The Cambridge Handbook of Biolinguistics

Biolinguistics involves the study of language from a broad perspective that embraces natural sciences, helping us better to understand the fundamentals of the faculty of language. This handbook offers the most comprehensive state-of-the-field survey of the subject available. A team of prominent scholars working in a variety of disciplines is brought together to examine language development, language evolution, and neurosciences, as well as providing overviews of the conceptual landscape of the field. The handbook includes work at the forefront of contemporary research devoted to the evidence for a language instinct, the Critical Period Hypothesis, grammatical maturation, bilingualism, the relation between mind and brain, and the role of natural selection in language evolution. It will be welcomed by graduate students and researchers in a wide range of disciplines, including linguistics, evolutionary biology, and cognitive science.

Cedric Boeckx is ICREA Research Professor at the Catalan Institute for Advanced Studies, and a member of the Linguistics Department at the University of Barcelona.

Kleanthes K. Grohmann is Associate Professor of Biolinguistics at the University of Cyprus and Director of the Cyprus Acquisition Team.
We would like to dedicate this handbook to Eric Lenneberg (1921–1975), whose early efforts set the standard for a biological science of language.
Contents

List of figures ix
List of tables xii
List of contributors xiii
Acknowledgements xv

1 Introducing the volume Kleanthes K. Grohmann and Cedric Boeckx 1
2 Biolinguistics: A historical perspective Lyle Jenkins 4
3 Biolinguistics yesterday, today, and tomorrow Massimo Piattelli-Palmarini 12
4 The philosophical foundations of biolinguistics James McGilvray 22

Part I Language development 47
5 (Evidence for) the language instinct Ianthi Maria Tsimpli 49
6 Sensitive phases in successive language acquisition: The critical period hypothesis revisited Jürgen M. Meisel 69
7 Discovering word forms and word meanings: The role of phrasal prosody and function words Séverine Millotte, Elodie Cauvet, Perrine Brusini, and Anne Christophe 86
8 Luria’s biolinguistic suggestion and the growth of language Ken Wexler 94
9 Parameters in language acquisition Lisa Pearl and Jeffrey Lidz 129
10 Bilingualism beyond language: On the impact of bilingualism on executive control Mireia Hernández, Clara D. Martín, Núria Sebastián-Gallés, and Albert Costa 160
CONTENTS

Part II  Mind, brain, behavior
11 The role of experimental syntax in an integrated cognitive science of language  Jon Sprouse and Diogo Almeida  179
12 Working memory and language processing: Theory, data, and directions for future research  Matthew W. Wagers and Brian McElree  181
13 Computational primitives in phonology and their neural correlates  Philip J. Monahan, Ellen F. Lau, and William J. Idsardi  203
14 Computational primitives in syntax and possible brain correlates  Matthias Schlesewsky and Ina Bornkessel-Schlesewsky  233
15 Computational primitives in morphology and possible brain correlates  Ina Bornkessel-Schlesewsky and Matthias Schlesewsky  257
16 Grounding the cognitive neuroscience of semantics in linguistic theory  Liina Pykkänen, Jonathan Brennan, and Douglas Bemis  283
17 Modularity and descent-with-modification  Gary F. Marcus, Cristina D. Rabaglia, and Hugh Rabagliati  309
18 The role of Broca’s area in language function  Gregory Hickok  326
19 Lexical retrieval and its breakdown in aphasia and developmental language impairment  Naama Friedmann, Michal Biran, and Dror Dotan  341
20 Genetics of language: Roots of specific language deficits  Antonio Benítez-Burraco  350

Part III  Language evolution
21 The cognitive capacities of non-human primates  Klaus Zuberbühler  413
22 Birdsong for biolinguistics  Kazuo Okanoya  415
23 Language, culture, and computation: An adaptive systems approach to biolinguistics  Simon Kirby  431
24 Language and natural selection  Derek Bickerton  460

Notes  524
References  539
Index  671
Figures

Figure 7.1  Mean percentage of head-turns for 16-month-old French infants in the bisyllabic group and in the monosyllabic group to sentences containing the bisyllabic word and sentences containing its two syllables separated by a phonological phrase boundary (figure adapted from Millotte et al. 2010).  page 89

Figure 7.2  Mean percentage of pointing responses from 23-month-old French infants in the verb group and in the noun group towards videos depicting the familiar action and a new action (figure adapted from Bernal et al. 2007).  92

Figure 8.1  Proportions of variance in language-deficit status attributable to genes, environmental influences shared by both twins, or other influences (Bishop et al. 2006).  117

Figure 9.1  The Gaussian distribution, with different values of $\mu$ and $\sigma^2$. Courtesy of Wikipedia Commons.  130

Figure 10.1  Stroop-like tasks as a tool to measure conflict processing.  168

Figure 10.2  The two signatures of bilingualism in conflict processing.  169

Figure 10.3  Schematic illustration of Costa et al.'s (2009) meta-analysis showing in which proportion bilingualism modulates performance in Stroop-like tasks.  170
Figure 10.4 (a) Overall RTs broken by group of participants, task-version, and type of trial taken from Costa et al. (2009). (b) Difference between bilinguals and monolinguals in overall RTs (congruent and incongruent trials collapsed) as a function of task-version.

Figure 11.1 The sample size required to reach 80% power for the combined set of 95 effect sizes for both forced-choice and magnitude estimation experiments.

Figure 11.2 Example results for main effects and interaction.

Figure 12.1 Hypothetical SAT functions.

Figure 12.2 The focal attention advantage in three trial types.

Figure 12.3 McElree, Foraker, and Dyer (2003) Focal attention and subjects.

Figure 12.4 Two different conceptions of the capacity of focal attention in language processing.

Figure 14.1 Lateral view of the left hemisphere of the human brain including a schematic depiction of the brain regions discussed in this chapter.

Figure 14.2 Schematic illustration of how the hierarchy of cognitive control processes assumed by Koechlin and colleagues (Koechlin et al., 2003; Koechlin and Summerfield, 2007) can be applied to different aspects of linguistic sequencing.

Figure 14.3 Illustration of the incremental application of Merge in the approach by Phillips (1996, 2003).

Figure 14.4 Illustration of the incremental application of Merge in the approach by Haider (1992, 2000, 2012).

Figure 16.1 Summary of all our AMF results to date, including the typical MEG response to a visual word presentation in a sentential context.

Figure 18.1 Broca’s area is traditionally defined as the posterior portion of the inferior frontal gyrus of the left hemisphere, including the pars triangularis (light grey) and pars opercularis (dark grey).

Figure 19.1 Stages in lexical retrieval.

Figure 19.2 The dual-route model for single word reading.

Figure 19.3 Errors and effects that characterize each of the types of anomia.

Figure 19.4 The loci of impairment of four children with developmental anomia.

Figure 21.1 Experimental design and results to determine whether Diana monkeys are able to process the semantic properties associated with alarm calls (Zuberbühler et al. 1999).
Figure 21.2  (a): Photograph of the artificial beehive, consisting of a cavity with a narrow opening filled with honey beneath the surface (photograph by Thibaud Gruber). (b): Photograph of the “leaky stick,” the multi-functional tool provided to subjects to extract honey in three different ways: as a “stick” (by inserting the bare end), “brush” (by inserting the leafy end) or “leaf sponge,” by removing and chewing its leaves and inserting the resulting sponge (photograph by Thibaud Gruber).

Figure 21.3  Sequential analyses of the first 10 song notes in both predatory and duet song contexts.

Figure 21.4  Composition of Campbell’s monkey call sequences in different behavioral contexts.

Figure 21.5  (a) A playback experiment is carried out in the Tai Forest, Ivory Coast, to investigate the communication of wild chimpanzees in response to members of their own group as well as of neighboring and stranger groups. (b) Playbacks were carried out in the border areas of the home ranges of three chimpanzee groups habituated to the presence of human observers (Herbinger et al. 2001).

Figure 22.1  Birdsong terminology.

Figure 22.2  The schematic diagram of the brain of the songbird; description of the song system.

Figure 22.3  A sonogram and finite-state syntax extracted from a Bengalese finch.

Figure 22.4  Sonograms from a Bengalese finch and a white-rumped munia.

Figure 23.1  Smith’s (2002) populations model.

Figure 23.2  How a language can be compressed in such a way as to optimally trade off fit to data and generality using MDL.

Figure 23.3  An example of the evolution of grammars in Brighton’s simulation.

Figure 23.4  The three complex adaptive systems that underpin language, and their interactions. From Christiansen and Kirby (2003b).

Figure 23.5  Two “fitness landscapes” corresponding to a similar adaptive challenge with and without learning.
# Tables

11.1 Independent manipulation of dependency length and island structures.  

15.1 Summary of the key neurophysiological and neuroanatomical evidence for and against dual-route assumptions.  

21.1 Communication behavior of chimpanzees in response to the simulated presence of members of their own or other groups.
Contributors

Diogo Almeida, Assistant Professor, Michigan State University, USA
Sergio Balari, Professor, Universitat Autònoma de Barcelona and Center for Theoretical Linguistics, Spain
Douglas Bemis, Post-doctoral Research Fellow, INSERM-CEA, NeuroSpin, France
Antonio Benitez-Burraco, Assistant Professor, University of Huelva, Spain
Derek Bickerton, Professor Emeritus, University of Hawaii, USA
Michal Biran, Lecturer, Haifa University, Israel
Cedric Boeckx, ICREA Research Professor, Catalan Institute for Advanced Studies and University of Barcelona, Spain
Ina Bornkessel-Schlesewsky, Professor, University of Marburg, Germany
Jonathan Brennan, Assistant Professor, University of Michigan at Ann Arbor, USA
Perrine Brusini, Graduate Student, Ecole Normale Supérieure, Paris, France
Elodie Cauvet, Graduate Student, Ecole Normale Supérieure, Paris, France
Anne Christophe, CNRS Researcher, Ecole Normale Supérieure, Paris, France
Albert Costa, ICREA Research Professor, Catalan Institute for Advanced Studies and Pompeu Fabra University, Spain
Dror Dotan, Graduate Student, Tel Aviv University, Israel and INSERM, France
Naama Friedmann, Professor, Tel Aviv University, Israel
Kleanthes K. Grohmann, Associate Professor, University of Cyprus, Cyprus
LIST OF CONTRIBUTORS

Mireia Hernández, Graduate Student, Pompeu Fabra University, Spain
Gregory Hickok, Professor, University of California at Irvine, USA
William J. Idsardi, Professor, University of Maryland at College Park, USA
Lyle Jenkins, Researcher, Biolinguistics Institute, USA
Simon Kirby, Professor, University of Edinburgh, United Kingdom
Ellen F. Lau, Assistant Professor, University of Maryland at College Park, USA
Jeffrey Lidz, Professor, University of Maryland at College Park, USA
Victor M. Longa, Associate Professor, Universidade de Santiago de Compostela, Spain
Guillermo Lorenzo, Professor, Universidad de Oviedo, Spain
Gary F. Marcus, Professor, New York University, USA
Clara D. Martin, Post-doctoral Research Fellow, Pompeu Fabra University, Spain
Brian McElree, Professor, New York University, USA
James McGilvray, Professor (retired), McGill University, Canada
Jürgen M. Meisel, Professor Emeritus, University of Hamburg, Germany and Adjunct Professor, University of Calgary, Canada
Séverine Millotte, Associate Professor, University of Bourgogne, Dijon, France
Philip J. Monahan, Post-doctoral researcher, Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain
Kazuo Okanoya, Professor, University of Tokyo, Japan
Lisa Pearl, Assistant Professor, University of California at Irvine, USA
Massimo Piattelli-Palmarini, Professor, University of Arizona, USA
Liina Pytlkänen, Associate Professor, New York University, USA
Cristina D. Rabagliati, Graduate Student, New York University, USA
Hugh Rabagliati, Post-doctoral Research Associate, Harvard University, USA
Matthias Schlesewsky, Professor, Johannes Gutenberg-University Mainz, Germany
Núria Sebastián-Galles, Professor, Pompeu Fabra University, Spain
Jon Sprouse, Assistant Professor, University of California at Irvine, USA
Ianthi Maria Tsimpli, Professor, Aristotle University of Thessaloniki, Greece
Matthew Wagers, Assistant Professor, University of California at Santa Cruz, USA
Ken Wexler, Professor, Massachusetts Institute of Technology, USA
Klaus Zubergbühler, Professor, University of Saint Andrews, United Kingdom
A handbook like the present one doesn’t materialize from thin air – it requires a lot of organization, thinking, and especially writing. For the latter, we are extremely grateful to all our authors for agreeing to contribute and helping along the way throughout the process. We also want to thank Andrew Winnard, Sarah Green, and Helen Barton at Cambridge University Press for their faith in this project, and their patience as we were gathering contributions.

In preparing this handbook we have received support from various sources, which we would like to acknowledge: Cedric Boeckx is grateful for a Marie Curie International Reintegration Grant from the European Union (PIRG-GA-2009-256413), research funds from the Fundació Bosch i Gimpera, as well as a grant from the Spanish Ministry of Economy and Competitiveness (FFI-2010-20634; PI: Boeckx). Kleanthes Grohmann would like to acknowledge support from the University of Cyprus through annual research grants, the MinInv Project (UCY-8037-61013), the Gen-CHILD Project (UCY-8037-61017), and a Biolinguistics editorial office grant (ΑΙΤ-7020-0).

Last, but not least we would like to thank our wives for bearing with us in those tough moments when editing life took over more important aspects of life. Thank you, Youngmi and Maria, for your understanding and support.