Research Design and Causal Inference

AF

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Outline

- Purpose
- Organization
- Research Question
- Theory
- Data
- Use of that Data

Objectives

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- Analysts will not only be more certain about how to tackle a research question, but analysts will also be more certain and explicit about the threats posed to their research method and its findings

Research Design's Purpose

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- **Threats to Validity** - Systematic reasons why our inferences may be wrong
- **Validity** is a property of inferences and not a property of a method; roughly does the evidence support the proposition?

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- We must consider the results of all research in light of theory, design, method, and prior findings

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- For this reason, research design is best viewed as an iterative process
- Research design is multi-purpose and can be used for: (1) causal inference, (2) causal explanation, (3) descriptive inference, and (4) prediction

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- There are 12 steps involved in producing a functional research design

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- We do this because research designs are not just for private use by you, the creator, but they are also intended to be shared with others in the spirit of reproducibility
- Research designs should also be detailed in such a way that, if you the researcher had to revisit the same problem five years later and replicate your research with new data, you could easily follow along and understand the logic and intention behind the design

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- We specify research questions with these components to make it clear to *ourselves* and to our *audience* what the object (*the unit of analysis* and outcome (*the dependent variable*) of our research is

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- In *causal inference*, we are most interested in *why* questions because they make an explicit observation about a characteristic that varies
- It is that difference, that variation, that we want to better understand and make a causal explanation for

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- **Dependent Variable** - The outcome of research. The dependent variable is something that should be dependent, meaning that it is clearly the proposed effect, or outcome, of some process or interaction (the cause).

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- We propose explanations inside hypotheses which are conditional if-then statements that specify the relationship between the cause and the effect
- Since hypotheses are highly simplified theories, we should almost always begin theory-crafting by formally specifying a hypothesis

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- Plainly, hypotheses state that as a unit's value on the independent variable changes, so too does its value on the dependent variable
- We must choose a hypothesis that could be wrong and we should be able to specify, if asked: What evidence would convince us that we are wrong?

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- **Conditional Statement** - A specification of what happens to the dependent variable when the independent variable changes

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- It clearly identifies the dependent variable - *likelihood of voting*
- It clearly makes a conditional if-then statement: **if** we increase an individuals level of education, **then** their likelihood of voting increases

Step 3: Hypotheses

The following hypothesis template will **always** yield a fully-specified hypothesis:

- In a comparison of *[unit of analysis]*, those having *[one value of the independent variable]* will be [*more/less likely*] to have *[one value of the dependent variable]* than will those having *[a different value on the independent variable]*

Step 4: Specifying Dependent and Independent Variables

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- Thus, our next logical task is to build constructs

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- For an explication and step-by-step walk through of these ideas, please see part 1 and part 2 of the Essential Empirical Methods course

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- Due to these threats, concept construction is often an iterative process that forces us to update our research design

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- Additional criteria for evaluating reliability is outside the scope of this class, but can be found by researching: (1) Test Retest Method, and (2) Alternative Form Method

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- An empirical assessment examines whether the concept behaves the way it should, usually through statistical techniques like correlation (with other variables) and factor analysis, given the concept's theory.

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- We complete this section by: (1) identifying the mechanism, and (2) explicating how the mechanism connects the independent variable to the dependent variable by the trace it leaves

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- Thus, the incumbent learns a great deal about his/her opposition's position on issues and therefore uses this information to reduce the opposition's ability to veto incumbent policy and precise judicial reform is enacted.

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- Thus, evidence of our causal mechanism would come in the form of finding elites engaging in conflict over policy to which they then reference or use to their advantage in the future as the reasons for their intention to reform the judiciary. The cause has left a trace.
- While I find them important and useful to specify, mechanisms remain a hotly debated methodological consideration and are not viewed with the same importance across scholars

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- Far from trivial, this is a very important step to follow because it: (1) forces us to think about how we would organize a data set for our research, and (2) pushes us toward thinking about what the perfect data set might look like, despite the improbability of acquiring such a data set

Step 7: Specifying the Unit of Analysis

Table: Hypothetical Dataset

Month	Year	Dyad	Toleration	Repression	Interaction	Backsliding Event
Jan	2002	Incumbent-Opposition	X1	X2	X1×X2	0
Jan	2002	Incumbent-President	X1	X2	X1×X2	0
Jan	2002	Incumbent-Media	X1	X2	X1×X2	0
Jan	2002	Incumbent-Judiciary	X1	X2	X1×X2	0
...	...	...	...	...	...	...

Step 8: Describing Data Sources

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- The sources and types of the data that we intend to access and use for our research should also be clearly explicated through text, graphs, or tables. For instance:

Table 2: Sources of Data

Outlet	Type
Firat	News
Hurriyet	News
Star	News
Milliyet	News
Cumhuriyet	News
Yeni Safak	News
Zaman	News
Zaman Online	News
Sabah	News
Ortadogu	News
Radikal	News
Vatan	News
Neu-Isenburg Ozgur Politika	News
Bugun	News
TRT	TV
Anatolia	TV
Kanal 7	TV
NTV	TV
CNN TURK	TV
Kanal 7	TV

Outlet	Type
Index	News
MTI	News
Nepszabadsag	News
Budapest MNO	News
Nepszava Online	News
Magyar Hirlap	News
Magyar Nemzet	News
HVG.hu	News
Hungary Around the Clock	News
168 Ora	News
Magyar Narancs	News
MR1-Kossuth	News
Heti Valasz	News
Heti Vilaggazdasag	News
Nepszava	News

Left: Turkey
Right: Hungary

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- The theory section explicates the hypothesis to greater detail; meaning it details how the independent and dependent variable manifest in the empirical world
- Theory should also be described in generalized ways, meaning that it is void of historical examples to make its case
- Aside from explaining the manifestation of the independent and dependent variables, the central goal of theorycrafting is to develop it to such an extent that we can use it identity observable implications

Step 10: Observable Implications

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- After developing a theory, its observable implications, essentially testable conclusions and propositions, should be enumerated
- We do this to guide our data collection because it helps distinguish relevant from irrelevant facts; it also helps us infer the correctness of the theory

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- **Internal validity** examines whether the observed change in the dependent variable is indeed caused by a corresponding change in the hypothesized independent variable and not by a **confounder**.
- If a compositional difference (Z) is related to both (X) and (Y), then (Z) is a confounding variable; to be a confounder (Z) means to be related to (X) and (Y)

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- Before diving deeper into confounders, lets briefly discuss what is going on with the introduction to **internal validity**
- **Internal validity** presupposes that our research design is executed as an experiment whereby we as investigators have the ability to *randomly select the units* for observation **as well as** the ability to *randomly assign the units* to treatment
- What an experiment does is it approximates a **counterfactual**, which is the knowledge of what *would have happened* to the subjects if they did not receive the treatment

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- So let's step back even further and figure out where we are in terms of the threats posed to our research given that we are almost always dealing with observational data

Step 11: Threats to Internal Validity

	Random Assignment	**Non-Random Assignment**
Random Selection	Minimize threats to internal and external validity	Minimize threats to external validity
Non-Random Selection	Minimize threats to internal validity	Minimize threats to neither

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- Our central task is to create reasonable approximations to the impossible counterfactual that controlled experiments seek to create
- In terms of our research, what we are trying to do is to approximate John Stuart Mill's Method of Difference

Step 11: Threats to Internal Validity

- In essence, we seek to compare two or more cases that are identical in every respect other than the hypothesized cause (X) and the observed effect (Y). The logic is: if the cases under comparison are identical in every other way other than the hypothesized cause, then the cause is most likely responsible for the difference in the effect.

Case	X	Z	Z	Y
A	1	1	0	1
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Table: Mill's Method of Difference

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- For a detailed walk-through with step-by-step processes, please see the Comparative Methods course

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- Left uncontrolled, confounding variables give us an inaccurate understanding of the (XY) relationship
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- Thus, Step 11 forces us to think about: What else? What other factors might be related to (X) and (Y) and how can we control for them?

Step 11: Threats to Internal Validity

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- **Interactive**: The (XY) relationship persists but differs across the strata of (Z), thus making the (XY) relationship conditional on the value of (Z)

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- To complicate matters, you can never test or eliminate all causes because there is infinite potential

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- Our goal, then, is to explicate the following in our research design:

- (1) How our research design would be executed as an experiment
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- (4) How you will mitigate non-random assignment to treatment

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- (6) How you will mitigate the enodgeneity problem

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- (4) How you will mitigate non-random assignment to treatment
- (5) How (Y) would not have happened anyway absent the treatment
- (6) How you will mitigate the enodgeneity problem
- (7) How alternative explanations do not explain (Y)

Step 11: Threats to Internal Validity

- When thinking about how our research design would be executed as an experiment, we primarily need to *explain* how we would generate a counterfactual condition, a la an experiment or Mill's Method of Difference, in our study

Step 11: Threats to Internal Validity

- When checking whether or not the treatment is manipulable, we need to explain or show that the independent varies across the unit of analysis

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- We demarcate between pre- and post-treatment by showing how their is clear separation between the two categories in the case of a categorical variable.

- We also make this case by showing a separation between large groups of our units of analysis when stratifying on the independent variable; a 2x2 table is sufficient

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- Aside from these mitigation techniques, the research design should also explicate how units are assigned to treatment: What is the process?

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- Next, we must contend with the following threat: The outcome would have happened anyway either because the treatment was absent or because the treatment had no effect.
- We combat this threat primarily through a mixture of theory, logic, and assumptions
- In your research design, a statement should be written contending with this threat

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- One of the most serious threats facing researchers is *endogeneity*, which is sometimes called reverse causality
- Outside of instruments, a topic outside the scope of this class, *endogeneity* threats can be minimized in two ways: (1) we can show that the independent variable reliably and temporally precedes the outcome, and (2) we can argue its minimization through theory

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- Lastly, we must seriously contend with rival explanations and show how they, in fact, do not explain the outcome

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- Lastly, we must seriously contend with rival explanations and show how they, in fact, do not explain the outcome
- Serious treatment should be given to each feasible independent variable and a lengthy explanation should reason why it cannot possibly cause the outcome

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    - Similar levels: from one sample to another
    - To a similar or different kind: male job applicants in Richmond to male job applicants in the U.S.

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- There are a number of reasons why the inferences from our study might not hold over variations in persons, settings, treatments, and outcomes, for instance:

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- An effect found on one kind of *outcome* observation may not hold if other outcome observations were used
- An effect found in one kind of *setting* may not hold if other kinds of settings were to be used

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- There are many serious threats that you must contend with prior to embarking on research
- The general consequence for failing to address most threats elaborated here is that, on average, $\hat{\beta}$, usually the central result we are interested in, will be biased.

References

Source List

These courses are primarily based on the following academic works and courses:

- *Goertz, Gary. Social science concepts: A user's guide. Princeton University Press, 2006.*
- *Pollock III, Philip H. The essentials of political analysis. Cq Press, 2015.*
- *King, Gary, Robert O. Keohane, and Sidney Verba. Designing social inquiry: Scientific inference in qualitative research. Princeton university press, 1994.*
- *Shadish, William R., Thomas D. Cook, and Donald T. Campbell. "Experimental and quasi-experimental designs for generalized causal inference." (2002).*
- *Waldner, David. PLAD 7090 - Research Methods and Design in Political Science. University of Virginia. 2015.*