A methodology to build causal models within critical realism

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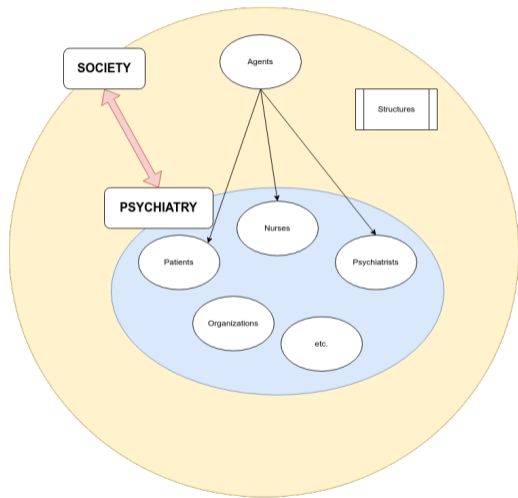
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Agenda I

Introduction

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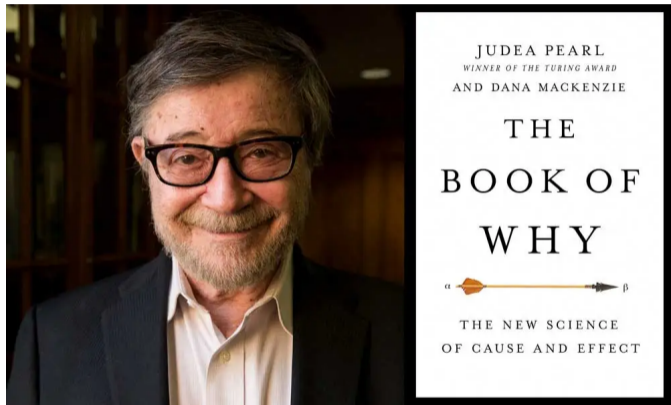University of Ottawa (Canada)

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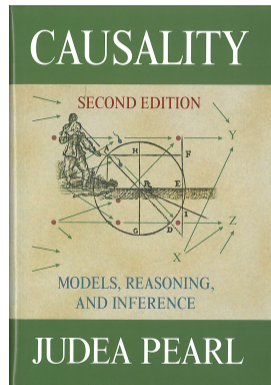https:
//crisnavarrete.github.io/cnavarrete/

PhD Thesis

Research Question
What causal mechanisms play a role in the assignment of a diagnosis of Borderline Personality Disorder?

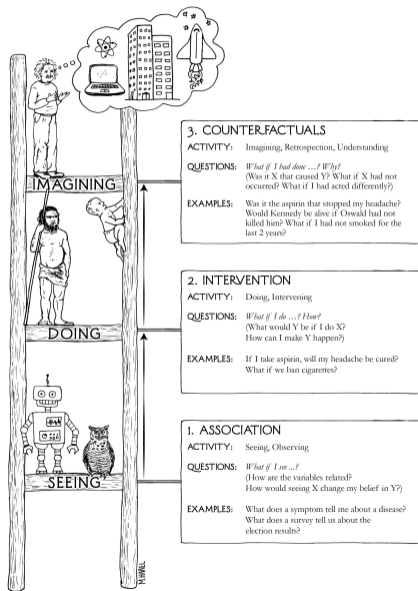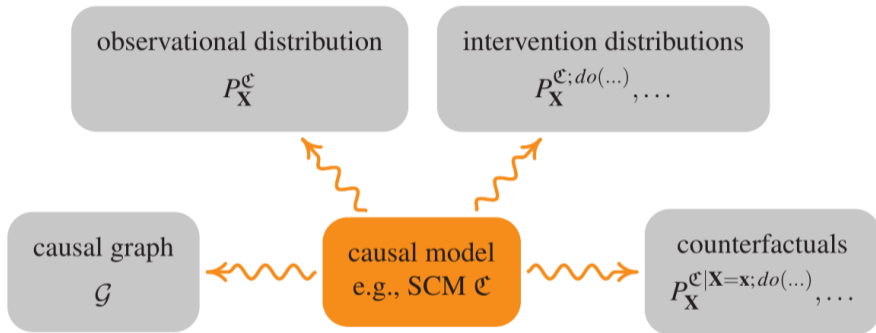# Methodology: Structural Causal Model

(Pearl, 2009, 2018)

Ladder of Causation

3. COUNTERFACTUALS

ACTIVITY: Imagining, Retrospection, Understanding

QUESTIONS: *What if I had done …? Why?*
(Was it X that caused Y? What if X had not occurred? What if I had acted differently?)

EXAMPLES: Was it the aspirin that stopped my headache? Would Kennedy be alive if Oswald had not killed him? What if I had not smoked for the last 2 years?

2. INTERVENTION

ACTIVITY: Doing, Intervening

QUESTIONS: *What if I do …? How?*
(What would Y be if I do X? How can I make Y happen?)

EXAMPLES: If I take aspirin, will my headache be cured? What if we ban cigarettes?

1. ASSOCIATION

ACTIVITY: Seeing, Observing

QUESTIONS: *What if I see …?*
(How are the variables related? How would seeing X change my belief in Y?)

EXAMPLES: What does a symptom tell me about a disease? What does a survey tell us about the election results?

What is a Structural Causal Model (SCM)?

observational distribution
$P_{\mathbf{X}}^{\mathfrak{C}}$

intervention distributions
$P_{\mathbf{X}}^{\mathfrak{C};do(...)}, \ldots$

causal graph
$\mathcal{G}$

causal model
e.g., SCM $\mathfrak{C}$

counterfactuals
$P_{\mathbf{X}}^{\mathfrak{C}|\mathbf{X}=\mathbf{x};do(...)}, \ldots$

(Peters et al., 2017)

What is a Directed Acyclic Graph (DAG)?

RAIN	SPRINKLER	
	T	F
F	0.4	0.6
T	0.01	0.99
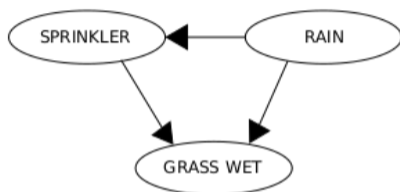
RAIN	
T	F
0.2	0.8

SPRINKLER	RAIN	GRASS WET	
		T	F
F	F	0.0	1.0
F	T	0.8	0.2
T	F	0.9	0.1
T	T	0.99	0.01

SCM Workflow

Step 1:
Create DAG

Step 2: Test
DAG-Data
Consistency

SCM

Step 3:
Apply
Backdoor or
Frontdoor
Criterion

Step 4:
Choose a
Statistical
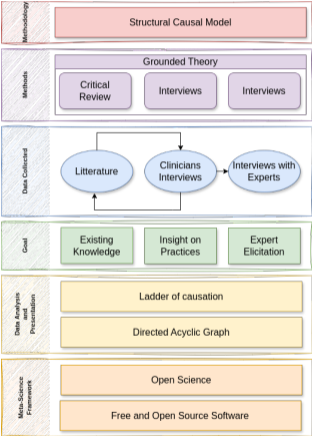Model

Step 5:
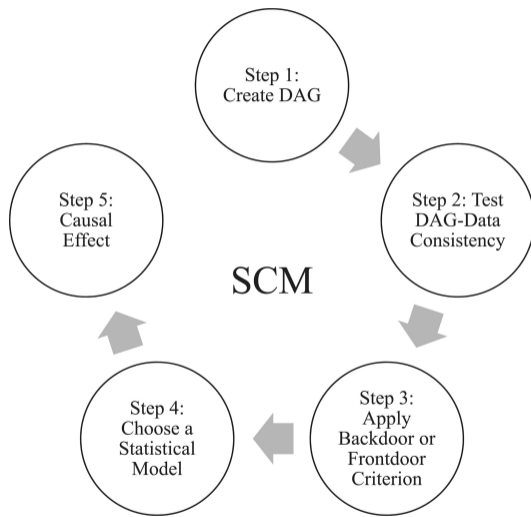Causal
Effect
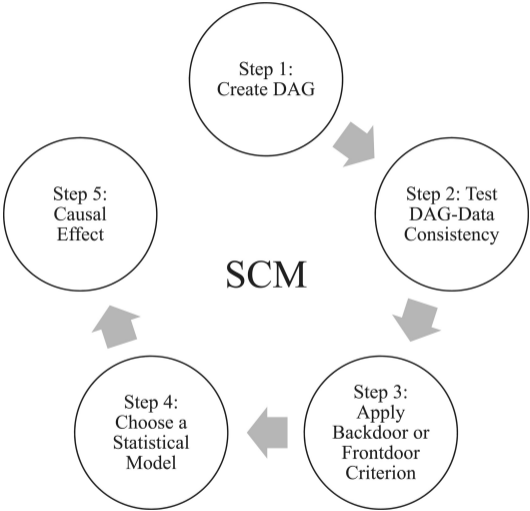
(Arif & MacNeil, 2023)

Example
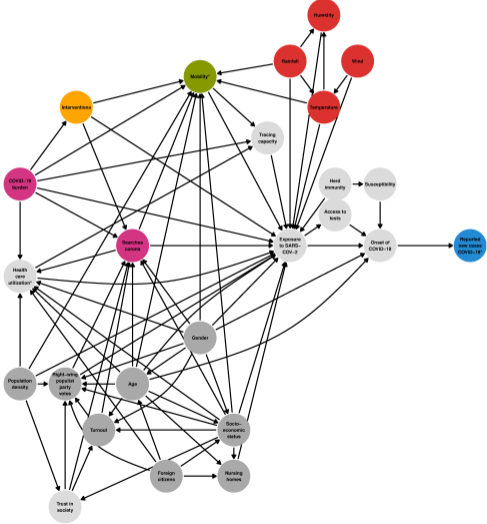
(Steiger et al., 2021)

How to build a DAG

What do you do next with your DAG?

(Arif & MacNeil, 2023)

What's in it for Critical Realists (and everyone)?

▶ a visualization tool for causal theories

▶ transitivity of knowledge: keep track of knowledge building

▶ a human-driven AI approach in a context of big data.

▶ collaboration between disciplines (and beyond) - Wikipedia model?

▶ Open science: tracking of the decisions and what led to them.

▶ Morphogenetic approach.

▶ a tool to generate research projects.

▶ "DAG now, input the data later"

Conclusion

▶ a promising methodology for CR
▶ a communication tool!

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References II

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