USA, all experiments using human subjects must satisfy federal, state and local laws.
    - Result of Milgrom and Tuskeegee experiments
  - All experiments using human subjects must be approved by a committee that includes medical professionals and distinguished members of the community.
  - Such review does not occur in many other countries (e.g., Germany.)

2. Methodology of Economics Experiments

- Methodological Issues
  - Lab environments differ from naturally-occurring environments:
    - Subjects know they are being scrutinized
    - Not always true
    - Stakes are typically small
    - Robustness tests have been/can be conducted
    - Participants are self-selected
    - Not clear when this matters. Self-selection is a feature of nearly all naturally occurring environments.
  - Does this pose a problem for extrapolating lab findings?
    - What are we trying to extrapolate? (Houser, 2008)

3. Experimental Design

- Terminology
  - *Session*: sequence of periods, games, or other decision tasks involving the same group of subjects on the same day.
  - *Cohort*: a group of subjects that participated in a session.
  - *Treatment*: a unique configuration of treatment variables (information, experience, incentives, rules).
  - *Cell*: a set of sessions with the same treatment conditions.

3. Experimental Design

- Terminology
  - If sessions have repeated decisions, a decision unit is called:
    - *Trial* in individual decision experiments
    - *Game* in game experiments
    - *Trading period* in market experiments

3. Experimental Design

- Direct Control: Constants and Treatments
  - Hold controllable variables *constants*.
  - And the main alternative is to chose two or more different levels that may produce sharply different outcomes and to control the variable at each chosen level.
  - Variables controlled at two or more levels are called *treatment* variables.
  - Tradeoff between controlling variables as constants and as treatments
  - Vary all treatment variables *independently* to obtain the clearest possible evidence on their effects.

3. Experimental Design

- Indirect Control: Randomization
  - Unobservable nuisances (e.g. subject's alertness and interest) are much less controllable.
  - Uncontrolled nuisances can cause inferential errors if they are confounded with focus variables.
  - We need make the uncontrolled nuisances independent of the treatment variables.
  - *Randomization* provides indirect control of uncontrolled (even unobservable) variables by ensuring their *eventual* independence of treatment variables.
  - Assign chosen levels of the treatment variables in random order.

3. Experimental Design

- Indirect Control: Randomization
  - Completely Randomized
    - Each treatment is equally likely to be assigned in each trial.
  - Random Block
    - One or more nuisance variables are controlled as treatments rather than randomized.
    - Nuisance treatment variables are called blocking variables, held constant with a block (subset of trials) but varied across blocks.

3. Experimental Design

- Between Subjects Design
  - *Between Subjects Design*: Each participant receives only one level of the independent variable.
  - Between Subjects designs versus a grouping variable (e.g. males versus females).
  - Multiple levels versus multivariate designs
    - *Multiple levels design*: multiple levels of the same independent variable and only one dependent variable.
    - *Multivariate design*: more than one dependent variable is recorded.

3. Experimental Design

- Within Subjects Design
  - *Within Subjects Design*: Each participants provides data for all the levels of the independent variable.
  - You can measure the subjects repeatedly on the same dependent variable under different conditions.(also referred to as repeated measures designs)

3. Experimental Design

- Within Subjects Design
  - Advantages
    - Holds subject variables constant.
    - Increases statistical power by reducing random variation.
    - Reduces the number of subjects needed.
  - Disadvantages
    - Imitation (lasting effects of) treatments
    - Maturation and other time sensitive effects (e.g., fatigue)
    - Testing effects

3. Experimental Design

- Factorial Design
  - Definition: when more than one independent variable is evaluated in an experimental design. Each level of each independent variable is combined with each of the levels of the other independent variables.(Note: only one dependent variable)

4. Applications

- Research Fields
  - Behavioral Game Theory
  - Coordination Game
  - Decision Making
  - Social Preferences
  - Bargaining
  - Industrial Organization Theory
  - Auction Theory
  - Market Mechanism
  - Learning Theory
  - Search and Matching
  - Field Experiments

4. Applications

- Research 1: Market Mechanism (Smith, 1962)
- Research 2: Labor Economics (Fehr etal., 1993)