

Contents

Introduction **V**
Alexander Mehler, Andy Lücking, Sven Banisch, Philippe Blanchard, Barbara Frank-Job

1 On the Content of This Book **V**
2 Overview of the Book **VII**
2.1 Part I: Cognition **VII**
2.2 Part II: Topology **VII**
2.3 Part III: Syntax **VIII**
2.4 Part IV: Dynamics **VIII**
2.5 Part V: Resources **IX**

Part I: Cognition

Language Networks as Models of Cognition: Understanding Cognition through Language **3**
Nicole M. Beckage, Eliana Colunga

1 Introduction **3**
2 Language as a Network **5**
2.1 Semantic Networks **5**
2.2 Phonological Networks **6**
3 Global Level Network Structure **7**
3.1 Small-World Structure **8**
3.2 Scale-Free Networks **10**
4 Human Performance in Relation to Network Structure **11**
4.1 Spreading Activation **11**
4.2 Frequency Effects **15**
5 Network Models within Linguistic Networks **16**
5.1 Acquisition **17**
5.2 Network Navigation **21**
6 Understanding Atypical Processes **23**
7 The Future of Language Networks **25**
References **26**

Path-Length and the Misperception of Speech: Insights from Network Science and Psycholinguistics 29

Michael S. Vitevitch, Rutherford Goldstein, Elizabeth Johnson

1	Introduction	29
2	Network Analysis: What Can Be Perceived When Speech Is Misperceived?	31
3	Psycholinguistic Experiment: What Is Perceived When Speech Is Misperceived?	34
3.1	Method	35
3.2	Results	37
4	Conclusion	40
	References	43

Structure and Organization of the Mental Lexicon: A Network Approach Derived from Syntactic Dependency Relations and Word Associations 47

Simon De Deyne, Steven Verheyen, Gert Storms

1	Introduction	47
1.1	Macro-, Meso-, and Microscopic Properties of the Mental Lexicon	48
1.2	Acquiring a Mental Lexicon through Language	50
1.3	Chapter Outline	51
2	Constructing the Networks	53
2.1	Mental Networks	53
2.2	Language Networks	54
3	Exploring the Structure of Language and Mental Networks	56
3.1	Macroscopic Structure	56
3.2	Mesosopic Structure	59
3.3	Semantic Relatedness Evaluation	66
4	Discussion	70
4.1	Relationship between Language and Word Associations	72
4.2	Final Words	73
	References	74

Part II: Topology

Network Motifs Are a Powerful Tool for Semantic Distinction 83

Chris Biemann, Lachezar Krumov, Stefanie Roos, Karsten Weihe

1	Introduction	84
2	Related Work	86
3	The Case Studies	87
3.1	Co-occurrence Graphs from Natural Vs. Artificial Language	87
3.2	Co-occurrence Graphs from Verbs Vs. Other Word Classes	94

3.3	Peer-to-Peer Streaming Networks	99
3.4	Co-Authorship Networks from Two Subdisciplines of Physics	100
3.5	Mailing Networks	102
4	Conclusions and Outlook	103
	References	103
Multidimensional Analysis of Linguistic Networks		107
<i>Tanya Araújo, Sven Banisch</i>		
1	Introduction	107
2	Linguistic Networks Are Special	109
2.1	Three Types of Networks	109
2.2	Network Induction	112
3	Three Levels of Statistical Analysis	114
3.1	A Brief Note on Signal Processing on Graphs	115
3.2	The Statistical Levels	115
3.3	Stylized Facts in Network Analysis	116
3.4	Levels in the Statistical Analysis of Networks	118
4	On the Intelligibility of Statistical Indicators in Linguistic Networks	120
4.1	Path-Based Measures	120
4.2	Links and Flows, Structure and Function	121
4.3	Types of Network Flow	122
4.4	Flow in Linguistic Networks	122
5	Examples	124
6	Discussion	124
7	Concluding Remarks	126
	References	127
Semantic Space as a Metapopulation System: Modelling the Wikipedia Information Flow Network		133
<i>A. Paolo Masucci, Alkiviadis Kalampokis, Víctor M. Eguíluz, Emilio Hernández-García</i>		
1	Introduction	133
2	The Dataset	136
3	Topology of the Semantic Space	136
4	Modelling the Semantic Space	141
5	Discussion	143
	Appendix	145
	References	148
Are Word-Adjacency Networks Networks?		153
<i>Katharina Anna Zweig</i>		
1	Introduction	153
1.1	Perspectives of Network Analysis	154

2	Definitions	156
2.1	Definition of Word-Adjacency Networks	156
3	Walk-Based Methods and Network Flows	157
3.1	Models of Walks	159
4	Word-Adjacency Networks in the Literature	160
5	Summary	162
	References	163

Part III: Syntax

Syntactic Complex Networks and Their Applications 167

Radek Čech, Ján Mačutek, Haitao Liu

1	Introduction	167
2	Basic Characteristics of Syntactic Networks	168
3	Early Development of Syntactic Complex Network Analysis	169
4	Role of Syntax in Syntactic Dependency Complex Networks	172
5	Preprocessing of Data for a Syntactic Complex Network Analysis – Pitfalls to be Avoided	177
6	Applications of Syntactic Complex Networks to Language Typology and Acquisition	179
6.1	Language Typology	180
6.2	Language Acquisition	181
7	Conclusion	182
	References	183

Function Nodes in Chinese Syntactic Networks 187

Xinying Chen, Haitao Liu

1	Introduction	187
2	The Chinese Dependency Networks for This Study	189
3	Chinese Function Words	192
4	Chinese Function Words in the Language Networks	193
4.1	Network Properties of Chinese Function Words	193
4.2	Network Manipulation	196
5	Conclusion	198
	References	199

Non-crossing Dependencies: Least Effort, Not Grammar 203

Ramon Ferrer-i-Cancho

1	Introduction	203
2	The Syntactic Dependency Structure of Sentences	207
3	The Null Hypothesis	208
4	Alternative Hypotheses	212
4.1	A Principle of Minimization of Dependency Crossings	213
4.2	A Principle of Minimization of Dependency Lengths ...	214

4.3	The Relationship between Minimization of Crossings and Minimization of Dependency Lengths	216
5	A Stronger Null Hypothesis	219
5.1	The Probability That Two Edges Cross	220
5.2	The Expected Number of Edge Crossings	221
6	Another Stronger Null Hypothesis	224
7	Predictions, Testing and Selection	224
8	Discussion	227
	Appendix	229
	References	231

Part IV: Dynamics

Simulating the Effects of Cross-Generational Cultural Transmission on Language Change 237

Tao Gong, Lan Shuai

1	Introduction	237
2	Modified Acquisition Framework	240
3	Simulation Results	242
4	Discussions and Conclusions	244
	Appendix	248
	References	254

Social Networks and Beyond in Language Change 257

Gareth J. Baxter

1	Introduction	257
2	Utterance Selection Model of Language Change	258
3	Numerical Model	260
4	Analysis	264
5	Social Networks in the Neutral Model	267
6	Weighted Interactor Selection	268
6.1	Asymmetry Independent of Network Structure	269
6.2	Asymmetry Depends on Speakers Degree	272
7	Conclusions	274
	Appendix	275
	References	276

Emergence of Dominant Opinions in Presence of Rigid Individuals 279

Suman Kalyan Maity, Animesh Mukherjee

1	Introduction	279
2	Related Work	282
3	The Model Description	283
4	Results and Discussion	283
4.1	The Mean-Field Case	283
4.2	Scale-Free Networks	287

5	Time-Varying Networks	290
5.1	Dataset Description	291
5.2	The Model Adaptation in the Time-Varying Setting	291
5.3	Results and Discussion	292
6	Conclusions and Future Works	294
	References	294

Part V: Resources

Considerations for a Linguistic Network Markup Language 299

Maik Stührenberg, Nils Diewald, Rüdiger Gleim

1	Introduction	299
2	Data Formats	299
2.1	Data Models	300
2.2	Data Structures	301
2.3	Data Serialization	302
3	Existing Formats	304
3.1	GML	305
3.2	XGMML	306
3.3	GraphXML	307
3.4	GraphML	309
3.5	GXL	311
3.6	GrAF	313
3.7	Summary	315
4	Network Tools	315
5	Proposal for a Linguistic Network Markup Language	318
5.1	Extending GraphML by Redefinition	320
5.2	Extending GraphML by XML Namespaces	322
5.3	Example Instance	325
6	Conclusion	327
	References	327

Linguistic Networks – An Online Platform for Deriving Collocation

Networks from Natural Language Texts 331

Alexander Mehler, Rüdiger Gleim

1	Introduction	331
2	On the Parameter Space of LN	334
3	The Software Architecture of LN	336
4	Summary	340
	References	340