Within-Participant Statistical Mediation Analysis: A path-analytic framework

Scientific progress, particularly in social science, is heavily impacted by the types of statistical methods available and made accessible to practicing scientists. My research aims to extend an already popular statistical method, mediation analysis, to within-participant designs, and to provide an easy to use tool for researchers to implement this analysis in their own work. Statistical mediation analysis allows researchers to assess questions related to the process through which some effect occurs. When individuals are choosing between cake and an apple, what process do they use? Do they consider health benefits, taste, or ease of consumption? Mediation analysis is used to assess the effect of a presumed cause (e.g. type of snack) on some outcome (e.g. choice) through some intervening variable (e.g. taste). Linear regression or structural equation modeling are used to estimate the effect of the cause on the intervening variable (a-path) and the effect of the intervening variable on the outcome (b-path). Using algebra based on path-analytic mathematics the product of these two paths can be used to estimate the indirect effect (a⨯b), which is the effect of the cause on the outcome specifically through the intervening variable.

Statistical mediation analysis has been popularly used in a variety of social and behavioral sciences such as psychology, business, communications, and many more; however, methods for statistical mediation have been limited to specific kinds of data or experimental designs. When the presumed cause is purely observed (as opposed to manipulated) or assigned through an experimental design such that each individual is in one and only one condition, the methods for statistical mediation have been well discussed and established. In repeated-measures or within-participant designs, where individuals are measured more than once across different situations, statistical mediation analysis has been discussed very little. For example, researchers might ask individuals to read both a happy story and a sad story and report how connected they felt to the main character in each story. If the researcher believes that story tone (happy vs. sad) influences connection through mood while reading each story, the statistical methods for testing this question are underdeveloped. Judd et al. (2001) propose a series of individual hypothesis tests to assess mediation; however, in between-subjects or correlational designs, mediation researchers have moved on from individual tests to path-analytic methods which rely on an estimate of the indirect effect. Judd et al (2001), however, do not provide an estimate of such an effect.

My research aims to reframe the approach outlined by Judd et al (2001) into a path-analytic model, which will then allow for an estimate of an indirect effect in within-participant designs. I completed this work by using statistical principles developed when between-subjects mediation analyses transitioned from individual hypothesis tests to a path-analytic model. By transitioning into a path-analytic framework, we open opportunities for mediation analyses with multiple mediators working either in parallel (independently) or in serial (working together). I will outline extensions of the within-participant mediation model to multiple mediators. Additionally, I will discuss extensions to moderated mediation models, where some of the effects depend on other variables. For example, perhaps individuals are more likely to assess snack options based on taste when they are hungry, but if they are not hungry they are more likely to consider health benefits.

Researchers throughout the social sciences often conduct their own analyses using popular statistical packages (e.g. SPSS and SAS). However, these software packages do not have built in functions for inferential methods related to mediation. Other researchers have published plug-in like tools for these languages to allow researchers to easily implement complicated analyses like mediation in their prefered statistical package. As part of my research I have created a freely available, easy to use tool which can be used in SPSS or SAS, to allow researchers to conduct their own statistical mediation analyses for two-condition within-participant designs.

One of the primary goals of scientists is to understand the nature of cause. Particularly for social scientists, researchers are often interested in processes which occur within individual people. Mediation analysis has been key in understanding process, however, until this point it has not been generalized to intra-individual study designs. Within-participant designs boast higher statistical power and more closely examine effects occurring within an individual, which is incredibly important to researchers interested in decision making, social processes, learning, and many other cross-disciplinary topics. By pairing statistical mediation with within-participant designs researchers in these and many other areas will be much closer to understanding causal processes.