

Class 5 - Elements II: Models and hypotheses

Agenda

- Wrap-up and Research Question Presentations (40 minutes)
- Conceptual grounding (10 minutes)
- Quick introduction to this week's papers (10 minutes)
- *Break*
- Compare-contrast presentation (Group 9-12; 30 minutes)
- Summative lecture on concepts (15 minutes)
- Key thinking tool: Directed acyclic graphs (15 minutes)

Grounding

Making things concrete

- Model-building: Drawing in theory and phenomenological features
- Hypotheses: Making model-based predictions and providing a basis to accumulate knowledge

Grounding
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Readings for Today
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Lecture - Models and hypotheses
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DAGs and formal theory
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Preparation for next class
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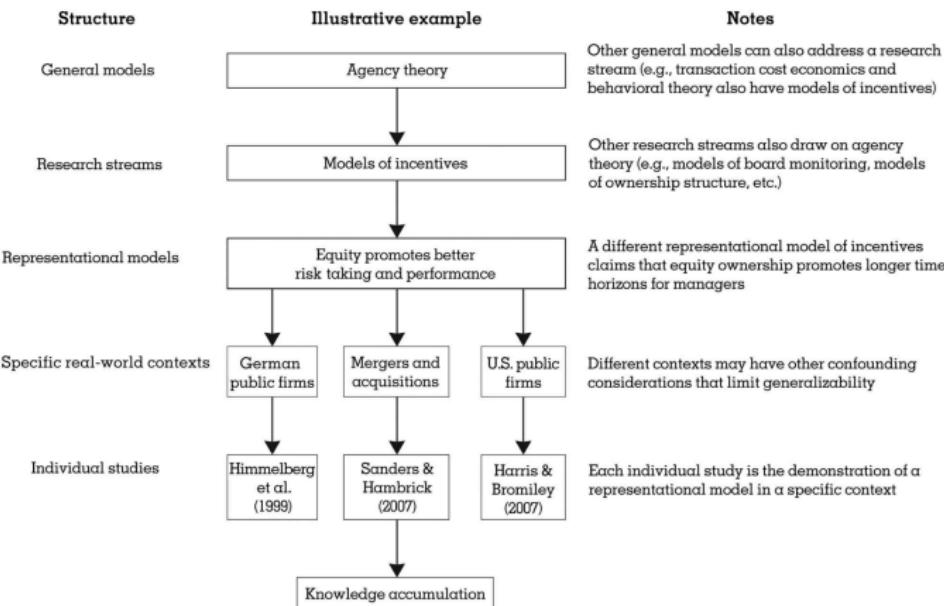
Readings for Today

Common Readings

- 1 Harris, J. D., Johnson, S. G., & Souder, D. 2013. Model-Theoretic Knowledge Accumulation: The Case of Agency Theory and Incentive Alignment. *Academy of Management Review*, 38(3), 442-454.
- 2 Chamberlin, T. C. (1965). The Method of Multiple Working Hypotheses. *Science*, 148(3671), 754-759.
<https://doi.org/10.1126/science.148.3671.754>
- 3 Pearl, J. 2010. 3. The Foundations of Causal Inference. *Sociological Methodology*, 40(1), 75-149.

Harris Johnson and Souder (2013)

FIGURE 1
Law-Statement versus Model-Theoretic Interpretation of Knowledge Accumulation



Interpretation from a law-statement perspective:
Knowledge accumulates as studies verify the axioms

Interpretation from a model-theoretic perspective:
Knowledge accumulates as studies develop representations

Harris Johnson and Souder (2013)

Discussion Questions

- Can you see yourself employing a model-theoretic lens in your work?
- Is this view consistent with our research “principles”?

Harris Johnson and Souder (2013)

Key Points

- Empirical research can build theory without changing theoretical claims by building models that graft, contextualize, and repurpose **representational models**: synthesizing general models / theories with aspects of the real world **from which hypotheses can be derived** (Harris, Johnson, and Souder 2013, 445)
- Figure 1 provides a nice worked example of how we can traverse from a particular phenomenon to a theory and back

Chamberlin (1965)

The effort is to bring up into view every rational explanation of new phenomena, and to develop every tenable hypothesis respecting their cause and history. The investigator thus becomes the parent of a family of hypotheses: and, by his parental relation to all, he is forbidden to fasten his affections unduly upon any one. (Chamberlin 1965, 756)

Chamberlin (1965)

Discussion Questions

- How would you actually implement the method of multiple working hypotheses in your work?
- Where might our discussion of “thinking about thinking” (Bayesian and skeptical thinking) help or hurt us in its application?

Chamberlin (1965)

Fertility in processes is also the natural outcome of the method. Each hypothesis suggests its own criteria, its own means of proof, its own methods of developing the truth; and if a group of hypotheses encompass the subject on all sides, the total outcome of means and of methods is full and rich. (Chamberlin 1965, 765)

Chamberlin (1965)

Key Points

- While a particular theory focuses our attention when designing a study, we should not be blinded to alternative explanations
- Alternative explanations should be “baked into” a study and given due consideration
- Discriminating evidence is needed to distinguish between multiple plausible theories

Pearl (2010)

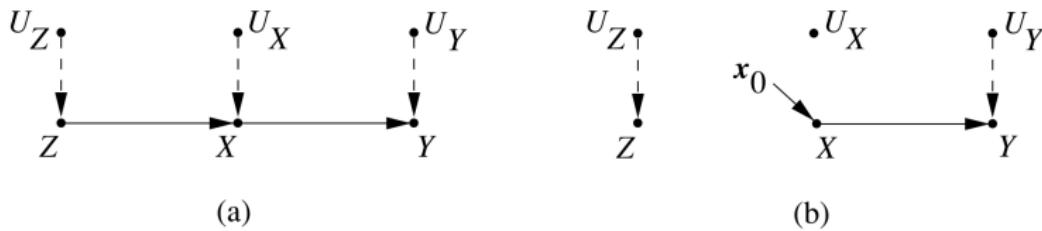


FIGURE 2. The diagrams associated with (a) the structural model of equation (5) and (b) the modified model of equation (6), representing the intervention $do(X = x_0)$.

Pearl (2010)

Discussion questions

- I know this was dense, what did you get out of this paper?
- Based on this paper, what is necessary to make a causal claim?

Pearl (2010)

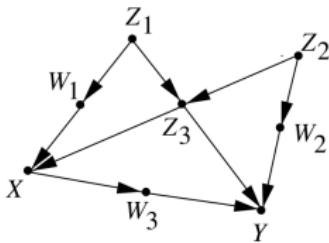


FIGURE 4. A Markovian model illustrating the back-door criterion. Error terms are not shown explicitly.

Pearl (2010)

Key points

- Models can be represented using **directed acyclic graphs**
- The effects do not need to be linear in nature (but it is often nicer to talk about the linear case and generalize)
- To determine if an estimated effect is causal, the graph must meet certain criteria such as the back-door criteria (e.g., {W1, Z3})
- Experimental designs allow for a “do X” operation which make identification easier
- What is perhaps more subtle is that ***each relationship is technically a hypothesis***, but you will focus your attention on the focal relationships of interest

Break



COFFEE BREAK

Compare / Contrast Presentations

- Adner, R., Pólos, L., Ryall, M., & Sorenson, O. 2009. The Case for Formal Theory. *Academy of Management Review*, 34(2), 201-208.
- Miller, K. D. & Tsang, E. W. K. 2011. Testing management theories: Critical realist philosophy and research methods. *Strategic Management Journal*, 32(2): 139-158.

Grounding
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Readings for Today
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Lecture - Models and hypotheses
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DAGs and formal theory
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Preparation for next class
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Lecture - Models and hypotheses

Model building styles

- Verbal theorizing: the standard method employed by most papers
- Directed acyclic graphs (DAGs): becoming more common, even if the logic is operating in the background
- Formal theory: use varies significantly by discipline

Hypotheses as a means to accumulate knowledge

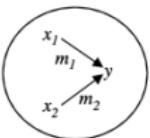
Bhaskar (2008) distinguishes between the domains of the real, actual, and empirical. The real domain consists of generative mechanisms, which refer to 'the ways of acting of things' (Bhaskar, 2008: 14).4 Through enabling or preventing change, mechanisms give rise to events in the actual domain. Some events are experienced, and some are not. The empirical domain is made up of events experienced through direct or indirect observation (Miller and Tsang 2011, 144)

Hypotheses as a means to accumulate knowledge

Knowledge accumulates through refining the theoretical statements at the top of the diagram, but it also accumulates as scholars cobble together a better understanding of reality (Cartwright, 1999) by improving their ability to develop and use representational models. Empirical support for hypotheses derived from a representational model demonstrates the usefulness of that model in the proscribed context. (Harris, Johnson, and Souder 2013, 447)

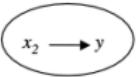
Hypotheses as a means to test model validity

Step 1: Identify the hypothesized mechanisms.

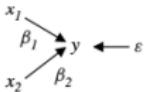


Step 2: Test for the presence of the mechanisms (m_1 and m_2) in the empirical setting.

Step 3: Test isolated causal relations.



Step 4: Test the theoretical system.



Hypotheses as a foundational element

Given that hypotheses are so fundamental to model building, you would expect that I would have given you a reading about how to write them, right?

Despite trying, I could not find a great one - the best I could find (drawn upon below is Neuman (2014) in concert with Pearl (2001) - both books)

Hypotheses - some desiderata

| Criteria | Why |
|-------------|---|
| Falsifiable | We are looking to update our beliefs regarding the truth of the hypothesis, due to the number of alternative explanations the law of the excluded middle is difficult to apply; easier to show the falseness of a hypothesis than its truth |
| Predictive | Allows us to take action on our beliefs or forecast the future |
| Pertinent | We want our hypothesis to provide useful information to address our research question / concern |
| Specific | If <u>actually</u> testing the hypothesis (and not just formulating as a proposition), you need to be able to measure the elements to perform statistical analyses |
| Relational | Relationships allow us to begin to ask questions about causality (but note that hypotheses about the level of something can still be informative) |
| Causal | (This is hard for us to do, but the intent); there should be a temporal sequencing between the independent and dependent variable and this relationship should (at least) satisfy the “backdoor criterion” |

Figure 2: Selected desiderata

Hypotheses - some anti-criteria

(Some) anti-criteria

| | |
|----------------------------|---|
| Compound "double-barreled" | Ambiguous predictions make it difficult to discern what information we have learned (may sometimes be reformulated as an interaction) |
| Tautological | Truth inherent through deduction; i.e., non-falsifiable (Can help verify whether you have made false assumptions) |
| Value-laden | "Should" questions do not help us uncover the underlying states of the world |
| Teleological | "Just so" stories where we don't specify the temporal order of goal formation and attainment (or not) |
| Ecological fallacy | We try to predict an individual outcome with aggregate-level behavior without considering individual level differences |
| Reductionist fallacy | We try to predict an aggregate outcome with individual behavior without appropriate consideration of aggregation |
| Spuriousness | Failing to take into account a reasonable alternative explanation (this can be done empirically through design or controls) |

Figure 3: Selected anti-criteria

Progressing your final project - building a model

This week's readings should help start launching you on a trajectory to convert your research question into a **model** with associated **hypotheses**

These hypotheses are often one of three flavors:

- 1 Tests of relationships between two constructs that you intend to perform (the standard empirical paper strategy)
- 2 Relationships that are implied by a theoretical system that can be tested in the future (these are often called propositions)
- 3 Assertions of the existence of a particular construct or mechanism (this is often the point of a qualitative piece)

Given the nature of this class, my preference is (1)

Preparation for next workshop

During our second in-person meeting, we will have another workshop session about four hours long. For the first two hours or so, students will make a five-minute presentation about the draft model that they will examine for their dissertation work that builds upon their research topic/idea. Again, this can involve a few PowerPoint slides to help guide the discussion. This will be graded by the presence or absence of your preparation for this session. The balance of the workshop will be group work to discuss and advance those research questions, where I will move from group to group to facilitate discussions.

DAGs and formal theory

Key Thinking Tool: DAGs

Directed acyclic graph

has nodes (constructs) and edges (relationships)

there are no loops

the relationships have a direction of influence (correlations are bidirectional)

Key Thinking Tool: DAGs

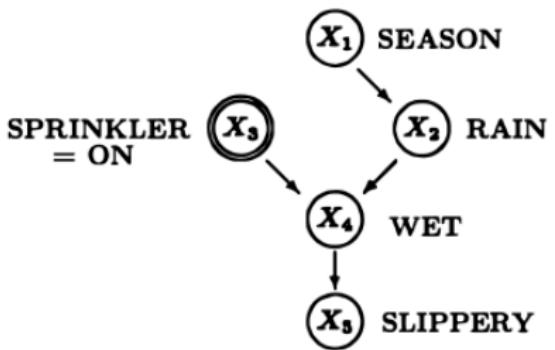


Figure 1.4 Network representation of the action “turning the sprinkler On.”

Figure 4: A Bayesian DAG model courtesy of (Pearl 2001)

Why DAGs?

They provide a visual tool to determine if the claims we make can possibly be causal (Pearl 2010)

They provide a scaffold upon which future researchers can more easily build

And at a minimum, they force us to **write out our model explicitly** in terms of constructs and relationships

Key Thinking Tool: Formal theory

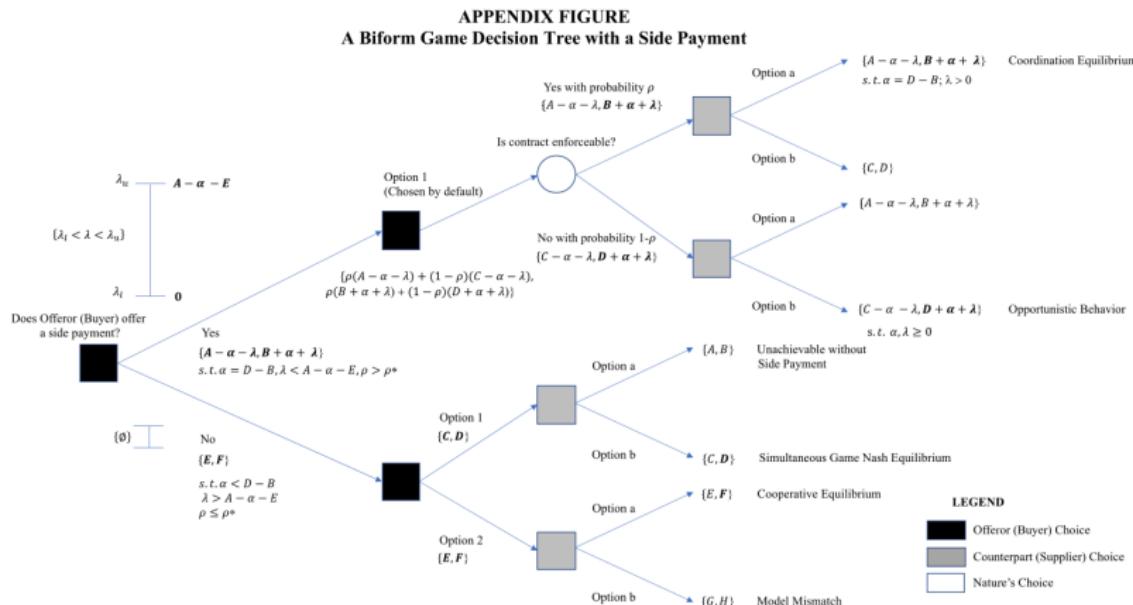


Figure 5: An example analytic model from Fox Grove and Souder 2021

Why formal theory?

- 1 precision and transparency
- 2 logical consistency, and
- 3 an ability to identify unanticipated implications. (Adner et al. 2009, 202)

Integrating DAGs with formal theory

- DAGs can make clear how a model fits within a larger set of nomological networks, be they theoretical or phenemenonological
- Formal theorizing provides the tools to consider more complex relationships and nth-order effects than verbal theorizing readily affords, which tends to capture first-order, linear chains of logic¹

¹Note that linearity is not as constraining as it seems. Linearity means that a tested function must be linear with respect to its **parameters**, not its **arguments**. Thus, $y = \beta x^2$ is permissible but $y = \beta^2 x$ is not

Integrating DAGs with formal theory

When might they be used together?

- Empirical models of complex phenomena with many interactions
- Seeking to isolate the causal effect of a subtle mechanism

When might they be better separated?

- When theory development and empirical analyses are separated across papers

When might they both be unnecessary?

Grounding
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Lecture - Models and hypotheses
oooooooooooo

DAGs and formal theory
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Preparation for next class
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Preparation for next class

Next class

Elements III: Constructs and variables

- 1 Suddaby, R. (2010). Editor's Comments: Construct Clarity in Theories of Management and Organization. *Academy of Management Review*, 35(3), 346-357.
<https://doi.org/10.5465/amr.35.3.zok346>
- 2 Van Maanen, J., Sorensen, J. B., & Mitchell, T. R. 2007. The interplay between theory and method. *Academy of Management Review* 32(4): 1145-1154.
- 3 Bagozzi, R. P., Yi, Y., & Phillips, L. W. (1991). Assessing Construct Validity in Organizational Research. *Administrative Science Quarterly*, 36, No. 3, 421-458.
<https://doi.org/10.2307/2393203>

Next class

Elements III: Constructs and variables

4 Compare / Contrast

- Schaffer, J. A., DeGeest, D., & Li, A. 2016. Tackling the problem of construct proliferation: A guide to assessing discriminant validity of conceptually related constructs. *Organizational Research Methods*, 19: 80- 110.
- Law, K. S., Wong, C.-S., & Mobley, W. H. (1998). Toward a Taxonomy of Multidimensional Constructs. *The Academy of Management Review*, 23(4), 741.
<https://doi.org/10.2307/259060>

References

- Adner, Ron, László Pólos, Michael Ryall, and Olav Sorenson. 2009. "The Case for Formal Theory." *Academy of Management Review* 34 (2): 201–8.
- Chamberlin, T. C. 1965. "The Method of Multiple Working Hypotheses." *Science* 148 (3671): 754–59.
- Harris, Jared D., Scott G. Johnson, and David Souder. 2013. "Model-Theoretic Knowledge Accumulation: The Case of Agency Theory and Incentive Alignment." *Academy of Management Review* 38 (3): 442–54.
- Miller, Kent D., and Eric W. K. Tsang. 2011. "Testing Management Theories: Critical Realist Philosophy and Research Methods." *Strategic Management Journal* 32 (2): 139–58.
- Neuman, William Lawrence. 2014. *Social Research Methods: Qualitative and Quantitative Approaches*.