## Introduction to Mediation, Moderation, and Conditional Process Analysis

A Regression-Based Approach

SECOND EDITION

Andrew F. Hayes

Series Editor's Note by Todd D. Little



## **Contents**

## PART I. FUNDAMENTALS 3 1 • Introduction 1.1 A Scientist in Training 1.2 Questions of Whether, If, How, and When 5 1.3 Conditional Process Analysis 1.4 Correlation, Causality, and Statistical Modeling 1.5 Statistical and Conceptual Diagrams, and Antecedent and Consequent Variables 1.6 Statistical Software 1.7 Overview of This Book 24 1.8 Chapter Summary 27 2 • Fundamentals of Linear Regression Analysis 29 2.1 Correlation and Prediction 2.2 The Simple Linear Regression Model 2.3 Alternative Explanations for Association 2.4 Multiple Linear Regression 2.5 Measures of Model Fit 54 2.6 Statistical Inference 56 . 2.7 Multicategorical Antecedent Variables 2.8 Assumptions for Interpretation and Statistical Inference 2.9 Chapter Summary PART II. MEDIATION ANALYSIS 77 3 • The Simple Mediation Model 3.1 The Simple Mediation Model 3.2 Estimation of the Direct, Indirect, and Total Effects of X 3.3 Example with Dichotomous X: The Influence of Presumed Media Influence 86 3.4 Statistical Inference

	3.5	An Example with Continuous X: Economic Stress	
		among Small-Business Owners 107	
	3.6	Chapter Summary 112	
4	Cau	sal Steps, Confounding, and Causal Order	113
		What about Baron and Kenny? 113	
		Confounding and Causal Order 121	
		Effect Size 132	
		Statistical Power 140	
		Multiple Xs or Ys: Analyze Separately or Simultaneously? 141	
	4.0	Chapter Summary 146	
<b>5</b> .	Nor	e Than One Mediator	147
5		<del></del>	147
		The Parallel Multiple Mediator Model 149	
		Example Using the Presumed Media Influence Study 154	
		Statistical Inference 161	
		The Serial Multiple Mediator Model 167	
		Models with Parallel and Serial Mediation Properties 180	
	5.6	Complementarity and Competition among Mediators 183	
	5.7	Chapter Summary 186	
		•	
6 .	Med	iation Analysis with a Multicategorical Antecedent	187
	6.1	Relative Total, Direct, and Indirect Effects 189	
		An Example: Sex Discrimination in the Workplace 195	
		Using a Different Group Coding System 204	
		Some Miscellaneous Issues 212	
		Chapter Summary 215	
	0.0	Chapter building 210	
	<b></b>	I MODEDATION ANALYSIS	
PΑ	RI II	I. MODERATION ANALYSIS	
7 .	Fund	damentals of Moderation Analysis	219
		Conditional and Unconditional Effects 223	
	7.2	An Example: Climate Change Disasters	
	72	and Humanitarianism 231	
		Visualizing Moderation 243	
		Probing an Interaction 248	
	7.5	The Difference between Testing for Moderation	
		and Probing It 259	
		Artificial Categorization and Subgroups Analysis 263	
	7.7	Chapter Summary 265	
8 4	Exte	nding the Fundamental Principles of Moderation Analysis	267
	8.1	Moderation with a Dichotomous Moderator 268	
		Interaction between Two Quantitative Variables 276	
		Hierarchical versus Simultaneous Entry 289	
		The Equivalence between Moderated Regression Analysis	
	J. I	and a 2 × 2 Factorial Analysis of Variance 292	
	8.5	Chapter Summary 301	

9 •	Som	e Myths and Additional Extensions of Moderation Analysis	303
	9.1	Truths and Myths about Mean-Centering 304	
		The Estimation and Interpretation of Standardized Regression	
		Coefficients in a Moderation Analysis 313	
	9.3	A Caution on Manual Centering and Standardization 319	
		More Than One Moderator 320	
		Comparing Conditional Effects 342	
		Chapter Summary 346	
	7.0	Chapter Summary 540	
10 •		icategorical Focal Antecedents and Moderators	349
	10.1	Moderation of the Effect of a Multicategorical	
		Antecedent Variable 350	
		An Example from the Sex Discrimination in the Workplace Study 354	
		Visualizing the Model 362	
	10.4	Probing the Interaction 366	
		When the Moderator Is Multicategorical 379	
	10.6	Using a Different Coding System 387	
		Chapter Summary 388	
PA	RT IV	V. CONDITIONAL PROCESS ANALYSIS	
11 •	Fund	damentals of Conditional Process Analysis	393
	11.1	Examples of Conditional Process Models in the Literature 397	
	11.2	Conditional Direct and Indirect Effects 402	
	11.3	Example: Hiding Your Feelings from Your Work Team 407	
	11.3 11.4	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414	
	11.3 11.4	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect	
	11.3 11.4 11.5	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417	
	11.3 11.4 11.5 11.6	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423	
	11.3 11.4 11.5 11.6	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417	
12 •	11.3 11.4 11.5 11.6 11.7	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423	431
12 •	11.3 11.4 11.5 11.6 11.7	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430 her Examples of Conditional Process Analysis	431
12 •	11.3 11.4 11.5 11.6 11.7 Furt 12.1	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis Revisiting the Disaster Framing Study 432	431
12 •	11.3 11.4 11.5 11.6 11.7 Furt 12.1	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional	431
12 •	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439	431
12 •	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453	431
12 •	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459	431
12 •	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453	431
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent	<b>431</b>
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470	
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1 13.2	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470 Looking at the Components of the Indirect Effect of X 480	
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1 13.2	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470	
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1 13.2 13.3	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470 Looking at the Components of the Indirect Effect of X 480	
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1 13.2 13.3 13.4	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470 Looking at the Components of the Indirect Effect of X 480 Relative Conditional Indirect Effects 487	
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1 13.2 13.3 13.4 13.5	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470 Looking at the Components of the Indirect Effect of X 480 Relative Conditional Indirect Effects 487 Testing and Probing Moderation of Mediation 491 Relative Conditional Direct Effects 495	
	11.3 11.4 11.5 11.6 11.7 Furt 12.1 12.2 12.3 12.4 12.5 Con 13.1 13.2 13.3 13.4 13.5 13.6	Example: Hiding Your Feelings from Your Work Team 407 Estimation of a Conditional Process Model Using PROCESS 414 Quantifying and Visualizing (Conditional) Indirect and Direct Effects 417 Statistical Inference 423 Chapter Summary 430  her Examples of Conditional Process Analysis  Revisiting the Disaster Framing Study 432 Moderation of the Direct and Indirect Effects in a Conditional Process Model 439 Statistical Inference 453 Mediated Moderation 459 Chapter Summary 467  ditional Process Analysis with a Multicategorical Antecedent Revisiting Sexual Discrimination in the Workplace 470 Looking at the Components of the Indirect Effect of X 480 Relative Conditional Indirect Effects 487 Testing and Probing Moderation of Mediation 491 Relative Conditional Direct Effects 495	

Þ	Δ	B,	T	V	. M	1	9	C	FI	1	1	ΔI	N	F	Δ

14 •	Misc	ellaneous Topics and Some Frequently Asked Questions		507		
		A Strategy for Approaching a Conditional Process Analysis	509			
		How Do I Write about This? 514				
	14.3	Should I Use Structural Equation Modeling Instead of				
		Regression Analysis? 527				
		The Pitfalls of Subgroups Analysis 530				
	14.5	Can a Variable Simultaneously Mediate and Moderate Another Variable's Effect? 536	,			
	14.6	Interaction between X and M in Mediation Analysis 540				
	14.7	Repeated Measures Designs 541				
	14.8	Dichotomous, Ordinal, Count, and Survival Outcomes 545				
	14.9	Chapter Summary 546				
APP	ENI	DICES				
<b>A •</b> l	Jsing	PROCESS		551		
B • Constructing and Customizing Models in PROCESS						
C • Monte Carlo Confidence Intervals in SPSS and SAS						
	Refe	rences	i	637		
	Auth	or Index		668		
	Subj	ect Index		679		
	Abou	ut the Author	~,	692		

Data files for the examples used in the book and files containing the SPSS and SAS versions of PROCESS are available on the companion web page at www.afhayes.com.