

Causality Theorists

Aristotle

Kant

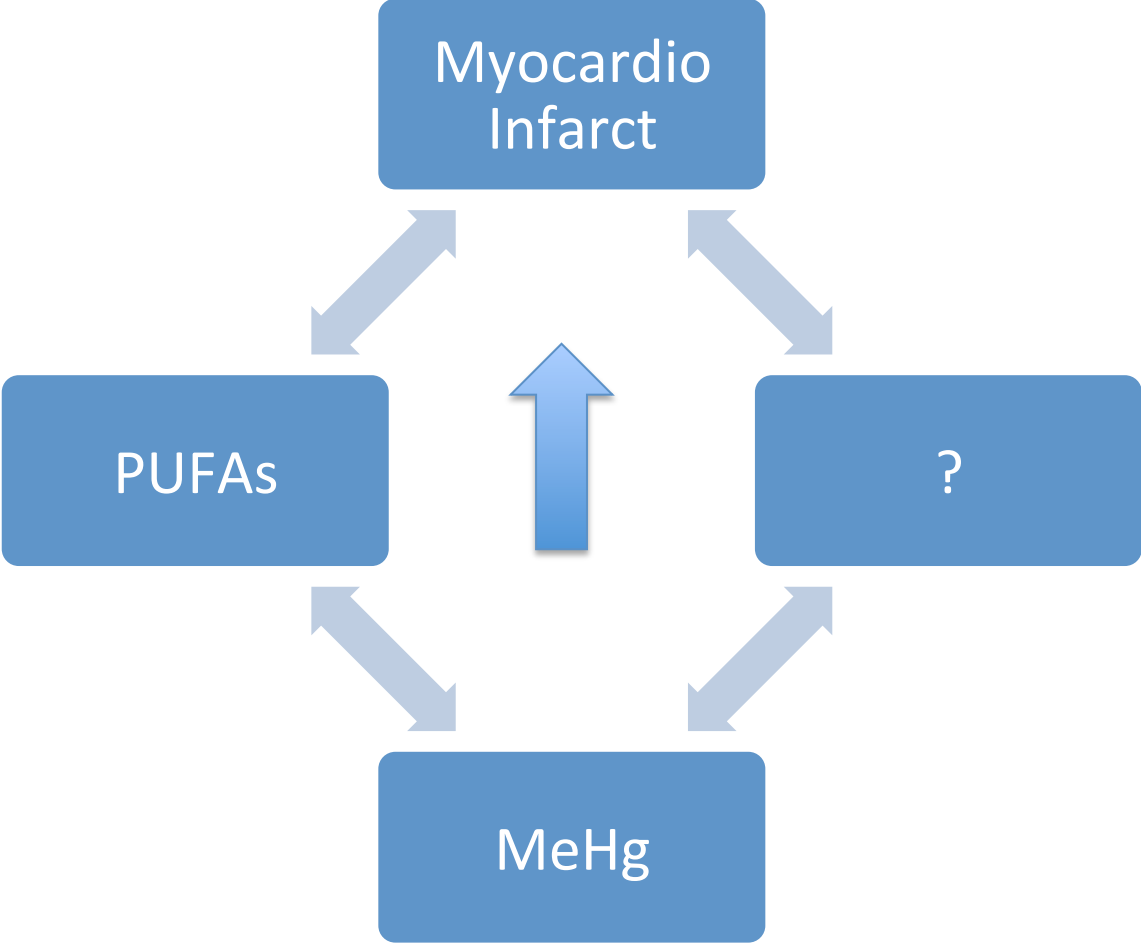
Hume

Popper

Wright

Causality Concepts

- Inductive vs. Deductive
- Counterfactual
- Direct
- Mechanistic
- Parallel
- Confounding
- Bias



Bradford Hill Doctrine

Philosophical Underpinnings

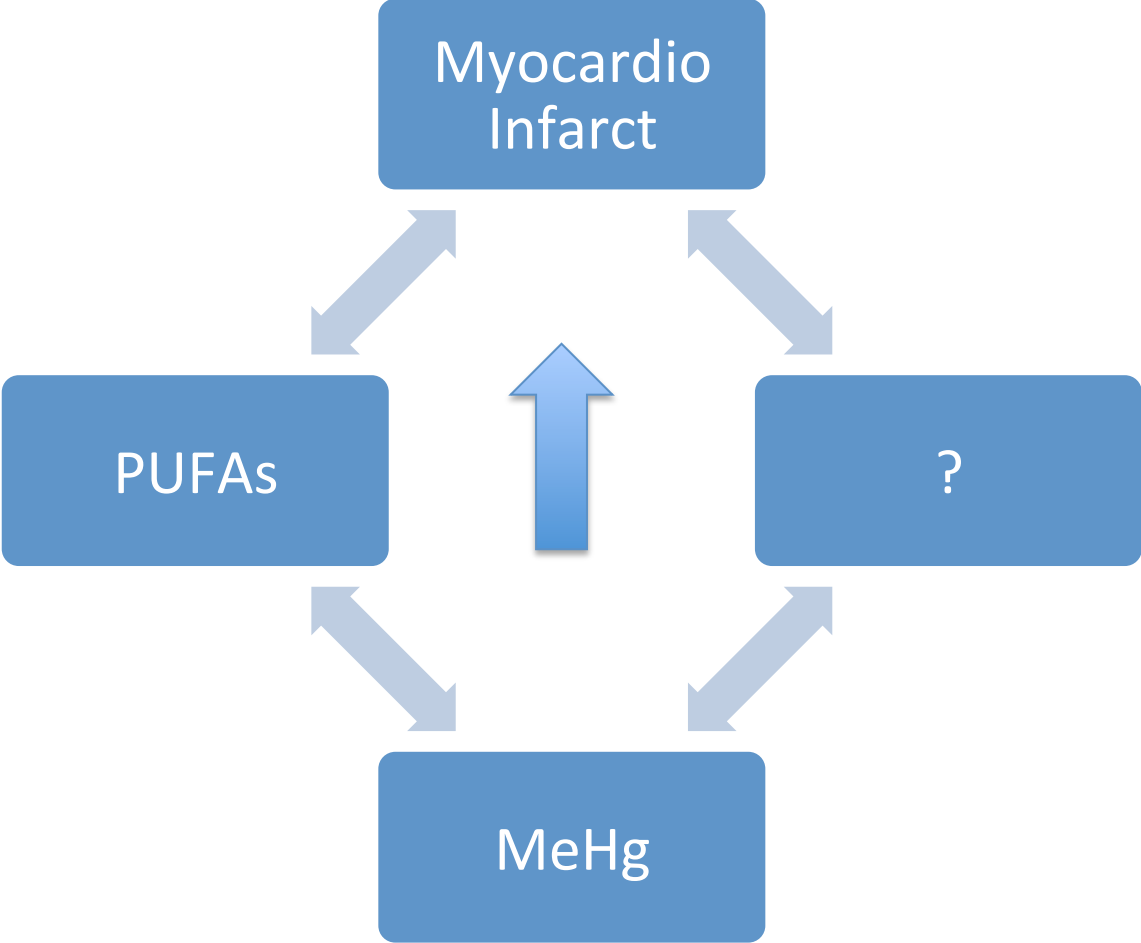
- **Plausibility (aka pathway; mechanism)** - MeHg causes MI through an oxidative stress pathway
- **Temporality (outcome preceded by the effect)** – 3 prospective studies, 1 positive, 1 negative, 1 inverse
- **Experiment (aka RCT)** – no studies induced MI through MeHg dosing/ or saw decrease in MI by removing MeHg exposure

Empiricists

- **Strength of Association (aka statistical test)**
both positive studies OR of 2 or less
- **Biological Gradient (aka dose response)** both positive studies show dose response; HPFS no association; NSHDS Sweden study inverse

Regulatory Scientists

- Reproducibility (aka weight of evidence) – studies limited to a handful with mixed findings
- Specificity – (aka confounders controlled)
- Coherence – (aka tox and epi agree) for each endpoint, findings inconclusive between animal and human
- Analogy – MeHg is to carotid artery as MeHg is to the brain; or MeHg is to oxidative stress as lead, cadmium and arsenic are to oxidative stress



experimental observation makes a theory untenable (falsifies it) and a new theory is found that has greater *explanatory power* (can account for the previously unexplained phenomena), and as a result, *provides greater opportunity for its own falsification*

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FAILURE



WHY SCIENCE IS SO SUCCESSFUL



STUART FIRESTEIN

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We pay a heavy price for our fear of failure. It is a powerful obstacle to growth. It assures the progressive narrowing of the personality and prevents exploration and experimentation. There is no learning without some difficulty and fumbling. If you want to keep on learning, you must keep on risking failure-all your life.

John W Gardner

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