

# Contents

<i>List of Figures</i>	page xii
<i>List of Tables</i>	xv
<i>Preface</i>	xvii
<i>Acknowledgments</i>	xix
PART I. INTRODUCTION	
1 Sequence Analysis in the Social Sciences	3
1.1 Timing and Context of the Book	4
1.2 Contributions	7
1.3 Audience and Scope	9
1.4 Related References	14
1.5 Plan of the Book	16
PART II. THEORETICAL BACKGROUND	
2 Theoretical Foundations of Social Sequence Analysis	21
2.1 What Are Social Sequences?	21
2.2 The Structural Origins of Social Sequences	22
2.3 Why Social Sequences Matter	25
2.4 Origins of Social Sequence Analysis Techniques	32
2.4.1 <i>Narrative Positivism</i>	33
2.4.2 <i>The Relational Nature of Social Phenomena</i>	36
2.4.3 <i>The Development of Whole-Sequence Analysis Methods</i>	38
2.4.4 <i>Pivotal Criticisms</i>	41
2.5 The Second Wave of Social Sequence Analysis	45
2.5.1 <i>Sequences as Networks</i>	46
2.5.2 <i>Microsequence Analysis</i>	52
2.6 Looking Ahead	55

PART III. SOCIAL SEQUENCE ANALYSIS CONCEPTS  
AND TECHNIQUES

3	Sequence Analysis Concepts and Data	59
3.1	Sequence Properties	59
3.1.1	<i>Positions</i>	60
3.1.2	<i>Elements</i>	60
3.1.3	<i>Substructures</i>	61
3.1.4	<i>Subjects</i>	62
3.2	Key Issues in Sequence Data	62
3.2.1	<i>Recurrence</i>	63
3.2.2	<i>Ties and Multidimensionality</i>	65
3.2.3	<i>Gaps</i>	66
3.3	The Sequence Universe	67
3.3.1	<i>Size</i>	67
3.3.2	<i>Boundary Specification</i>	69
3.4	Sequence Data	70
3.4.1	<i>Data Collection</i>	70
3.4.2	<i>Element-Position Sampling</i>	73
3.4.3	<i>Units of Measure</i>	74
3.5	Data Used in This Book	75
3.5.1	<i>The Survey of Health, Ageing, and Retirement in Europe (SHARE)</i>	75
3.5.2	<i>The Correlates of War Global Trade Network</i>	76
3.5.3	<i>The Davis, Gardner, and Gardner Deep South Study</i>	78
3.5.4	<i>The Multinational Time Use Study (MTUS)</i>	79
3.5.5	<i>The American Time Use Survey (ATUS)</i>	80
4	Detecting Sequence Structure	83
4.1	Descriptive Analysis	83
4.1.1	<i>Sequence Length</i>	84
4.1.2	<i>Element Frequencies</i>	84
4.1.3	<i>n-grams</i>	85
4.1.4	<i>Position Reports</i>	85
4.2	Describing Stochastic Patterns	86
4.2.1	<i>Transition Matrices</i>	86
4.2.2	<i>Markov Chains</i>	91
4.3	Sequential Connection	91
4.3.1	<i>Empirical Illustration: Gender Differences in the Parenthood-Stress Link</i>	93
4.4	Stationarity	94
4.4.1	<i>Empirical Illustration: Stationarity in the World System</i>	96
4.5	Spells	97

4.6	Homogeneity	98
4.7	On Using Summary Statistics and Tests	99
4.8	Visual Aids	100
4.8.1	<i>Transition Bubble Graphs</i>	100
4.8.2	<i>State Transition Diagrams</i>	101
4.8.3	<i>Sequence Index Plots</i>	102
4.8.4	<i>State Distribution Graphs</i>	104
4.8.5	<i>Tempograms</i>	104
4.8.6	<i>Sequence-Network Diagrams</i>	105
4.8.7	<i>On the Use of Color and Grayscale</i>	105
4.9	Looking Ahead	108
5	Whole-Sequence Comparison Methods	109
5.1	Sequence Alignment	110
5.1.1	<i>Sequence Alignment Operations</i>	110
5.1.2	<i>Operation Costs and Distance</i>	111
5.2	Classical Optimal Matching (OM)	111
5.2.1	<i>Finding the Optimal Solution</i>	113
5.2.2	<i>The Needleman–Wunsch Algorithm</i>	114
5.3	Basic Operation Cost Regimes	115
5.3.1	<i>Levenshtein Distance</i>	115
5.3.2	<i>Levenshtein II Distance</i>	115
5.3.3	<i>Hamming Distance</i>	116
5.4	Considerations in Setting Operation Costs	116
5.4.1	<i>Order versus Timing</i>	116
5.4.2	<i>Time Warping</i>	118
5.5	Criticisms of Classical OM	119
5.5.1	<i>Theory/Method Fit</i>	120
5.5.2	<i>Arbitrary Operation Costs</i>	120
5.6	Improvements on Classical OM	122
5.6.1	<i>Variable Substitution Costs</i>	122
5.6.2	<i>Distance Normalization</i>	124
5.6.3	<i>Reference Sequence Comparison</i>	125
5.6.4	<i>Spell-Adjusted Distances</i>	126
5.6.5	<i>The Dynamic Hamming Method</i>	127
5.7	Detecting Whole Sequence Patterns	129
5.7.1	<i>Hierarchical Cluster Analysis</i>	130
5.7.2	<i>Identifying Sequence Classes</i>	133
5.7.3	<i>Assessing Validity and Reliability</i>	136
5.7.4	<i>Describing Sequence Classes</i>	139
5.8	Recent Advances in Sequence Comparison	143
5.8.1	<i>Multidimensional Sequence Analysis</i>	144
5.8.2	<i>Two-Stage Optimal Matching (2SOM) Analysis</i>	146
5.8.3	<i>Transition Sequence Analysis</i>	147

5.8.4	<i>Nonalignment Techniques</i>	148
5.8.5	<i>Beyond Cluster Analysis</i>	150
PART IV. NEW DIRECTIONS IN SOCIAL SEQUENCE ANALYSIS		
6	Network Methods for Sequence Analysis	155
6.1	Theoretical Rationale	156
6.1.1	<i>Networks of Sequences</i>	156
6.1.2	<i>Sequences as Bases of Affiliations</i>	160
6.2	Network Concepts and Terms	163
6.2.1	<i>Network Matrices and Components</i>	163
6.2.2	<i>Directed and Undirected Networks</i>	164
6.2.3	<i>One- and Two-Mode Networks</i>	165
6.2.4	<i>Subject Comembership and Element Overlap</i>	165
6.3	Sequence-Network Construction	167
6.3.1	<i>Nonrecurrent Sequence Networks</i>	167
6.3.2	<i>Recurrent Sequence Affiliation Networks</i>	170
6.3.3	<i>Directed Sequence Networks</i>	171
6.3.4	<i>Multidimensional Sequence Networks</i>	172
6.4	Visualization	172
6.4.1	<i>Relationships among Subjects</i>	173
6.4.2	<i>Two-Mode Ordered Event Networks</i>	174
6.4.3	<i>Two-Mode Recurrent Sequences</i>	176
6.4.4	<i>Directed Sequence Networks</i>	179
6.5	Structural Measures for Sequence Networks	184
6.6	Identification of Subject/Element Subsets	189
6.6.1	<i>Subsets in Sequence Affiliation Networks</i>	190
6.6.2	<i>Element Subsets in Directed Sequence Networks</i>	193
6.6.3	<i>Sequence Motifs</i>	195
6.7	Event Structure Analysis	196
6.8	Statistical Network Models for Sequential Events	200
6.8.1	<i>Exponential Random Graph (<math>p^*</math>) Models</i>	200
6.8.2	<i>ERGMs for Ordered Nonrecurrent Sequence Networks</i>	201
6.9	Dynamic Sequence Networks	202
6.9.1	<i>Subject- and Element-Level Change</i>	203
6.9.2	<i>Sequence Subset Evolution</i>	206
6.9.3	<i>Whole Sequence-Network Evolution</i>	207
6.10	Conclusion	209
7	Social Microsequence Analysis	210
7.1	An Exemplary Sequence Context	211
7.2	The Elements of Social Microsequences	214
7.2.1	<i>Relationship to Microinteraction Sequences</i>	215

<i>Contents</i>	xi
7.2.2 <i>Elements and Positions</i>	215
7.2.3 <i>Data Collection and Availability</i>	216
7.3 <i>Nonnetwork Sequence Approaches</i>	217
7.3.1 <i>OM Sequence Classification</i>	220
7.3.2 <i>Transition and Switching Analysis</i>	222
7.4 <i>Sequence-Network Approaches</i>	226
7.4.1 <i>Synchrony</i>	227
7.4.2 <i>Measurement of Synchrony</i>	230
7.4.3 <i>Identifying Sources of Synchrony</i>	238
7.4.4 <i>Routine</i>	241
7.4.5 <i>Measurement and Visualization of Routine</i>	244
7.5 <i>Next Steps</i>	251
PART V. CONCLUSIONS	
8 <i>The Promise of Social Sequence Analysis</i>	255
8.1 <i>Limitations</i>	256
8.2 <i>Future Research</i>	257
8.2.1 <i>Routine and Routinization</i>	257
8.2.2 <i>Sequence Networks, Network Sequences</i>	258
8.2.3 <i>Sequential Statistical Inference</i>	259
8.2.4 <i>Data Collection</i>	261
<i>Appendix A Recent Whole-Sequence Pattern Analyses</i>	263
<i>Appendix B Linkage Criteria for Agglomerative     Hierarchical Clustering</i>	270
<i>References</i>	275
<i>Index</i>	303