



The Role of Causality in Autonomous Fault Handling for Cyber-Physical Production Systems

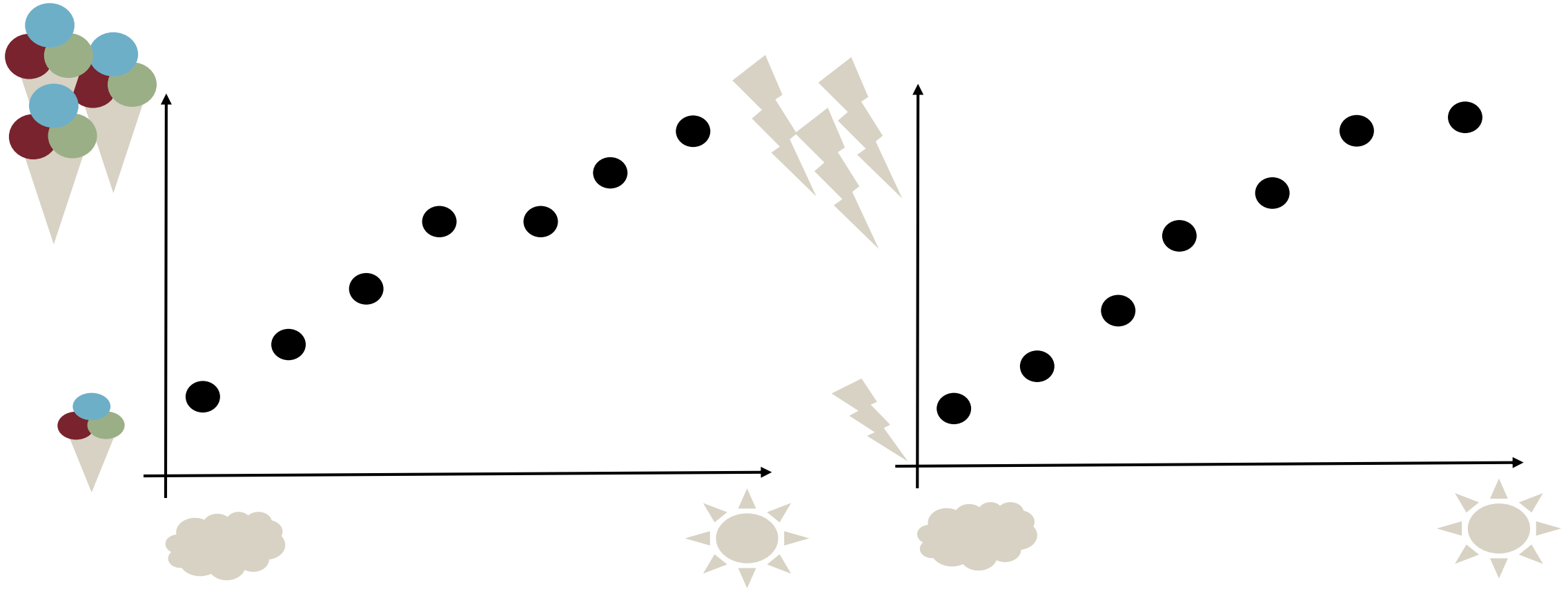
Dr. Kaja Balzereit
22.05.2025

FOUNDATIONS OF CAUSALITY

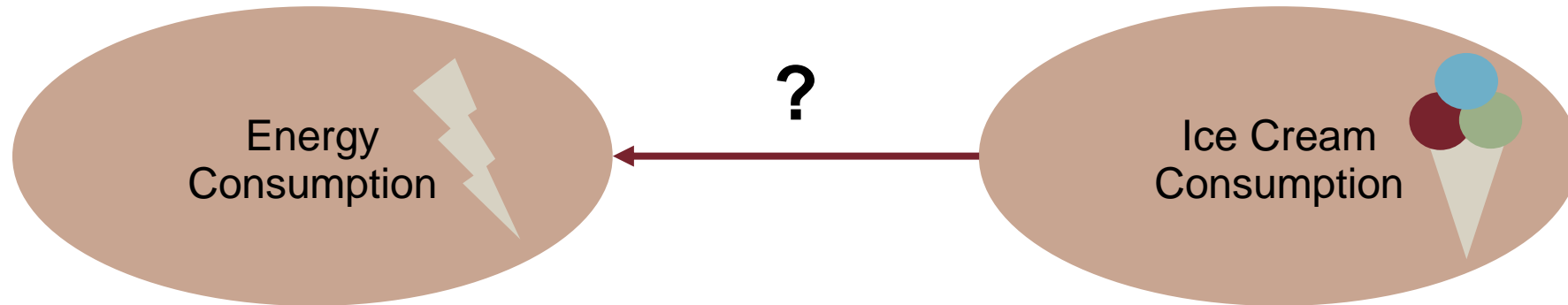
WHAT IS CAUSALITY?

LAPLACE'S DEMON

CONFUSING CORRELATION AND CAUSALITY IS PROBLEMATIC



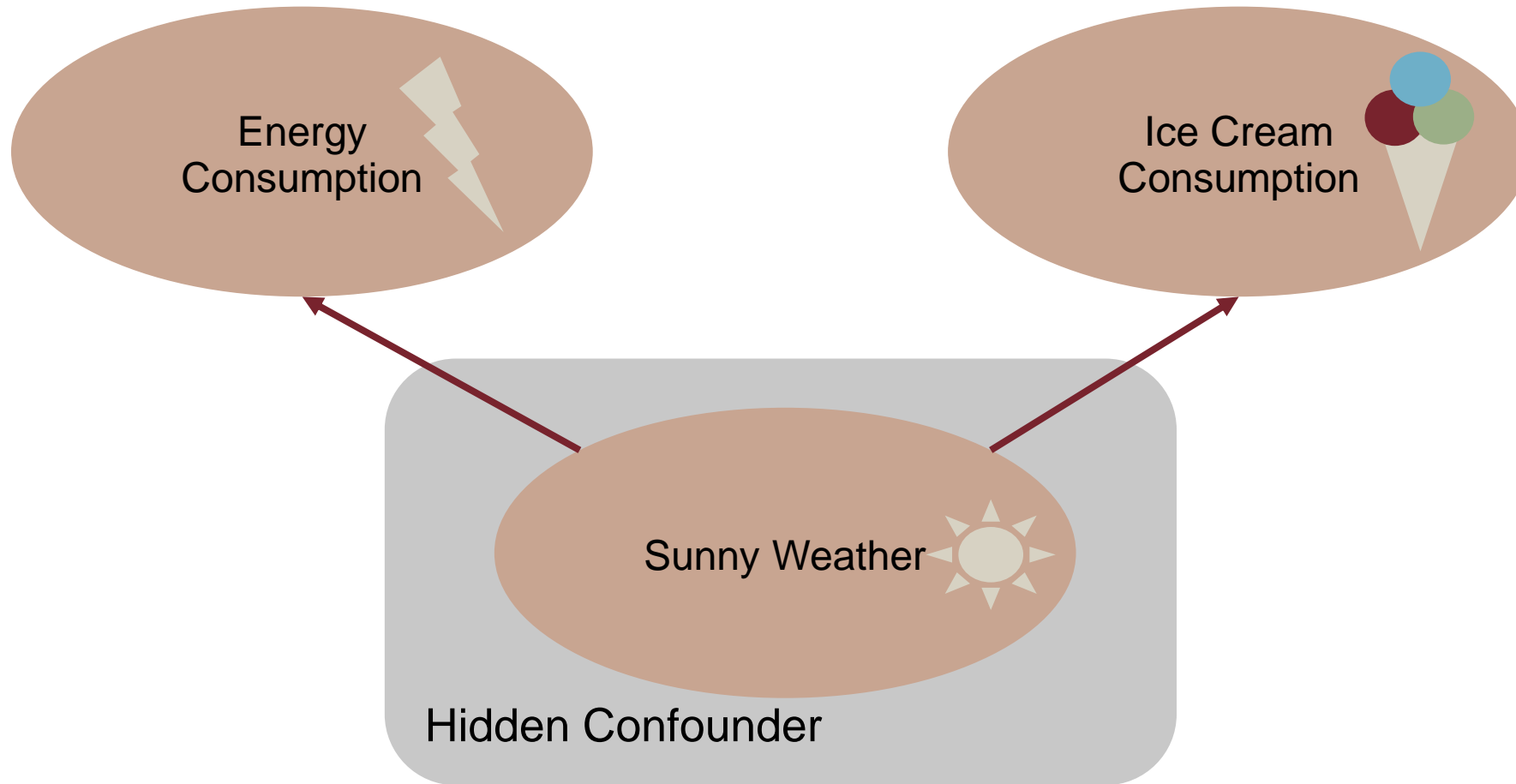
ICE CREAM CONSUMPTION AFFECTING ENERGY CONSUMPTION?



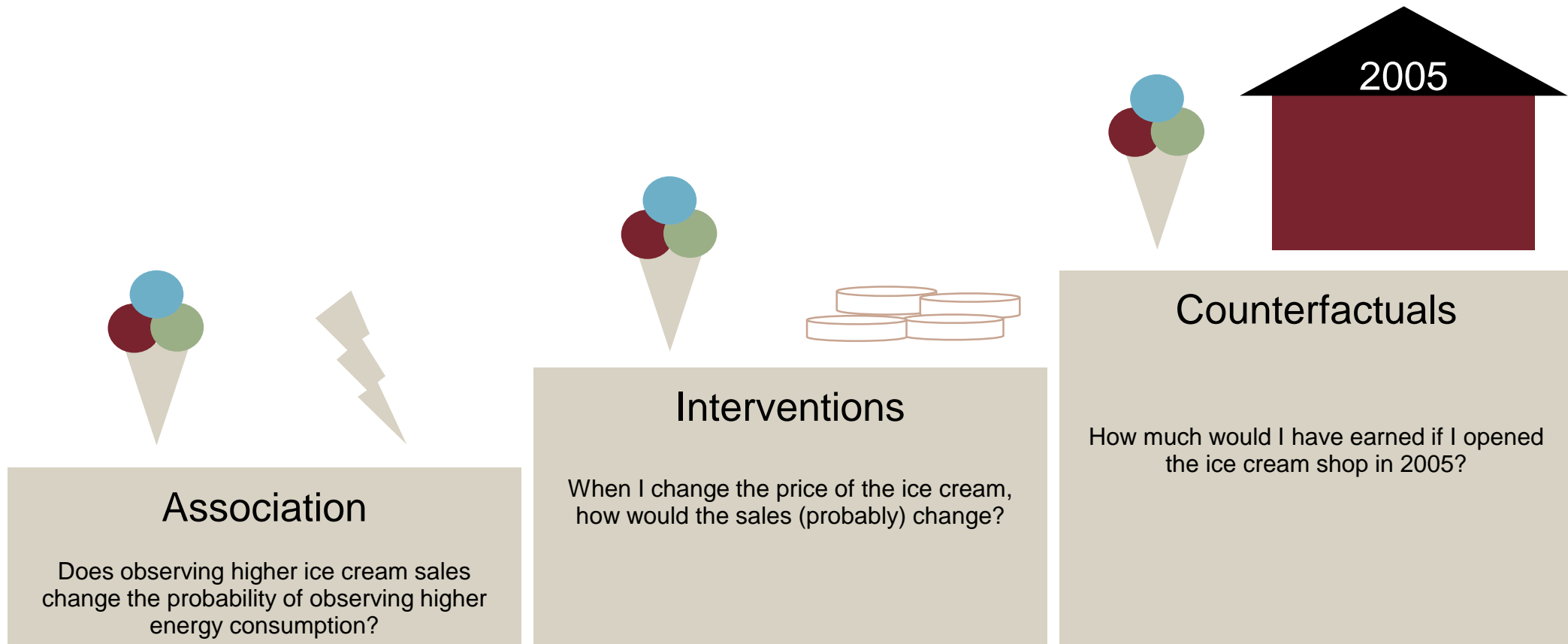
OR ENERGY CONSUMPTION AFFECTING ICE CREAM CONSUMPTION?



TEMPERATURE AFFECTING BOTH

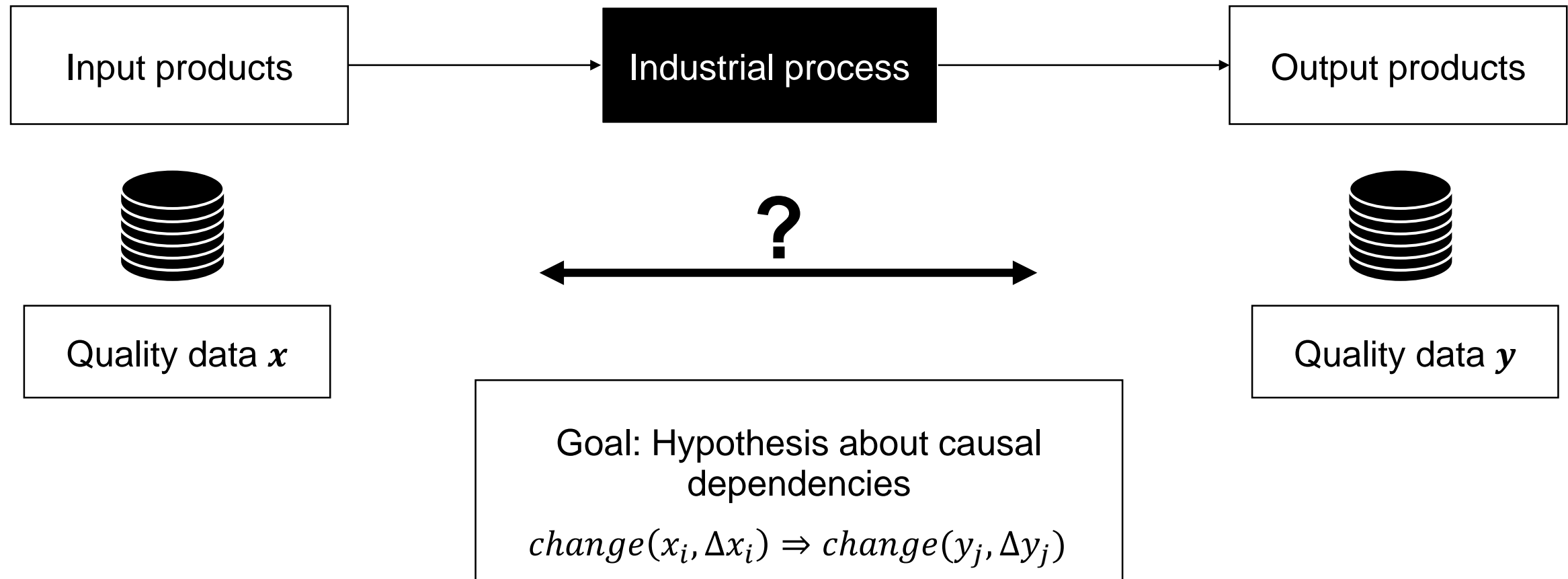


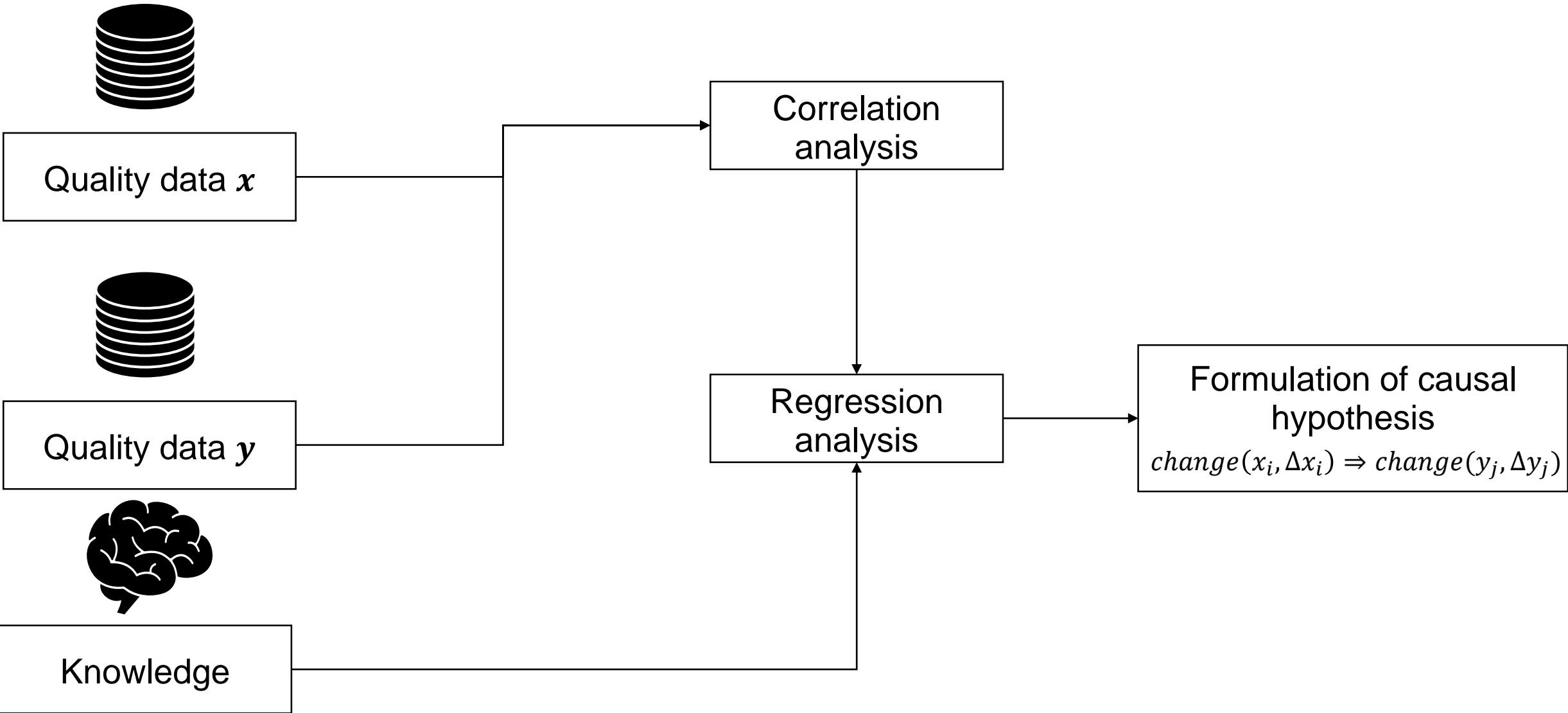
THE LADDER OF CAUSATION



IDENTIFICATION OF CAUSALITY

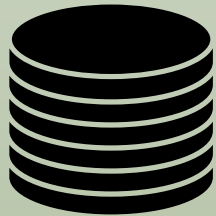
PROBLEM FORMULATION





SOME THOUGHTS ON CAUSAL DISCOVERY

Are data enough?



Spurious Correlations

Assumptions

Causal Sufficiency

Temporal Priority Condition

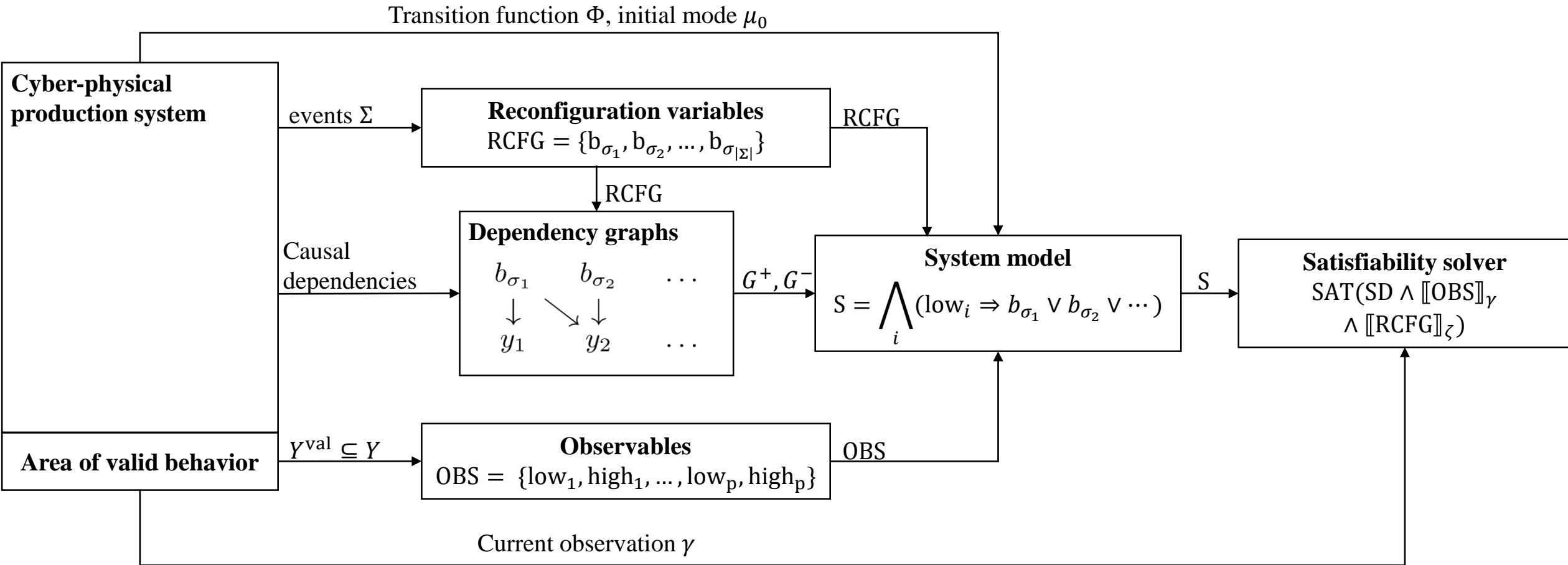
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NOW THAT WE HAVE CAUSALITY...

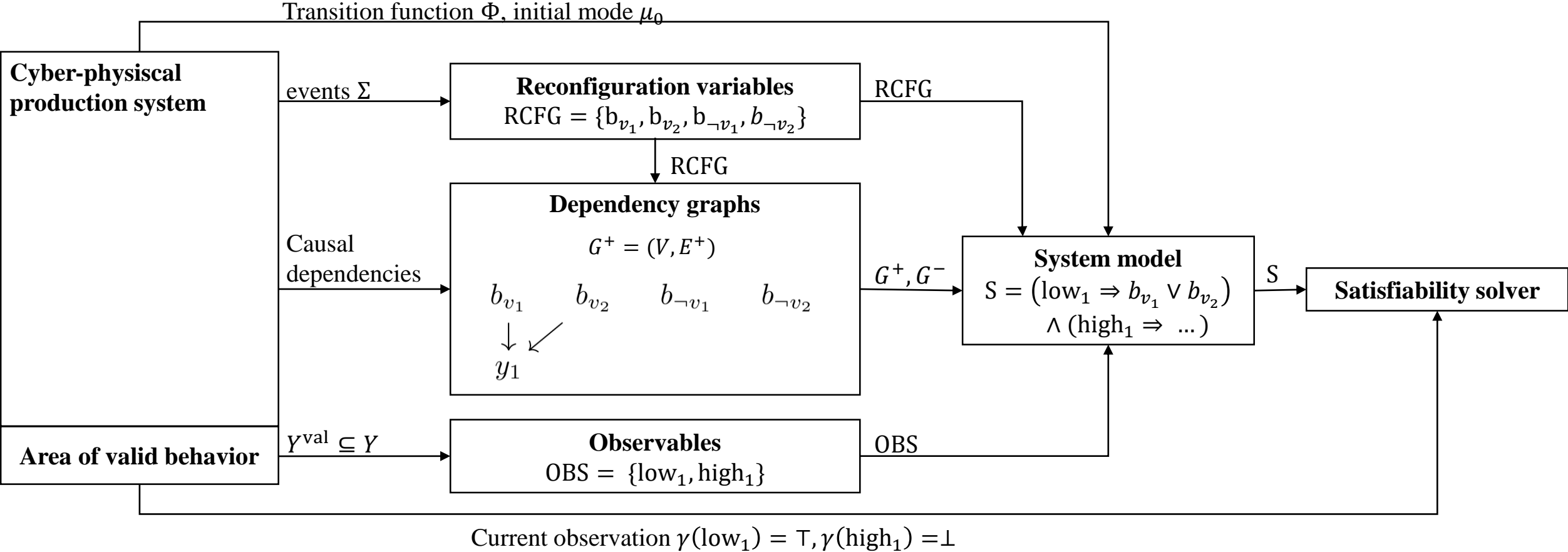
APPLICATION EXAMPLE

AUTONOMOUS FAULT HANDLING

LOGIC-BASED RECONFIGURATION



LOGIC-BASED RECONFIGURATION



CONCLUSION

- Spurious correlations might set false trails.
- Many assumptions made by causal discovery methods might be difficult to satisfy in practical applications.
 - Combination with expert knowledge can be fruitful.
- With the knowledge of causality, we can do a lot, e.g., diagnose a fault or reconfigure a system.

Knowledge about causalities is crucial, but difficult to acquire.

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