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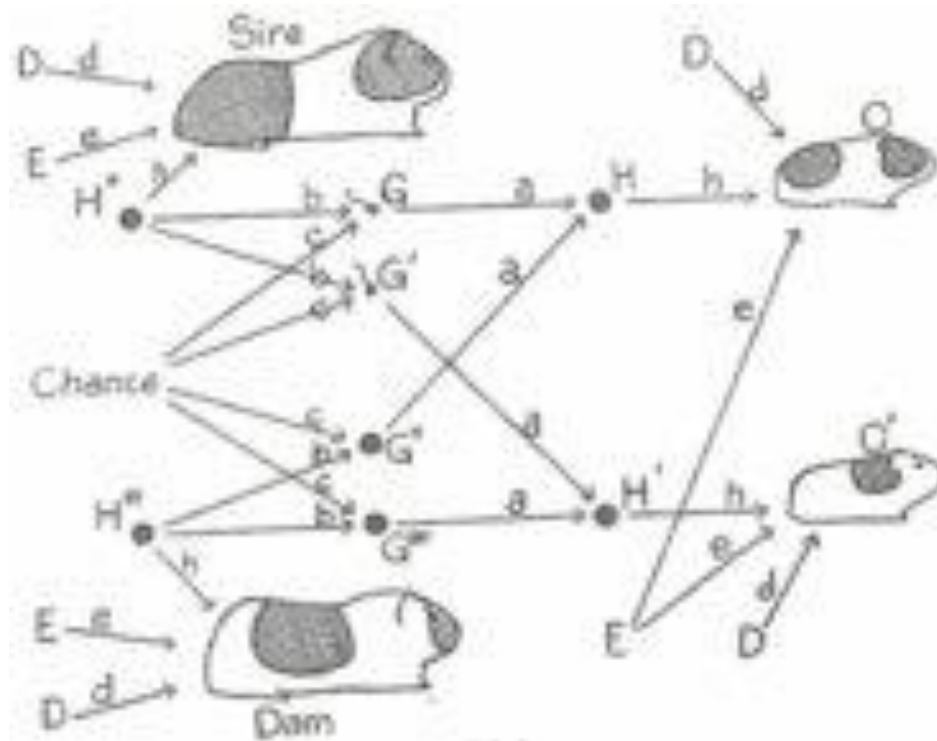
Symposium on causal mediation

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A (brief) history of mediation analysis





Research on mediation

Much research effort has been spent on

(a) complex parametric modeling of mediational processes and

(b) standard errors and statistical significance tests of indirect effects



Complex models

- Multiple mediators, sequential mediators, latent mediators, moderated mediators, mediators in growth models, mediators in longitudinal models, quantile regression mediators, mediators in multi-level models



Standard errors

- Delta-method derived standard errors, percentile bootstrap standard errors, bias-corrected bootstrap standard errors, distribution of product standard errors



Use of mediation analysis in psychology, education, nutrition, prevention, communication...

- “I am not claiming causal effects, but I am interested in mediational pathways”
- “My mediated effects might not be unbiased, but it gives me additional insight into processes”



Recent developments

- Transition from a focus on parametric models to causal assumptions, identification, and interpretation
- Green, Ha, Bullock provided strongly worded critique of applied mediation analysis in psychology

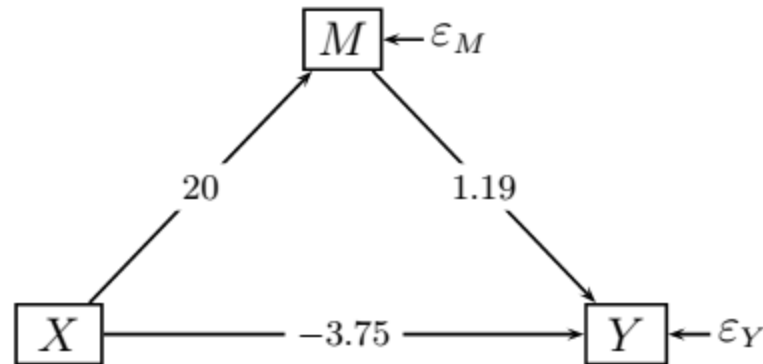


Recent developments

- Imai's work on causal mediation expressed quantities of direct and indirect effects in potential outcomes language and formulated assumptions – much work followed by VanderWeele, Vansteelandt, and many others
- Pearl conceptualized causal mediation using graphical models
- Muthen “translated” work on causal mediation into SEM computer code (Mplus)

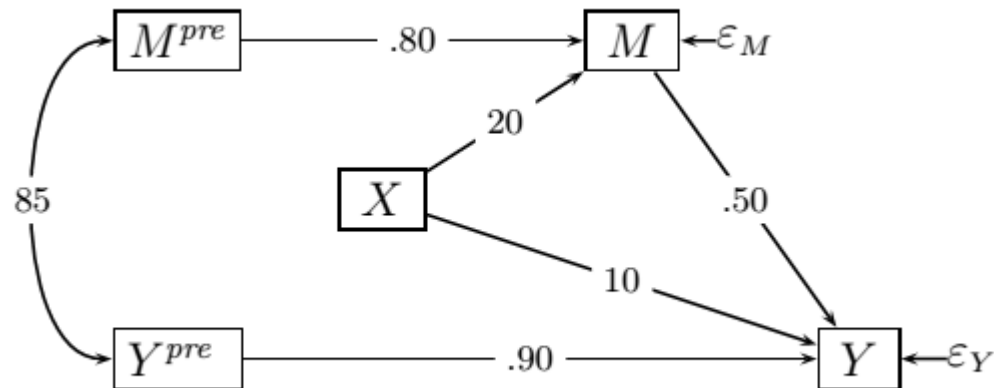


Bias in mediation models





Bias in mediation models





Bias in mediation models

- The mediator is a collider variable that opens up paths that induce dependencies between X and Y that are non-causal, thus biasing the direct (and indirect) effect – even if X is randomized
- Conditional on M , X and M_{pre} become correlated



Bias in mediation models

- Underlying structure of mediation model is important
- Adjusting on covariates almost always necessary, even when X is randomized



Equivalent models (partial mediation)

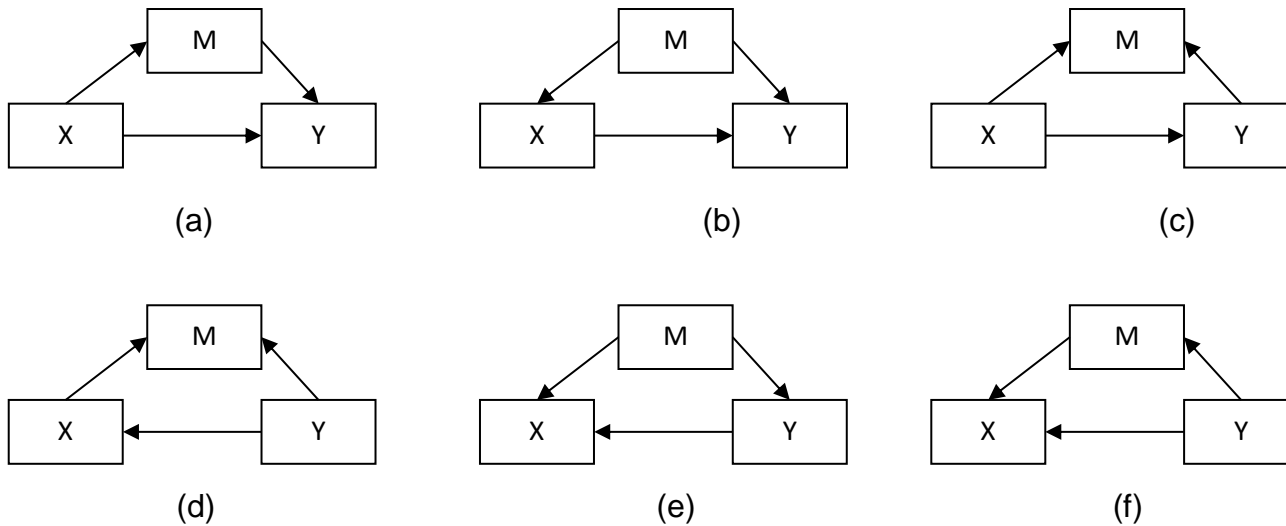


Figure 1. The six possible models of three inter-correlated variables in the absence of confounding. All six models imply the same d-separation (conditional independence) statements and are statistically indistinguishable.



Equivalent models (full mediation)

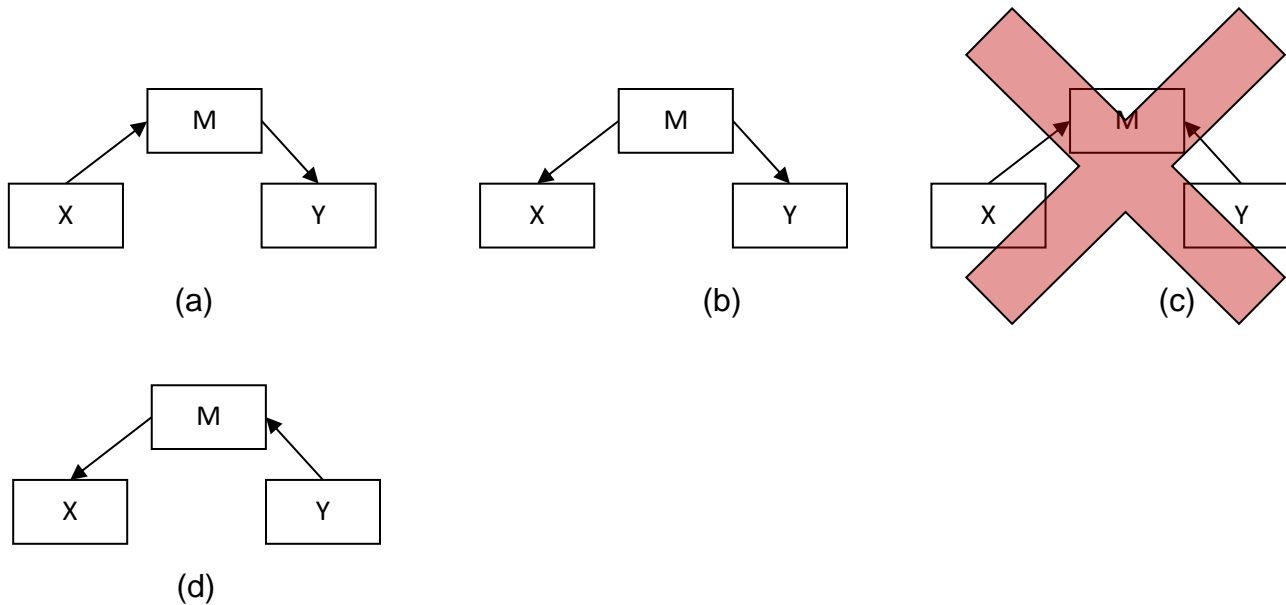


Figure 1. The three possible models of a full mediation model in the absence of confounding. All three models imply the same d-separation (conditional independence) statements and are statistically indistinguishable.



Equivalent models

- Equivalent models can be spelled out and can be refuted based on theoretical knowledge or temporal / causal precedence
- Local tests of fit can identify problematic parts of models



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Paradigm shifts