



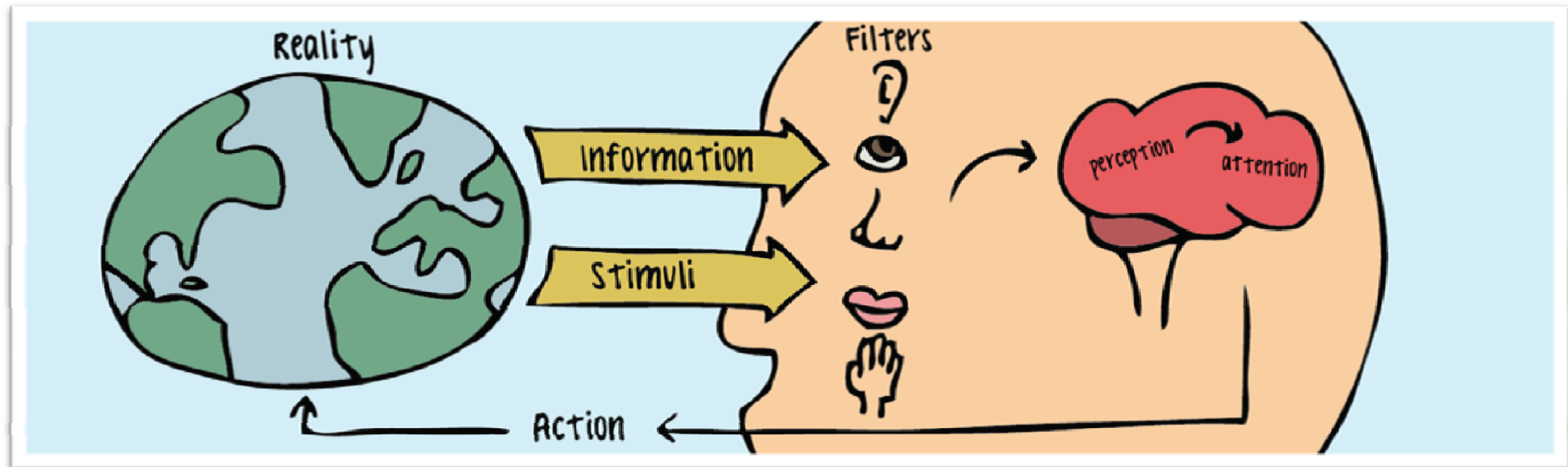
Causal inference in hospital epidemiology

Mo Yin

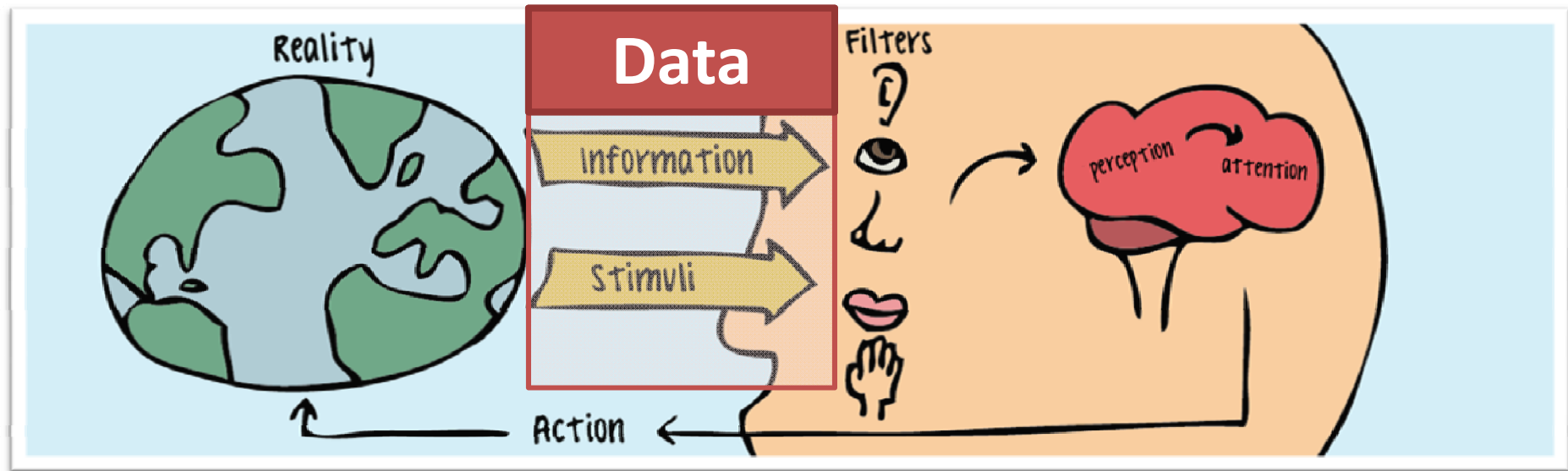
Mathematical And Economic MODelling Unit, Mahidol-Oxford Research Unit, Bangkok
Associate consultant, Division of infectious disease, National University Hospital, Singapore



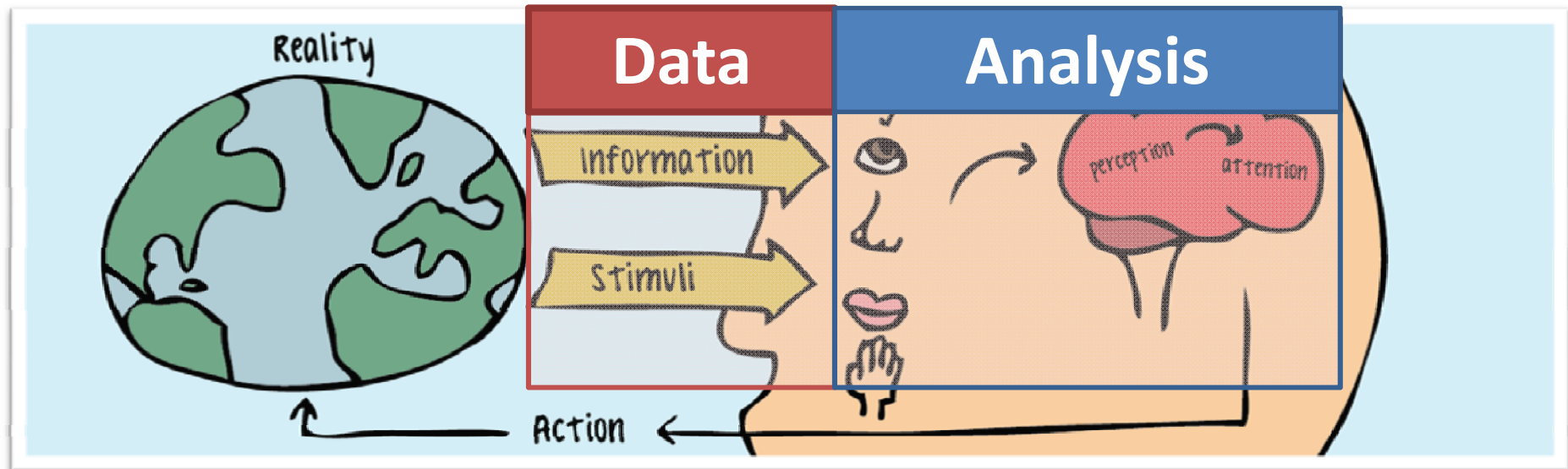
The pursuit of meaning



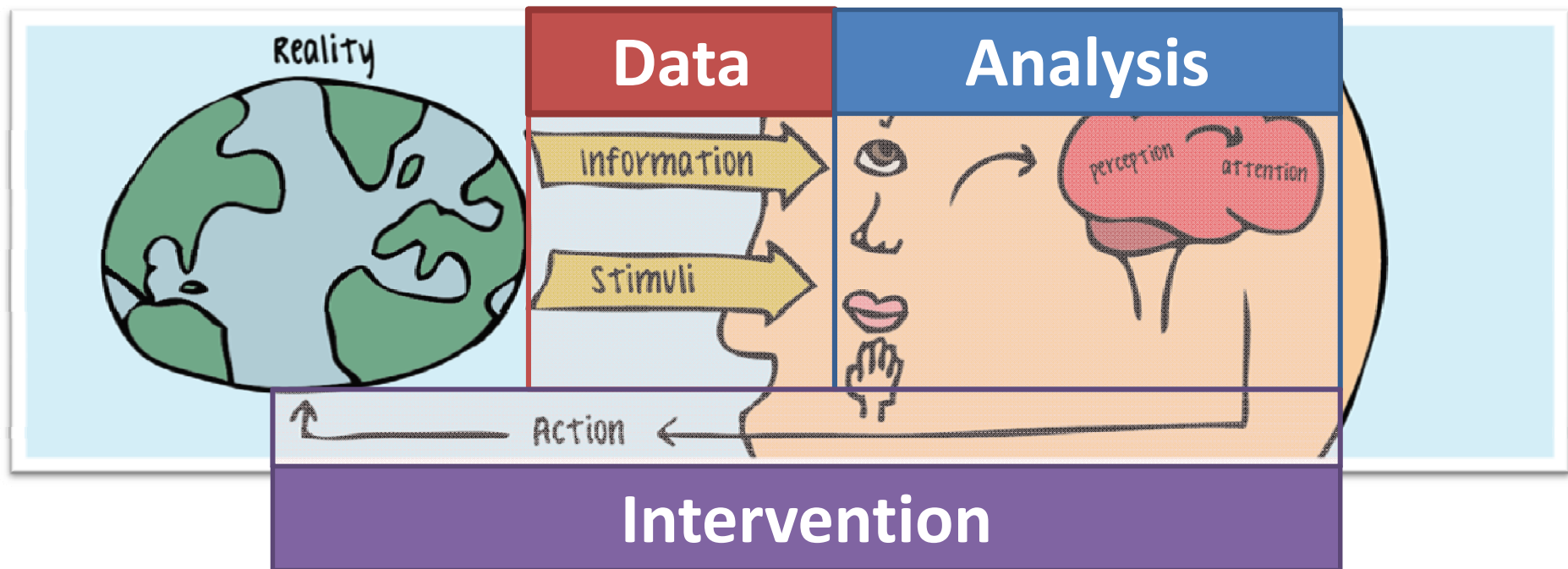
The pursuit of meaning



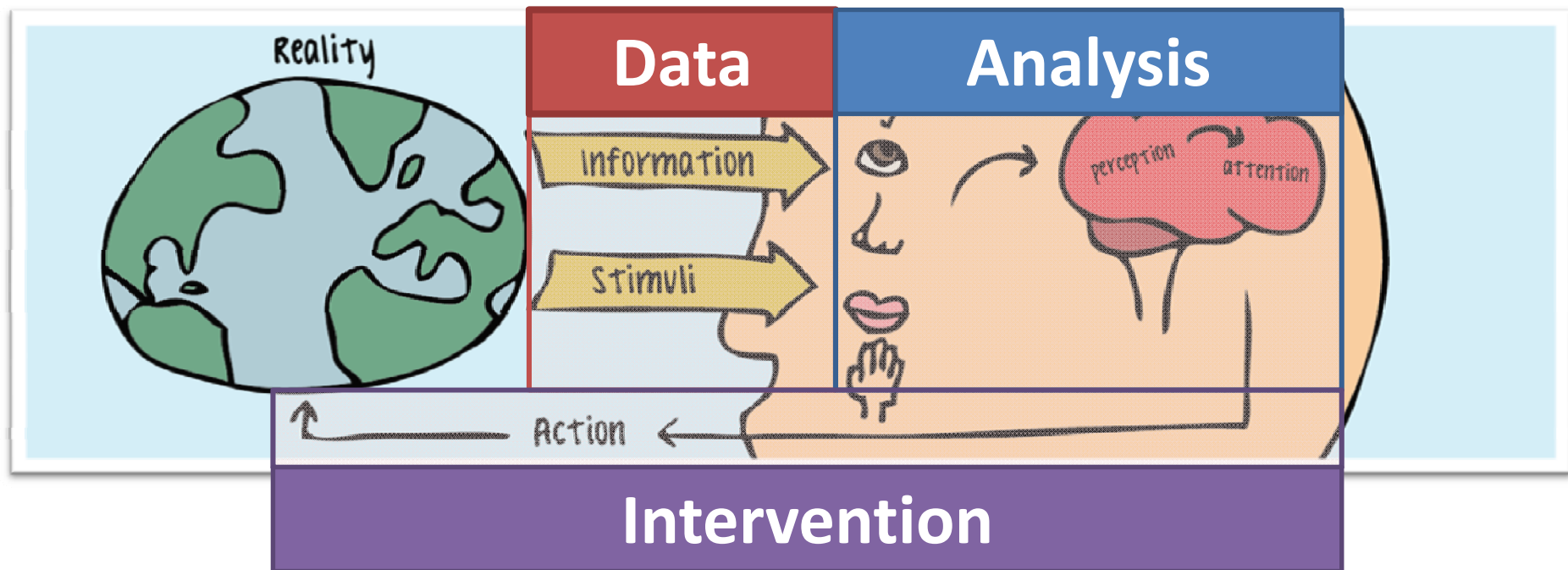
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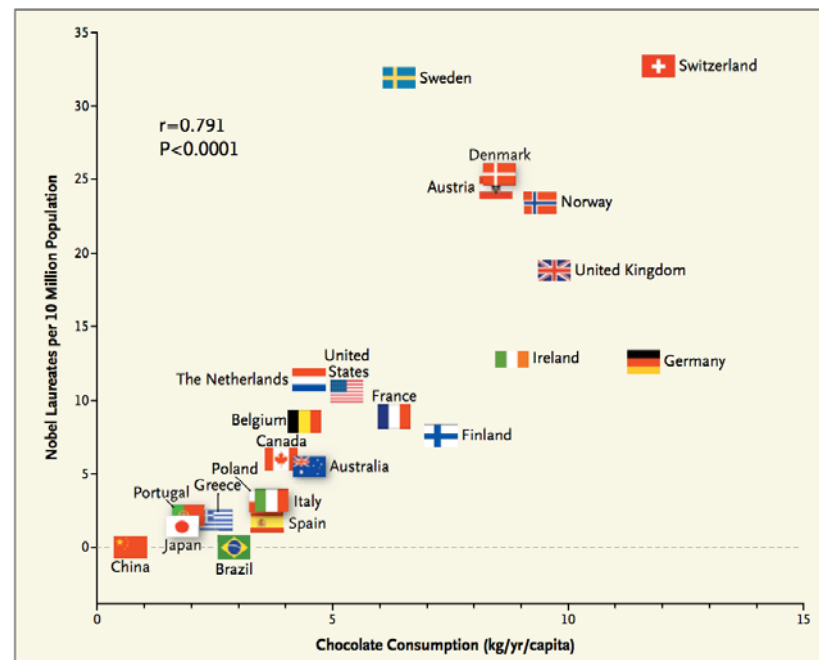
The pursuit of meaning



Understanding relationships is critical

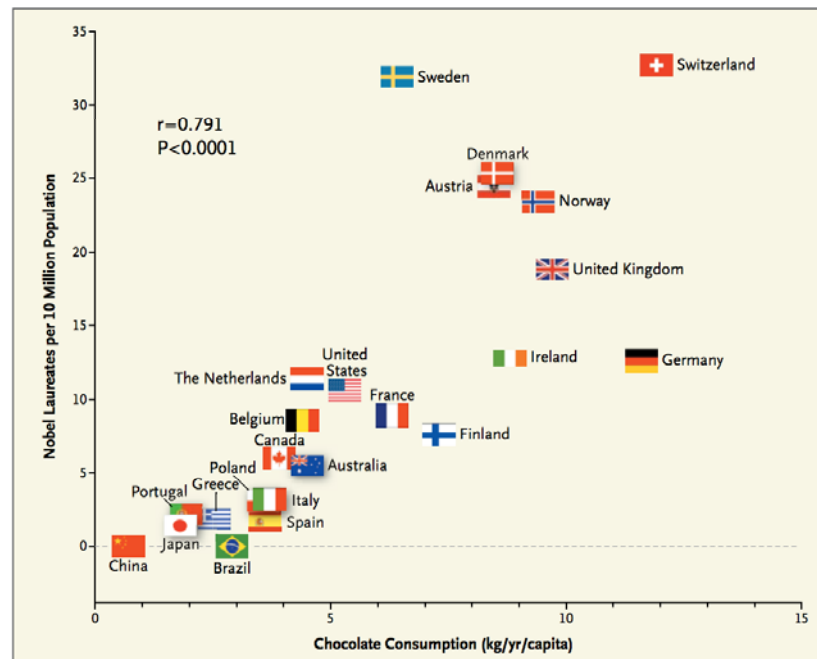
Relationships

“Surprisingly powerful correlation between chocolate intake per capita and the number of Nobel laureates in various countries...”



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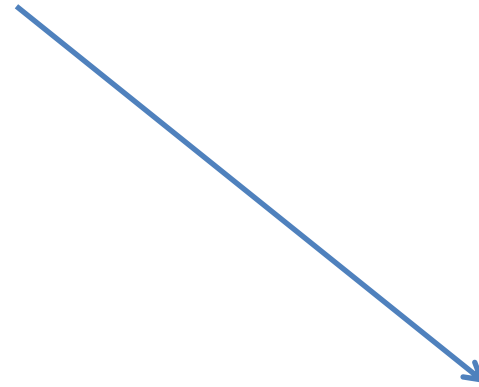
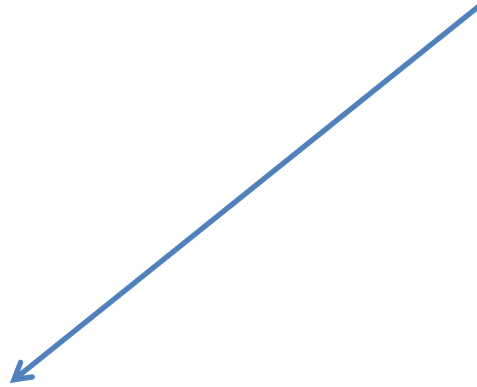


“...it seems most likely that in a dose-dependent way, chocolate intake provides the abundant fertile ground needed for the sprouting of Nobel laureates...”

Causality?

Chocolate → Nobel laureate

GDP

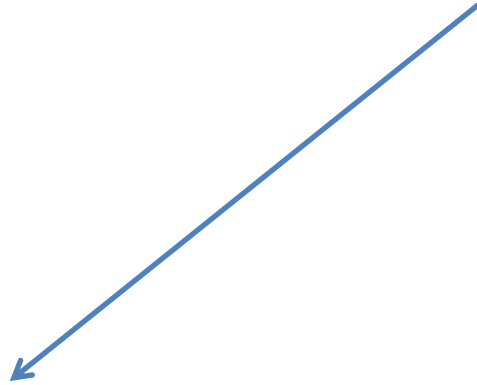


Chocolate

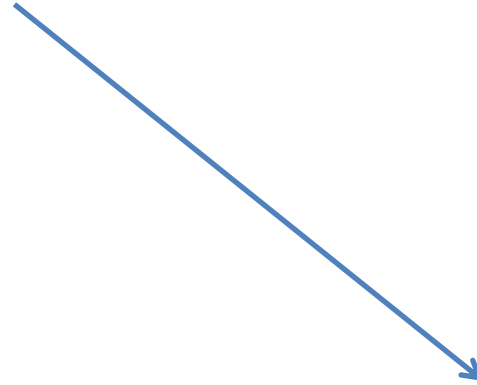


Nobel laureate

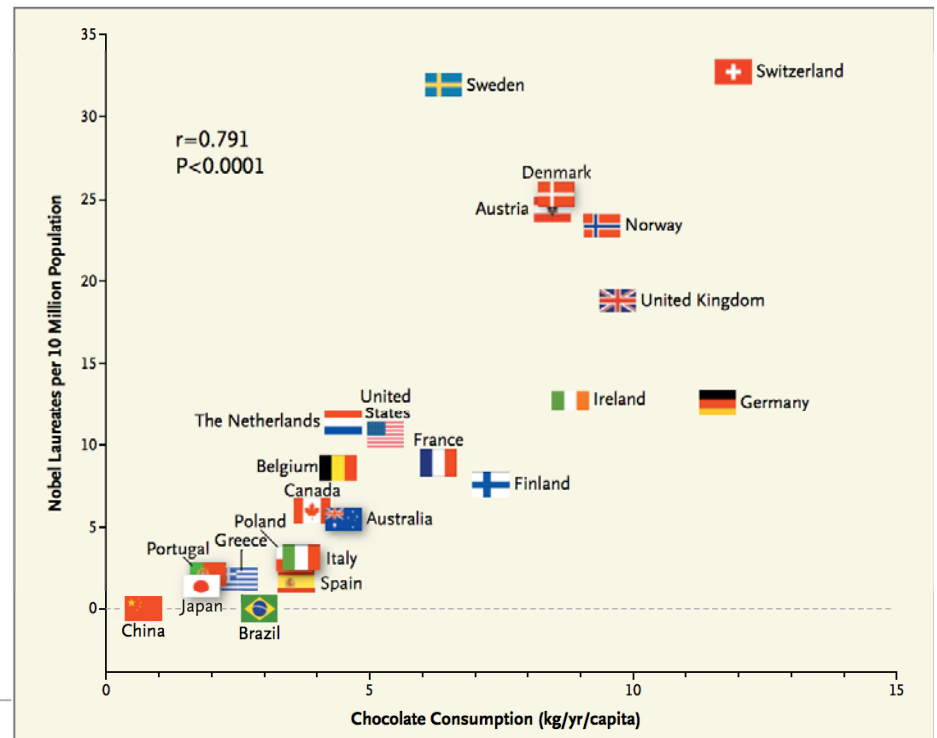
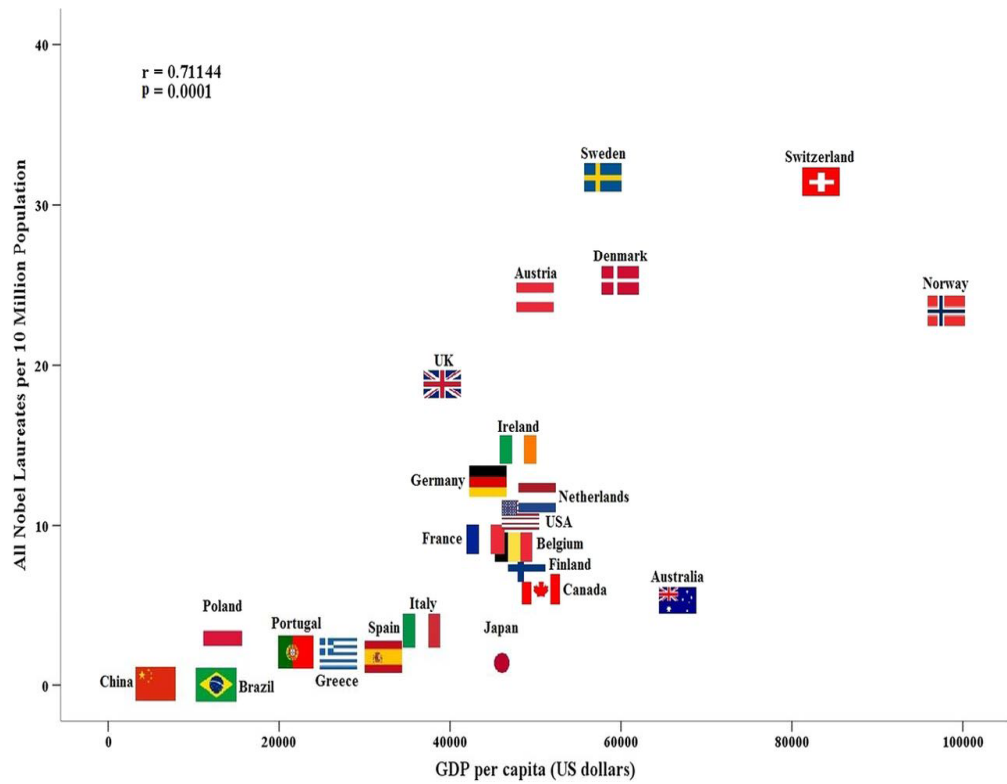
GDP



Chocolate



Nobel laureate



Association vs causality

- Hill's criteria
 - **Strength** of association
 - **Consistency** in different studies and different populations
 - **Specificity** of the agent in eliciting a particular effect
 - **Temporality** of relationship
 - **Coherence** with other types of evidence

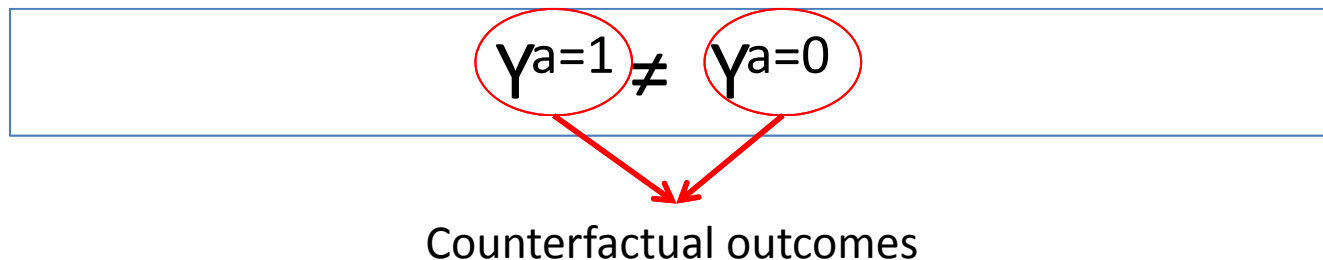
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- Causal inference
 - A has a causal effect on Y if:

$$\gamma^{a=1} \neq \gamma^{a=0}$$

Association vs causality

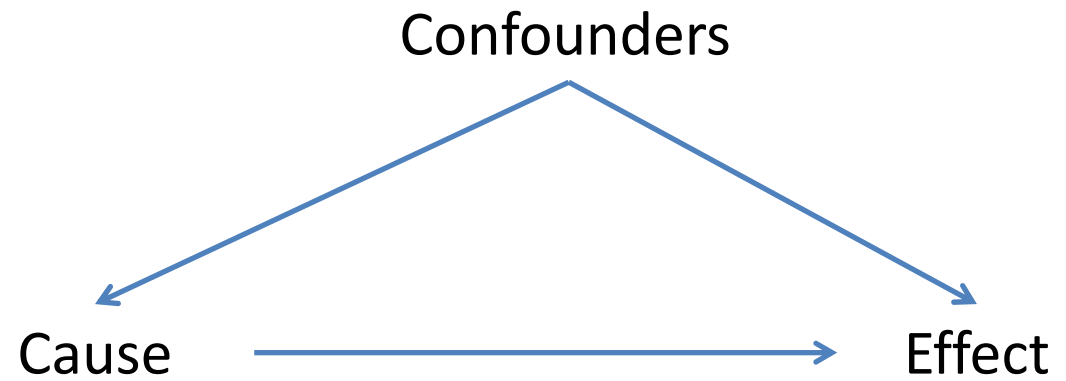
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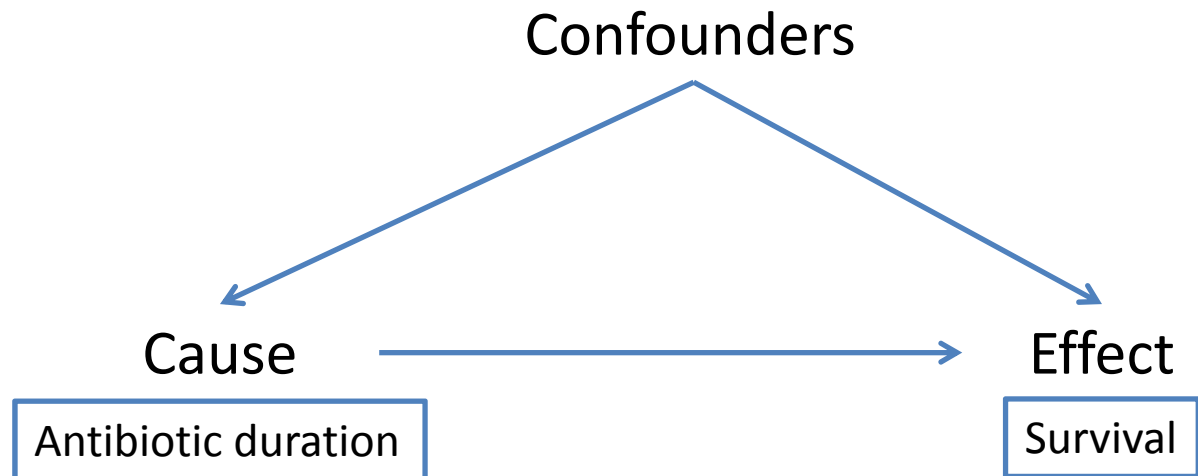
What is causal inference?

- Individual causal effects cannot be identified
- Aim is to derive average causal effect in a population
- Ideal experiment – Randomised controlled trial

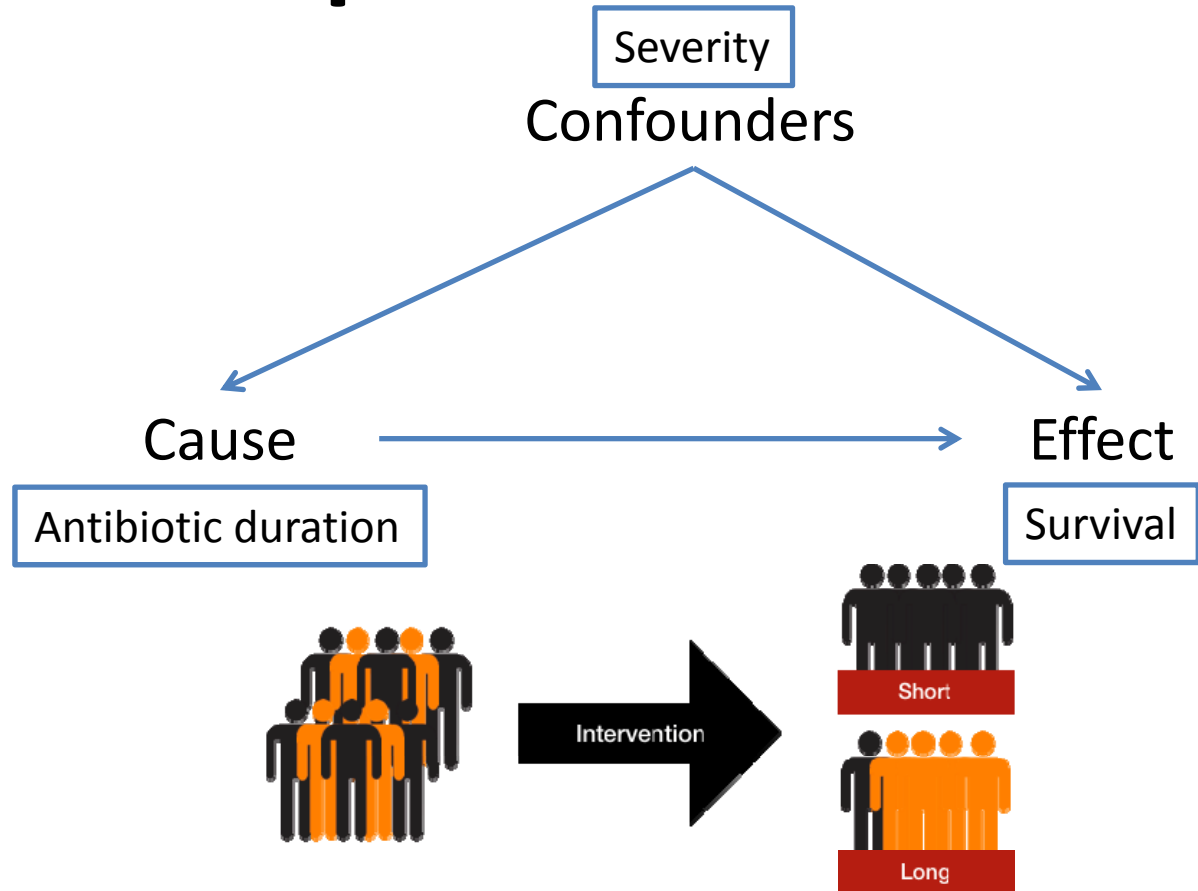
The ideal experiment...



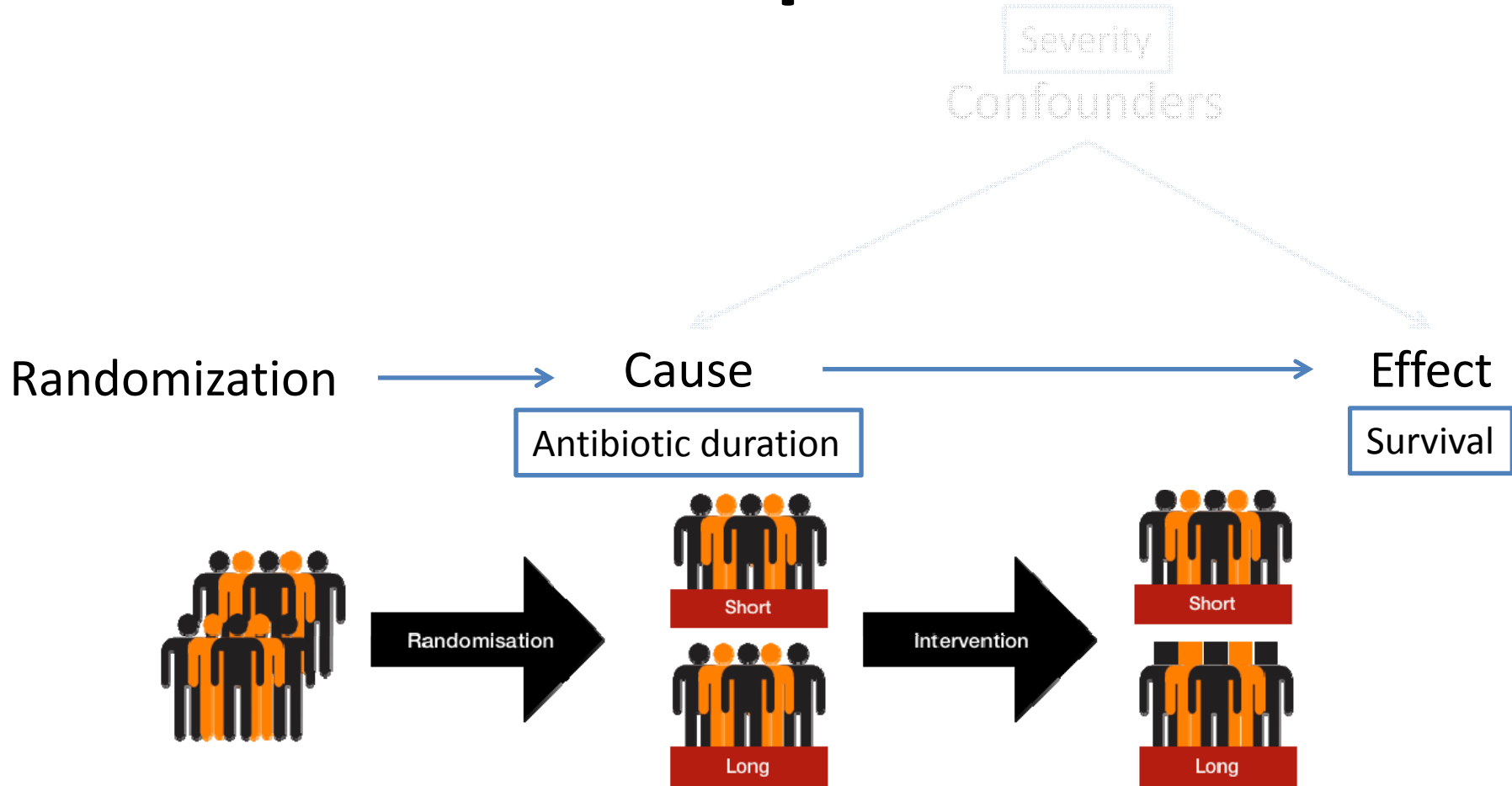
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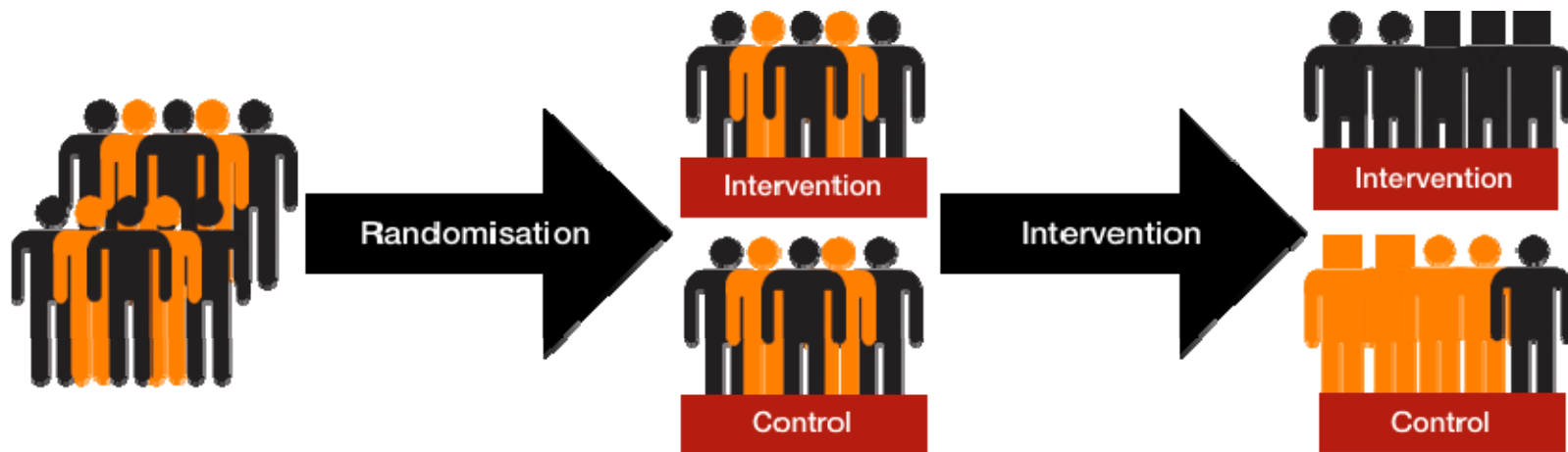
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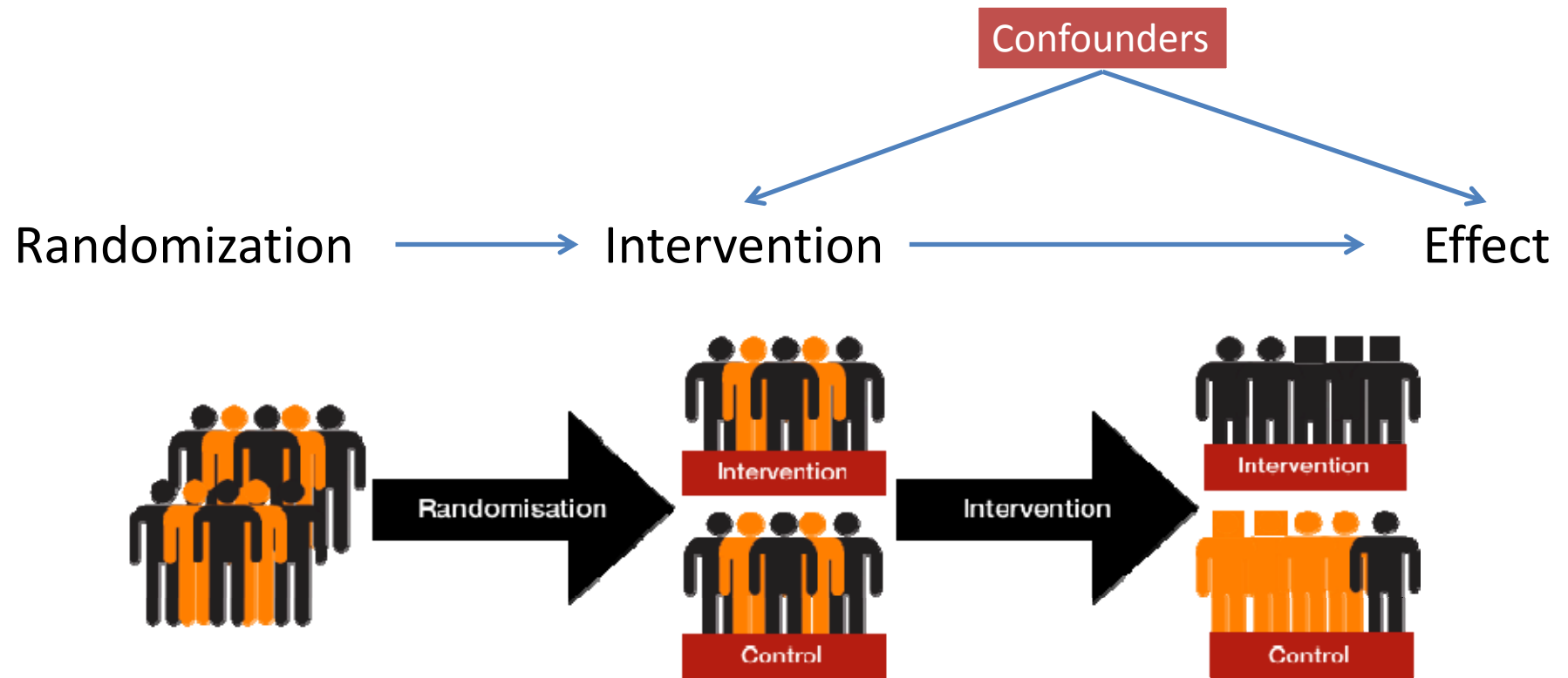
The ideal experiment...



The ideal experiment... in reality

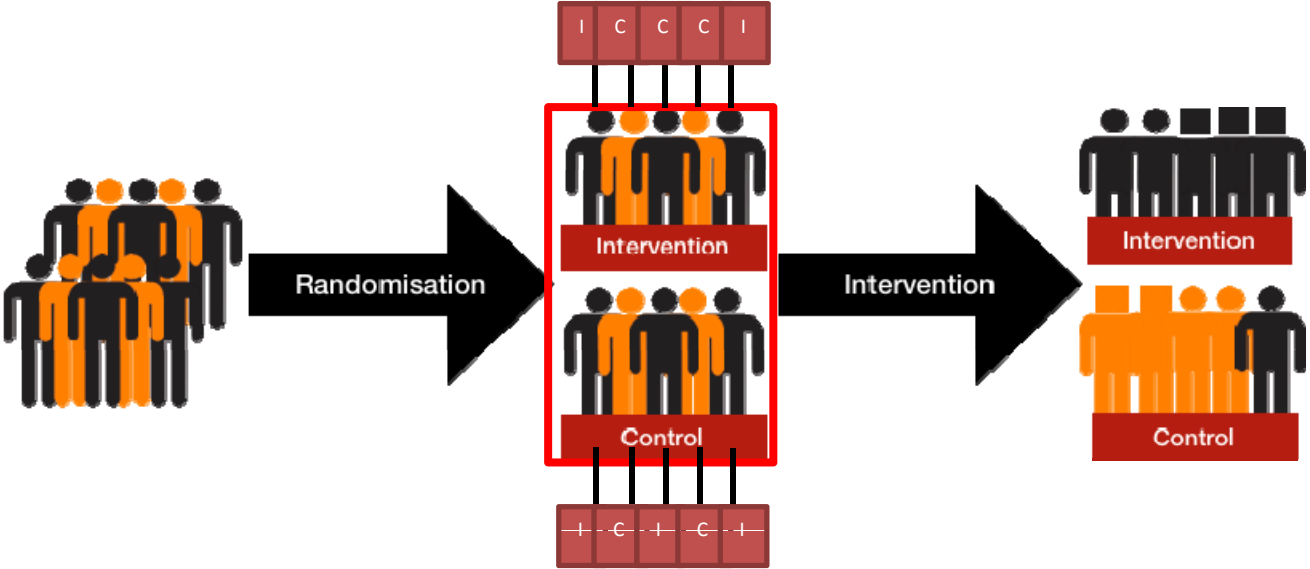


The ideal experiment... in reality



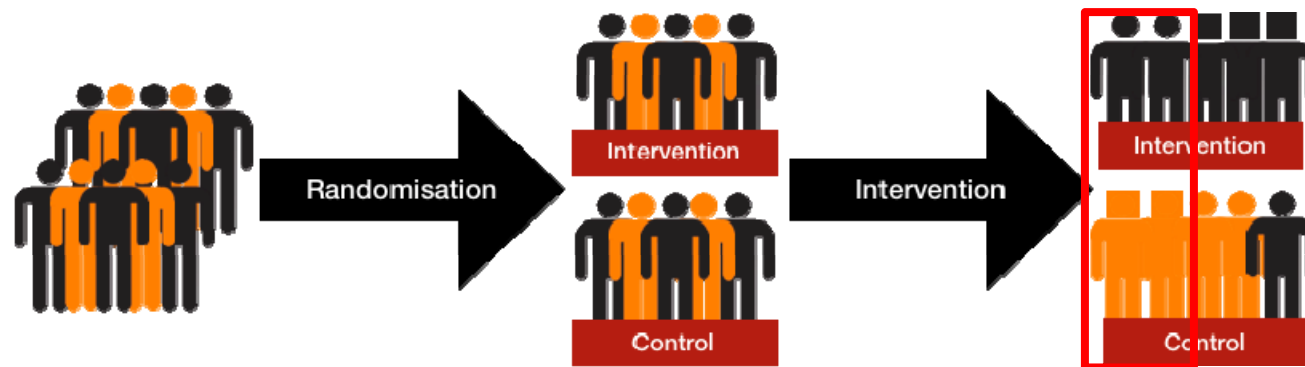
Conventional methods of analyses

Intention to treat



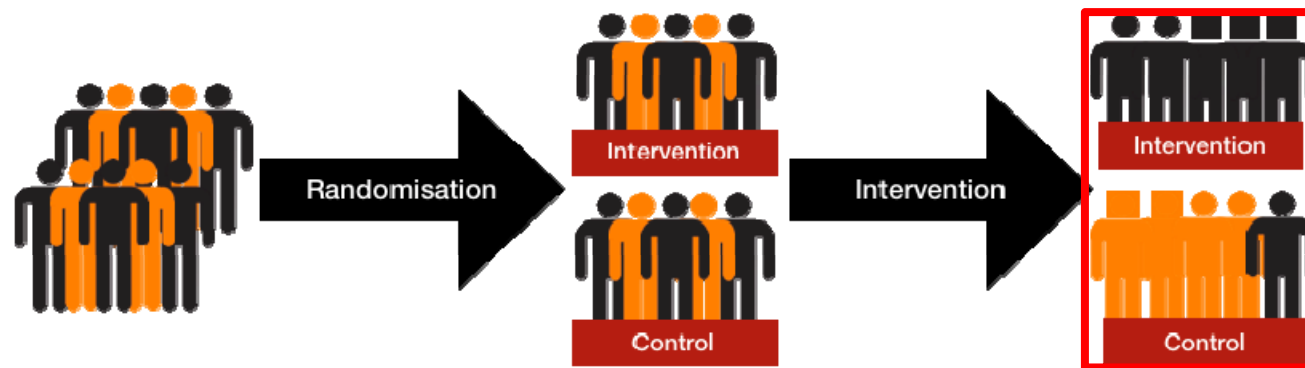
Conventional methods of analyses

Per protocol



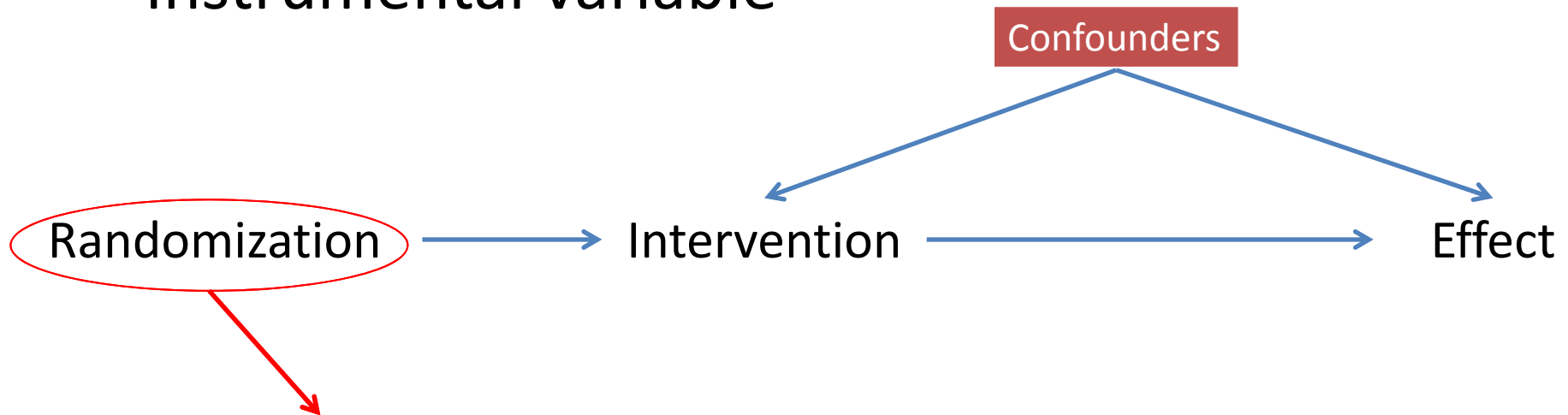
Conventional methods of analyses

As treated



Causal inference methods

- Instrumental variable



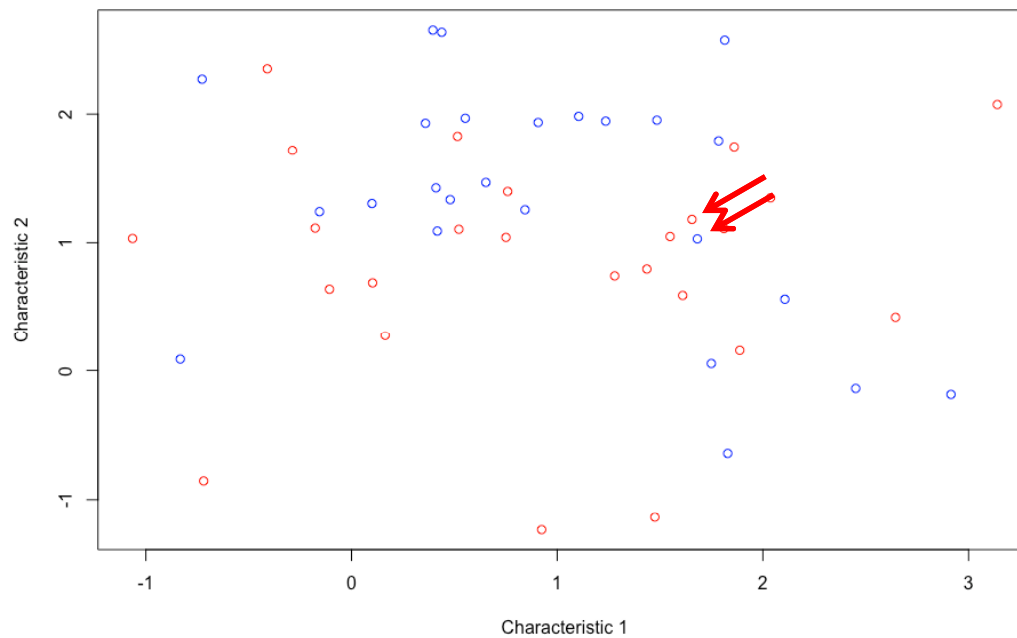
Assesses how instrument is related to intervention and the outcome, then uses that to understand how the exposure predicts the outcome

Causal inference methods

- Inverse probability weighting
 - estimate the probability of the intervention for a particular person, and using the predicted probability as a weight

Causal inference methods

- Matching



When non-compliance is driven by confounders

 Intention to treat

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When non-compliance is driven by confounders

 Intention to treat

 Per protocol

 As treated

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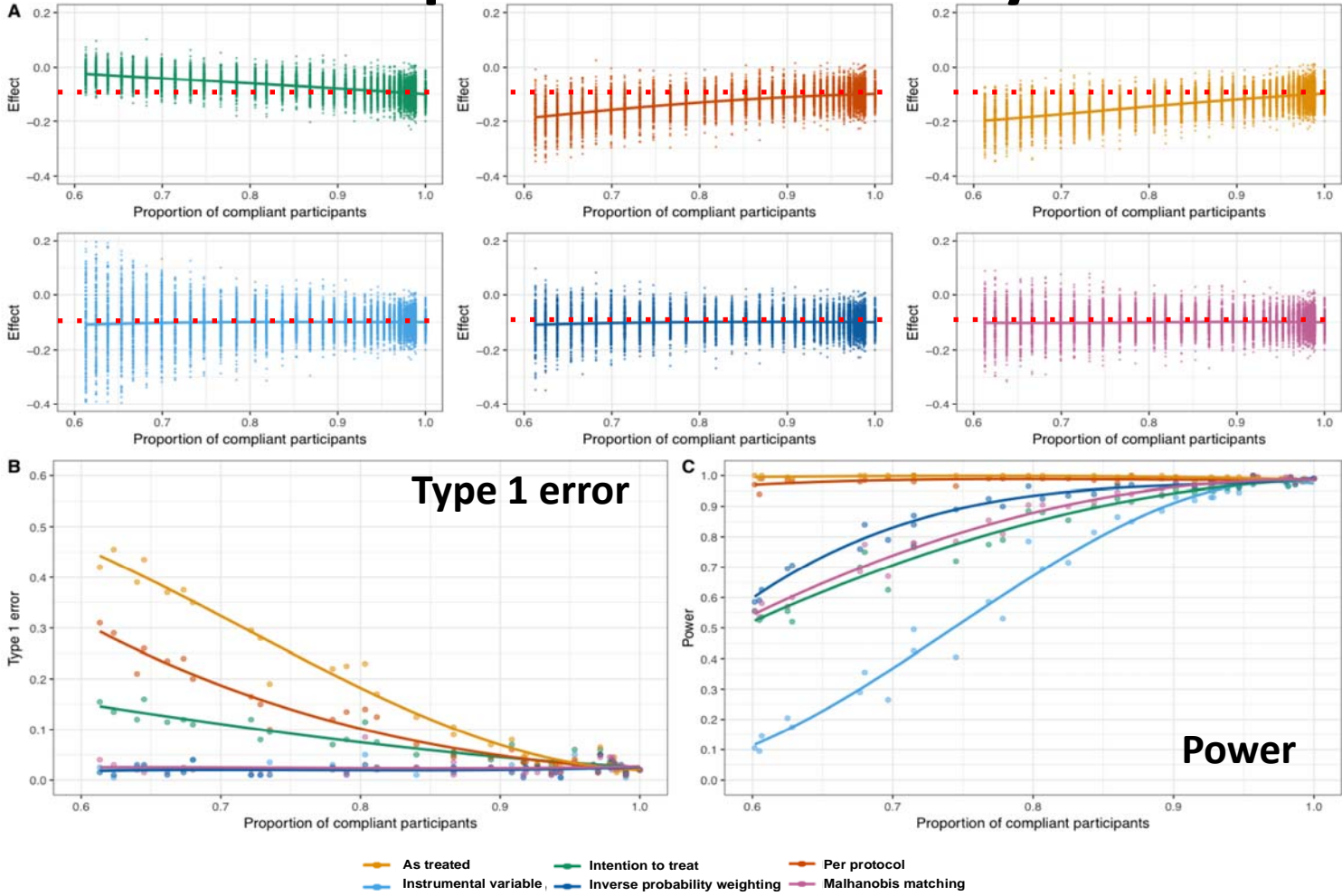
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Instrumental variable

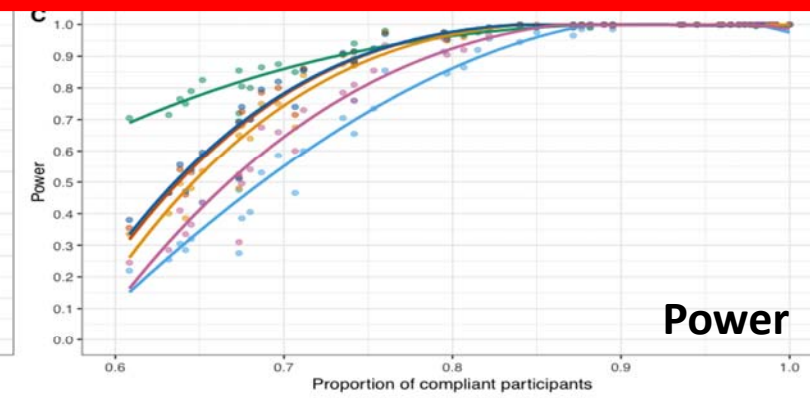
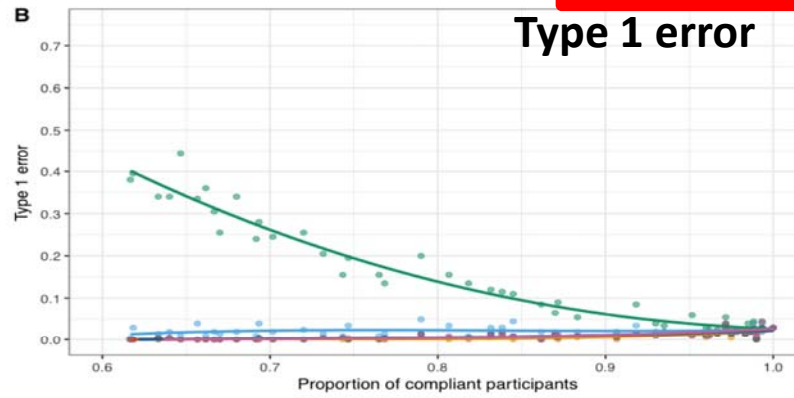
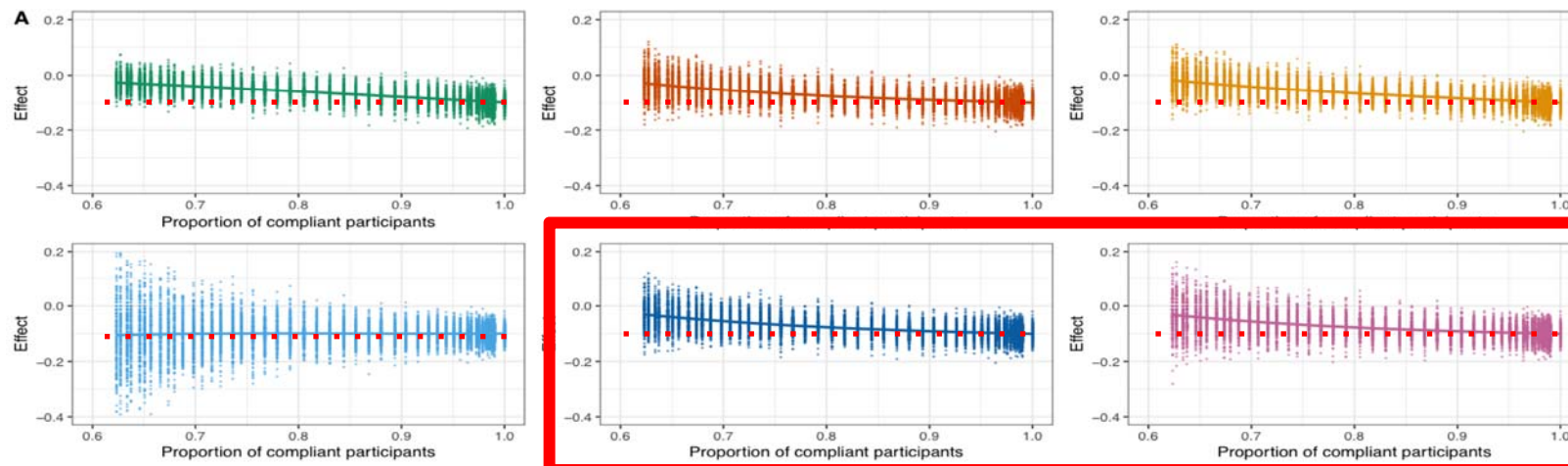
Inverse probability weighting

Malhanobis matching

When non-compliance is driven by confounders



In the presence of unobserved confounders

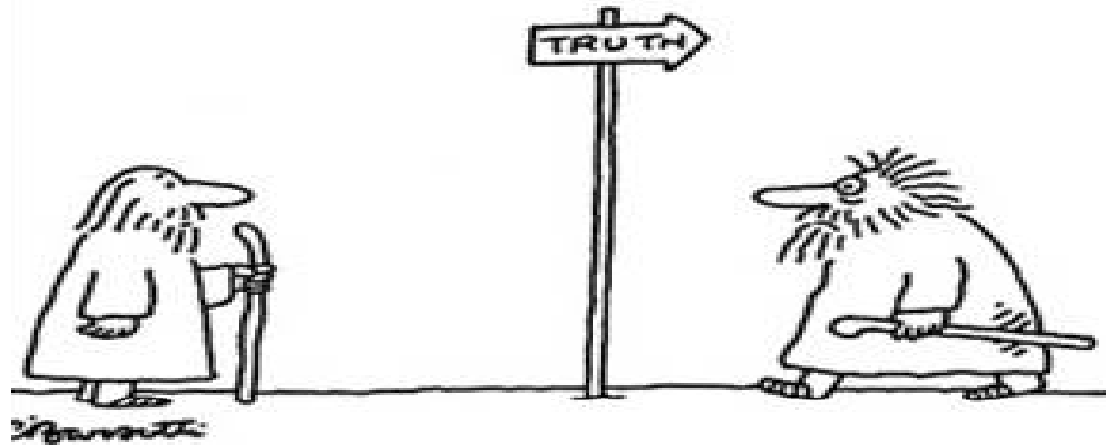


As treated — Intention to treat — Per protocol
 Instrumental variable — Inverse probability weighting — Malhanobis matching

Summary

- Causal inference is a 'paradigm shift of mind over data'
- Requires clarity in causal pathways
- Potential for harnessing observational data to establish causality

Thank you!



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