

## Neurolinguistics

What biological factors make human communication possible? How do we process and understand language? How does brain damage affect these mechanisms, and what can this tell us about how language is organized in the brain? The field of neurolinguistics seeks to answer these questions, which are crucial to linguistics, psychology and speech pathology alike. Drawing on examples from everyday language, this textbook introduces the central topics in neurolinguistics: speech recognition, word and sentence structure, meaning, and discourse – in both ‘normal’ speakers and those with language disorders. It moves on to provide a balanced discussion of key areas of debate such as modularity and the ‘language areas’ of the brain, ‘connectionist’ versus ‘symbolic’ modelling of language processing, and the nature of linguistic and mental representations. Making accessible over half a century of scientific and linguistic research, and containing extensive study questions, it will be welcomed by all those interested in the relationship between language and the brain.

JOHN C. L. INGRAM is Senior Lecturer on the Linguistics Program at the University of Queensland. He has published widely on speech and language disorders, sound change in second language acquisition, phonetic variation in Australian English, connected speech processes, acoustic phonetics, foreign accent phenomena and forensic speaker identification.

Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)

---

CAMBRIDGE TEXTBOOKS IN LINGUISTICS

*General editors:* P. AUSTIN, J. BRESNAN, B. COMRIE, S. CRAIN,  
W. DRESSLER, C. EWEN, R. LASS, D. LIGHTFOOT, K. RICE,  
I. ROBERTS, S. ROMAINE, N. V. SMITH

## Neurolinguistics

An Introduction to Spoken Language Processing and its Disorders

Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)*In this series:*

- J. ALLWOOD, L.-G. ANDERSON and Ö. DAHL *Logic in Linguistics*  
 D. B. FRY *The Physics of Speech*  
 R. A. HUDSON *Sociolinguistics* Second edition  
 A. J. ELLIOT *Child Language*  
 P. H. MATTHEWS *Syntax*  
 A. REDFORD *Transformational Syntax*  
 L. BAUER *English Word-Formation*  
 S. C. LEVINSON *Pragmatics*  
 G. BROWN and G. YULE *Discourse Analysis*  
 R. HUDDLESTON *Introduction to the Grammar of English*  
 R. LASS *Phonology*  
 A. COMRIE *Tense*  
 W. KLEIN *Second Language Acquisition*  
 A. J. WOODS, P. FLETCHER and A. HUGHES *Statistics in Language Studies*  
 D. A. CRUSE *Lexical Semantics*  
 A. RADFORD *Transformational Grammar*  
 M. GARMAN *Psycholinguistics*  
 G. G. CORBETT *Gender*  
 H. J. GIEGERICH *English Phonology*  
 R. CANN *Formal Semantics*  
 J. LAVER *Principles of Phonetics*  
 F. R. PALMER *Grammatical Roles and Relations*  
 M. A. JONES *Foundations of French Syntax*  
 A. RADFORD *Syntactic Theory and the Structure of English: A Minimalist Approach*  
 R. D. VAN VALIN, JR, and R. J. LAPOLLA *Syntax: Structure, Meaning and Function*  
 A. DURANTI *Linguistic Anthropology*  
 A. CRUTTENDEN *Intonation* Second edition  
 J. K. CHAMBERS and P. TRUDGILL *Dialectology* Second edition  
 C. LYONS *Definiteness*  
 R. KAGER *Optimality Theory*  
 J. A. HOLM *An Introduction to Pidgins and Creoles*  
 G. G. CORBETT *Number*  
 C. J. EWEN and H. VAN DER HULST *The Phonological Structure of Words*  
 F. R. PALMER *Mood and Modality* Second edition  
 B. J. BLAKE *Case* Second edition  
 E. GUSSMAN *Phonology: Analysis and Theory*  
 M. YIP *Tone*  
 W. CROFT *Typology and Universals* Second edition  
 F. COULMAS *Writing Systems: An Introduction to their Linguistic Analysis*  
 P. J. HOPPER and E. C. TRAUOGOTT *Grammaticalization* Second edition  
 L. WHITE *Second Language Acquisition and Universal Grammar*  
 I. PLAG *Word-Formation in English*  
 W. CROFT and A. CRUSE *Cognitive Linguistics*  
 A. SIEWIERSKA *Person*  
 D. RADFORD *Minimalist Syntax: Exploring the Structure of English*  
 D. BÜRING *Binding Theory*  
 N. HORNSTRIN, J. NUÑES and K. GROHMANN *Understanding Minimalism*  
 B. C. LUST *Child Language: Acquisition and Growth*  
 M. BUTT *Theories of Case*  
 G. G. CORBETT *Agreement*  
 J. C. L. INGRAM *Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders*

Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)

# Neurolinguistics

## An Introduction to Spoken Language Processing and its Disorders

---

JOHN C. L. INGRAM

*University of Queensland, Australia*



Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)

CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press

The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

[www.cambridge.org](http://www.cambridge.org)

Information on this title: [www.cambridge.org/9780521796408](http://www.cambridge.org/9780521796408)

© John C. L. Ingram 2007

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2007

Printed in the United Kingdom at the University Press, Cambridge

*A catalogue record for this publication is available from the British Library*

ISBN 978-0-521-79190-8 hardback

ISBN 978-0-521-79640-8 paperback

---

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

---

Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)

---

For Carolyn

# Contents

<i>List of figures</i>	page xv
<i>List of tables</i>	xvii
<i>Preface and acknowledgements</i>	xix
<i>Note on the text</i>	xxi

## Part I Foundational concepts and issues

<b>1 Introduction and overview</b>	3
Introduction	3
Co-evolution of language and the brain	5
An alternative view of co-evolution	7
Language areas in the brain	10
Aphasia as evidence of the brain's representation of language	11
The language faculty (localization and modularity)	12
<b>2 Aspects of linguistic competence</b>	15
Introduction	15
Forms and meanings	17
Minimal design features of a language	21
Phonology and syntax as aspects of form	23
Phonology: the sound patterns of spoken language	24
Prosody: the phonology of supra-segmental features	26
Semantics: the representation of meaning	30
Assertion/presupposition and clause structure	31
Specificity, reference and deixis	32
Thematic roles and case	34
Time reference: tense, aspect and modality	35
Concluding remarks	36
<b>3 The neuroanatomy of language</b>	40
Introduction	40
An orientation to the structures of the cerebral cortex	42
Discovery of the language areas	48
The classical account: the Broca-Wernicke-Lichtheim (BWL) model	50
Non-localizationist views	55
Site of lesion studies	56
The neuropsychological perspective	57
Neural imaging	59

---

Metabolic functional imaging	60
Encephalographic functional imaging	60
Magnetoencephalography	62
Combined imaging methods	63
The subtraction method	63
Summary: functional neural imaging	64
Postscript: linguistic structures and the neuroanatomy of language	64
<b>4 On modularity and method</b>	<b>66</b>
Introduction	66
Chomskian modularity	68
Fodorian modularity	69
Summary: Fodor's concept of modularity	72
Modularity uncoupled: Max's chocolate factory	73
Modularity and real-time processing	76
Real-time processing	77
The connectionist challenge	79
Connectionist architectures	80
Connectionist models and neural networks	82
Symbolic algorithms versus statistical processors	82
Hybrid models	83
Summarizing	84
Modularity of linguistic competence	85
Fodor's modularity of processing	88
Coltheart's functional modularity	89
<b>Part II Speech perception and auditory processing</b>	
<b>5 The problem of speech recognition</b>	<b>93</b>
Introduction	93
Three aspects of word recognition	93
Speech signals, spectrograms and speech recognition	94
A simple model of speech recognition: phoneme to sound matching	95
An alternative model: word to sound pattern-matching	96
Why speech recognition is difficult	96
The segmentation problem	96
The variability problem	97
The rate of information transmission in speech perception	100
Lexical retrieval in speech perception	101
Phonological parsing prior to lexical access	102
Phonetic forms and phonological representations	105
Under-specified (abstract) versus fully specified (concrete) forms	108
Discrete (categorical) versus graded (continuous) properties	108
Hierarchical organization versus entrainment	109
Summary	110



	Contents	xi
<b>6 Speech perception: paradigms and findings</b>	112	
Introduction	112	
The speech mode hypothesis	113	
Strong and weak versions of the speech mode hypothesis	114	
Dichotic listening	115	
Categorical perception	117	
Coarticulation effects and category boundary shifts	122	
Duplex perception	123	
Sine wave speech	125	
Conclusions: is speech perception special?	126	
Linguistic experience and phonological parsing	127	
Tuning the auditory system: perceptual magnet effects	128	
Prosodic bootstrapping	129	
Phonetic and phonological levels of processing in speech recognition	132	
Conclusions from the gating experiments	137	
<b>7 The speech recognition lexicon</b>	140	
Introduction	140	
Search models of lexical retrieval	142	
The TRACE model	144	
Architecture of TRACE	144	
Lexical effects in TRACE	146	
Empirical tests of the TRACE model	147	
Modelling coarticulation effects and other sequential dependencies	149	
Modelling variability: a challenge for connectionist models?	152	
Auditory-phonetic and phonological levels of representation	154	
<b>8 Disorders of auditory processing</b>	155	
Introduction	155	
Flow-on effects of temporal sequencing deficit	157	
Levels and types of auditory processing disorder	158	
Clinical classification of auditory processing disorders	159	
Disturbances of auditory-acoustic processing	160	
Cortical deafness	161	
Auditory agnosia	161	
Auditory-acoustic processing deficits and aphasia	163	
Effects of brain damage on phonetic feature extraction	164	
Pure word deafness	164	
Studies of prevalence of word-sound deafness	165	
The nature of word-sound deafness	165	
The neural basis for speech agnosia or pure word deafness	168	
Mirror neurons and the speech-motor loop	171	
Disturbances in accessing the recognition lexicon	173	
Summary	175	

**Part III Lexical semantics**

<b>9 Morphology and the mental lexicon</b>	179
Introduction	179
Morphological decomposition in the mental lexicon	181
Psycholinguistic studies of word structure	184
Semantic and morphological relatedness	186
Priming effects of prefixes and suffixes	187
Conclusions from the Marslen-Wilson <i>et al.</i> study	188
Cross-linguistic generalizations on morphological processing	189
Neuroimaging studies of normal and aphasic morphological processes	190
PET and MEG studies of morphological processing	190
Summary	196
<b>10 Lexical semantics</b>	199
Introduction	199
Semantic networks	201
Testing Quillian's model	204
Evaluation of TLC	205
From word to sentence meanings	205
Conceptual dependency theory	207
Evaluation of symbolic models of lexical semantics	209
Investigating semantic structures	210
The role of context in word-sense disambiguation	211
Semantic priming and the activation/retrieval of word meaning	211
Results: associative and semantic priming and the effect of prime type	214
Brain imaging studies of lexical semantic activation	215
Summary	219
<b>11 Lexical semantic disorders in aphasia</b>	221
Introduction	221
Early work	223
Competence or performance deficit in lexical semantic disorder?	225
Behavioural on-line measures of lexical access and organization in aphasia	226
On-line lexical processing in Wernicke's aphasia	227
On-line lexical processing in Broca's aphasia	228
Lexical integration in aphasia	230
Category-specific semantic impairment	232
A case study of domain-specific semantic impairment	235
Explaining patterns of category-specific semantic impairment	237
Summary	238

**Part IV Sentence comprehension**

<b>12 Sentence comprehension and syntactic parsing</b>	243
Introduction	243

	Contents	xiii
Syntactic processing and sentence comprehension	244	
The grammar and the parser	245	
Competing models of sentence processing	249	
Asyntactic sentence comprehension: the case of agrammatism	250	
Thematic role assignment and sentence comprehension	250	
Reversible passive constructions	251	
Canonical word order and thematic relations in complex sentences	253	
Strategies for processing complex sentences	254	
Summary: grammatical heuristics and agrammatism	255	
Ambiguity resolution and syntactic parsing strategies	256	
Lexical and syntactic ambiguity	257	
Why ambiguity is important for theories of language processing	258	
Minimal attachment	259	
Testing minimal attachment	261	
Local ambiguities and garden path sentences	261	
Summary	264	
<b>13 On-line processing, working memory and modularity</b>	<b>266</b>	
Introduction	266	
Working memory, parsing and syntactic complexity	266	
Individual differences in working memory capacity and sentence processing	269	
Modularity and VWMC	270	
Sequential or parallel processing as a capacity effect	273	
Syntactic complexity	275	
Gibson's model of parsing complexity	276	
Properties of Gibson's parser	278	
Summary and recapitulation	279	
Syntactic trace reactivation	280	
Load/capacity effects and the cross-modal lexical priming paradigm	284	
Recapitulation and summary: trace reactivation and the CMLP paradigm	285	
Neural imaging techniques and on-line sentence processing	286	
Phrase structure and argument structure violations and ERPs	288	
Jabberwocky sentence processing and ERPs	290	
Deep and surface anaphora	291	
General summary and conclusions	294	
<b>14 Agrammatism revisited</b>	<b>297</b>	
Introduction	297	
Agrammatism revisited	299	
Off-line methods of language comprehension assessment	300	
A case for syntactic deficit in Broca's aphasia	301	
A case against syntactic deficit in Broca's aphasia	304	
Three theories of agrammatism	309	
Weighing the evidence	312	
Grammaticality judgement and sentence comprehension	312	

---

Trace reactivation and on-line measures of sentence processing	317
Slow retrieval or under-activation of lexical items	319
Self-paced listening and transient processing load	320
ERP imaging of on-line sentence processing in aphasia	323
Summary and conclusion	324
<b>Part V Discourse: language comprehension in context</b>	
<b>15 Discourse processing</b>	331
Introduction	331
Discourse modelling	332
Discourse construction: an example	333
Reference management and pragmatic knowledge	335
Relevance	336
Strong and weak implicature and relevance	337
Refining a model of discourse	338
Under-specification	339
Sentence-level discourse devices	339
Studies of discourse anaphora resolution	341
On-line studies of discourse anaphora	343
Summary	345
<b>16 Breakdown of discourse</b>	346
Introduction	346
Language and psychosis	349
Characteristics of thought disordered speech	350
A study of thought disordered speech	351
Cognitive impairment and thought disordered language	354
Summarizing the evidence on executive dysfunction in thought disorder	359
Neurological models of thought disorder	361
The dopamine hypothesis	362
The cingulate modulation hypothesis	363
Conclusion	366
<b>17 Conclusion and prospectus</b>	367
Introduction	367
Connectionist models of language processing: a case study	367
Embodied cognition as a perspective on language processing	374
Concrete or abstract perceptual representations of speech sounds	377
Lexical retrieval mechanisms	378
Discourse structure and embodiment	378
<i>Glossary</i>	380
<i>References</i>	387
<i>Index</i>	414

## Figures

1.1	The cerebral cortex: the language areas and major anatomical landmarks	page 11
1.2	Phrenology diagram: frontispiece to Spurzheim's <i>Outlines of phrenology</i> , 1827	13
2.1	Components of the linguistic model	37
3.1	Lobes of cerebral cortex	43
3.2	Somatosensory cortex	44
3.3	Flat projections of human and macaque cerebral cortex	47
3.4	The Wernicke-Lichtheim model	52
3.5	Disturbances in phoneme perception	57
3.6	The single word processing model	59
4.1	Neural network for printed word recognition	81
5.1	Spectrogram: <i>sheep like soft grass</i>	94
5.2	Speaking style and alternative pronunciations of <i>I'm going to leave</i>	99
5.3	Spectrogram: <i>I should have thought spectrograms were unreadable</i>	99
5.4	Transcription accuracy of the nonce phrases	104
5.5	Levels of prosodic structure	109
6.1	Stop consonant + vowel syllables produced by the pattern playback synthesizer	116
6.2	Discrimination and identification functions for /b-d-g/ for three listeners	119
6.3	Morphing visual images to create a 'Clinton-Kennedy' continuum	121
6.4	Duplex stimulus construction	124
6.5	Prototype (P) and non-prototype (NP) [i] vowels and perceptual magnet effects	128
6.6	The gating paradigm	133
6.7	Gating experiment: Bengali listeners' response to nasalized vowels	136
7.1	How coarticulation effects are simulated in TRACE	146
7.2	Simple recurrent network (SRN)	150
8.1	Hickok and Poeppel's dorsal and ventral stream model	170

xvi	List of figures	
9.1	PET activation for regular, irregular and nonce past-tense forms	192
9.2	MEG differences to regular and irregular verbs	196
10.1	Three planes representing the meaning of <i>Plant</i> in Quillian's TLC model	202
10.2	Conceptual dependency diagram for <i>John ate a frog</i>	208
10.3	Augmented conceptual dependency diagram for <i>John ate a frog</i>	209
10.4	The areas activated in the verbs–nouns contrast	218
11.1	Types and relative incidence of category-specific semantic disorders	233
12.1	Partial parsing of <i>A cat is on the couch</i>	246
12.2	Minimalist derivation of <i>A cat is on the couch</i>	247
12.3	Surface structure syntax	257
12.4	Contrasting 'underlying' structures for sentence	258
13.1	Reading times for relative clauses: Ferreira and Clifton (1986)	272
13.2	Interaction of verbal working memory capacity with syntactic and pragmatic cues	273
13.3	Three NPs awaiting case assignment	277
13.4	ERPs to well-formed, semantically anomalous and syntactically anomalous verbs	287
13.5	Differences in ERPs under ellipsis and discourse model interpretive (MI) anaphora	293
14.1	Dendrograms for <i>The baby cries</i>	302
14.2	Dendrograms for sentences 2–3	303
15.1	Hypothetical process of construal of mini-discourse 3	337
16.1	Sample of syntactic and error coding	352
16.2	The Tower of London Test	357
16.3	Temporal lobe activation differences and relation to prefrontal activation in schizophrenia	364
17.1	Hierarchical clustering of hidden-unit vectors	370
17.2	Relative clause mini-grammar	371
17.3	Elman: state space trajectories	373

## Tables

2.1	Distributional properties of nouns and verbs (in English)	page 18
2.2	Compositionality of form and meaning	21
2.3	Basic levels and components of linguistic representation in human languages	23
2.4	Semantic components and syntactic exponents	31
2.5	Grammatical case, thematic role and grammatical function	35
3.1	Typical phonological errors in Wernicke's aphasic speech	50
3.2	Complementary symptoms of Broca's and Wernicke's aphasia	51
3.3	Components of the ERP response	61
4.1	Fodor's criteria for modularity	71
4.2	Production plant states of operation	75
4.3	Competing approaches to language modelling	84
5.1	Properties distinguishing phonetic and phonological representations	107
6.1	Tendencies towards right-ear advantage in dichotic listening	116
6.2	Results of three gating experiments: percentage of responses up to vowel offset	137
8.1	Disorders of auditory processing and word recognition	160
9.1	Form–frequency relations in English past tense	183
9.2	Test conditions and morphological priming effects	185
9.3	Morphological and semantic relatedness priming effects	187
9.4	Morphological type and priming effect	187
10.1	Some meanings of <i>show</i> and (scrambled) contexts of usage	200
10.2	Searching semantic space for commonalities of word meaning	204
10.3	TLC's responses to word-pair meaning comparisons	205
10.4	Prime–probe relations used by Moss <i>et al.</i> (1995)	213
10.5	Triplet stimuli used in semantic judgement task (Tyler <i>et al.</i> , 2004)	218
11.1	Semantic feature specification	222
11.2	Semantic feature assignment	223

Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)

xviii	List of tables	
11.3	Semantic similarity scores	223
11.4	Types of semantic relation between word pairs	224
13.1	ERP effects of phrase structure and argument structure violations	289
13.2	ERP effects of Jabberwocky sentences	291
14.1	Sentence types used in Zurif <i>et al.</i> 's (1972) study	301
14.2	Sentences from Linebarger <i>et al.</i> (1983)	305
14.3	Theories of receptive agrammatism	311
14.4	Trace violations and ease of detectability	314
14.5	Sentence types used in Caplan and Waters (2003)	321
15.1	Sentence-level discourse (focusing) devices	340
15.2	Examples of discourse connectives	341
16.1	Discriminant function analysis	353
16.2	Categories of communication failure (Docherty <i>et al.</i> , 1996)	355
16.3	Tests of executive control and semantics (Barrera <i>et al.</i> , 2005)	359



## Preface and acknowledgements

This book is intended as a self-contained introduction to the study of the language–brain relationship for students of cognitive science, linguistics and speech pathology. The essentially interdisciplinary nature of the subject matter posed considerable difficulties for the author and will likely do so also for the reader. So please be warned. Despite my considerable efforts to keep the pathways open between the villages of the cognate disciplines concerned, the jungle is everywhere and its capacity for re-growth is relentless.

As appropriate for an introductory text, the book is accessible to a wide readership. Foundational concepts and issues on the nature of language, language processing and brain language disorders (aphasiology) are presented in the first four chapters. This section of the book should be complementary with many stand-alone introductory courses in linguistics, psychology or neuroanatomy. Subsequent sections deal with successively ‘higher’ levels of language processing and their respective manifestations in brain damage: speech perception (chapters 5–8); word structure and meaning (lexical processing and its disorders; chapters 9–11); syntax and syntactic disorder (agrammatism; chapters 12–14); discourse and the language of thought disorder (chapters 15–16), followed by a brief final chapter, speculating on unsolved problems and possible ways forward. Each major section of the book begins by posing the principal questions at an intuitive level which is hopefully accessible to all. The often quite specialized research methods by which answers to these questions have been sought are then introduced, in a selective review of the literature.

The field of relevant studies was broad to begin with and has grown vastly since the pioneering studies in psycholinguistics, neurolinguistics and computational models of language processing were undertaken in the 1970s and surveyed with such flair and scholarship in Caplan’s *Neurolinguistics and linguistic aphasiology: An introduction* (1987). It would be an impossible task to update Caplan’s seminal text in a single volume. Yet that was one of the quixotic goals that originally motivated the writing of this book. So, in each of the major topics that are taken up, the aim is to bring the reader to a view of the problems and issues that animate contemporary research. In this sense, the book is intended as an ‘introduction’ to the field and as such may serve as a resource for an advanced undergraduate or first-year graduate seminar.

It is difficult to date precisely the origins of this book and therefore to duly acknowledge the many people who have contributed towards it. But officially it

began life as a collaboration with Helen Chenery, under the enthusiastic mentorship of Christine Bartels of Cambridge University Press. Helen's ghost-like presence can be detected in the persistence of the authorial 'we', a writing habit that I evidently found hard to break and a device that I may be guilty of deploying at times, to persuade the reluctant reader to my point of view on matters of deep uncertainty. I am grateful to both of them for their support and wise editorial counsel, especially through the difficult early stages, where something is taking shape, but God knows what the outcome will be and the enormity of the task ahead is beginning to sink in.

Neil Smith read the entire manuscript – not once, but twice – and offered many invaluable and always tactfully put suggestions. I am greatly indebted also to Lucy Carolan, whose impeccable stylistic judgement greatly improved the readability of the text. Max Coltheart and Stephen Crain read selected chapters and offered cogent feedback. Thanks particularly to the students who read drafts of these chapters and in some cases showed in their term essays how the story could be better told. Teaching can be a humbling experience and nothing motivates hard thinking like the blank stares that can accompany the presentation of one's latest pearls of wisdom. Most importantly, I would like to thank my wife, whose name appears in the dedication, for putting up with a distracted fool for several years of late nights and the squeaking chair in the wee hours.

Cambridge University Press

978-0-521-79190-8 - Neurolinguistics: An Introduction to Spoken Language Processing and its Disorders

John C. L. Ingram

Frontmatter

[More information](#)

---

## Note on the text

Words in bold type are explained in the Glossary (pp. 380–6 below).