



ROUTLEDGE  
HANDBOOKS



# The Routledge Handbook of Phonological Theory

Edited by S. J. Hannahs and Anna R. K. Bosch



"This is a great handbook. It's a thoughtful survey of contemporary phonological frameworks and of issues that arise in phonological argument. Many chapters disagree with each other in interesting ways, authentically reflecting the glories of current phonological debate. My advice? Read them all!"

— **Patrick Honeybone**, *University of Edinburgh, UK*

"This handbook is particularly valuable in that it presents not only articles dealing with issues that any phonological theory has to ... but it also offers succinct overviews of different models in the field. As such, it will be of interest to linguists from all kinds of backgrounds in the years to come."

— **Markus A. Pöchtrager**, *University of Vienna, Austria*

*The Routledge Handbook of Phonological Theory* provides a comprehensive overview of the major contemporary approaches to phonology. Phonology is frequently defined as the systematic organisation of the sounds of human language. For some, this includes aspects of both the surface phonetics together with systematic structural properties of the sound system; for others, phonology is seen as distinct from, and autonomous from, phonetics. *The Routledge Handbook of Phonological Theory* surveys the differing ways in which phonology is viewed, with a focus on current approaches to phonology. Divided into two parts, this handbook:

- Covers major conceptual frameworks within phonology including: Rule-based Phonology; Optimality Theory; Government Phonology; Dependency Phonology; and connectionist approaches to generative phonology;
- Explores the central issue of the relationship between phonetics and phonology;
- Features 23 chapters written by leading academics from around the world.

*The Routledge Handbook of Phonological Theory* is an authoritative survey of this key field in linguistics, and is essential reading for students studying phonology.

**Contributors:** John Alderete, Diana Archangeli, Iris Berent, Ricardo Bermúdez-Otero, Bart de Boer, Anna R. K. Bosch, Diane Brentari, Abigail C. Cohn, Kearsy Cormier, Eugeniusz Cyran, Jordon Fenlon, Cécile Fougeron, Stefan A. Frisch, Nancy Hall, Michael Hammond, S.J. Hannahs, Marie K. Huffman, Pavel Iosad, Martin Krämer, Nancy C. Kula, Neil Myler, Heather Newell, Douglas Pulleyblank, Thomas Purnell, Michael Ramsammy, Charles Reiss, Tobias Scheer, Joseph Paul Stemberger, Paul Tupper, Harry van der Hulst, Jeroen van de Weijer and Bert Vaux.

**S. J. Hannahs** is a Reader in Linguistics at Newcastle University, UK. He is on the advisory board of the *Linguist List* and annual phonology conferences the *Manchester Phonology Meeting* and the *Old World Conference on Phonology*.

**Anna R. K. Bosch** is Associate Dean for Undergraduate Programs in the College of Arts and Sciences, and Associate Professor in Linguistics at the University of Kentucky, USA.

## ENGLISH LANGUAGE & LINGUISTICS

Cover image: © Shutterstock



 **Routledge**  
Taylor & Francis Group  
[www.routledge.com](http://www.routledge.com)

an informa business

Routledge titles are available as eBook editions in a range of digital formats



# The Routledge Handbook of Phonological Theory

Edited by S. J. Hannahs and Anna R. K. Bosch



**ROUTLEDGE**

---

# The Routledge Handbook of Phonological Theory

*Edited by S. J. Hannahs and Anna R. K. Bosch*

First published 2018  
by Routledge  
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge  
711 Third Avenue, New York, NY 10017

*Routledge is an imprint of the Taylor & Francis Group, an informa business*

© 2018 selection and editorial matter, S. J. Hannahs and Anna R. K. Bosch;  
individual chapters, the contributors

The right of the editors to be identified as the authors of the editorial material,  
and of the authors for their individual chapters, has been asserted in accordance  
with sections 77 and 78 of the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this book may be reprinted or reproduced or  
utilised in any form or by any electronic, mechanical, or other means, now  
known or hereafter invented, including photocopying and recording, or in any  
information storage or retrieval system, without permission in writing from the  
publishers.

*Trademark notice:* Product or corporate names may be trademarks or  
registered trademarks, and are used only for identification and explanation  
without intent to infringe.

*British Library Cataloguing-in-Publication Data*

A catalogue record for this book is available from the British Library

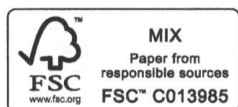
*Library of Congress Cataloging-in-Publication Data*

A catalog record for this book has been requested

ISBN: 978-1-138-02581-3 (hbk)

ISBN: 978-1-315-67542-8 (ebk)

Typeset in Times New Roman  
by Apex CoVantage, LLC



Printed in the United Kingdom  
by Henry Ling Limited

# The Routledge Handbook of Phonological Theory

*The Routledge Handbook of Phonological Theory* provides a comprehensive overview of the major contemporary approaches to phonology. Phonology is frequently defined as the systematic organisation of the sounds of human language. For some, this includes aspects of both the surface phonetics together with systematic structural properties of the sound system; for others, phonology is seen as distinct from, and autonomous from, phonetics. *The Routledge Handbook of Phonological Theory* surveys the differing ways in which phonology is viewed, with a focus on current approaches to phonology. Divided into two parts, this handbook:

- Covers major conceptual frameworks within phonology including: Rule-based Phonology; Optimality Theory; Government Phonology; Dependency Phonology; and connectionist approaches to generative phonology;
- Explores the central issue of the relationship between phonetics and phonology;
- Features 23 chapters written by leading academics from around the world.

*The Routledge Handbook of Phonological Theory* is an authoritative survey of this key field in linguistics, and is essential reading for students studying phonology.

**S.J. Hannahs** is a Reader in Linguistics at Newcastle University, UK. He is on the advisory board of the *Linguist List* and annual phonology conferences the *Manchester Phonology Meeting* and the *Old World Conference on Phonology*.

**Anna R.K. Bosch** is Associate Dean for Undergraduate Programs in the College of Arts and Sciences, and Associate Professor in Linguistics at the University of Kentucky, USA.

## **Routledge Handbooks in Linguistics**

*Routledge Handbooks in Linguistics* provide overviews of a whole subject area or sub-discipline in linguistics, and survey the state of the discipline including emerging and cutting-edge areas. Edited by leading scholars, these volumes include contributions from key academics from around the world and are essential reading for both advanced undergraduate and postgraduate students.

### **The Routledge Handbook of Metaphor and Language**

*Edited by Elena Semino and Zsófia Demjén*

### **The Routledge Handbook of Systemic Functional Linguistics**

*Edited by Tom Bartlett and Gerard O'Grady*

### **The Routledge Handbook of Handbook of Heritage Language Education**

*From Innovation to Program Building*

*Edited by Olga E. Kagan, Maria M. Carreira and Claire Hitchins Chik*

### **The Routledge Handbook of Language and Humor**

*Edited by Salvatore Attardo*

### **The Routledge Handbook of Language and Dialogue**

*Edited by Edda Weigand*

### **The Routledge Handbook of Language and Politics**

*Edited by Ruth Wodak and Bernhard Forchtner*

### **The Routledge Handbook of Language and Media**

*Edited by Daniel Perrin and Colleen Cotter*

### **The Routledge Handbook of Ecolinguistics**

*Edited by Alwin F. Fill and Hermine Penz*

### **The Routledge Handbook of Lexicography**

*Edited by Pedro A. Fuertes-Olivera*

### **The Routledge Handbook of Discourse Processes, Second Edition**

*Edited by Michael F. Schober, David N. Rapp and M. Anne Britt*

Further titles in this series can be found online at [www.routledge.com/series/RHIL](http://www.routledge.com/series/RHIL)

# Contributors

---

**John Alderete** teaches linguistics and cognitive science at Simon Fraser University. He uses methods in psycholinguistics, traditional fieldwork, and theoretical linguistics to probe how complex language systems are learned and used in fluid speech.

**Diana Archangeli** (PhD 1984, MIT) is Professor of Linguistics at the University of Arizona and an Honorary Professor at the University of Hong Kong. Her research in phonological theory addresses the extent to which phonological systems can be learned without the benefit of an innate linguistic endowment. With Douglas Pulleyblank she is the author of *Grounded Phonology* (MIT Press, 1994).

**Iris Berent** is Professor of Psychology at Northeastern University. Her research has appeared in journals such as *Science* and the *Proceedings of the National Academy of Sciences*. She is the author of *The Phonological Mind* (Cambridge, 2013).

**Ricardo Bermúdez-Otero** is based at the University of Manchester. His research focuses on the morphosyntax–phonology and phonology–phonetics interfaces, with particular attention to diachronic issues. He works predominantly on English (especially the Old, Middle, and present-day periods) and on Romance.

**Bart de Boer** works on the evolution of speech as Professor in Artificial Intelligence at the Vrije Universiteit Brussel. He has published numerous papers on the evolution of speech, both on the evolution of anatomical and behavioural adaptations, and using computer models, experiments, and comparative data.

**Anna R. K. Bosch** is Associate Dean of Arts & Sciences at the University of Kentucky, and faculty member in Linguistics. Her research interests include phonological theory, Scottish Gaelic phonology, and the history of transcription practices. She has held research fellowships from the American Philosophical Society, the Institute for Advanced Studies in the Humanities at Edinburgh University, and the Thomas J. Watson Foundation.

**Diane Brentari** is the Mary K. Werkman Professor of Linguistics and Director of the Center for the Study of Gesture, Sign, and Language at the University of Chicago. Her current work focuses on cross-linguistic variation among sign languages, the emergence of new sign languages, and the pro-tactile variety of American Sign Language used by DeafBlind individuals.



**Abigail C. Cohn** is Professor of Linguistics at Cornell University. Her research focuses on the relationship between phonology and phonetics and is informed by laboratory phonology approaches. She is co-editor of *Oxford Handbook of Laboratory Phonology* and co-organizer of LabPhon 15.

**Kearsy Cormier** is Reader in Sign Language Linguistics at the Deafness Cognition and Language (DCAL) Research Centre and Department of Linguistics at University College London. She is interested broadly in the linguistic structure of sign languages, especially British Sign Language (BSL), and in visual aspects of language more generally.

**Eugeniusz Cyran** is Professor of Linguistics and Chair of the Department of Phonology and Phonetics at the John Paul II Catholic University of Lublin. He has authored a book on substantive and formal complexities and licensing in phonology (*Complexity Scales and Licensing in Phonology*, 2010), and a study on the relation between phonology and phonetics based on voicing phenomena in Polish (*Between Phonology and Phonetics Polish Voicing*, 2014), both volumes published by Mouton de Gruyter.

**Jordan Fenlon** is Assistant Professor in British Sign Language (BSL) at Heriot Watt University in Edinburgh. His research focuses on the linguistics of BSL at the phonological, morphological, and syntactic levels using the British Sign Language Corpus ([www.bslcorpusproject.org](http://www.bslcorpusproject.org)).

**Cécile Fougeron** is Research Scientist in Experimental Phonetics at CNRS/University of Paris 3 and co-organizer of LabPhon 10. Her research interests include the segmental manifestation of prosodic organization and the phonetic characteristics of speech disorders. She is co-editor of *Oxford Handbook of Laboratory Phonology*.

**Stefan A. Frisch** is Associate Professor of Communication Sciences and Disorders at the University of South Florida. He studies the processes of speech production, speech perception, and metalinguistic language processing in order to better understand the ways in which language sound structure is organized in the mind/brain.

**Nancy Hall** received her PhD from the University of Massachusetts Amherst, and is now Associate Professor of Linguistics at California State University Long Beach. Her research currently focuses on the phonetics and phonology of Levantine Arabic.

**Michael Hammond** is Professor of Linguistics at the University of Arizona. He received his PhD from UCLA in 1984. His areas of interest include statistical phonology, stress and syllabification, English, Welsh, Scottish Gaelic, computational linguistics, psycholinguistics, and poetic meter.

**S.J. Hannahs** is Reader in Linguistics at Newcastle University. He is author and editor of numerous books and articles on phonological theory, with a focus on Celtic and Romance linguistics. He is also the author of *The Phonology of Welsh* (Oxford, 2013) and the widely used introductory textbook *Introducing Phonetics and Phonology* (with Mike Davenport; 2010, 3rd ed.), and editor of the *Journal of Linguistics*.

**Marie K. Huffman** is Associate Professor of Linguistics at Stony Brook University. Her research focuses on the acoustic analysis of speech, especially its temporal structure, and the mechanisms underlying speech adaptation. She is co-editor of *Oxford Handbook of Laboratory Phonology*.

**Pavel Iosad** holds a PhD from the University of Tromsø and is Lecturer in Theoretical Phonology at the University of Edinburgh. He specializes in phonological theory, especially phonological architecture and feature theory, and has a particular interest in the phonology of the Celtic languages.

**Martin Krämer** is Professor of Linguistics at the University of Tromsø, The Arctic University of Norway. He is the author of *Vowel Harmony and Correspondence Theory* (Mouton de Gruyter), *The Phonology of Italian* (Oxford), and *Underlying Representations* (Cambridge).

**Nancy C. Kula** is Professor of Linguistics in the Department of Language and Linguistics at the University of Essex. She has worked on a range of issues in phonology including segmental representations, tone and prosody, and phonological interfaces with morphology and syntax. Her empirical focus mainly centres on Bantu languages. She is co-editor of the *Bloomsbury Companion to Phonology* and has published in a wide range of journals.

**Neil Myler** is Assistant Professor of Linguistics at Boston University. He received his doctorate from New York University in 2014, under the supervision of Alec Marantz. His research interests include morphology, micro-comparative syntax (particularly with respect to English dialects and languages of the Quechua family), argument structure, and the morpho-syntax and semantics of possession cross-linguistically. He is the author of *Building and Interpreting Possession Sentences* (MIT Press, 2016).

**Heather Newell** is Associate Professor at the Université du Québec à Montréal. Her work investigates how morphological phenomena inform theories of phonology, morpho-syntax, and their interface. She is co-editor of *The Structure of Words at the Interfaces* (Newell et al., OUP, 2017) and of the *Canadian Journal of Linguistics*.

**Douglas Pulleyblank** (PhD MIT) is Professor of Linguistics at the University of British Columbia. His research and publications in phonology have focused on featural properties such as tone and vowel harmony, and his work demonstrates a particular emphasis on African languages, particularly languages of Nigeria. He has collaborated frequently with Diana Archangeli.

**Thomas Purnell** (PhD Delaware) is Professor of English Language and Linguistics at the University of Wisconsin-Madison. His research interests focus on submodules in the speech chain, particularly tone–stress interactions, the phonetics–phonology interface, and dialectological rules. He is currently serving the American Dialect Society as Editor, *American Speech*.

**Michael Ramsammy** holds a PhD and MA in Linguistics from the University of Manchester. He is Lecturer in Linguistics at the University of Edinburgh. He specializes in experimental phonetics and theoretical phonology with a focus on the Ibero-Romance languages and English.

**Charles Reiss** teaches at Concordia University in Montreal. He is co-author of *I-language: An Introduction to Linguistics as Cognitive Science* (2013, with Daniela Isac), *The Phonological Enterprise* (2008, with Mark Hale), and *Phonology: A Formal Introduction* (forthcoming, with Alan Bale).

**Tobias Scheer** is a senior CNRS researcher (Directeur de Recherche) working at the Université Côte d'Azur in Nice. He has authored a book on Strict CV, *A Lateral Theory of Phonology* (2004); a historically oriented overview guide to the interface of phonology with morpho-syntax, *A Guide to Morphosyntax–Phonology Interface Theories* (2011); and a volume on his own theory of the latter, *Direct Interface* (2012), all at Mouton de Gruyter. He has also published a textbook on syllable structure, *Précis de structure syllabique* (ENS Editions, 2015, in French).

**Joseph Paul Stemberger** is Professor in the Department of Linguistics at the University of British Columbia. His research focuses on phonological and morphological processing in language production, with a secondary focus on child phonological and morphological development. He finds that linguistic and psychological theories contribute to our knowledge of human language in interestingly different ways.

**Paul Tupper** is Professor of Mathematics at Simon Fraser University. He uses his expertise in applied mathematics and scientific computation to study systems that arise in phonology, phonetics, and cognitive psychology.

**Harry van der Hulst** (PhD 1984, University of Leiden) is Full Professor of Linguistics at the University of Connecticut. He has edited over 30 books, and published two monographs and over 170 articles on various aspects of languages. He has been Editor-in-Chief of the international linguistic journal *The Linguistic Review* since 1990.

**Jeroen van de Weijer** (PhD 1994, University of Leiden) is Full Professor of English Linguistics at Shanghai International Studies University. His interests are phonology, phonetics, morphology, and psycholinguistics and the relations between these linguistic areas. He works on English, Dutch, Chinese, Japanese, and other languages.

**Bert Vaux** is Reader in Phonology and Morphology at Cambridge University. He is interested in the structure and origins of the phonological component of the language faculty, especially in the realms of psychophonology, historical linguistics, microvariation, and nanovariation. He also enjoys documenting endangered varieties of Armenian, Abkhaz, and English.



# Contents

---

<i>List of figures</i>	viii
<i>List of tables</i>	x
<i>List of contributors</i>	xi
1 The study of phonology in the 21st century: overview and introduction to <i>The Routledge Handbook of Phonological Theory</i> <i>S. J. Hannahs and Anna R. K. Bosch</i>	1
<b>PART I</b>	
<b>Theoretical frameworks</b>	<b>11</b>
2 Optimality Theory: motivations and perspectives <i>Pavel Iosad</i>	13
3 Current issues and directions in Optimality Theory: constraints and their interaction <i>Martin Krämer</i>	37
4 The phonology–phonetics interface in constraint-based grammar <i>Michael Ramsammy</i>	68
5 Stratal Phonology <i>Ricardo Bermúdez-Otero</i>	100
6 Rule-based phonology: background, principles and assumptions <i>Thomas Purnell</i>	135
7 Issues and prospects in Rule-Based Phonology <i>Bert Vaux and Neil Myler</i>	167
8 The syntax–phonology interface in Rule-Based Phonology <i>Heather Newell</i>	197

9	Government Phonology: Element Theory, conceptual issues and introduction <i>Tobias Scheer and Nancy C. Kula</i>	226
10	Syllable structure in Government Phonology <i>Tobias Scheer and Eugeniusz Cyran</i>	262
11	Interfaces in Government Phonology <i>Tobias Scheer and Eugeniusz Cyran</i>	293
12	Dependency Phonology <i>Harry van der Hulst and Jeroen van de Weijer</i>	325
13	Connectionist approaches to generative phonology <i>John Alderete and Paul Tupper</i>	360
14	Interfaces in connectionist phonology <i>Joseph Paul Stemberger</i>	391
<b>PART II</b>		
	<b>Approaches</b>	<b>423</b>
15	Substance Free phonology <i>Charles Reiss</i>	425
16	The phonology of sign languages <i>Jordan Fenlon, Kearsy Cormier, and Diane Brentari</i>	453
17	Phonology as an emergent system <i>Diana Archangeli and Douglas Pulleyblank</i>	476
18	Laboratory phonology <i>Abigail C. Cohn, Cécile Fougeron, and Marie K. Huffman</i>	504
19	Articulatory Phonology <i>Nancy Hall</i>	530
20	Exemplar theories in phonology <i>Stefan A. Frisch</i>	553
21	Algebraic phonology <i>Iris Berent</i>	569

22 Statistical phonology	589
<i>Michael Hammond</i>	
23 Phonology and evolution	617
<i>Bart de Boer</i>	
<i>Language index</i>	636
<i>Subject index</i>	638



# Figures

4.1	Modular grammatical architecture	70
4.2	Computational procedure in classic OT	71
4.3	Computational procedure in Stratal OT	71
4.4	Diachronic generalisation (left) and geographic spread (right) of spirantisation. Map: solid lines = spirantisation of all stops, dotted lines = spirantisation of {COR, DOR} stops, dashed lines = spirantisation of [DOR] stops only	75
4.5	Lenition scale for GT (top) and lenition statistics for voiceless stops (bottom) (adapted from Villafaña-Dalcher 2008)	76
4.6	Categorical vs gradient spirantisation of intervocalic voiceless stops based on data from Villafaña-Dalcher (2008)	77
4.7	Gestural implementation of a /VC <sub>[-cont]</sub> V/ sequence. The solid contour schematises accurate achievement of all articulatory targets including the formation of a complete oral seal for the realisation of the intervocalic stop. The dashed contour represents a realisation of the same /VC <sub>[-cont]</sub> V/ sequence in which the target for the intervocalic stop is undershot: this results in an incomplete articulatory seal and the generation of aerodynamic turbulence across the partial closure	78
4.8	Phonologisation and stabilisation in the life cycle of phonological processes	79
4.9	The BiPhon model	80
4.10	Production of <i>oca</i>	81
4.11	Gestural scores for [ɔka] (bold line), [ɔ <sup>x</sup> ka] (dotted line) and [ɔk <sup>x</sup> a] (dashed line)	86
4.12	Style-dependent variation in cognitively-controlled gradient stop friction	88
4.13	Stabilisation of /k/-spirantisation. Spirantisation is a cognitively-controlled gradient process in grammar 1 (left). In grammar 2 (right), gradient spirantisation has undergone stabilisation into a categorical phrasal process	89
4.14	Stylistic variation of spirantisation in the innovative grammar. In the most casual speaking register (c), spirantisation is categorical and under the control of the phonological module. In the formal register (a), spirantisation is blocked both by the style-specific ranking of markedness and faithfulness in the categorical phonology and by implementational constraints in the phonetic module. In a more informal register (b),	

the constraint ranking in the phonological module prevents categorical spirantisation; however, assuming a stabilisation scenario in which spirantisation becomes synchronically scattered between the phonological and phonetic modules, some amount of controlled, gradient spirantisation may still arise in phonetic implementation through style-specific ranking of auditory and articulatory constraints	91
4.15 Diachronic generalisation of spirantisation	92
6.1 Broad picture of linguistic grammar with relations to other cognitive modules (adapted from Purnell, Raimy & Salmons, 2017)	139
6.2 Hypermodular grammar of phonology from morpho-syntax to motor control (adapted from Purnell, Raimy & Salmons, 2017)	140
6.3 Two primary aspects of phonology in a rule-based grammar (adapted from Purnell, Raimy & Salmons, 2017)	141
6.4 Multidimensional representations of a segment at one point in time (from Purnell 1998: 21, Figure 2.2)	151
6.5 Distinctive feature hierarchy depicted by organizational nodes (e.g., Oral Place), dimensions (e.g., Labial) and features (e.g., [round]) that complete the dimensions (revised from Avery & Idsardi 2001: 66)	152
13.1 Spread of activation in a simple three-layer feed-forward network	363
13.2 Single-layer local network for Berber syllabication, based on Goldsmith and Larson (1990); $(\alpha, \beta) = (.6, .1)$	369
13.3 Three-layer feed-forward network for English past tense, based on Plunkett and Marchman (1991, 1993)	374
13.4 Sequential network of Hare (1992) for vowel harmony	376
14.1 Fragment of the system, showing levels and interconnections	393
14.2 Basic nonrecurrent net, with two units in each layer; for additional units, add connections to all units in other layers. Each connection has an independent weight	395
14.3 Recurrent net, with both internal and external context units added	397
16.1 Sign language lexicon (adapted from Brentari and Padden, 2001)	454
16.2 Sign pairs with handshape, location movement, and orientation contrasts in BSL (stills from BSL SignBank (Fenlon et al., 2014))	455
16.3 Overview of the Prosodic Model	456
16.4 Inherent Features structure	456
16.5 Prosodic Features representation within the Prosodic Model	458
16.6 Different types of movement in ASL and as represented within the Prosodic Model	459
16.7 Syllable counting criteria (Brentari, 1998)	460
16.8 Entity construction and handling construction (pictures from Cormier et al., 2012)	466
16.9 Sets of complex handshapes in HKSL displaying primary selected fingers (SF1), secondary selected fingers (SF2), as well as unselected fingers (−SF)	468

# Tables

---

2.1	Factorial typology of spirantization	18
3.1	Sonority and cumulative violation	49
3.2	Gradience versus categoriality	49