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# Explanation in Causal Inference: Methods for Mediation and Interaction

*By Tyler VanderWeele*



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**Explanation in Causal Inference: Methods for Mediation and Interaction** By Tyler VanderWeele

The book provides an accessible but comprehensive overview of methods for mediation and interaction. There has been considerable and rapid methodological development on mediation and moderation/interaction analysis within the causal-inference literature over the last ten years. Much of this material appears in a variety of specialized journals, and some of the papers are quite technical. There has also been considerable interest in these developments from empirical researchers in the social and biomedical sciences. However, much of the material is not currently in a format that is accessible to them. The book closes these gaps by providing an accessible, comprehensive, book-length coverage of mediation.

The book begins with a comprehensive introduction to mediation analysis, including chapters on concepts for mediation, regression-based methods, sensitivity analysis, time-to-event outcomes, methods for multiple mediators, methods for time-varying mediation and longitudinal data, and relations between mediation and other concepts involving intermediates such as surrogates, principal stratification, instrumental variables, and Mendelian randomization. The second part of the book concerns interaction or "moderation," including concepts for interaction, statistical interaction, confounding and interaction, mechanistic interaction, bias analysis for interaction, interaction in genetic studies, and power and sample-size calculation for interaction. The final part of the book provides comprehensive discussion about the relationships between mediation and interaction and unites these concepts within a single framework. This final part also provides an introduction to spillover effects or social interaction, concluding with a discussion of social-network analyses.

The book is written to be accessible to anyone with a basic knowledge of statistics. Comprehensive appendices provide more technical details for the interested reader. Applied empirical examples from a variety of fields are given throughout. Software implementation in SAS, Stata, SPSS, and R is provided. The book should be accessible to students and researchers who have completed a first-year graduate sequence in quantitative methods in one of the social- or biomedical-sciences disciplines. The book will only presuppose familiarity with linear and logistic regression, and could potentially be used as an advanced undergraduate book as well.

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### Editorial Review

#### Review

"VanderWeele's new book is a landmark achievement in the emerging field of causal inference, pulling together material scattered across dozens of technical journals into a coherent whole. The book blends intuitive explanation, rigor, and scholarship with a clear and friendly writing style, making it broadly accessible and a pleasure to read. It and its subsequent editions should become a standard teaching and reference work for decades to come." --Sander Greenland, Professor of Epidemiology and Statistics, UCLA

"Yes, mediation is an important topic. It has longed been used in the social sciences especially psychology. Of late there has been interest in many different fields including economics, sociology, epidemiology, political science and education, among other fields. Tyler VanderWeele is very qualified to author this book. He has contributed important work to the development of this topic and is a talented and careful researcher. I think there is potential for adoption in graduate courses in the social and biomedical sciences. I also think it could be widely purchased by applied researchers as a reference. I recommend publication." -- Luke Keele, Associate Professor, Department of Political Science, Penn State University

"Mediation is about understanding pathways between a treatment and an outcome that lead to the outcome, i.e., mechanisms. Mechanisms are a central thing in science and statisticians have been providing new principled methods for studying these topics over especially the last 10 years. Especially in the social and behavioral sciences and in epidemiology there has been great interest in these methods, and the methodology the author wants to write about is the new stuff from the last 10 years [VanderWeele] is the key player in statistical literature these days. He's a good communicator. Primary market: applied researchers doing mediation in epidemiology, social and behavioral sciences. Secondary market: applied statisticians teaching causal inference and/or working in the area. Yes, I think this might get some adoptions, and as the potential outcomes framework becomes more established in disciplines such as epidemiology and psychology, more adoptions." --Michael Sobel, Dept Sociology, Columbia

"Vanderweele has written the first book-length treatment of mediation and interaction (*née* moderation) using the causal-inference approach. Regardless of discipline, anyone who has a serious interest in the application of statistical methods to estimate, test, and probe causal processes will greatly benefit from this book." --David A. Kenny, Distinguished Board of Trustees and Alumni Professor, University of Connecticut

"Mediation analysis has been a highly active area of research in recent years, and VanderWeele arguably has been the most important contributor to this research. His book provides an accessible but comprehensive presentation of mediation, providing an introduction to both past and cutting-edge research. A must-read. An instant classic." --Christopher Winship, Diker-Tishman Professor of Sociology, Harvard University

"This outstanding book fills a void by describing new methods based on the counterfactual framework. VanderWeele provides a unified approach to several difficult aspects of mediation analysis." --David Mackinnon, Professor of Psychology, Arizona State University

"Have you ever tried to estimate how or why a cause leads to an effect, using methods you learned more than a few years ago? Want to know what you did wrong and how to fix it? Then I recommend you read this important and unusually accessible report from the cutting-edge of statistical science." --Gary King, Albert J. Weatherhead University Professor and Director of the Institute for Quantitative Social Science, Harvard University

#### About the Author

**Tyler J. VanderWeele, Ph.D.**, is a methodologist at Harvard University. He holds degrees in biostatistics, mathematics, finance, philosophy and theology and is currently Professor of Epidemiology in the Departments of Epidemiology and Biostatistics at the Harvard School of Public Health and a faculty affiliate of the Institute of Quantitative Social Science at Harvard University. His empirical research has been in epidemiology, various fields within the social sciences, and the study of religion and health.

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