

The Methods of Experiments

Benjamin Chiao

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Types of Experiments
Examples of Economic Experiments
Philosophical Foundations
Internal v. External Validities
Threats to Internal Validities
Controlling Threats

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- ▶ Thought Experiments
 - ▶ e.g. St. Petersburg Paradox
- ▶ True v. Quasi Experiments
 - ▶ Based on randomized sampling or not
- ▶ Lab v. Field Experiments
 - ▶ Experiments outside the lab are field experiments
- ▶ Natural v. Naturalistic Experiments
 - ▶ Natural experiments are not initiated by the experimenters, who simply evaluate them
 - ▶ Naturalistic experiments contrive to collect data under natural conditions
 - ▶ The Small World Experiment (Milgram 1967)

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Types of Economic Experiments (Other Notable Examples)

- ▶ 3G Auction
- ▶ Stock Markets
- ▶ Prediction Markets
- ▶ On-Campus Housing
- ▶ School Choice
- ▶ Interns Matching Markets
- ▶ Space-shuttle Payload Design
- ▶ fMRI Experiments

Types of Economic Experiments (Available from Virginia EconLab)

Auctions:	Takeover Game, Common Value, Private Value, Reserve Price
Bargaining:	Ultimatum/Dictator, Principal/Agent, Reciprocity, and Trust Games
Decisions:	Bayes' Rule, Lottery Choice, Probability Matching, Search
Macro/Finance:	Investment Game, Asset Market, Macro Markets, Gains from Trade
Games:	Centipede, Coordination, Guessing Game, Matrix Games, Traveler's Dilemma
Information:	Cascades, Lemons Market, Signaling/Poker, Statistical Discrimination
Markets:	Bertrand, Call Market, Cournot, Double Auction, Posted Offer, Supply Chain, Vertical Monopoly
Public:	Common Pool Resource, Congestion/Entry, Public Goods, Rent Seeking, Volunteer's Dilemma
Surveys:	Questionnaire (for on-line surveys), Quiz Program

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One of the great distinguishing features of modern science, as compared to the science of earlier periods, is its emphasis of what is called the "experimental method".

–Rudolf Carnap (1974). "The Experimental Method", *An Introduction to the Philosophy of Science*, pp 40-47. Full text available for free at books.google.com

Philosophical Foundations I

- ▶ This section is largely from Carnap (1974)
- ▶ The empiricists have argued that all empirical knowledge rests finally on observations
- ▶ We could passively make observations or actively create observational results
- ▶ But experiments are not used in all fields of science? Why?

Philosophical Foundations I

- ▶ This section is a mixture of my own interpretation, Carnap (1974) and Bernard (2000) Ch. 4.
- ▶ The empiricists have argued that all empirical knowledge rests finally on observations
- ▶ We could passively make observations or actively create observational results
- ▶ But experiments are not used in all fields of science? Why?
 - ▶ In astronomy, we can't give the moon a push to see what happens.
 - ▶ In some social sciences, large-group experiments are not possible, especially with ethical concerns

Philosophical Foundations II: How to Run Experiments?

- ▶ Formulate a hypothesis (some argue that ex post hypotheses are acceptable)
- ▶ Decide the relevant factors according to prior experiences
 - ▶ We leave out air resistance for experiments with slow-moving objects
 - ▶ We leave out movements of the other planets for experiments that measure the speed of cars because the planets are "too far away".
- ▶ Divide the participants (or objects) into control group and treatment group
- ▶ Do a pretest: Measure the dependent variable
- ▶ Introduce an intervention only in the treatment group
- ▶ Do a posttest. Measure the dependent variable again
- ▶ Then find laws to connect the regularities using some causality principles

Philosophical Foundations III: On Irrelevance

- ▶ Imagine we now live in the time without radios, a person comes to you and say if you sing to this box, another person will hear it one thousand miles away
- ▶ You probably would say, "Impossible, they are too far away."
- ▶ But this is exactly the reasoning we ruled out the planet movement in our speed experiments
- ▶ The central problem here is that we can never be sure which factors are really irrelevant

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Internal v. External Validities

- ▶ External validity refers to the case where an experiment captures reasonably well the relevant factors in the real world
- ▶ Internal validity refers to the case where an experiment's conclusion is probably right: The dependent variable is probably caused by the independent variables

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Threats to Internal Validities (Largely from Bernand (2000) Ch. 4.)

- ▶ History Confound
 - ▶ Any independent variable, other than the treatment, that 1) occurs between the pretest and the posttest stages, 2) affects the groups differently
 - ▶ Example: electricity outage
- ▶ Maturation
 - ▶ People become more experienced during the experiment
- ▶ Testing
 - ▶ People respond differently because they know they are being tested or used to the testing
- ▶ Instrumentation
 - ▶ Changing measurement instruments
 - ▶ Instruments decay over time

Threats to Internal Validities

- ▶ Regression to mean
 - ▶ The value of the dependent variables eventually converge to the mean
 - ▶ Example: If you want to find out if the bottom 1% of the students will improve over time, chances are that they will as their performances can't get any worse
- ▶ Selection of Participants (or Selection Bias)
 - ▶ A well known sampling issue
- ▶ Mortality
 - ▶ Participants leave or cannot complete during the experiment
- ▶ Diffusion of Experiment
 - ▶ When a control group cannot be prevented from receiving the treatment in an experiment

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▶ The Classic Two-Group Pretest-Post Test Design with Randomization of Participants into Groups

	Time 1	Time 2	Time 3
	Pretest	Intervention	Posttest
Group 1	O1	X	O2
Group 2	O3		O4

▶ The Solomon 4-Group Design

	Time 1	Time 2	Time 3
	Pretest	Intervention	Posttest
Group 1	O1	X	O2
Group 2	O3		O4
Group 3		X	O5
Group 4			O6

Other Variations

- ▶ Non Randomization
- ▶ The Posttest-Only Design with Randomization
 - ▶ Low cost, simple, suitable for experiments where pre-test is unimportant
- ▶ One Group Posttest-Only Design without Randomization or One-shot Case Study
 - ▶ Almost all ethnography belongs to this
- ▶ Two-Group Posttest-Only Design without Randomization or Static Group Comparison
- ▶ One-Group Pretest-Posttest Design
- ▶ Factorial Designs

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