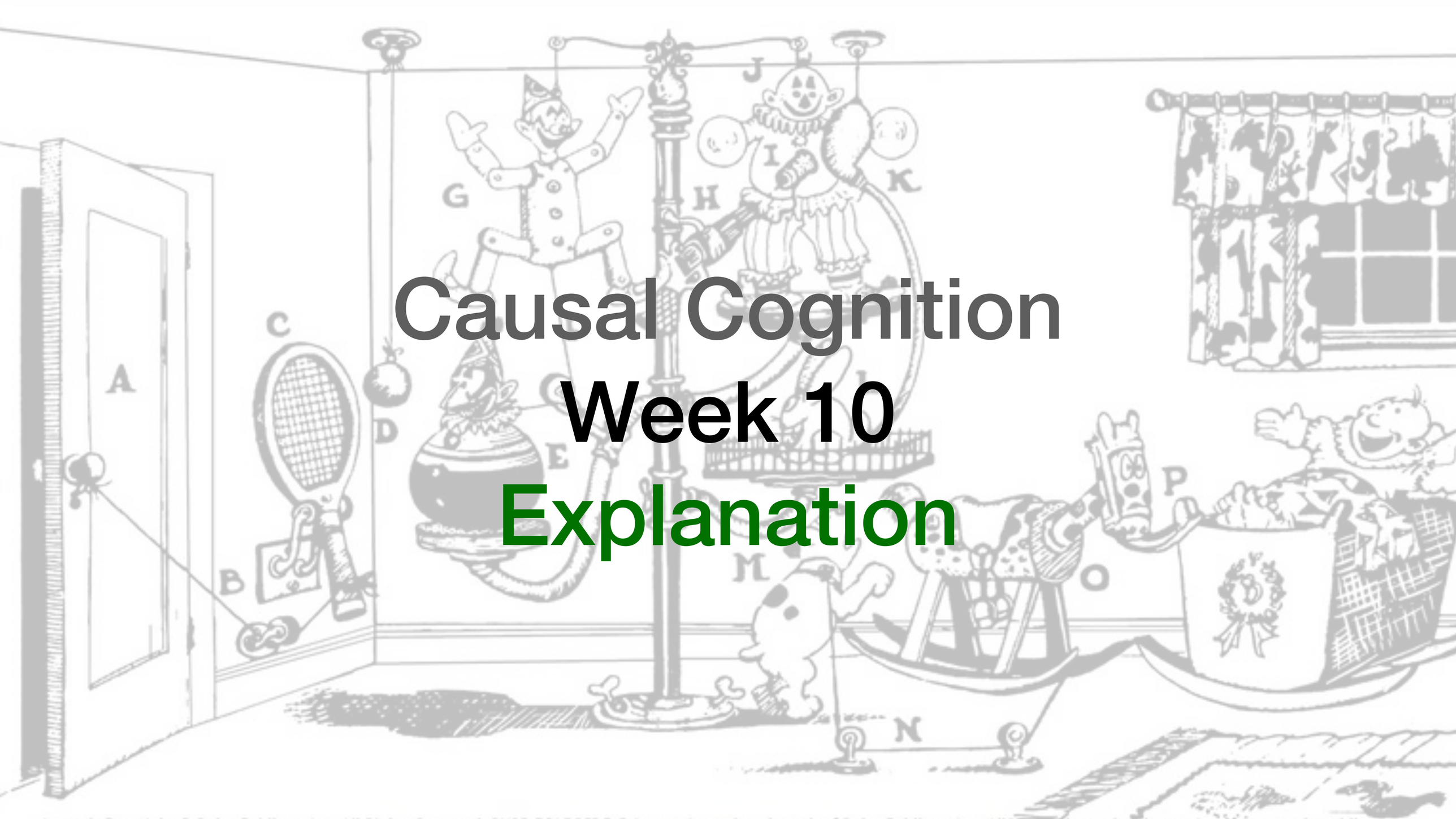


Causal Cognition

Week 10

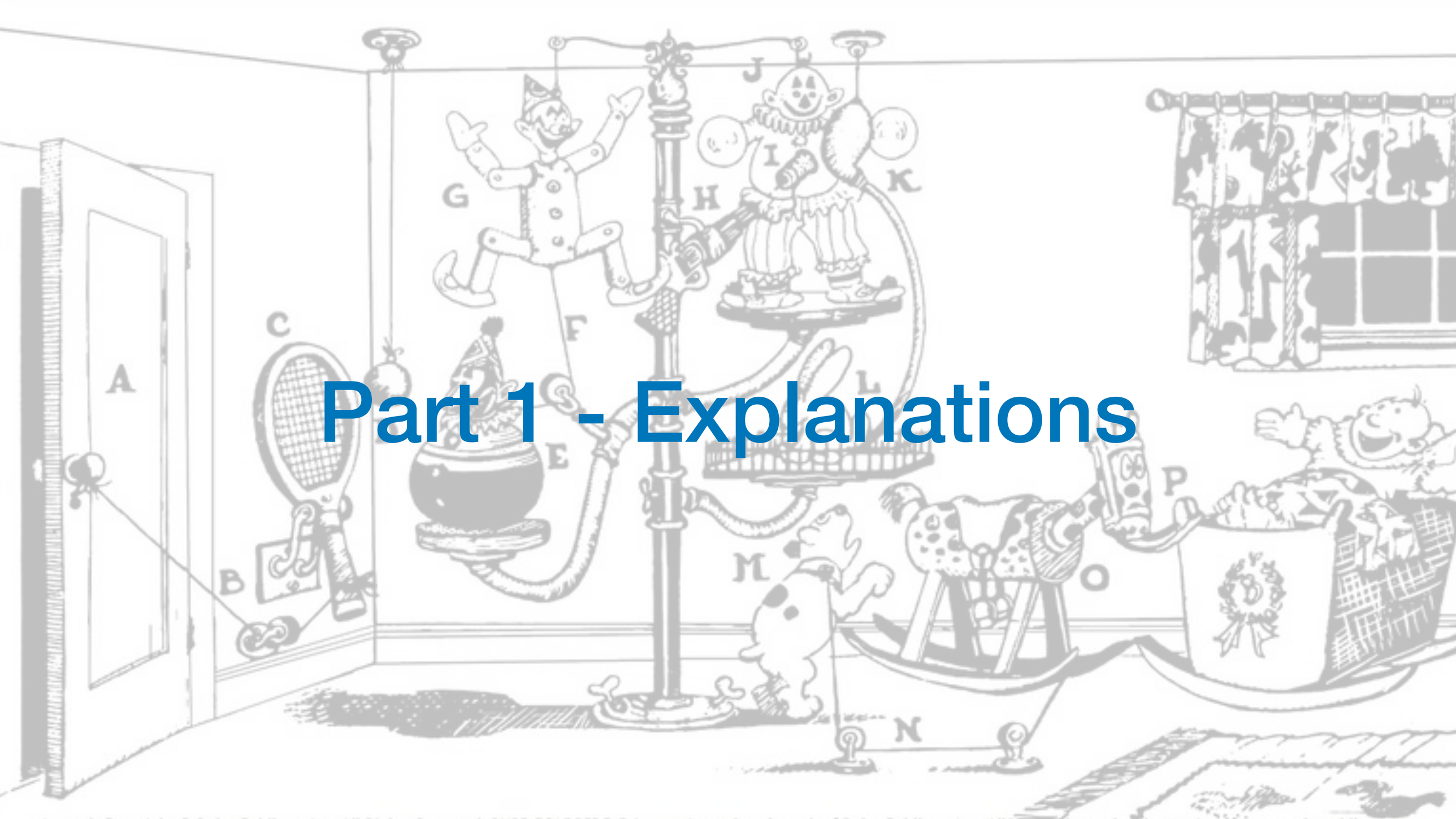
Explanation

Recap: Last Class

- Type/Token Causation
- Process and Dependence accounts of causation
- Casual responsibility
- Pivotality and Criticality
- Counterfactual Simulation

Today

1. Explanations
2. Causal Selection
    1. Abnormal-inflation
    2. Abnormal-deflation
3. Models of Causal Selection
    1. Necessity & Sufficiency
    2. Counterfactual Effect Size
4. Learning from Explanations



Part 1 - Explanations

Structure of Explanations

- Causal theories
  Explanations identify the cause(s) of an event to property
- Subsumption/unification theories
  An explanation sublimes an explanandum under an explanatory pattern
- Mechanistic theories
  A mechanism consists of components, operations, and their organisation
- A unified theory
  Could capture all of these under some “generative process that can subsume both causal and mathematical or formal relationships”

Functions of Explanations

- Scaffold the kind of learning that supports our behaviour
- Heider (1958) explain events to relate them to more general processes
  - token to type level cause
- **Learning and inference**
- Persuasion
- Assigning blame

Useful distinctions for explanations

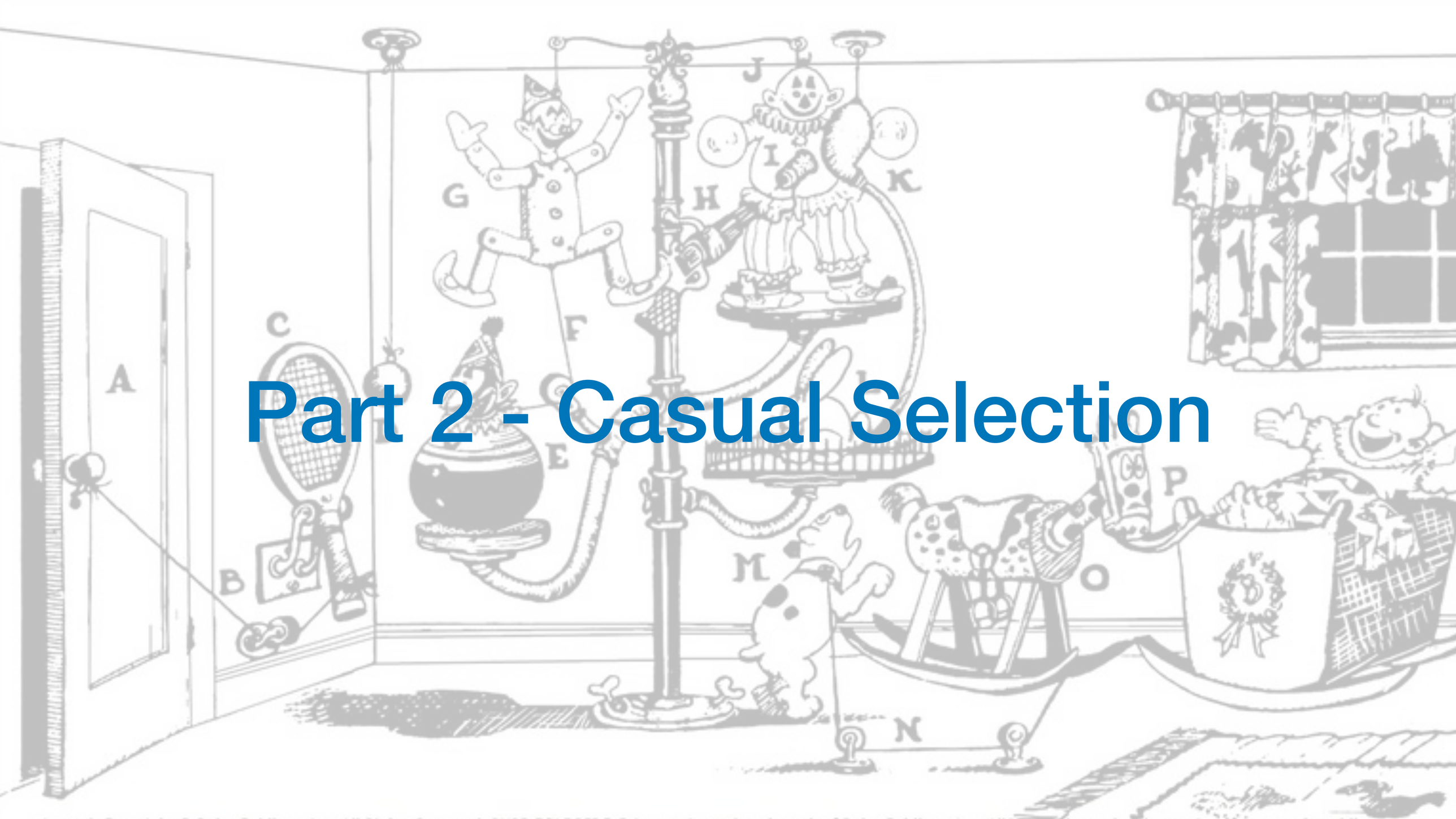
- Lombrozo (2012) proposes useful distinctions for explanations
- Process vs. Product explanations
  - Process explanations describe in general how a system works (type-level explanation)
  - Product explanations explain specific events in the context of some system (token-level explanation
- Complete vs. Selected explanations
  - Complete explanations try to describe the system in full. What are all the relevant variables (types) what are all the possible outcomes (tokens)
  - Selected explanations may choose to only focus on a subset of the total system

Counterfactuals or causality which comes first?

- Lewis: Counterfactuals —> Causality
- Pearl: Causality —> Counterfactual
- What is it really?
  - Causal theories and we use causal language to explain our causal theories:
    - Counterfactual explanations
    - Responsibility judgements
    - Casual judgements

End of part 1

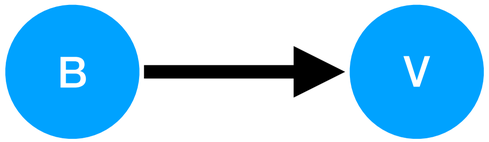
- Questions?
- Clarifications?

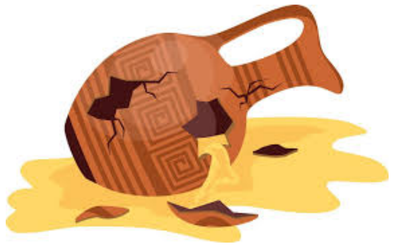


Part 2 - Casual Selection

Token causation

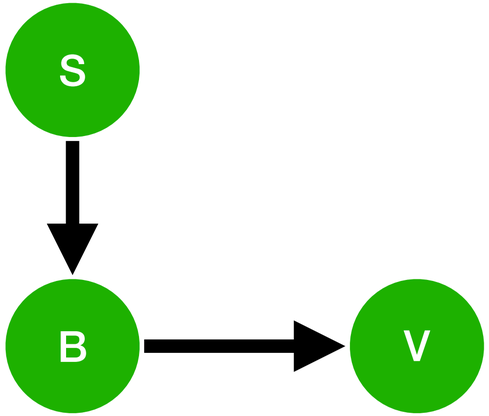
- Billy throws a rock and hits a vase and the vase shatters upon impact





Counterfactuals:

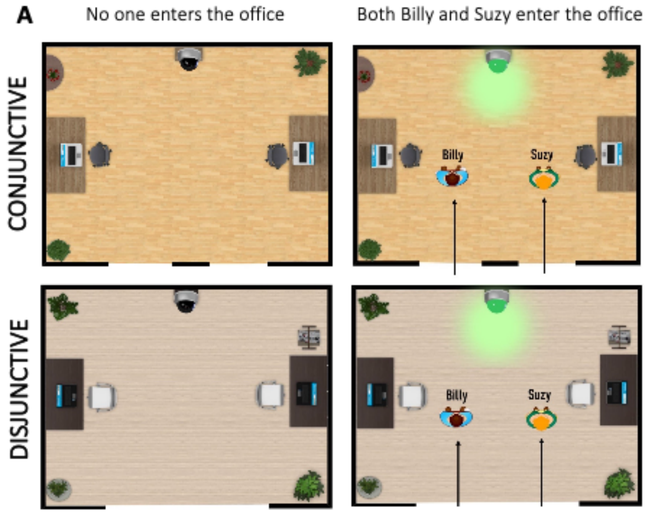
- If Billy had not thrown the rock, the vase would not have shattered
- If *Suzy* had stopped Billy then the vase would not have shattered
- If there had been a protective *case*, the vase would not have shattered

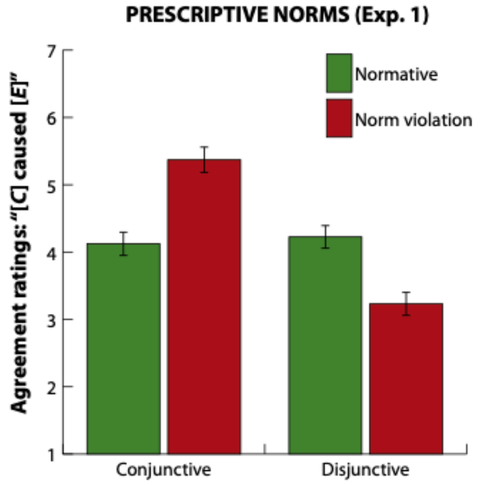


How do we select causes?

- Kominsky et al. (2015): *Causal Superseding*

1a) Morally good: Suzy and Billy are working on a project that is very important for our nation's security. The boss tells them both: "Be sure that you are here at exactly 9am. It is absolutely essential that you arrive at that time."	*1b) Morally bad:* Suzy and Billy are working on a project that is very important for our nation's security. The boss tells Suzy: "Be sure that you are here at exactly 9am. It is absolutely essential that you arrive at that time." Then he tells Billy:"Be sure that you do not come in at all tomorrow morning. It is absolutely essential that you not appear at that time."
2) Event: Both Billy and Suzy arrive at 9am.	
3a) Conjunctive: As it happens, there was a motion detector installed in the room where they arrived. The motion detector was set up to be triggered if *more than one person* appeared in the room at the same time. So the motion detector went off.	*3b) Disjunctive:* As it happens, there was a motion detector installed in the room where they arrived. The motion detector was set up to be triggered if *at least one person* appeared in the room. So the motion detector went off.





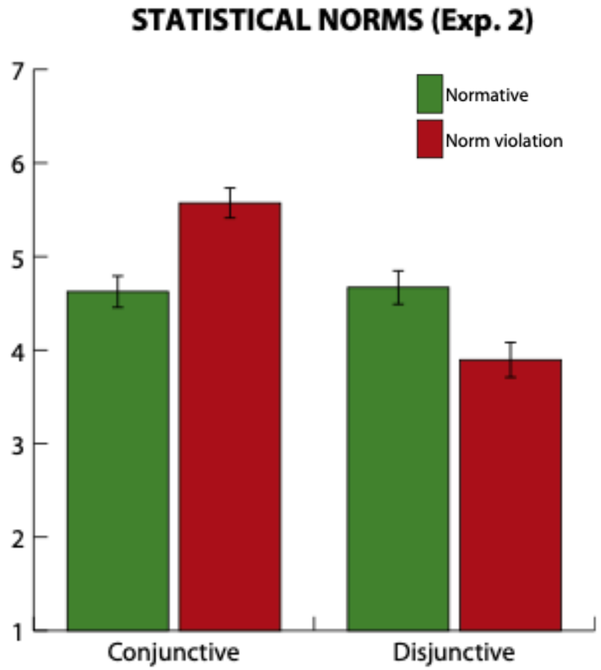
How do we select causes?

- Kominsky et al. (2015): *Causal Superseding*
  - When an agent violates a norm, other agents are rated less of a cause
  - Similar to responsibly: Agents who violate norms are held more accountable
  - Only occurs when both agents are *necessary* for the outcome
  - Only looked at cases of moral norm violations
- Icard et al (2017): Normality and actual Causal Strength
  - It is not just prescriptive norms
  - It applies to statistical norms too!

How do we select causes?

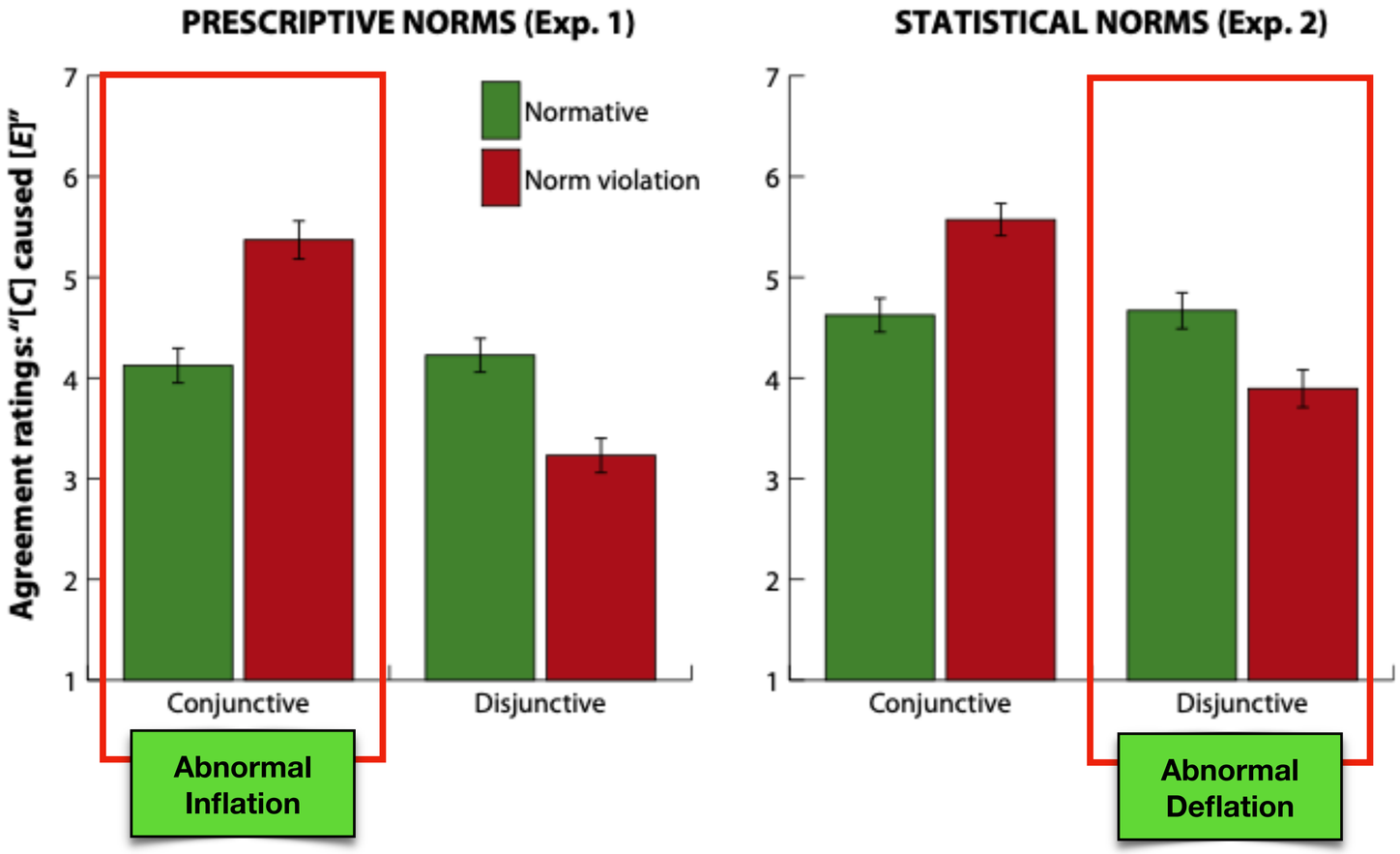
- Icard et al. (2017): Normality and actual causal strength

1) Background: Prof. Smith works at a large university. At this university, in order to get new computers from the university, faculty like Prof. Smith must send an application to two administrative committees, the IT committee and the department budget committee.	
2a) Conjunctive: Prof. Smith will be able to get her new computers if the IT committee approves her application AND the department budget committee approves her application. Both committees must approve the application for her to get the new computers.	*2b) Disjunctive:* Prof. Smith will be able to get her new computers if the IT committee approves her application OR the department budget committee approves her application. Only one of the committees needs to approve her application for her to get the new computers.
3a) Likely: The IT committee almost always approves these applications. The department budget committee also almost always approves these applications. The budget committee is notorious for approving almost every application they receive. Prof. Smith sends in her applications. Each committee meets independently and they decide without talking to each other, but their meetings are scheduled for the exact same time. The IT committee approves her application, and as expected, the department budget committee approves her application. So, Prof. Smith got her new computers.	*3b) Unlikely:* The IT committee almost always approves these applications. The department budget committee almost never approves these applications. The budget committee is notorious for turning down almost every application they receive. Prof. Smith sends in her applications. Each committee meets independently and they decide without talking to each other, but their meetings are scheduled for the exact same time. The IT committee approves her application, and surprisingly, the department budget committee approves her application. So, Prof. Smith got her new computers.



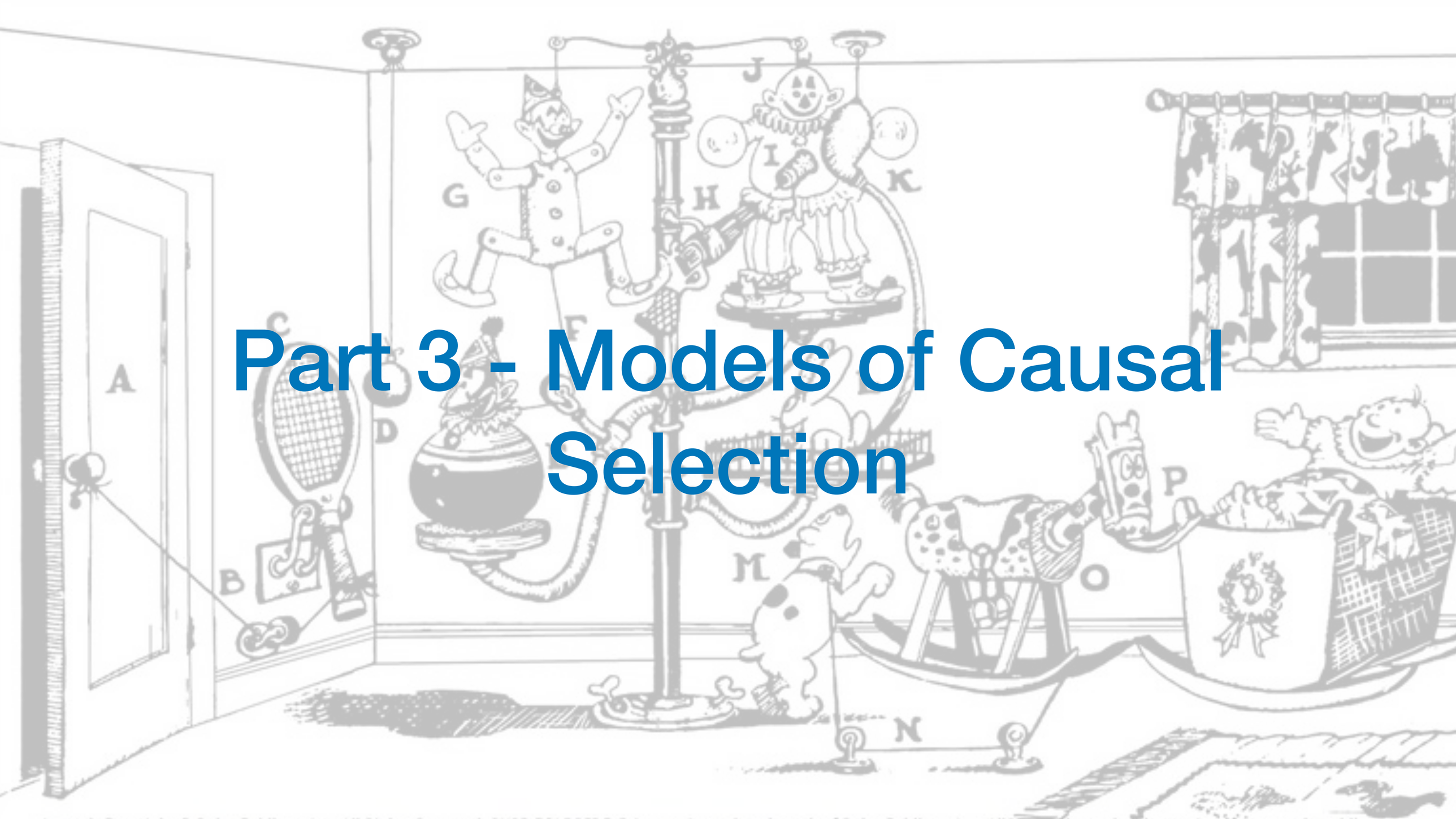
Results

- Icard et al. (2017) find two opposing effects



Summary

- Token causation can tell use what can be a casual explanation
- Normality of events helps select causes
- Causal selection is affected by
  - Moral norms
  - Statistical norms
  - Causal rules (disjunctive or conjunctive)
- Two selection patterns emerge
  - Abnormal inflation when two causes are necessary (conjunctive)
  - Abnormal deflation when both causes are sufficient (disjunctive)



Part 3 - Models of Causal Selection

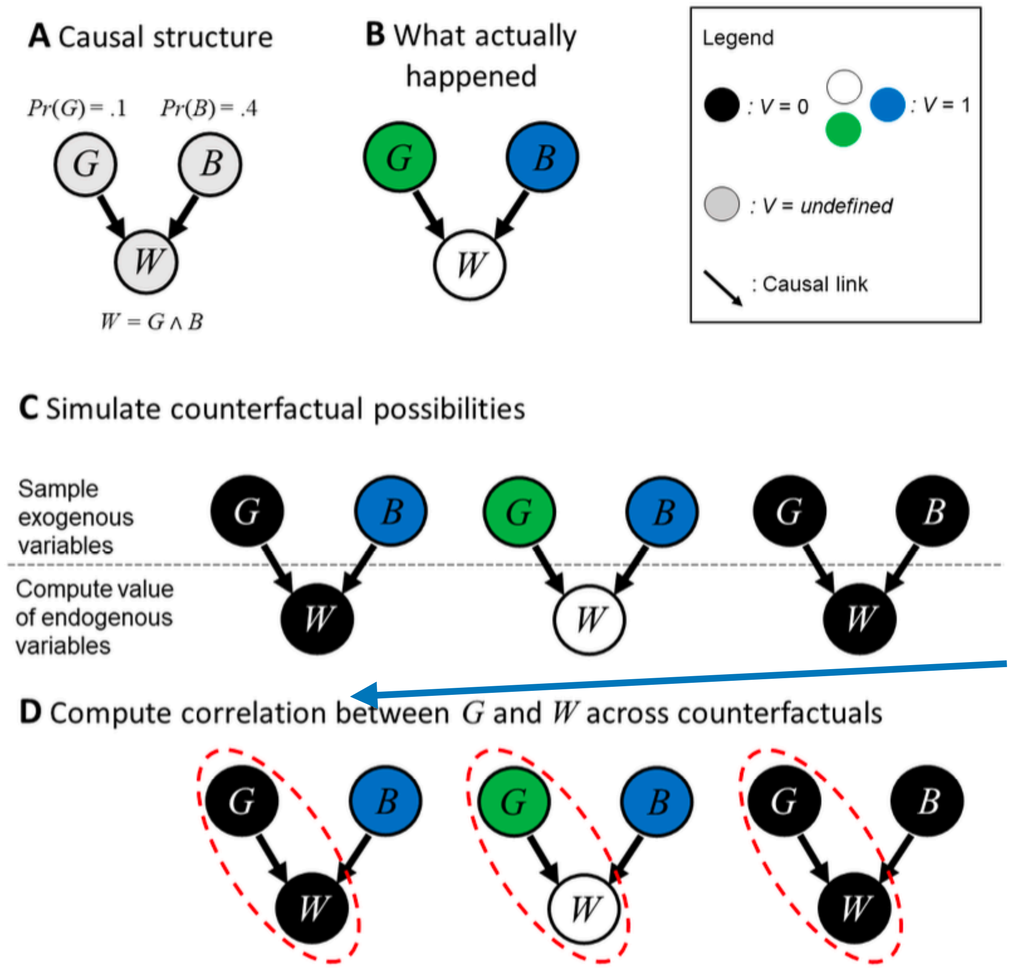
Necessity and Sufficiency

- Icard et al. (2017) also propose a model of how actual causal strength can be computed
- How **necessary and sufficient** is C to produce E?
- Counterfactual interpretations:
  - Necessity: *If C had not happened, would E still have happened?*
  - Sufficiency: *If conditions had been slightly different, would C happening be enough for E to happen?*
- Like pivotality, necessity is more of a *retroactive* judgement
- Like criticality, sufficiency is more of a *prospective* judgement

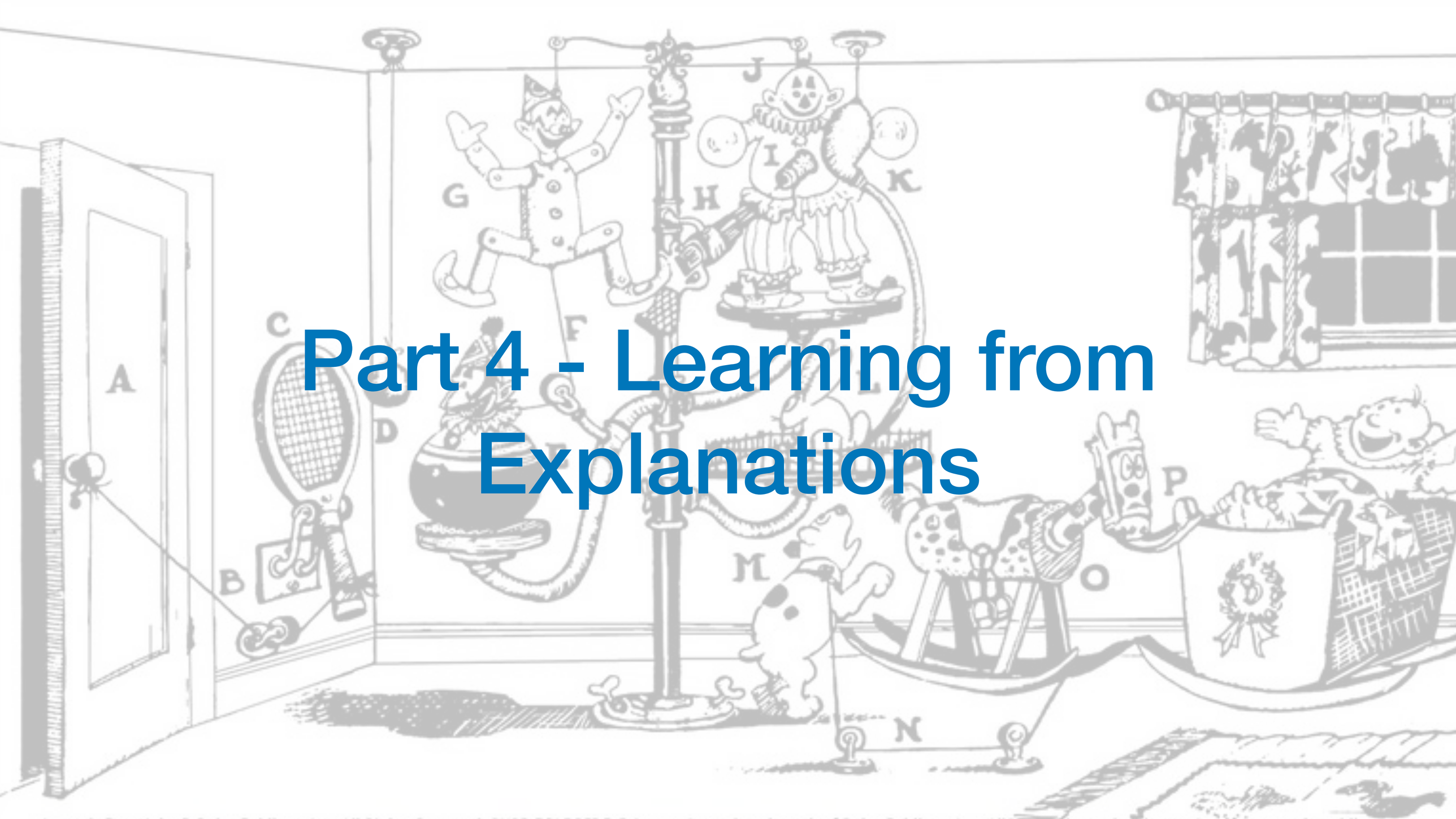
Counterfactual Effect Size

- Quillien (2020) takes a different approach to measuring causal effects
- Does not make any explicit reference to necessity or sufficiency
- All that matters is counterfactual simulations for possible worlds that are:
  - Normal (correspond to the norms)
  - Close to the actual world (given some observations)
- Measures the effect of intervention across several simulated counterfactual worlds

Counterfactual Effect Size



Correlation is a technicality of this kind of structure.
In general, compute the effect size of an intervention to alter the outcome

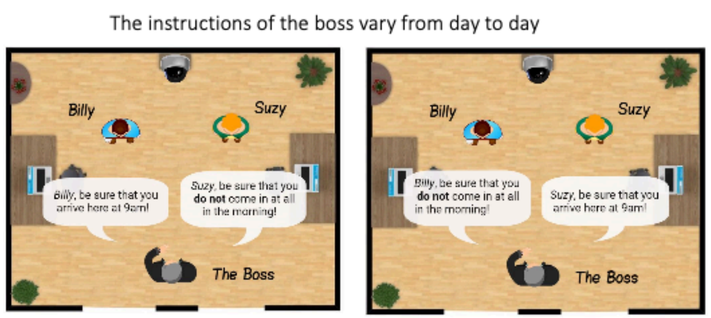


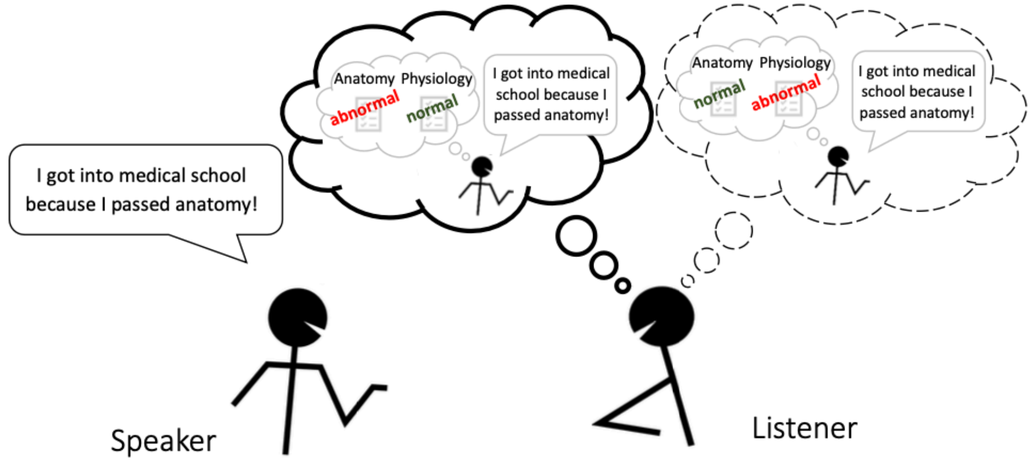
Part 4 - Learning from Explanations

Inference from Explanations

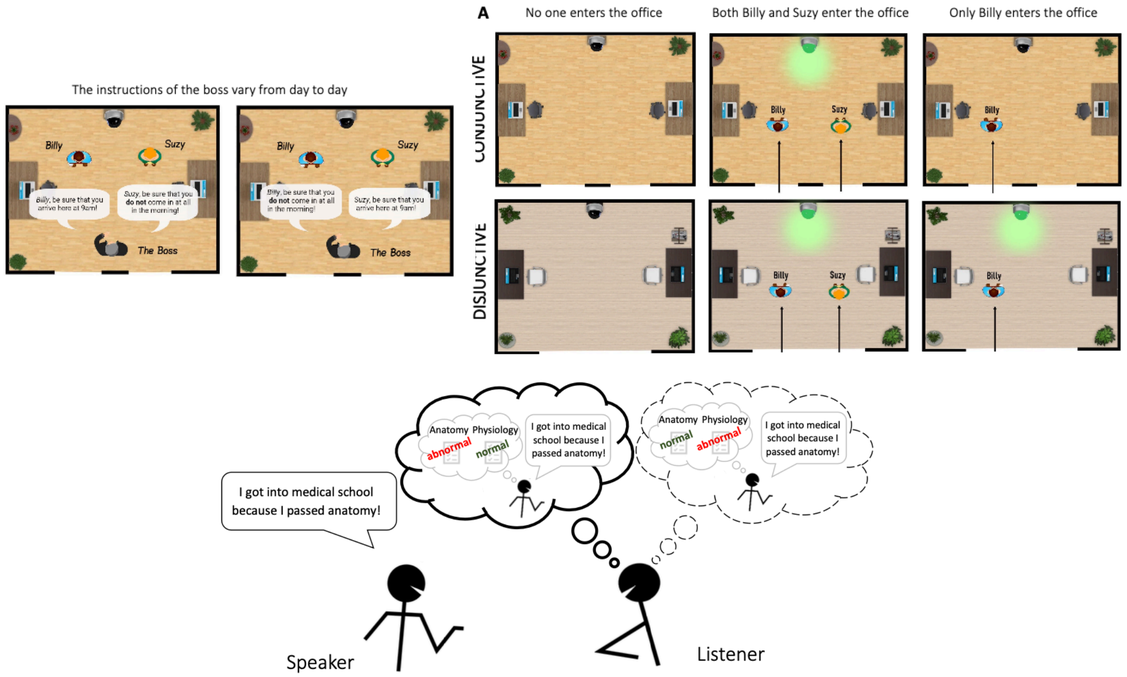
- Why do we have a tendency for abnormal inflation/deflation in different contexts?
- Kirfel et al. (2021) treat causal selection judgements as explanations
- They propose that causal selection judgements serve as useful explanations if you are missing information
- Inference patterns
  - Known norms —> causal rule
  - Known rule —> norms
- Still true for both statistical and prescriptive norms

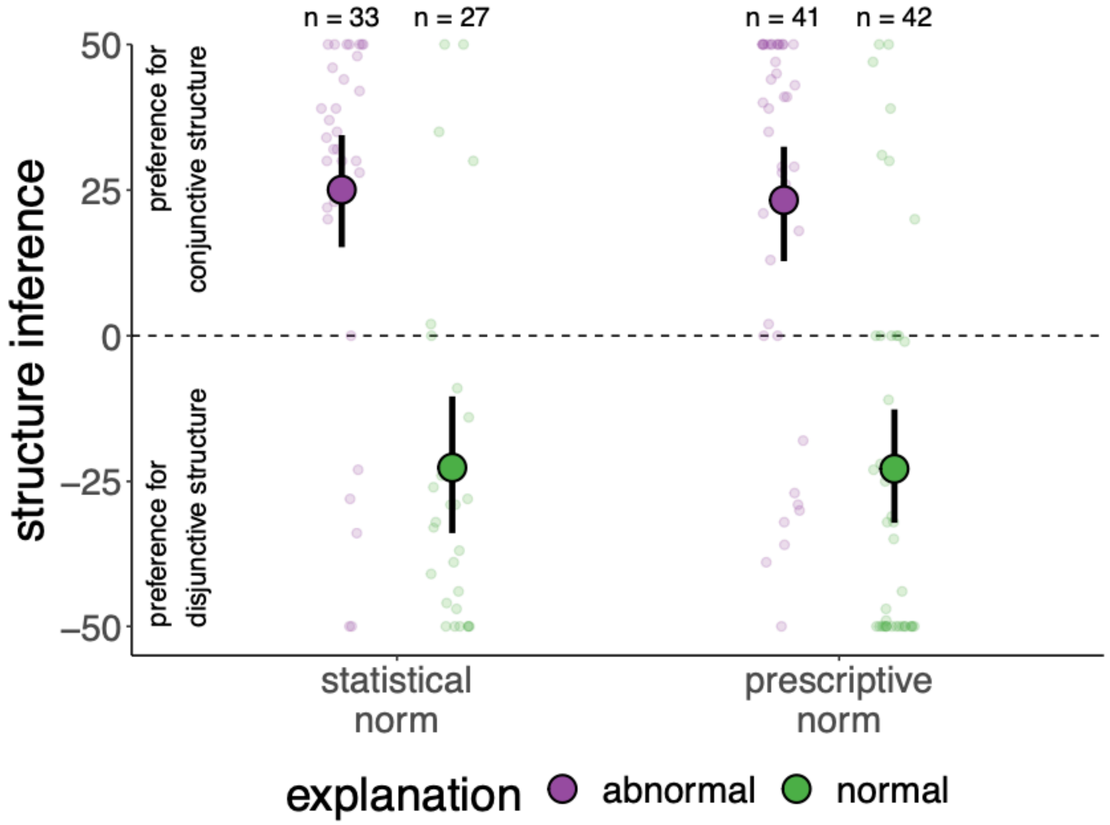
Example scenarios





Results


The instructions of the boss vary from day to day
Billy
Suzy
Billy, be sure that you arrive here at 9am!
Suzy, be sure that you do not come in at all in the morning!
Billy, be sure that you do not come in at all in the morning!
Suzy, be sure that you arrive here at 9am!
The Boss
A
No one enters the office
Both Billy and Suzy enter the office
Only Billy enters the office
CONJUNCTIVE
DISJUNCTIVE
Anatomy Physiology
abnormal
normal
I got into medical school because I passed anatomy!
I got into medical school because I passed anatomy!
Speaker
Listener


n = 33
n = 27
n = 41
n = 42
structure inference
50
25
0
−25
−50
preference for conjunctive structure
preference for disjunctive structure
statistical norm
prescriptive norm
explanation
abnormal
normal

Today: Sum up

- Explanations serve as a way of exchanging causal theories
- Counterfactual explanations give us an indication towards possible causes
- Causal selection leverages the functional rule and normality of events to select most salient causes
- Two models of causal selection
  - Necessity and Sufficiency
  - Counterfactual effect size
- Making inferences from explanation
  - Determining causal rules from norms and explanations

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