Statistical Power in Mediation Analysis for Repeated Measures Designs

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March 2, 2018 Atlanta, GA

Introduction

Mediation analysis is commonly used in social and personality research. Fritz and MacKinnon (2007) found that 75% of studies which use mediation analysis are underpowered. Changing the design of a study from between- to within-subjects can potentially increase power.

Two-instance repeated-measures designs, where participants are measured in instances (conditions or over time), are very common in psychology.

Montoya & Hayes (2017) showed how to do mediation analysis in these designs. This analysis examines if the effect of condition (manipulated within participants, e.g. happy story, sad story) influences some measured outcome (measured in each condition; e.g., helping) through some mediator (measured in each condition; e.g., empathy).

In this research we investigate if using a repeated-measures design has power advantages over a between-subjects design, and what factors influence statistical power in repeated-measures designs.

Monte Carlo Simulation

Generated 1000 datasets per condition and tested mediation using 6 methods of inference for both between and repeated-measures designs.

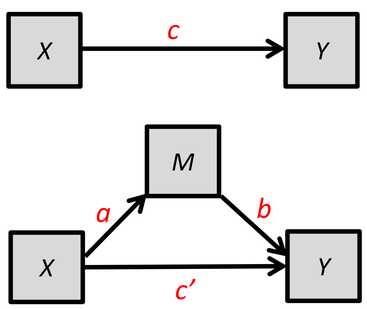
Population Characteristics:

- Sample size: 20, 50, 100, 200
- *a* path: 0, 0.14, 0.39, 0.59
- *b* path: 0, 0.14, 0.39, 0.59
- *c'* path: 0, 0.14, 0.39, 0.59
- *d* path: 0, 0.14, 0.39, 0.59
- ρ_M : 0, .3, .6, .9
- ρ_Y : 0, .3, .6, .9

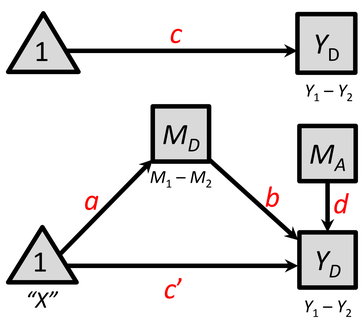
Methods of Inference:

- Causal Steps
- Joint Significance
- Sobel Test (1st and 2nd Order)
- Bootstrapping (Percentile)
- Monte Carlo CI

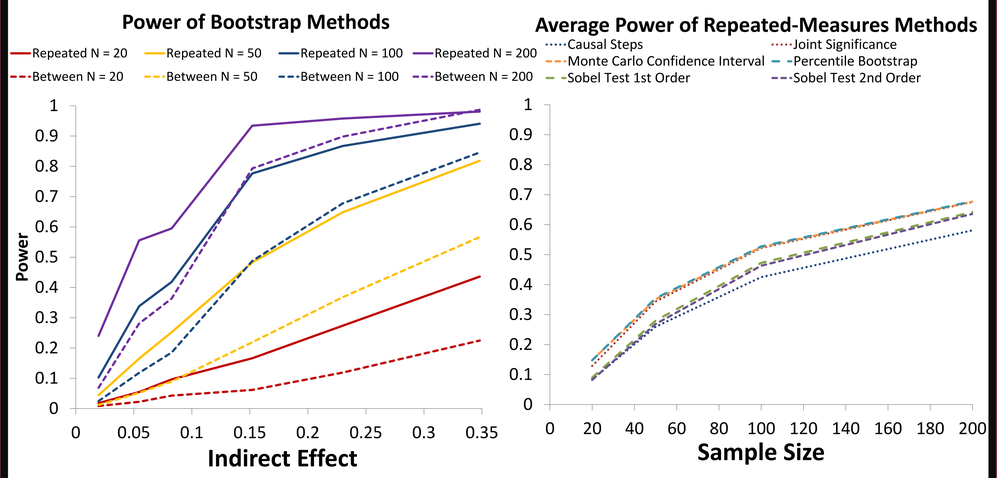
Between-Subjects Model



Repeated-Measures Model



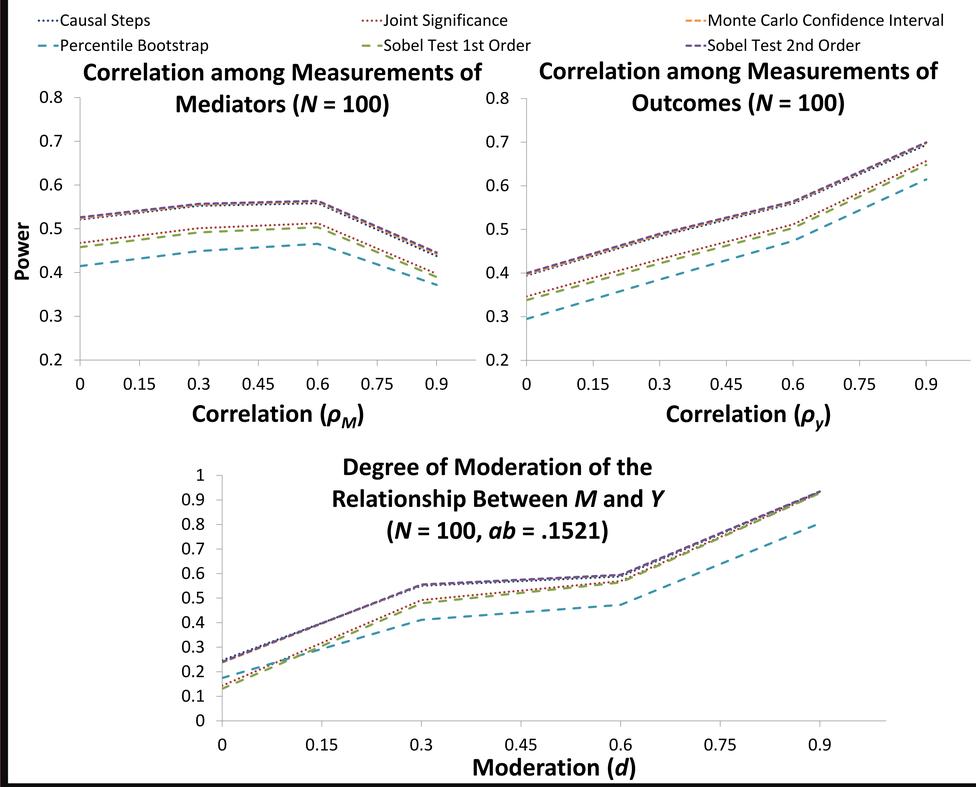
Power and Research Design



Design with Higher Power
(Proportion of Cases)

	CS	JS	Sobel1	Sobel2	Boot	MC
Repeated	0.94	0.91	0.92	0.92	0.91	0.92
Equal	0.02	0.00	0.01	0.02	0.00	0.00
Between	0.04	0.08	0.07	0.07	0.09	0.08

Factors Impacting Power in Repeated-Measures Designs



MEMORE: A Macro for Repeated-Measures Mediation

MEMORE is a macro for SPSS and SAS available at *akmontoya.com* that will estimate the total, direct, and indirect effects of *X* on *Y* through one or more mediators in the two-instance repeated-measures design.

Model Specification: After running the syntax file, a simple command can be used to run a within-subjects mediation analysis.

```
MEMORE Y = depA depB /M = medA medB
```

This command would estimate the direct and total effects of *X* on *Y* as well as the indirect effect of *X* on *Y* through *M* using a percentile bootstrap confidence interval based on 5,000 bootstrap samples.

Some options:

- Inferential methods for the indirect effect
  - Percentile bootstrap confidence interval
  - Bias-corrected bootstrap confidence interval
  - Monte Carlo confidence interval
  - Normal theory tests (i.e. Sobel test)
- Confidence level
- Number of resamples
- Pairwise contrasts for indirect effects
- Save bootstrap or Monte Carlo coefficients

EXAMPLE OUTPUT

Discussion

Repeated-measures mediation analysis has higher power than between-subjects mediation analysis with the same sample size.

One caveat is that all data were generating assuming no carry-over effects.

The cases when between-subjects methods had higher power were when correlation among mediators was very high (e.g., .9)

Mediation analysis in repeated-measures designs has highest power when correlation among mediators is moderate, correlation among outcomes is high, moderation is high, and bootstrapping or Monte Carlo CIs are used.

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