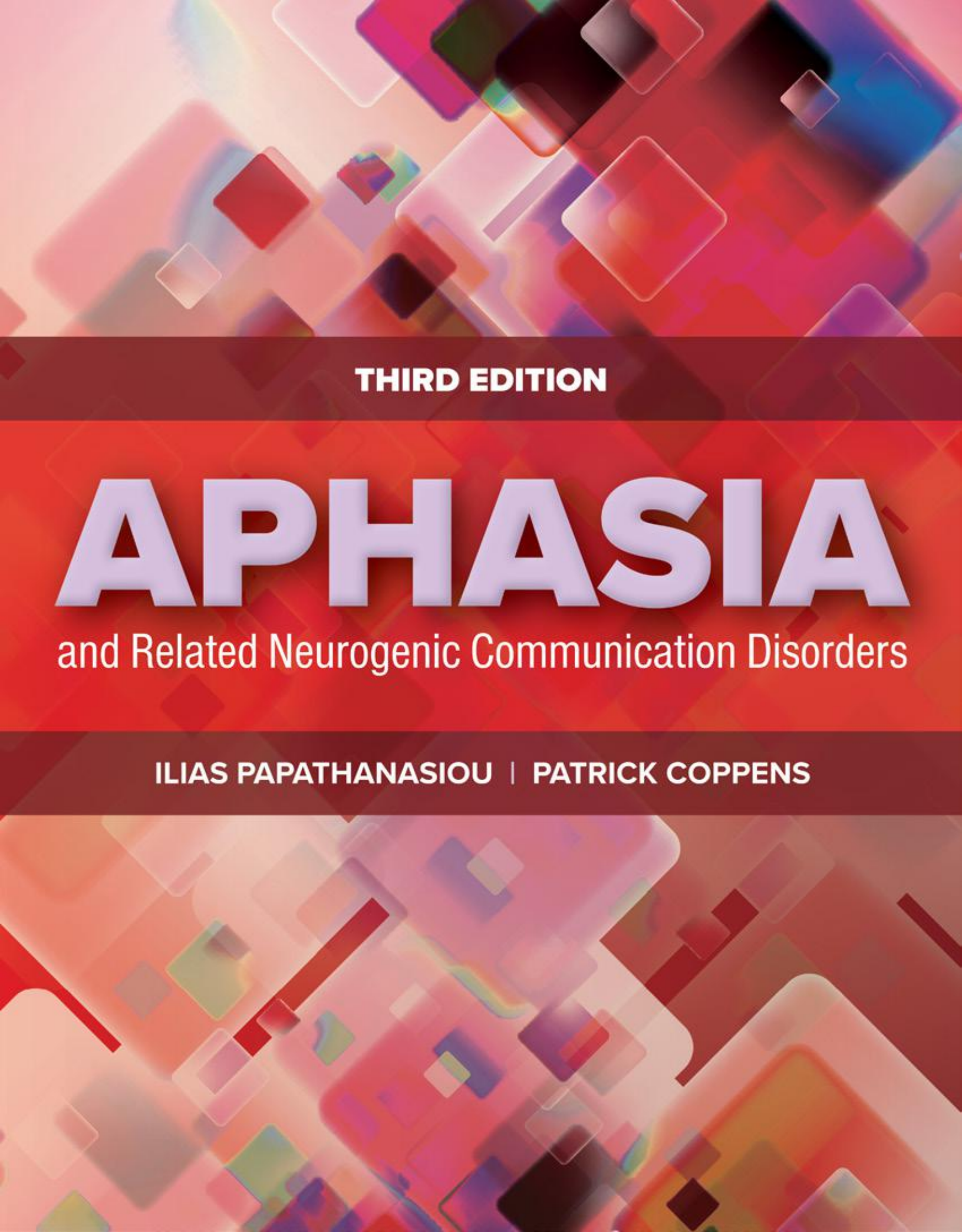
THIRD EDITION
APHASIA
and Related Neurogenic Communication Disorders
ILIAS PAPATHANASIOU | PATRICK COPPENS

THIRD EDITION

APHASIA

and Related Neurogenic Communication Disorders

Ilias Papathanasiou, PhD, FRCSLT, ASHA Fellow
Professor
Department of Speech and Language Therapy
University of Patras, Greece
and
Visiting Professor
Medical School
National Kapodistreian University of Athens
Athens, Greece

Patrick Coppens, PhD, CCC-SLP
Professor Emeritus
Department of Communication Sciences and Disorders
SUNY Plattsburgh

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Jones & Bartlett Learning
5 Wall Street
Burlington, MA 01803
978-443-5000
info@jblearning.com
www.jblearning.com

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Brief Contents

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Introduction

Scientific fields constantly evolve. Aphasiology and related acquired neurogenic communication disorders are no exception. Keeping pace with the new research and clinical developments in these fields is a challenge for clinicians and clinicians-in-training. The purpose of this text is to offer a state-of-the-art overview of our fields by emphasizing important recent advances and presenting clinically relevant information. We trust that this volume provides a practical clinical resource for professionals as well as an informative learning tool for clinicians-in-training.

The contents of a text reflect, in part, the priorities of its editors. As such, this volume represents our attempt at an overview of neurogenic communication disorders with emphasis on the elements that we view as crucial for clinicians. We deem it important that any analysis of a professional issue be illuminated by diverse points of view thus we strove to include contributors from all over the world and we encourage experts from different countries and continents to collaborate by contributing to an international perspective on all topics discussed. As boundaries between disciplines blur and as technology facilitates exchanges between professionals worldwide, a true global perspective became a necessity in the development of this volume. The quality of a text is also a function of the expertise of its contributors. We are extremely grateful that each chapter is authored by expert clinicians and researchers who are able to present both theoretical information and clinical issues clearly and competently. We owe them a debt of gratitude.

Another important element in our view is to include the major recent developments in neurogenic rehabilitation, such as the recent emphasis on the International Classification of Functioning, Disability and Health (ICF) of the World Health Organization and the integration of evidence-based practice (EBP) in all clinical endeavors. The field of communication sciences and disorders has never been static. It is always in a state of flux because of theoretical, clinical, or technological innovations, or even the occasional expansion of scope of practice. However, it appears that in the recent past, the winds of change have been blowing from a variety of directions, with a compounding effect. For example, the ICF provides a framework that combines the clinical consequences of brain lesions on communication as well as the impact on social communication and quality of life. Consequently, each disorder chapter in this volume provides the reader with clinical information pertaining to all ICF categories. Furthermore, EBP should be each clinician's philosophy of rehabilitation. Therefore, EBP concepts are clearly presented and, in each disorder chapter, the pertinent literature is reviewed critically, the strength of the evidence is reported, and its relevance for best clinical practices is addressed. A final example of another recent change in the field of rehabilitation and brain plasticity is the reconceptualization of language representation as network connectivity as opposed to the more static traditional localizationist perspective. A new chapter in this text integrates this new field of research.

Further, we tailored the depth of coverage to incorporate a thorough literature review and included practical clinical applications. This reflects our view that clinicians (and clinicians-in-training) not only need practical information, but also must understand the underlying theoretical issues to provide therapy based on critical thinking and EBP. We also believe that the illustrative case studies included in all clinical chapters can facilitate the reader's understanding of the concepts. Additional demonstrations are provided by the available video clips, which enable both clinicians and clinicians-in-training to witness several important concepts and applications come to life. Finally, the "Future Directions" section in each chapter provides a glimpse of where the field may be headed. Based on their thorough knowledge of their topic, the authors have anticipated the issues most likely to be addressed in the near future so that readers are given a "heads-up" to follow the development of each topic area.

New to This Edition

We purposefully avoided organizing chapters based upon aphasia type. This should not be taken to imply that we find no value in aphasia classification per se, but rather that students should be trained to make symptom-specific clinical decisions rather than be influenced by a diagnostic label. The first part of the text covers aphasiology, and the second part addresses related disorders.

- In **Chapter 1**, Ilias Papathanasiou, Patrick Coppens, and Bronwyn Davidson include more details about issues related to the concept of aphasia and aphasia rehabilitation. Specifically, the authors discuss international challenges in service delivery, review a variety of aphasia management approaches, examine the use of technology in aphasia therapy, and present the ICF framework and how it impacts aphasia rehabilitation.
- In **Chapter 2**, Chris Code provides an overview of the history of aphasiology. All of the major contributions are highlighted, which should help the reader understand aphasiology and aphasia rehabilitation as an evolving area of study.
- In **Chapter** 3, Natalie Gilmore, Emily J. Braun, and Swathi Kiran offer clinically relevant information on neuroanatomy and neurophysiology of stroke and describe the typical symptomatology and lesion location of the major aphasia types. Importantly, they focus on the relationship between brain and language from a network connectivity perspective, a cutting-edge development in aphasiology.
- In **Chapter 4**, Ilias Papathanasiou, Patrick Coppens, Edith Durand, and Ana Inés Ansaldo review the principles underlying poststroke language reorganization and neuroplasticity. This topic takes on renewed importance now that imaging technology allows us to observe firsthand the processing changes associated with communication and communication disorders.
- In **Chapter** 5, Laura Murray and Patrick Coppens provide theoretical and practical information about the linguistic, cognitive, and psychosocial measurement tools available; their properties and use; and the formal and informal assessment and baselining procedures.
- In **Chapter** 6, Linda Worrall, Sue Sherratt, and Ilias Papathanasiou describe the therapy process and its context, such as the timing of therapy and the development of clinical goals. They further emphasize the complementary character of all the ICF categories.
- NEW! In **Chapter 7**, Sarah J. Wallace, Kirstine Shrubsole, and Marian C. Brady describe the principles of EBP, the issues surrounding efficacy of aphasia therapy, and the concepts of outcome in aphasia rehabilitation.
- In **Chapter 8**, Laura Murray and Jamie Mayer describe the extralinguistic cognitive factors important for understanding aphasia. The authors review important cognitive skills that underlie language processing, address assessment issues associated with these cognitive skills, and discuss their rehabilitation potential in the context of aphasia.
- In **Chapter 9**, Julie Morris and Kelly Knollman-Porter address a specific aphasia symptom: auditory comprehension. They review the language-decoding stages and pair each level with appropriate therapy options. In addition, they have added an important section on the effects of auditory comprehension impairment on discourse and the everyday functioning of the person with aphasia.
- In **Chapter 10**, Nadine Martin discusses the ubiquitous aphasia symptom of anomia. She delineates the current models of word production and associates naming errors with specific stages of the model. This strategy allows clinicians to identify the underlying nature of a naming deficit and to develop clinical objectives accordingly.
- In **Chapter 11**, Elizabeth B. Madden, Diane L. Kendall, and Ellyn A. Riley outline the various types of acquired alexias and analyze their respective symptomatology in light of the current dual-route model. They further critically review the therapy techniques available for each alexia type.

- In **Chapter 12**, Ilias Papathanasiou, Evangelia-Antonia Efstratiadou, and Zsolt Cséfalvay provide an overview of the various types of agraphias and therapy techniques for each.
- In **Chapter 13**, Jane Marshall presents the theoretical constructs underlying sentence production and the therapy strategies to remediate sentence-level disorders.
- In **Chapter 14**, Elizabeth Armstrong, Lucy Bryant, Alison Ferguson, and Nina Simmons-Mackie examine language with a wider lens, focusing on the use of language in everyday talk and providing an analysis at the level of discourse, conversation, and narrative, which includes communicative context and psychosocial issues.
- In **Chapter 15**, Katerina Hilari and Madeline Cruice provide an overview of the impact of aphasia on an individual's quality of life. They review many specific measurement tools and offer some strategies for clinicians to include quality-of-life concerns in clinical decisions.
- In **Chapter 16**, Bronwyn Davidson and Linda Worrall discuss client-centered aphasia assessment and intervention. This approach sensitizes clinicians to recognize that a life-changing event such as aphasia has an impact on a person's identity and has repercussions on a host of psychosocial issues.
- In **Chapter 17**, José Centeno, Ladan Ghazi-Saidi, and Ana Inés Ansaldo address the important topics of not only bilingualism and multilingualism, but also aphasia in a multicultural world. Because a majority of individuals around the globe speak more than one language, many clinicians will likely encounter bilingual individuals with aphasia in their practice.
- In **Chapters 18 and 19**, Margaret Lehman Blake addresses communication and cognition disorders in individuals who suffered a right-hemisphere stroke. In Chapter 18, she outlines in detail the theories underpinning our understanding of the nature of communication disorders in this population and the best practices for assessment and rehabilitation of the communication difficulties. In chapter 19, she outlines the cognitive problems associated with right-hemisphere disorders, and how they affect communication. She further critically describes the assessment options and the management approaches to improve the cognitive and communicative functioning of people with right-hemisphere disorders.
- In **Chapter 20**, Fofi Constantinidou and Mary Kennedy offer an overview of communication and neuropsychological disorders associated with traumatic brain injury. They discuss principles of rehabilitation as well as specific therapy techniques supported by EBP. In addition, they include timely information on sport-related concussions.
- In **Chapter 21**, Nidhi Mahendra and Tammy Hopper describe the cognitive and communicative difficulties in persons with dementia. They further detail the assessment process and the intervention principles and review the available rehabilitation techniques.
- NEW! In **Chapter 22**, Jerry K. Hoepner and Leanne Togher address the important topic of living with cognitive communication disorders. More specifically, they provide an overview of the social consequences of cognitive communicative disorders, a discussion on assessment issues, and insights on the development and planning of appropriate therapy approaches based on the social participation model.
- NEW! In **Chapter 23**, Christos Papatzalas, Kostas Fountas, Eftychia Kapsalaki, and Ilias Papathanasiou address language and communication disorders associated with tumors and neurosurgery, including how to assess language during awake brain surgery.
- In **Chapter 24**, Nick Miller and Julie Wambaugh present a thorough overview of the symptomatology, differential diagnosis, assessment, and rehabilitation of individuals with acquired apraxia of speech.
- In **Chapter 25**, Anja Lowit, Raymond Kent, and Anja Kuschmann provide an in-depth review of dysarthria. The authors describe the models of speech production, discuss the taxonomy of the dysarthria syndromes, and expand on practical clinical issues related to dysarthria assessment and rehabilitation.

Acknowledgments

As the examples show, in the third edition of this text, our efforts focused on adding important updates and relevant information related to the clinical process. To identify these elements, we relied upon the input of many individuals, all of whom are deserving of our thanks. We would like to express our gratitude to all the professionals who have relied on the first two editions of this textbook for their professional needs, particularly those who have given us the constructive feedback needed to create an even better textbook. Your comments guided our discussions and decisions, and we sincerely hope that you will enjoy this third edition. We are also grateful to the team members at Jones & Bartlett Learning for their attention to detail and to the anonymous reviewers of both previous editions. Last but not least, we thank all of the chapter authors for their tremendous efforts to produce such outstanding contributions.

With gratitude,
Ilias Papathanasiou
Patrick Coppens

About the Authors

Ilias Papathanasiou, PhD, FRCSLT, ASHA Fellow, Professor, Department of Speech and Language Therapy, University of Patras, Patras, Greece and Visiting Professor, Medical School, National Kapodistreian University of Athens, Athens, Greece.

Born in Greece, Dr. Papathanasiou trained in speech–language pathology at the University College London, University of London, England, and holds a master's degree in health sciences from St. George's Medical School, University of London. He completed his PhD at the Institute of Neurology, University College London, University of London, where he studied the mechanisms of recovery of writing in aphasia. His clinical and research interests include the study of the cognitive processes and neural substrates that support spoken and written language, as well as the nature and treatment of acquired impairments of language. Dr. Papathanasiou has contributed numerous scientific papers to refereed journals, written several book chapters, and organized a number of international meetings. He is the founder of the international series of conferences, "The Sciences of Aphasia," which started in 2000. He is the editor of the book *Acquired Neurogenic Communication Disorders: A Clinical Perspective* and coeditor of the book *The Sciences of Aphasia: From Therapy to Theory*. He is on the editorial board of *Aphasiology*, *Communications Disorders Quarterly,* and the *Perspectives of the ASHA Special Interest Groups*. Currently, he is a professor in the Department of Speech and Language Therapy, University of Patras, and a Visiting Professor in the Medical School, National Kapodistreian University of Athens, Greece, where he is actively involved in teaching, clinical research, and service delivery. Dr. Papathanasiou is a Fellow of the Royal College of Speech and Language Therapists (FRCSLT) in the United Kingdom and a Fellow of the American Speech-Language-Hearing Association (ASHA). He is the 2020 recipient of the ASHA Certificate of Recognition for Outstanding Contributions in International Achievement.

Patrick Coppens, PhD, CCC-SLP, Professor Emeritus, Department of Communication Sciences and Disorders, State University of New York–Plattsburgh, Plattsburgh, New York.

Dr. Coppens was born and educated in Brussels, Belgium, where he acquired an undergraduate degree in Germanic Linguistics and a master's degree in neurolinguistics under the mentorship of Dr. Yvan Lebrun. His doctorate in communication disorders and sciences was awarded at Southern Illinois University–Carbondale under the mentorship of Dr. Randall Robey. Dr. Coppens has more than 30 years of experience teaching and conducting research in aphasiology. He has published and presented extensively in his area of expertise. He is the editor of *Aphasia in Atypical Populations* (1998, Lawrence Erlbaum) and *Aphasia Rehabilitation: Clinical Challenges* (2018, Jones & Bartlett Learning). He has sat on the editorial board of *Aphasiology* for many years and has been actively involved in various official capacities with the *Academy of Neurologic Communication Sciences and Disorders*, a professional group dedicated to promoting research and enhancing clinical services related to neurologic disorders.

Contributors

Ana Inés Ansaldo
Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal and École d'Orthophonie et d'Audiologie Faculté de Médecine
Université de Montréal
Montreal, Canada

Elizabeth Armstrong
School of Medical and Health Sciences
Edith Cowan University
Western Australia

Margaret Lehman Blake
Department of Communication Sciences & Disorders
University of Houston
Houston, Texas, USA

Marian C. Brady
Nursing, Midwifery and Allied Health Professions Research Unit
Glasgow Caledonian University
Glasgow, Scotland

Emily J. Braun
Aphasia Research Laboratory
Speech, Language and Hearing Sciences
Boston University
Boston, Massachusetts, USA

Lucy Bryant
Graduate School of Health
University of Technology Sydney
New South Wales, Australia

José G. Centeno
Rutgers School of Health Professions
Biomedical & Health Sciences
Newark, New Jersey, USA

Chris Code
Department of Psychology
University of Exeter
Exeter, England

Fofi Constantinidou
Department of Psychology and Center for Applied Neuroscience
University of Cyprus
Nicosia, Cyprus

Madeline Cruice
Division of Language and Communication Science
School of Health Sciences
City, University of London
London, England

Zsolt Cséfalvay
Department of Communication Disorders
Comenius University
Bratislava, Slovakia

Bronwyn Davidson
Department of Audiology and Speech Pathology
The University of Melbourne
Victoria, Australia

Edith Durand
Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal and École d'Orthophonie et d'Audiologie Faculté de Médecine
Université de Montréal
Montréal, Canada

Evangelia-Antonia Efstratiadou
Department of Speech and Language Therapy
University of Patras
Patras, Greece

Alison Ferguson
School of Humanities and Social Sciences
University of Newcastle
New South Wales, Australia

Kostas Fountas
Faculty of Medicine, School of Health Sciences
University of Thessaly
Larisa, Greece

Ladan Ghazi-Saidi
Department of Communications Disorders
University of Nebraska at Kearney
Kearney, Nebraska, USA

Natalie Gilmore
Aphasia Research Laboratory
Speech, Language and Hearing Sciences
Boston University
Boston, Massachusetts, USA

Katerina Hilari
Division of Language and Communication Science
School of Health Sciences
City, University of London
London, England

Jerry K. Hoepner
Department of Communications Sciences and Disorders
University of Wisconsin—Eau Claire
Eau Claire, Wisconsin, USA

Tammy Hopper
Department of Speech Pathology and Audiology
Faculty of Rehabilitation Medicine
University of Alberta
Alberta, Canada

Eftychia Kapsalaki
Faculty of Medicine, School of Health Sciences
University of Thessaly
Larisa, Greece

Diane L. Kendall
Department of Speech and Hearing Sciences
University of Washington
Seattle, Washington, USA

Mary Kennedy
Department of Communication Sciences and Disorders
Crean College of Health and Behavioral Sciences
Chapman University
Orange, California, USA

Raymond Kent
The Waisman Center
University of Wisconsin Madison
Madison, Wisconsin, USA

Swathi Kiran
Aphasia Research Laboratory
Speech, Language and Hearing Sciences
Boston University
Boston, Massachusetts, USA

Kelly Knollman-Porter
Department of Speech Pathology and Audiology
Miami University
Oxford, Ohio, USA

Anja Kuschmann
School of Psychology Sciences and Health
Strathclyde University
Glasgow, Scotland

Anja Lowit
School of Psychology Sciences and Health
Strathclyde University
Glasgow, Scotland

Elizabeth B. Madden
School of Communication Sciences and Disorders
Florida State University
Tallahassee, Florida, USA

Nidhi Mahendra
Department of Communicative Sciences and Disorders
California State University—East Bay
Hayward, California, USA

Jane Marshall
Division of Language and Communication Science
School of Health Sciences
City, University of London
London, England

Nadine Martin
Department of Communication Sciences and Disorders
Temple University
Philadelphia, Pennsylvania, USA

Jamie Mayer
School of Allied Health & Communicative Disorders
Northern Illinois University
DeKalb, Illinois, USA

Nick Miller
Speech and Language Sciences
School of Education, Communication and Language Sciences
Newcastle University
Newcastle, England

Julie Morris
Speech and Language Sciences
School of Education, Communication and Language Sciences
Newcastle University
Newcastle, England

Laura Murray
School of Communication Sciences & Disorders
Faculty of Health Sciences
Western University
London, Canada

Christos Papatzalas
Faculty of Medicine, School of Health Sciences
University of Thessaly
Larisa, Greece

Ellyn A. Riley
Department of Communication Sciences and Disorders
Syracuse University
Syracuse, New York, USA

Sue Sherratt
Communication Research Australia
Rankin Park
NSW 2287, Australia
Brisbane, Australia

Kirstine Shrubsole
School of Health and Human Sciences
Southern Cross University
Gold Coast Campus
Bilinga, Queensland, Australia

Nina Simmons-Mackie
Department of Health & Human Sciences
Southeastern Louisiana University
Hammond, Louisiana, USA

Leanne Togher
Speech Pathology, School of Health Sciences
Faculty of Medicine and Health
The University of Sydney
New South Wales, Australia

Sarah J. Wallace
Queensland Aphasia Research Centre
School of Health and Rehabilitation Sciences
The University of Queensland
Queensland, Australia

Julie Wambaugh
Department of Communication Sciences & Disorders
University of Utah
Salt Lake City, Utah, USA

Linda Worrall
School of Health and Rehabilitation Sciences
University of Queensland
Brisbane, Australia

SECTION I

Aphasia

CHAPTER 1

Aphasia and Related Neurogenic Communication Disorders: Basic Concepts, Management, and Use of Technology

Ilias Papathanasiou, Patrick Coppens, and Bronwyn Davidson

OBJECTIVES

The reader will be able to:

1. Define aphasia.
2. Describe the epidemiology of aphasia.
3. Understand the principles of care for people with aphasia.
4. Describe the basic concepts of the ICF framework.
5. Examine the effectiveness of group therapy and pharmacotherapy for aphasia rehabilitation.
6. Synthesize the issues related to technology use in aphasia therapy.

Introduction

The main objective of this text is the study of aphasia and aphasia rehabilitation. Throughout, aphasia is approached from a variety of perspectives including neurological, linguistic, neuropsychological, and psychosocial. Each chapter further seeks to provide practical clinical applications supported by evidence-based practice (EBP) principles to link theoretical models to clinical practice for researchers, clinicians, and clinicians-in-training. Because these important basic concepts permeate all chapters, it is imperative that we define and explain them at the outset. This introduction, therefore, defines aphasia, outlines its management approaches and service delivery options, and describes the use of new technology in aphasia therapy.

What Is Aphasia?

Many definitions of aphasia have been proposed during the history of aphasiology. These reflect the theoretical constructs and concerns of their time, and there is no reason to believe that any current definition will necessarily withstand further scientific developments. Still, generating an operational definition of aphasia is a necessary, albeit challenging, task because it is a multidimensional concept. From a neurological perspective, aphasia is an acquired language impairment resulting from a focal brain lesion in the absence of other cognitive, motor, or sensory impairments. This language impairment can be present in all language components (phonology, morphology, syntax, semantics, pragmatics), across all modalities (speaking, reading, writing, signing), and in the output (expression) and input (comprehension) modes. Describing the language symptoms of a given individual with aphasia may help identify a particular lesion location and possibly suggest a specific brain pathology (Damasio, 1992; Goodglass & Kaplan, 1983). From a neurolinguistic perspective, aphasia is a breakdown in specific language domains resulting from a focal lesion (Lesser, 1987). From a cognitive perspective, aphasia is considered the selective breakdown of language processing itself, of underlying cognitive skills, or of the necessary cognitive resources resulting from a focal lesion (Ellis & Young, 1988; McNeil, 1982). Finally, from a functional perspective, aphasia is a communication impairment masking inherent competence (Kagan, 1995). So, through the years, these different schools of thought have led researchers to generate many different definitions of aphasia.

Regardless of the perspective one espouses, most researchers agree on common elements in any definition of aphasia: Aphasia (1) is a mostly language-level problem, (2) includes receptive and expressive components, (3) is multimodal in nature, and (4) is caused by a central nervous system dysfunction. The first element seems obvious, but some authors do use the label *aphasia* to refer to acquired language impairment secondary to cognitive difficulties (following closed head injury or dementia, for example). Although it is possible for a closed head injury to cause damage to the language areas of the brain, the symptomatology is usually difficult to classify using the aphasia taxonomy because most of the communicative difficulties are caused by the preeminent cognitive dysfunction (Wiig et al., 1988). On the other hand, it is not the case that the aphasic symptomatology displayed by a stroke victim is the consequence of cognitive impairments only, although cognitive processes can be involved. We argue in favor of using the term *aphasia* exclusively for acquired focal lesions in the language-dominant hemisphere. Therefore, the first part of this text covers *aphasia*, and the second part addresses *related* disorders.

Whereas most definitions of aphasia center on the acquired neurological impairments impeding language function, the International Classification of Functioning, Disability, and Health (ICF; World Health Organization [WHO], 2001) focuses our attention on the consequences that these impairments have on the person's communicative and social functioning and quality of life (Martin et al., 2008). Therefore, an up-to-date working definition of aphasia should include all these elements.

For the purpose of this text, we operationally define *aphasia* as *an acquired selective impairment of language modalities and functions resulting from a focal brain lesion in the language-dominant hemisphere that affects the person's communicative and social functioning and quality of life and the quality of life of his or her relatives and caregivers.*

Population and Public Health Approaches in Aphasia

Approximately 30–35% of stroke survivors have aphasia on discharge from the hospital following a stroke, with the prevalence of speech (dysarthria) and language (aphasia) disability 6 months after stroke reported as 30–50/100,000 (Dickey et al., 2010; Enderby & Davies, 1989; Engelter et al., 2006). Mitchell et al. (2020) report 40% of inpatient stroke survivors presenting with aphasia. People with aphasia have higher healthcare costs (8.5% or $1,700 attributable cost) and longer length of stay (LOS) in the hospital (6.5%) compared with stroke survivors without aphasia (Ellis et al., 2012). People with stroke-related aphasia may require additional services to address their communication disability in the hospital and also during community life, and such services might reduce their LOS or incidence of adverse events (Bartlett et al., 2008; Hemsley et al., 2013). However, the management of swallowing disorders (dysphagia) may be prioritized over aphasia services in acute hospital settings due to inadequate staffing ratios and lack of appropriate therapy space/resources (Foster et al., 2015; Rose et al., 2014). In addition, people with aphasia have poor long-term outcomes after stroke including consequences such as social isolation, depression, and poor quality of

life for themselves and their family members (Cruice et al., 2006; Enderby & Davies, 1989; Grawburg et al., 2014; Hilari & Byng, 2009; Vickers, 2010). As a chronic disability, aphasia generates a number of long-term service needs, including therapy to enable functional and socially relevant communication (Worrall et al., 2011). Provision of quality, efficient, evidence-based care is critical for people with aphasia and their families and healthcare systems.

The study of aphasia and the service delivery systems for people with aphasia have traditionally centered on the individual with aphasia. Increasingly, the need for greater public awareness of aphasia has become apparent, as research has reported that people with aphasia and their families have identified barriers to social inclusion that exist due to a lack of community understanding of what aphasia is and how changes in spoken and written language have an impact on a person's daily functioning (Code et al., 2001, 2016; Code & Petherham, 2011; Patterson et al., 2015; Worrall et al., 2013). Simmons-Mackie et al. (2020) emphasize the importance of a strategic research agenda to increase the effectiveness and evaluation of aphasia awareness campaigns worldwide. Education programs to train communication partners of people with aphasia provide an example of interventions that seek to address communication access for those with communication disability (Simmons-Mackie et al., 2010). Indeed, the creation of communication-accessible environments is essential in addressing the needs of people with aphasia for social inclusion, communication access in service encounters, and accessible health information (Booth et al., 2019; Rose et al., 2011; see https://www.latrobe.edu.au/research/centres/health/aphasia/resources for an example). In the context of public health, the 2020 COVID-19 global pandemic has heightened awareness of the importance of accessible health information for people with aphasia.

Thus, in addition to being responsive to the individual with aphasia, a need for public awareness and community interventions has been identified (McAllister et al., 2013). New models of public health highlight the promotion of health in the whole population, human rights, and the need to address health and social inequities, as discussed by the WHO (2013). Across the globe, there are many people with aphasia for whom services are unavailable or inaccessible. The term *underserved* specifies communities where the health and social services workforce is insufficient and in which people may experience barriers (e.g., distance, economic, and cultural) to accessing services and participation in their community. Underserved communities exist in both minority and majority world countries (Wylie et al., 2013), and the demand for services relevant to the cultural and community context grows.

The *World Report on Disability* (WHO & the World Bank, 2011) provides a catalyst for an examination of how the needs of people with aphasia throughout the world are currently met. It offers an opportunity for the speech pathology profession to further its engagement with people with aphasia to ensure public awareness of aphasia and equitable access to care (Worrall et al., 2013).

Care for People With Aphasia

At no other time in the history of care of people with aphasia has the context in which clinicians work influenced the care that people with aphasia are receiving. Throughout the world, changes in healthcare policies, insurance coverage, national health plans, political climate, clinical licensure and specialization, and professional training have a dramatic impact on the accessibility of services for people with aphasia as well as on the quality of the services provided. Also, advances in science and new technologies have changed the focus of services and their delivery. However, these developments are challenging the clinician, as the focus of therapy has moved from the management of specific communication impairments of the person with aphasia to a broader, more holistic management of the person and his or her specific environment.

The ICF Framework

A worldwide framework was introduced by the WHO to redefine functioning and disability in an effort to increase awareness of the holistic components of healthcare delivery and the interaction between impairment and environment that affects the participation and quality of life of the person with aphasia. The two primary levels within the most recent WHO ICF are (1) body structure and functioning and (2) activity and participation (WHO, 2001) (see **Figure 1.1**).

For a person with aphasia, *body functions and structure* refer to impairments of the brain and brain functions. *Activity* refers to tasks or actions that involve the four language modalities—listening, speaking, reading, and writing—as well as the daily functional communication tasks, such as conversing with family members and friends, reading a newspaper, writing an e-mail, and the like. These modalities have been the traditional focus of assessment and intervention.

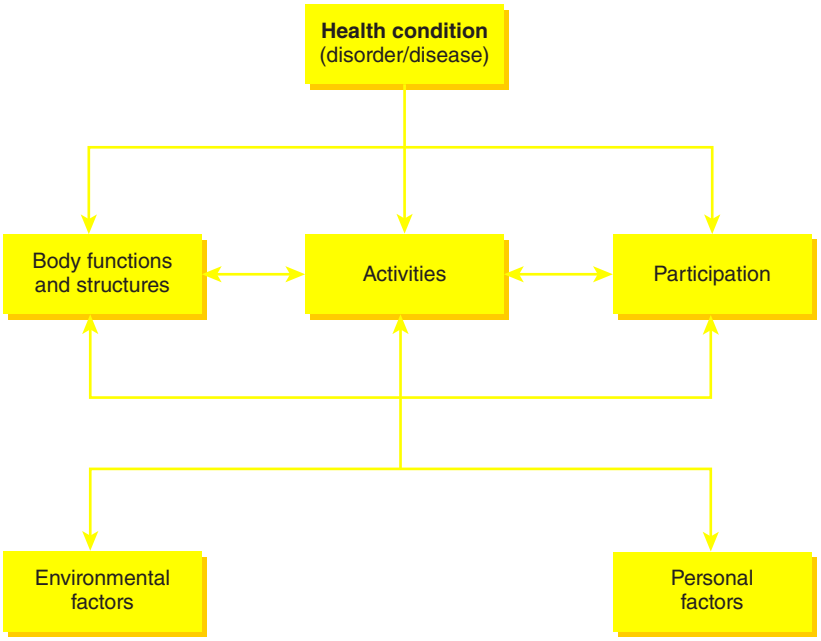

Figure 1.1 The World Health Organization's ICF model

Reproduced from World Health Organization. (2001). *International classification of functioning, disability and health* (2nd ed., p. 18). Author.

The concept of *activities and participation* adds the notion of engagement in daily life and includes immediate and long-term real-life goals. These might include shopping, going on a vacation, attending religious services, participating in local community organizations, and so on. For people with aphasia, these constructs represent the ability to use language in context to communicate. *Environment* is another key concept in the ICF. This includes relationships with others, policies and regulations, the use of assistive technology, physical environmental factors, and attitudes of individuals and society toward the person with aphasia.

The WHO-ICF framework broadens the classic biomedical models to a more holistic service delivery approach for people with aphasia. Viewing aphasia through this framework helps us consider social contacts as fundamental to the context in which people with aphasia communicate and engage in daily life activities and helps us realize that the communication partners are also responsible, in part, for the social consequences linked to aphasia. The framework highlights the dynamic interaction of all the important variables, such as risk factors, social support, etiologies, genetics, abilities, environmental factors, daily habits of social participation, and so on. Finally, this framework helps clinicians focus on the core features of health and well-being to see aphasia within the context of real-life situations and encourage full life participation, culminating in an overall focus on quality of life with aphasia.

What Is Aphasia Therapy?

Traditionally, aphasia rehabilitation has been behavioral in nature. That is, aphasia therapy is the supportive process designed to help people with aphasia modify their current communicative behaviors, with practice, to maximize their communication proficiency. This is true whether the service delivery model is one-on-one with a clinician, in group therapy, using a computer program, or through telepractice. However, nonbehavioral adjuvant therapy approaches for aphasia have also been recently investigated such as pharmacotherapy and noninvasive brain stimulation protocols. It is believed that, in time, these procedures have the potential to be used clinically if deemed efficacious and safe. The main focus of this text is to analyze the behavioral rehabilitation process of aphasia, emphasizing the clinician-client-family interaction based on the precepts of the ICF framework of the WHO. In the following sections, these adjuvant and alternative aphasia therapy delivery systems are briefly discussed.

Group Therapy

There are many types and approaches for group therapy in aphasia; they range from more didactic purposes to a focus on social and emotional support. However, most groups tend to be multipurpose (Kearns &

Elman, 2008). Treatment efficacy has been shown to be overall positive (e.g., Wertz et al., 1981), even in patients in the chronic stages of recovery (e.g., Elman & Bernstein-Ellis, 1999). However, the results are not universally positive for all language measures (particularly functional discourse) or for all individuals (Mason et al., 2019). Based on a systematic review, Lanyon et al. (2013) concluded that group therapy was efficacious for specific language processes, such as word finding, which translated into improved scores on formal assessment batteries. The authors further reported that group therapy effected positive changes in social networks but could not evidence improvements in the activity/participation domain of the ICF because of lack of data. Since then, more studies confirmed these positive outcome results (DeDe et al., 2019), including in individuals with severe aphasia (Hoover et al., 2020).

Individuals with aphasia generally perceive group therapy interactions positively; however, specific variables of group interactions seem important to consider. Lanyon et al. (2018) identified several elements that either maximized or hindered group participation such as providing a structure for participation and the opportunity for all to contribute and shaping a supportive environment with meaningful activities.

More recently, aphasia groups have focused on themes beyond conversational interactions to include aphasia book clubs (Knollman-Porter & Julian, 2019) and aphasia choirs (Hurkmans et al., 2012; Tamplin et al., 2013; Zumbansen et al., 2017). Both types of group approaches have been associated with positive outcomes, particularly for functional measures.

Group therapy for aphasia was traditionally seen either as a transitional phase between individual therapy and dismissal or as an add-on technique to facilitate stimulus generalization. However, group therapy is now considered an essential component of aphasia therapy within the framework of the ICF (Kearns & Elman, 2008) and should be considered an intrinsic part of a typical service delivery for all individuals with aphasia at all phases of recovery.

Pharmacotherapy

The rationale for using pharmacological agents to improve aphasia symptoms relates to the manipulation of neurotransmitter levels with the intent of stimulating widespread cerebral activity. As such, these agents do not have an impact on language specifically but rather influence the widespread cognitive substrates of language processing, such as attention/concentration, short-term memory, or mood (Berthier, 2014). A wide variety of drugs have been investigated that act on an array of neurotransmitters (Berthier et al., 2011; Zhang et al., 2018), with variable results. For example, in a review of dopaminergic therapy for aphasia, Gill and Leff (2014) noted that half the studies reviewed showed an effect and half did not, a discrepancy likely due to unspecified candidacy issues.

However, for some patients, the language improvements seem to be significant. Galling et al. (2014) treated a person with nonfluent aphasia with a combination of bromocriptine and language therapy. The client improved on all measures of language production but not comprehension. The authors concluded that, because bromocriptine affects mostly frontal brain regions, the best candidates would be patients with Broca or transcortical motor aphasia, particularly if adynamic characteristics predominate. Furthermore, they noted that only a concomitant regimen of language therapy and medication affected positive changes, an observation confirmed by other studies (e.g., de Boissezon et al., 2007). Interestingly, the intensity of the language therapy may also influence the amount of recovery. Berthier et al. (2014) compared massed-practice with distributed-practice language therapy in conjunction with donepezil (an acetylcholine agonist), and the more intensive therapy protocol yielded better results.

In a recent, thorough systematic review, Zhang et al. (2018) concluded that only donepezil (acetylcholine agonist) and memantine (glutamate antagonist) showed positive effects on post-stroke aphasia. Bromocriptine (dopamine agonist) showed mixed results, and galantamine (acetylcholine agonist), amphetamine (stimulant), and L-dopa (dopamine agonist) revealed minimal and inconsistent results across studies.

In sum, the addition of neuropharmacological agents seems to enhance the effects of speech-language therapy to some degree. However, the actions of these substances are not on language per se but rather on the underlying cognitive support functions. In the best cases, these neurological changes facilitate or prime the brain to take advantage of behavioral language therapy because it is only when the two approaches are concomitant that the best results are observed. Finally, the benefits of pharmacological agents seem to depend on patient candidacy factors such as lesion location or symptomatology, and on the intensity of the therapy delivery, but these factors are not well understood yet. Only when researchers have a better grasp on these issues will pharmacological adjuvant therapy be added to the existing behavioral therapy approaches for aphasia.

Technology in Aphasia Therapy

The recent developments in electronic technology offer individuals a way to access any kind of information readily and quickly. The ability to use technology varies, particularly in older individuals (Sitren & Vallila-Rohter, 2019). In individuals with aphasia, the ability to learn new procedures on an iPad is not related to the severity of the language impairment (Kurland et al., 2018) but does show a relationship with cognitive functioning (Sitren & Vallila-Rohter, 2019). Consequently, clinicians should not assume that severe aphasia is an automatic disqualifier for technology use (Sitren & Vallila-Rohter, 2019), although it has been reported that patients with more severe aphasia tend to improve to a lesser extent (Kurland et al., 2018). The decision to use technology must be collaborative and hinges on many variables, such as cost, familiarity with and readiness to use technology, portability, and environmental support. When applied to aphasia rehabilitation, the purposes of using technology in therapy fall in one of two broad categories: additional practice or communication compensation.

Additional Practice

The implementation of additional practice is based on the belief that more therapy is better than less (Bhogal et al., 2003; Brady et al., 2016), although the therapy intensity debate is far from settled (Cherney, 2012). Furthermore, when individuals with aphasia practice at home with the support of technology, the therapy period becomes more cost-effective (Macoir et al., 2019). This application of technology should be considered an extension of the therapy contents and should dovetail with the clinician-led sessions. That is, the independent practice must reflect the specific objectives of the rehabilitation program, require extensive training (Kurland et al., 2018; Macoir et al., 2019), and be closely followed by the clinician for treatment fidelity (Ball et al., 2018) and compliance (Kurland et al., 2018). However, completely self-delivered therapy can also be effective (Stark & Warburton, 2016).

The app market has seen a sharp increase in aphasia products in recent years. The reported products used in the literature are quite varied (e.g., Des Roches & Kiran, 2017), and some authors have even developed their own software app (e.g., Lavoie et al., 2019). Several systematic reviews of computer- and tablet-based aphasia therapy have been reported (Des Roches & Kiran, 2017; Lavoie et al., 2017; Zheng et al., 2016). Overall, the results show the effectiveness of this type of treatment delivery, but generalization to untrained items and more functional communicative situations tends to be limited (Lavoie et al., 2017). In some instances reported in the research literature, computer-based therapy was as effective as clinician-administered therapy (Zheng et al., 2016), with the amount of home practice positively related to outcome (Des Roches & Kiran, 2017). Independent skill practice has been described for a variety of objectives, including reading comprehension (Caute et al., 2019), naming (Kurland et al., 2018), oral reading (Cherney, 2010), sentence generation (Loverso et al., 1992), written naming (Laganaro et al., 2006), and complex sentence production and comprehension (Thompson et al., 2010). To assist clinicians in deciding whether to supplement aphasia treatment with a self-administered home program, Macoir et al. (2019) proposed a list of evaluation factors. The factors are related to the treatment (e.g., Is there a feedback loop?), the technology (e.g., Is it aphasia friendly?), or the person with aphasia (e.g., Is the person motivated?). The more positive the answers, the more likely the self-administered treatment will be successful. Finally, individuals with aphasia generally report satisfaction with this type of service delivery (Kearns et al., 2019).

There is a relatively recent avenue of research with therapist avatars. It is typically used within narrow confines of predictable conversational turns, such as script training (Cherney et al., 2008; Kalinyak-Fliszar et al., 2015), but as artificial intelligence paradigms improve it is expected that this type of service delivery will also develop further.

It is important to keep in mind that regardless of the technology selected the contents of the program must remain individualized and tailored to the needs of the individual with aphasia (Des Roches & Kiran, 2017). A one-size-fits-all program is just as inappropriate delivered by technology as it is delivered by a clinician.

Communication Compensation

Communication compensation or supplementation provides the individual with aphasia with an external aid to communicate more effectively (i.e., augmentative and alternative communication [AAC]). High-technology AAC refers specifically to systems using power (Taylor et al., 2019), as opposed to paper and pencil strategies, for example. The variables predicting successful implementation of a high-tech AAC system are complex and not fully understood. However, a recent review article (Taylor et al., 2019)

provides a useful summary of the important factors to consider. Among the noteworthy conclusions, the authors report that age is not an automatic barrier to high-tech AAC use, as generally assumed, and that one of the most crucial elements of success is a period of intense practice. If the individual with aphasia is not used to interacting with technology, a longer period of training that also includes the basic functions of the device may be necessary (Szabo & Dittelman, 2014). Traditionally, AAC is implemented later in the rehabilitation sequence, but this view is now being challenged (Dietz et al., 2020). Dietz et al. argue that AAC must be introduced earlier to provide individuals with aphasia more independence, thereby also facilitating social participation as early as possible in the rehabilitation phase. Implied in this philosophy is that the AAC system must be adaptable and may be temporary.

Hoover and Carney (2014) reported on a group of individuals with aphasia who were using apps to supplement and facilitate social communication. A significant improvement was noted on individual functional language measures as well as quality-of-life scales. Russo and colleagues (2017) further emphasize that AAC success must be measured in functional terms rather than merely language measures, thereby focusing more effectively on social participation.

Computer applications need not be designed specifically for aphasia to be useful in facilitating communication. Ramsberger and Messamer (2014) describe three individuals with aphasia who were successful in using readily available apps. One person used a speech-to-text app, one client used a story maker app, and the third individual relied on iPad touch screen capabilities to allow conversation partners to write key words to help with comprehension. Many more examples can be found (Hoover & Carney, 2014; Szabo & Dittelman, 2014).

Telepractice

The technological advances in various electronic devices and broadband availability now allow for reliable remote video contacts between individuals. As a consequence, clinicians and clients do not need to be in the same physical location for a therapy session. This service delivery method is variously referred to as *telepractice*, *telerehabilitation*, *teletreatment*, *telehealth*, or *teletherapy*. This may be particularly useful when the person with aphasia is unable to travel to a clinic because of physical constraints or distance. Furthermore, the recent pandemic of COVID-19 has made telepractice a popular and safe means of service delivery. The American Speech-Language Hearing Association (ASHA) is interested in this service delivery, as the association created a special interest group (SIG 18) devoted to the subject.

Telepractice venues include medical centers, rehabilitation hospitals, community health centers, outpatient clinics, universities, clients' homes, residential healthcare facilities, and corporate settings. There are no inherent limits to where telepractice can be implemented as long as the services comply with national, state, institutional, and professional regulations and policies. However, clinicians and programs should verify state licensure and payer regulations to ensure that a particular type of service delivery is consistent with rules and payment policies (ASHA, 2019).

ASHA recognizes telepractice as an appropriate service delivery model provided that clinicians have adequate knowledge of the technologies utilized, appropriately adapt assessment or intervention materials for telepractice delivery, and competently select clients appropriate for remote service delivery. Further information and guidance can be found at ASHA's Practice Portal on telepractice (ASHA, 2019). Telepractice is currently being used to fill service gaps in educational settings and in some adult healthcare settings.

ASHA (n.d.) refers to common terms describing types of telepractice as follows:

- **Synchronous** (client interactive)—services are conducted with interactive audio and video connection in real time to create an in-person experience similar to that achieved in a traditional encounter. Synchronous services may connect a client or group of clients with a clinician, or they may include consultation between a clinician and a specialist.
- **Asynchronous** (store-and-forward)—images or data are captured and transmitted (i.e., stored and forwarded) for viewing or interpretation by a professional. Examples include transmission of language sampling, testing results, or outcomes of independent client practice.
- **Hybrid**—applications of telepractice that include combinations of synchronous, asynchronous, and/or in-person services.

The literature supporting the use of telepractice in the adult healthcare environment is emerging. Various systematic reviews, which are helpful in synthesizing information for clinicians, have investigated different facets of telepractice for communication rehabilitation in adults. In 2013, a Cochrane review

(Laver et al., 2013) examined the effectiveness of telerehabilitation in general for individuals with stroke but did not find enough evidence to make firm conclusions. Another systematic review (Hall et al., 2013) supported effectiveness and viability of telepractice for aphasia. The authors performed a systematic review of the accumulated evidence and concluded that, for both assessment and therapy purposes, telepractice was equivalent to face-to-face sessions. Differences in these conclusions are likely related to the broader scope of the Cochrane review and the types of studies included: Cochrane (Laver et al., 2013) included only randomized controlled trials, whereas Hall et al. (2013) did not restrict results by study design. The only concerns they reported included technology and privacy issues, which the authors deemed easily surmountable.

Weidner and Lowman (2020) conducted a systematic review of the literature from 2014 to 2019 regarding adult telepractice services (screening, assessment, and treatment), including the telepractice literature for aphasia. In this review, studies were included if they examined evidence of feasibility, acceptability, efficacy, and/or effectiveness of telehealth for speech-language pathology screening, assessment, or intervention. They did not examine service outcomes, such as cost effectiveness and efficiency. They reported on studies that used synchronous, asynchronous, or hybrid delivery of skilled services and excluded studies examining remote patient monitoring, mobile health only, or computer-based interventions that did not involve telecommunications to facilitate interaction with the clinician. One of the variables that they analyzed was diagnostic accuracy, as measured by the agreement between evaluations completed in person versus remotely. Two studies involved screening or assessment of aphasia. Aphasia screening via a mobile tablet version of the Frenchay Aphasia Screening Test and store-and-forward technology were found to be reliable (Choi et al., 2015). Also, on a tablet version, aphasia assessment using videoconferencing had good agreement with in-person aphasia evaluation results and comparable intrarater and interrater reliability (Guo et al., 2017). Guo et al. (2017) used a custom application to allow a Speech-Language Pathologist (SLP) to administer the Assessment for Living with Aphasia (Kagan et al., 2013) and portions of the Psycholinguistic Assessments of Language Processing in Aphasia (Kay et al., 1992) to individuals with aphasia in their homes.

Another variable analyzed by Weidner and Lowman (2020) was the type of intervention. Fifteen studies investigated interventions delivered via telepractice, four of which used group interventions. Most of the studies involved individuals with chronic aphasia. A variety of common aphasia treatment techniques were used. Two studies used progressive cueing hierarchies to target word retrieval, finding similar results for remote and in-person delivery (Agostini et al., 2014; Woolf et al., 2016). Two studies reported on a combination of independent home practice of word retrieval and informal weekly videoconferencing check-ins, designed to sustain gains from a separate intensive in-person aphasia program. The results suggested that the practice helped maintain naming skills (Kurland et al., 2016, 2018). Four studies used videoconferencing to administer group therapy to individuals with chronic aphasia, demonstrating feasibility and potential benefits (Pitt et al., 2018, 2019; Steele et al., 2014; Walker et al., 2018). Steele et al. (2014) supplemented group intervention with individual videoconferencing sessions as well as home practice tasks on a proprietary software. In the aphasia intervention studies, specific interventions investigated were script training (Rhodes & Isaki, 2018), constraint-induced language therapy (Pitt et al., 2017), Promoting Aphasics' Communication Effectiveness (Macoir et al., 2017), Verb Network Strengthening Treatment (Furnas & Edmonds, 2014), and semantic mediation (Getz et al., 2016). Choi et al. (2016) used an asynchronous model that allowed participants to practice various expressive and receptive language tasks on a tablet, with feedback and guidance provided by an SLP remotely. Studies generally had positive results demonstrating feasibility and/or potential benefits. Finally, regarding their chosen telepractice technology, all but two studies (Choi et al., 2015, 2016) employed live (synchronous) videoconferencing. SLPs typically communicated with participants in real time using a videoconferencing software, either commercially produced (e.g., Skype, Zoom, and Adobe Connect) or custom made for research purposes.

In their review, Weidner and Lowman (2020) found preliminary evidence of feasibility and efficacy of telepractice delivery of speech-language pathology services for adults with aphasia (mostly in the chronic stage). Getz et al. (2016) also suggested aphasia treatments are well suited for telepractice given their audiovisual nature (Brennan et al., 2002). Some of the most promising evidence came from well-designed trials suggesting that adequate treatment outcomes can be achieved with telepractice. An important issue identified by Weidner and Lowman (2020) is the lack of control groups. Only 34% of reviewed intervention studies included control participants or conditions. Inclusion of control conditions is crucial

for establishing treatment efficacy because it helps eliminate the possibility of other factors causing treatment effects (Lemoncello & Ness, 2013).

Telepractice is a rapidly developing field, and there are many exciting opportunities for research. First, while we have evidence for feasibility and preliminary evidence for adult with aphasia telepractice efficacy, convincing arguments for treatment effectiveness require studies with a stronger methodology and the investigation of outcomes under typical clinical conditions. Further research is needed to elucidate the relationship between telepractice service delivery models and communication outcomes for people with aphasia.

WRAP-UP

Study Questions

1. List and explain the important elements in a definition of aphasia.
2. Describe the main elements of the ICF framework.
3. How does the ICF change the service delivery approach for aphasia?
4. Explain the globalization process of the WHO regarding aphasia therapy.
5. Cite and discuss two types of service delivery models for aphasia therapy that are different from the traditional one-on-one approach.
6. What are the two main categories of technology applications in aphasia therapy? Give a clinical example of each.
7. As a clinician, cite three things you would need to do with your client to maximize the success of a high-tech home program.
8. Discuss the efficacy of using telepractice in aphasia therapy.
9. Discuss the efficacy of pharmacotherapy for aphasia.

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CHAPTER 2

Significant Landmarks in the History of Aphasia and Its Therapy

Chris Code

OBJECTIVES

The reader will be able to:

1. Understand the origins of different classifications of aphasia.
2. Compare models of aphasia that have emerged in the history of aphasia.
3. Appreciate that the history of aphasia is influenced by social and political developments in different countries.
4. Name the main protagonists in the history of aphasia.
5. Identify the main events in the history of aphasia.
6. Identify the main shifts in approach to the treatment of aphasia throughout the history of aphasia.
7. Understand where ideas about the nature of aphasia originated.

"History doesn't repeat itself. At best it sometimes rhymes."

Mark Twain (1835–1910)

Introduction

In this chapter, we explore where aphasia and attempts to treat it came from. Along the way, we can test Mark Twain's pithy aphorism. We start with a survey of how thought, language, and speech were represented in the body from ancient to modern times. The ancient Egyptians thought that the heart was the seat of the "soul" and mental life, and pre-Christian Greece and Rome developed a theory of "fluids." Plato's view, that the mind was located in the head contrasted with Aristotle's idea that it was located in the heart. With early anatomical examinations of the brain, the ventricles of the brain, rather than the substance of the brain, was where the soul was considered to reside. This view lasted well into the Middle Ages. Not until the 15th century were basic treatments for aphasia beginning to be developed, based on the view that aphasia was a form of memory disorder. In the 18th century, Gall developed his language and speech localization theory, and Broca, Hughlings Jackson, and Bastian began to consider that recovery occurred because of some form of reorganization and treatment could be beneficial. But not until the First World War did Goldstein, Luria, and the Viennese

phoniatricians Hermann Gutzmann (1865–1922; the father of aphasia therapy) and Emil Froeschels develop the first systematic treatments.

Between the world wars, the focus shifted to North America, and a more behaviorist approach developed. Following World War II, there was a return to localization theory and an approach to treatment developed based on the Boston School and the "stimulation" approaches of Wepman and Schuell. In the latter part of the 20th century, approaches were developed based on linguistics, psycholinguistics, modular cognitive models, and psychosocial and social models.

The history of aphasia is vast, and we cannot hope to cover it completely in a single chapter. More detailed treatments are available (Eling, 1994; Tesak & Code, 2008; Howard & Hatfield, 1987).

Aphasia in the Ancient Past

An understanding of the past history of any field is essential to an appreciation of the present; the present, after all, is the realization of events in the past. St. Augustine (1,400 years before the present, henceforth BP) outlined a first understanding of what time past, time present, and time future might be. He contended that we can really know only the present because time past is only memory—even if it is recorded memory (and we know how unreliable memory can be)—and time future is, by definition, impossible to know. For the history of anything, we are particularly reliant on the written records handed down to us from the past, and writing did not develop until 5,500 years BP in the Middle East; even then, writing was limited to very few experts. But the brain had no great importance in ancient Egyptian medicine and religion. For instance, in mummification, all the organs were stored, but the brain was pulled out through the nose with a hook and discarded. This is a reflection of the cardiocentric view, where the heart was seen as the home of the soul, wherein resided a capacity for good and evil.

The oldest known reference to what we now call aphasia is in the Edwin Smith Papyrus (5000–4200 BP), a medical record of a number of cases of brain damage (Breasted, 1930). One record refers to a man who is "speechless" and states that the speechlessness is "an ailment not to be treated" but that rubbing ointment on the head and pouring a fatty liquid (possibly milk) into the ears is a beneficial therapy.

The Theory of Fluids

The causes of diseases in ancient times were thought to be due to some imbalance of the bodily fluids corresponding to the four basic elements, from which all matter was considered to be made, a view that was to persist into the 18th century. This four-element theory was developed by different philosophers within natural philosophy (e.g., Empedocles, 2504–2433 BP) in an attempt to understand nature and the essence of human nature. The four bodily fluids and their corresponding elements were yellow bile (air), blood (fire), phlegm (earth), and black bile (water). Healing involved manipulating the balance of fluids: bloodletting, starvation, fluid deprivation, heat treatment, regurgitation, fecal evacuation, and sweating. Deficits following brain injuries were interpreted as an accumulation of undesirable life fluids. Cranial drillings (trepanations) were attempts at the evacuation of undesirable fluids and in some cases may have been effective.

The Greco-Roman Period

The connection between cognitive processing and a possible localization in the structure of the human body emerged in Greco-Roman times, and the question was posed: Was the mind represented in the brain or in the heart? For Plato (2428–2347 BP), a tripartite soul corresponded to anatomically different parts of the body. Reason and mind were located in the head, but "higher" characteristics, such as pride, fear, and courage, were in the heart; the lower characteristics of lust and desire were located in the liver or the abdomen. As human speech had been associated with the rational part of the soul since Pythagoras (2580–2428 BP), this was an important step for the examination of the relationship among speech, language, and brain.

Plato's pupil Aristotle (2384–2322 BP) had a particularly significant impact in subsequent centuries on philosophy and the development of medicine. He defined humans as speaking animals and language as innate, with the variety of languages in the world coming about through social factors. In contrast to his teacher Plato, he argued that the heart was the home of all cognitive, perceptual, and associated functions.

Ventricular Theory

Over time, the brain began to figure in Greco-Roman thought. Herophilos (2335–2280 BP), who is recognized as the "father of anatomy," described the cortex, cerebellum, ventricles of the brain, and sensory and motor nerve trunks. It was with him that ventricular theory developed and where a

connection was made between the "psyche" (soul) and the ventricles of the brain. Ventricular theory, or cell theory, to give it its other name, dominated into the middle ages.

Galen (2130–2200 BP) was the most significant brain anatomist until the 17th century. Galen was a physician to the gladiators and so had extensive experience of wounds to the head and the brain, although the dissection of human bodies was prohibited by Rome. He dissected cows, monkeys, pigs, dogs, cats, rodents, and at least one elephant. Although working in the tradition of Aristotle, he rejected Aristotle's theory.

The Middle Ages

The Middle Ages run from the demise of the Roman Empire (400s) to the emergence of the Renaissance (1500s). During the Middle Ages, cell theory developed from ventricular theory (see **Figure 2.1**), but the ventricles were understood as theoretical concepts, rather than as anatomical structures, and simply depicted as circles. In this model, aphasic symptoms appear to result from damage to the third cell (the fourth ventricle) and were conceptualized as memory disorders. The idea that aphasia was a memory disorder was to dominate well into the 19th century.

Figure 2.1 The ventricles of the brain according to medieval cell theory

Modified from Magnus, A. (1490). *Philosophia pauperum, sive Philosophia naturalis* [*Poor philosophy or natural philosophy*]. Georgius Arrivabenus.

There are references to aphasia during this time. Antonio Guainerio (died 1440) suggested that the cause of aphasia was damage to the fourth ventricle (the third cell) and memory was impaired because the ventricle contained too much phlegm. Nicolò Massa (1489–1569) described a man who lost his speech after sustaining a head wound in battle; Massa thought that a bone splinter had been left in the brain. He located it and pulled it out, and immediately the patient called out (apparently in Latin!), "Ad Dei laudem, sum sanus!" (God be praised, I am healthy!). The Spaniard Francisco Arceo (1493–1573) described a worker who was hit on the head by a stone and was speechless for several days. Arceo remedied the fracture, and, some days later, the patient began to speak again and apparently recovered fully through spontaneous recovery.

The Renaissance to the 17th Century

The Renaissance (the "rebirth") emerged and succeeded the darkness of the Middle Ages. It began in Italy in the 15th century, spread throughout Europe, and is associated with the beginnings of modern science and modern medicine.

From the Renaissance to the 17th century, central advances were made in anatomy and physiology of the brain, and increasing attempts were made to connect behavioral and cognitive functions to specific structures of the brain. Descriptions of aphasic symptoms became more precise, and early hypotheses on the causes began to emerge. There were major advances in the development of medicine during the Renaissance, and a number of central personalities and their insights in medicine and philosophy stand out. Leonardo da Vinci (1472–1519) made significant contributions to anatomy. Da Vinci, the exemplary Renaissance man, used empirical methods, including anatomical investigations on animal and human corpses, and produced exact anatomical sketches far superior to those of the earlier medieval tradition. For example, he noted that there was only an imprecise connection between the medieval drawings of ventricles and his own, although he did not question the belief in ventricular theory.

Two prominent Renaissance anatomists who dismissed Galenian ventricular theory were Andreas Vesalius (1514–1564) and Thomas Willis (1621–1675). Vesalius published his famous book, *On the fabric of the*

human body, in 1543; the seventh and last volume is dedicated to the brain. This book was a major advance in anatomical detail and neurology and dismissed much of Galenian anatomy. The ventricles are described in detail, but memory is not localized there: It is in the cerebellum instead.

Thomas Willis (1621–1675) gained his knowledge of the brain from his observations of patients with neurological conditions and was of great importance for the developing neuroscience of the 17th century. His great work, *Cerebri Anatome (Anatomy of the Brain & Nerves*, 1664/1965), benefits from the anatomical drawings of the young Christopher Wren, later to design St. Paul's Cathedral and the center of London following the Great Fire of London. Willis dismissed ventricular theory, stating that mental life was essentially dependent on the cortex, thereby possibly advancing the first cortical theory of the control of muscles and reflexes (Bennett & Hacker, 2003). He also suggested that the gyri, or convolutions, of the brain are responsible for memory and will. He proposed a corporeal, or physical, soul present in humans and animals and associated it with *vital spirits*, a kind of distilled liquor that was made in the brain and circulated in the blood. For Willis, the soul was immortal, nonmaterial, and separate from the brain, with interaction between body and soul.

During the Renaissance and the following centuries, because man was thought to have been created in God's image, anatomical sectioning of the human body continued to be prohibited by the Church. The body was not to be violated by the anatomist's knife. A solution to this problem came from the philosopher René Descartes (1596–1650) in the 17th century.

Each age has its dominant technology—for us in the latter part of the 20th and early 21st centuries, it is computer technology—and we tend to use the computer metaphor to explain the workings of the mind. Mechanics and hydraulics were the most highly developed technologies in the 17th century, and Descartes described humans as machines, mechanical automatons, in his work *De Homine* (*On Man*). However, this automaton was a true human because it possessed a divine soul, and, when the body died, the soul lived on. The difficult question remained as to where the soul had its home, and Descartes suggested that it was in the pineal gland, a gland the size of a pea and lying at the base of the brain but, crucially (for neuroanatomists at the time), just outside the brain proper. For Descartes, the unity between soul and body was only possible in humans, a position called *Cartesian dualism*, which is still influential in current thought. This Cartesian separation of body and soul permitted the Church to lift its ban on anatomical sectioning, and so the basis for further advances in medicine in the 18th and 19th centuries was established.

The 18th Century Enlightenment: Reason and Nature

Isaac Newton (1642–1727) supposed, based on Aristotle's teachings, that all human bodies contain a hidden, vibrating "ether" that moved through the nerves from sensory organs to brain and then to muscles and was under the command of the will. This was Newton's vibration theory. The philosopher John Locke (1632–1704) considered the human mind a collecting point for sensory perceptions that are processed, connected, and associated with each other. David Hartley (1705–1757), most famous for his discovery of the circulation of the blood around the body, considered that the gyri were responsible for memory and the will and attempted to explain memory through association of ideas and Newton's vibration theory, which he combined in neurophysiology to produce associationism.

The idea that aphasia was an impairment of memory continued to dominate in the 17th and 18th centuries and indeed well into the 19th. For instance, Johannes Jakob Wepfer (1620–1695) described at least 13 clear cases of language disorder with brain injuries, which he attributed to memory loss. Johann Gesner (1738–1801) described his patient KD in the book *The Language Amnesia,* where he laid the foundation for the first real theory of aphasia, an impairment of memory caused by a congestion of the "nerve ducts," and, according to Benton (1965), his was the first associationist aphasia theory. Gesner separated language from speech programming and laid the foundations for a separation of communicative competence, the latter apparently unimpaired in KD.

The 19th Century and the Birth of a Science of Aphasiology

There was probably no real "science" of aphasiology until Gesner's work but not until the 19th century did the serious systematic study of aphasia begin. The 19th century is considered to be the foundation period of the modern history of aphasia mainly

because connections were made between the symptoms of aphasia and the localization of areas of brain damage, which emerged to form the basis for the later investigations of Broca, Wernicke, and others.

Napoleon's reign in France dominated the beginning of the 19th century in Europe. At that time, the scientific climate was notably more liberal in France than in the rest of Europe. This was one reason that Franz Josef Gall (1764–1828), a brilliant and highly significant anatomist, left Austria for France. His organology (better known as *phrenology*, the term coined by his student Spurzheim) had a massive influence on ideas about aphasia, neuroanatomy, and neuropsychology, even to the present day (see **Figure 2.2**). Organology considered that the inner form of the cranium was determined by the external form of the brain and it was therefore possible to detect the strength of particular human "faculties" from the shape and size of the cranium. He wrote:

> The possibility of a theory of the psychological and mental functions of the brain presupposes: . . . that the brain was the organ of all tendencies, all emotions and all faculties . . . [and] that the brain was composed of as many individual organs as there are tendencies, emotions, faculties, which essentially differ from one another. (Lesky, 1979 as cited in Tesak & Code, 2008)

With Gall, the foundations of cerebral localization of function began as a serious idea. He was a particularly skilled anatomist; he was also the first to recognize the importance of the neocortex in localization and described mental faculties (or "organs") that were localized in specific parts of the brain. While Gall attributed no specific functions to the separate hemispheres of the brain, he did claim that the faculty for words, which was part of the faculty for language, was located in the frontal lobe, although this insight was tenuously based on an observation Gall had made of a verbally gifted school friend who could learn verbal material very well. His friend had strongly protruding eyes, suggesting to Gall that the boy's brain was particularly well developed behind the eyes, causing them to protrude; this suggested a large language organ situated in the frontal lobes. For Gall, the faculty of language was innate, independent, and autonomous of reason and intelligence, and its primary purpose was as a means of expression. More recently, this has formed the basis for the idea that cognitive functions are organized into modules, an important feature of modern cognitive neuropsychology.

The most important follower of Gall in Paris was Jean Baptiste Bouillaud (1796–1881), a founding member of the French *Société Phrénologique* who was critical of most of the fanciful claims of phrenology in general but was a passionate supporter of Gall's

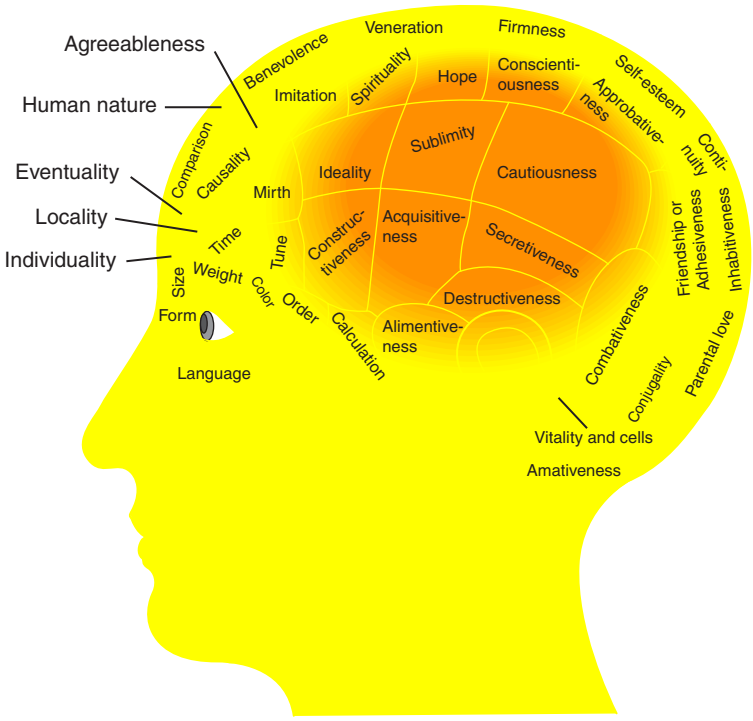


Figure 2.2 The 37 faculties, or phrenological organs, according to Johann Kaspar Spurzheim

Modified from O'Dell, E., & O'Dell, G. (1899). *Phrenology: Essays and studies.* London Phrenological Institution.

language localization theory. He published studies until the 1840s, describing more than 500 cases that he claimed supported his view that language and speech were localized in the frontal lobes. He identified the connection between the separate loss of language and speech and frontal brain damage in significant numbers of patients he described and divided the disorders, into articulation disorders (what we would now call apraxia of speech) and language disorders due to a memory problem. In the first, words are no longer correctly organized or retrievable or usable, and, in the other, the memory form of the word itself is damaged. But phrenology was scorned by most scientists at this time, and Bouillaud had few supporters. In opposition to the localizationists, like Bouillaud, were the holists, most prominent being Pierre Flourens (1794–1867) (Finger, 1994), who carried out brain ablation and stimulation experiments that would be considered primitive by today's standards. He used "spoons" for ablations and often removed large parts of the brain such that the behavioral losses following ablations were often similar. In his stimulation studies, he observed that irritation of the cortex produced no reaction at all. He concluded that the cortex is not divided into functional regions but that functions are represented throughout the brain, what we now call cortical equipotentiality. Bouillaud and other localizationists had difficulties getting their views accepted by the scientific community. From Flourens's first publications in the 1820s until the 1870s, equipotentiality was the dominating paradigm of brain physiology. However, the dispute between the localizers and the equipotentialists was not restricted to the question of localization in the brain. First, it was a question of what was the right methodology: the clinical observation/case studies of the localizers or the repeatable experiments (e.g., animal brain ablations), the approach of Flourens's followers. In addition, the two groups took different basic political and philosophical positions that influenced the neurological debate. Following the revolution of 1848 in France instigated by Napoleon III, the localizationists took the role of progressive liberals and the equipotentialists the role of conservatives. Bouillaud's son-in-law, Ernest Auburtin (1825–1893), was a significant figure in the Paris Anthropology Society and the Paris language localization debates of 1861–1866. He argued strongly for the localization of speech to the frontal lobes.

On April 4, 1861, Auburtin presented a patient, Bache, who had lost his speech but was left with the automatism "sacré nom de dieu" and was said to understand everything and to be of sound mind. He was already very ill, and his demise was imminent. Auburtin announced that he would publicly revoke his views on localization if Bache's brain (or that of any other speech/language-disordered patient) displayed no frontal brain damage in a postmortem autopsy. It was this public announcement by Aubertin that triggered the interest of Pierre-Paul Broca (1824–1880), and Auburtin's contribution has been overshadowed by the colleague he inspired. Anthropology played an essential role in the debates on localization at this time, and it was not a coincidence that questions of language localization were under discussion in the Anthropological Society in Paris in the 1860s (Broca, whose primary interest was anthropology, was cofounder and secretary). By coincidence, on April 12, a patient named Leborgne was transferred to the clinic of Bicêtre Hospital, where Broca was working. Auburtin accompanied Broca, who had little experience of aphasia at that time, in an examination of Broca's patient. The 51-year-old man had epilepsy since his youth, loss of speech 21 years earlier, and paralyses of the right arm for 10 years and of the leg for 4 years. Leborgne's comprehension was said to be intact, but for Broca comprehension was not part of language per se but of intelligence and memory. He had almost no speech apart from the speech automatisms *tan tan* (nonlexical) and *sacré nom de dieu* (lexical). Following Leborgne's death on April 17 and brain autopsy, Broca described Leborgne the next day (April 18) at a meeting of the Anthropology Society (Broca, 1861). Leborgne had a massive frontal lesion centered on the third frontal gyrus (see **Figure 2.3**), and Broca called Leborgne's disorder *aphemia*, meaning loss of articulate speech, a term that is still in use, although now mainly called apraxia of speech. With this, modern aphasiology and neuropsychology were born, and Broca proclaimed that the third frontal convolution was the seat for articulated language. Broca's description of Leborgne is still regarded as the most significant event in the modern history of aphasia and was taken by most as confirmation that the views of Bouillaud, Gall, and Auburtin were correct: that language and speech processing was indeed localized in this specific area of the brain. We have learned more about Leborgne the person recently, thanks to Domanski (2013). We now know that Louis Victor Leborgne was born in 1809 in Moret, France. His father was Pierre Christophe Leborgne, a teacher, who married Margueritte Savard, the daughter of a guardsman, in 1801. They had six children, including Louis Victor. The family was educated and literate; one of his nephews became an official in one of the ministries. The received opinion that Leborgne

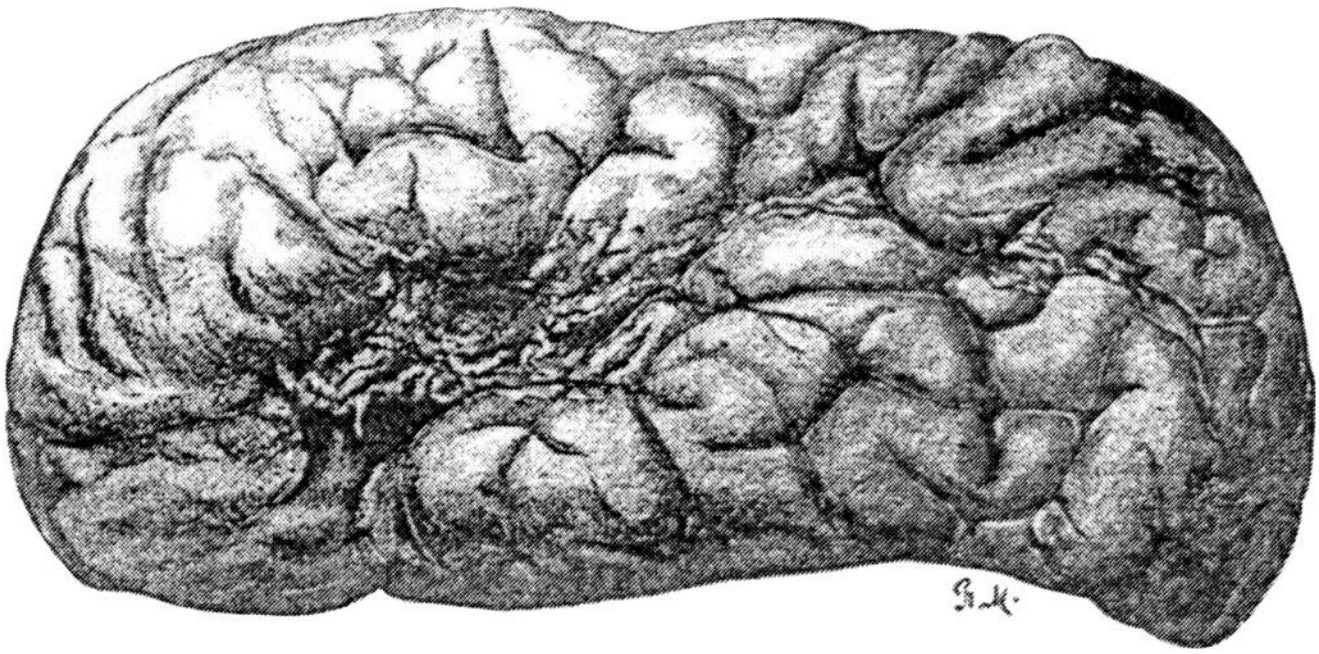


Figure 2.3 The brain of Leborgne (*tan tan*), the famous case presented by Broca in 1861

Courtesy of La Semaine Medicale.

was an uneducated illiterate from the lower social orders is clearly false, and we know that education and illiteracy are relevant to aphasia. He worked until he was 30 as a formier—a craftsman who produced forms for shoemakers.

Broca presented further cases of aphemia in 1863 (Broca, 1863), all of whom had damage to the left hemisphere, and for all, except one, the damage was to the third frontal gyrus. While he noted that it was strange that all the lesions were in the left hemisphere, he made no issue of the fact. The beginning of the idea that the left hemisphere was dominant for speech and language and for most other useful functions was formally crystalized in 1865 when Broca finally formulated a theory of language lateralization (Bogen, 1969)—that is, that language was represented in the left hemisphere. In 1865, he wrote his famous sentence, "We speak with the left hemisphere" ("'Nous parlons avec l'hémisphère gauche") (Broca, 1865, p. 384). He also discussed right-hemisphere compensation in the case of damage to the left (Broca, 1865, p. 384) and that people with aphemia could actually be treated under therapeutic guidance following the principles of child language acquisition. These ideas appear to be the first to propose the possibility of reorganization of the brain and language following damage (Code, 1987).

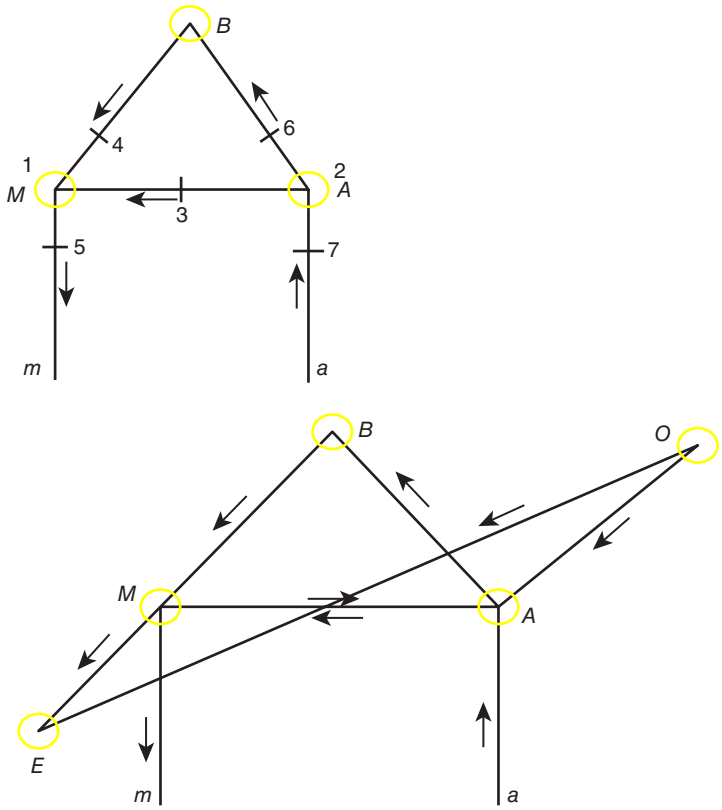
However, the position of Broca as the originator of the idea of left-hemisphere dominance remains controversial (Finger & Roe, 1996; Joynt & Benton, 1964; Schiller, 1992), with many contending that an unknown country doctor had already made the connection between left-hemisphere damage and speech and language impairment in 1836. Marc Dax (1770–1837) had already written a paper for a regional physicians' meeting in 1836, one year before his death but nearly 30 years before Broca's paper wherein the connection between left-hemisphere lesions and speech disorders was clearly stated: "There now remains a very interesting problem to solve: why does it happen that changes to the left cerebral hemisphere are followed by the loss of words, but not those of the right hemisphere?" (Dax, 1865, p. 260). But Marc Dax's work remained unpublished, and there is little evidence that he actually delivered the paper at the regional meeting, although it was submitted for publication to the *Académie de Médecine* by his son, Gustave Dax, together with his own contribution, as early as 1863, still 2 years before Broca's 1865 paper. But the Dax contribution was not published until 1865, when Broca also argued in favor of left lateralization. This led to a bitter conflict, with Gustave Dax claiming that his father was the first to discover the role of the left hemisphere in the control of speech production (Schiller, 1992). Dax's paper was discussed widely among the aphasiologists of Paris and its merits judged by a committee of the Academy led by Broca's colleague Bouillaud. They took months to come to a decision, and it is suspected that this delay was to give Broca time to finish and publish his own paper (Tesak & Code, 2008). So perhaps Marc Dax is the one who should

be credited with the original finding that language is lateralized to the left, but he was just a country doctor and Broca was already famous.

Despite Broca's fame and influence, his preferred term for the disorder he had described, *aphemia*, was replaced with the term *aphasia* mainly because of an article in 1864 by prominent physician Armand Trousseau (1801–1867) with the provocative title *On aphasia, a sickness formerly wrongly referred to as aphemia.* He pointed out that the term *aphasia* from the Greek meaning "without language," was more appropriate than *aphemia* (without speech). Trousseau believed that aphasia was a cognitive disorder that affected intellectual performance, a view also later expressed by John Hughlings Jackson. Of course, Broca's term referred to speech, as it still does today, and Trouseau's to language.

Henry Head (1926) noted that much of the great growth in German neurology and dominance in aphasiology was related to German victory in the Franco-Prussian war of 1870–1871. It was in this climate that universities in Germany and German-speaking countries became the world leaders for scientific research. A landmark development in neurology was fiber theory developed by Theodor von Meynert (1833–1892) in Vienna (Whitaker & Etlinger, 1993). Fiber theory described the important distinction between projection fibers, which connect subcortical to cortical regions, and association fibers, which connect cortical areas to one another. Thus, projection fibers communicate sensory information from the sensory organs to the cortex, and the association tracts transmit perceptions, ideas, and memory contents between areas. Von Meynert was also responsible for determining that the anterior part of the brain was responsible for motor function and the posterior part for sensory function. His work with patients with aphasia led him to describe a "sound image system." This, and other aspects of fiber theory, form parts of the theory developed by von Meynert's student Wernicke. In 1874, the young physician Carl Wernicke (1848–1905) completed his thesis, *The Symptom-Complex of Aphasia,* where in he described cases with sensory aphasia due to lesions in the posterior left brain. With Broca's anterior production aphasia (aphemia) and Wernicke's posterior sensory aphasia, the basis for a fuller theory of language processing was developed. However, the impact of Wernicke's thesis went well beyond describing "sensory" aphasia, which had already been described by Bastian (Tesak & Code, 2008). Wernicke devised what today we would call information processing components to underlie the basic operations and pathways involved in the production and reception of speech, at least at the single-word level, from the highest cognitive center to the peripheral input and output levels. The model included a sound-image system and fiber connections, explained pathologies of speech and language, and predicted forms of aphasia that had not yet been discovered. In 1885, Lichtheim took Wernicke's model and expanded and refined it to produce what we now know as the Wernicke–Lichtheim model (**Figure 2.4**), which was to dominate aphasia theory in most of the world well into the 20th century. Because of its obvious similarity to the outline of a house, it is sometimes called the Wernicke–Lichtheim House.

However, not everyone was seduced by the localizationist agenda. During the 1874 Berlin language debate, the localizationist Hitzig took an opposing view to that of Steinthal, who was probably the first real psycholinguist (Eling, 2006). Heymann (Chajim) Steinthal (1871) complained that the physicians' descriptions of language and aphasia were too superficial and lacked the necessary linguistic detail, a complaint that still resonates. Steinthal stated, exasperatedly, "The clinical pictures have been recorded by far too incompletely and imprecisely; our physicians have not understood what the function of language is" (1871, p. 464). In England, John Hughlings Jackson (1835–1911) was also opposed to localization and proposed that reorganization of function could take place following damage. Jackson was more than simply an antilocalizationist, however. Darwin's *On the Origin of Species* was published in 1859, and the colossal impact that his evolutionary theory had on both scientific and public opinion is legendary. Subsequently, Jackson developed his highly significant theory of the evolution and organization of the nervous system, informed by his observations of aphasia and epilepsy and extensively influenced by the evolutionary ideas of Herbert Spencer (1820–1903). Head (1926) noted that "Jackson derived all his psychological knowledge from Herbert Spencer, and adopted his phraseology almost completely (p. 31). But his work on aphasia had little impact outside Britain and remained relatively unrecognized until Head's writings led to its recognition in the early 20th century. Jackson had observed that people with aphasia can often produce complete phrases in particular contexts (e.g., curses, exclamations, and stereotypies), even when they possessed little or no spontaneous speech, and he acknowledged Baillarger's (1865) earlier distinction between *voluntary* and *involuntary* speech. Jackson (1878–1880, as cited in Taylor, 1958) hypothesized that both the ontogenic (individual development)



A: Acoustic center
M: Motor center
B: Concept center
O: Optical memory images for letters
E: Region from which writing movements are innervated
m: Motor pathway
a: Acoustic pathway

Figure 2.4 The Wernicke–Lichtheim model of language processing

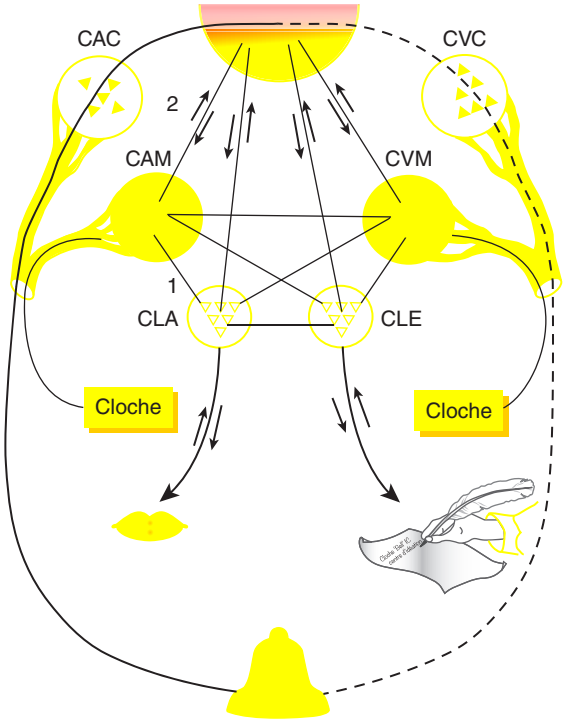
Modified from Lichtheim, L. (1885). Ueber Aphasie: Aus der medicinischen Klinik in Bern [About aphasia: From the medical clinic in Bern]. *Deutsches Archiv fur Klinische Medizin, 36*, 204–268.

and phylogenic (species development over time) evolution of the nervous system entailed the following: (1) a course from the most to the least organized, from the lowest, well-organized centers to the highest, least organized, centers; (2) a course from the most simple to the most complex; and (3) a course from the most automatic to the most voluntary. *Dissolution* is a term he acquired from Spencer and Jackson's model of the nervous system, and it mirrors Spencer's closely. Dissolution of the nervous system, with a loss of function, provides the inhibition of higher levels caused by brain damage, which Jackson saw as evidence of the reverse of evolution. Functions are organized hierarchically in the nervous system based on Jackson's theory at different levels of representation, from the oldest to the most recently developed in evolution and individual development, from the lowest to the highest, and from the most primitive to the most complex. Symptoms, for instance, aphasic recurrent utterances (speech automatisms), like Leborgne's tan tan, are the expression of lower levels released from inhibition of higher levels caused by brain damage.

Many aphasiologists at this time were very interested in clinical management and treatment of aphasia—Broca and Henry Charles Bastian (1837–1915), for instance. Bastian (1898) and Henry Head developed tests for aphasia, which were used well into the second half of the 20th century.

The French suffered a military defeat at the hands of the Germans in 1870–1871, which resulted in the Germans marching into Paris. As a result, the French scientific community became closed to developments in German science and the revolution taking place in German aphasiology. French aphasiology remained staunchly devoted to Broca's mid-1860s findings (Gelfand, 1999). Jean-Martin Charcot (1825–1893) was a leading neurologist in Paris and holder of the chair for nervous diseases at the Hospice de la Salpêtrière. He was an advocate of a reactively patriotic competition with German science, and, because of him and

his students, aphasia once again became an important topic in Paris, despite the fact that there was a significant lack of enthusiasm for advances outside France since Broca. Charcot was interested in localization throughout his career, although a small, but important, part of his work was with aphasia. In a series of lectures (in 1883 and 1884), *On the different forms of aphasia* (Charcot, 1884), he developed his famous bell diagram (**Figure 2.5**), which was meant to allow a better understanding of normal and pathological language processing. His model contained four centers for memory images (speech, language, writing, and reading) attributed to an association center. These centers were linked to the outside world by auditory and visual routes. Charcot, in common with many of his predecessors, thus saw aphasia as a memory disorder, with memory divided into subsystems; he also believed in submemories for language, understanding, writing, speaking, and reading, and the centers were linked to one another through many connections.



Cloche 'Bell'
IC *centre d'idéation*
Association center
CAC *centre auditif commun*
General auditory center
CAM *centre auditif des mots*
Hearing center for words
CLA *centre de language articulé*
Center for articulated speech
CVC *centre visuel commun*
General visual center
CVM *centre visuel des mots*
Visual center for words
CLE *centre du langage écrit*
Center for writing

Figure 2.5 Charcot's "bell" model

Modified from Bernard, D. (1889). *De l'aphasie et de ses diverses forms* [*Aphasia and its various forms*]. Lecrosnier & Babe.

He attempted to localize aphasic disorders and went along with Broca's finding that aphemia was caused by a lesion of the third frontal gyrus, with a lesion in the second frontal gyrus as the cause of agraphia. Word deafness was caused by a lesion in the first temporal gyrus and word blindness from a lesion to the lower parietal gyrus.

Charcot's diagram became well known through the work of the young Pierre Marie (1853–1940), who joined Charcot at the Salpêtrière in 1885 and became one of his most famous students. With the work of the eminent Charcot, aphasia again became a topic of intense discussion in Paris.

In England, Hughlings Jackson published more on his evolutionary approach to aphasiology and was hardly influenced by the localization debates going on in Germany and France, although, as an editor of the new journal *Brain*, he published Lichtheim's work in English in 1885. Bateman's work, *On Aphasia, or Loss of Speech,* appeared in 1890 in its second edition, in which Charcot, Kussmaul, and others were included, although Bateman was opposed to classifications and localization. At the end of the 1800s, Bastian (1898), in England, summarized his 30 years of work on aphasia.

Another important critic of connectionism and the Wernicke–Lichtheim model was Sigmund Freud (1891/1953) in Vienna, a neurologist and aphasiologist before he founded psychoanalysis, who spent a few months with Charcot in 1885. He published his monograph on aphasia in 1891, but it was to have little impact at the time. However, it was published in an English translation in 1953, and more recently his contributions to aphasiology have been better appreciated (Buckingham, 2006). Henry Head (1926) was famously opposed to the proliferation of diagrammatic models of the representation of language in the brain and launched a bitter assault on what he called "the diagram makers."

The Swiss Jules Joseph Dejerine (1849–1917) was Charcot's student and working in Paris, where he eventually became professeur de clinique des maladies du système nerveux in 1910. Dejerine described a classification system of aphasia, but mainly through two case descriptions of isolated writing and reading disorders his work became important. Dejerine (1891, 1892) described a 63-year-old man with word blindness (alexia) and total agraphia and a 61-year-old educated woman with word blindness without agraphia who could write spontaneously and to dictation and had no difficulties with spontaneous speaking (Hanley & Kay, 2003). Autopsies showed

a lesion in the angular gyrus on the left for the first case and a lesion in the area that separates the general language area from the angular gyrus in the second case (Dejerine, 1892). He suspected that visual word images are stored in the angular gyrus, which he assumed is necessary for reading and writing. Thus, alexia and agraphia would result from a lesion to the angular gyrus.

Three years later, he described yet another form of alexia as it commonly occurs in motor aphasia. This "third alexia" is explained with reference to Dejerine's language zone, containing Broca's area, Wernicke's area, and the angular gyrus, respectively responsible for production, auditory comprehension, and written language comprehension, and any disruption of the subcortical connecting pathways would lead to isolated phenomena. Cortical lesions of the language zone led to a disorder of "inner speech" and to disorders such as alexia in motor aphasia.

Also active in France in the later 1800s, Albert Pitres (1848–1928) is well known for his early work on *amnesic aphasia,* his term for impaired naming, and his book on aphasia in bilingual and multilingual speakers. The concept of amnesic aphasia received a great deal of discussion from the 1860s, and Pitres attempted to establish it as an independent form of aphasia (Pitres, 1898). He described amnesic aphasia as "a form of aphasia in which the language difficulties consist in having forgotten the words that are necessary to express thoughts" (Pitres, as cited in Benton, 1988, p. 210), emphasizing that pure cases are rare. Amnesic aphasia would play an important role in Geschwind's reintroduction of the neoclassical model, developed in the 1960s in the United States, where it would reemerge as what we now call anomic aphasia (Benton, 1988).

Ribot (1881) had suggested that bilingual speakers with aphasia would recover their native language first. This idea was in general support of his theory that recent memories are more vulnerable to loss than earlier ones (Paradis, 1981). Pitres (as cited in Paradis, 1983, pp. 26–49) firmly believed that the most recently learned and familiar language is the one that will recover first, and, unlike Ribot, he based his perspective on a detailed review of the research and an analysis of eight new cases. Discussion continued for several years, with some supporting "Pitres's rule" that the most recently used and familiar language would recover first and some "Ribot's rule" that the first learned—the native language—would recover first. Finally, Pitres strongly opposed the idea that different languages could occupy separate locations in the brain.

Pierre Marie followed Dejerine as professor of neurology at the University of Paris and was one of the most provocative figures in the history of aphasia. Head (1926) called him "the iconoclast." Marie was originally a localizationist, like his mentor Charcot, but in 1906 he published a paper with the title "Révision de la question sur l'aphasie: La troisième circonvolution frontale gauche ne joue aucun rôle spécial dans la fonction du langage" ("Revision of the question of aphasia: The third left frontal convolution plays no special role in the function of language"), which vehemently attacked Broca's model of aphasia. Marie reported cases in which severe damage to this area did not result in aphasia and Broca's aphasia could result without a lesion to the left third frontal convolution. He also stated that "l'anarthrie n'est pas de l'aphasie" ("anarthria [Marie's term for aphemia] is not aphasia"), and he coined the famous equation, Broca's aphasia equals Wernicke's aphasia plus anarthria.

The Growth of Linguistic Aphasiology in the 19th and 20th Centuries

Attempts were made in the 19th and early 20th centuries to introduce linguistics as relevant in aphasiology from Steinthal, Freud, and the physician Arnold Pick. On the basis of a more exact linguistic examination, the early psycholinguist Steinthal (1871, p. 478) had described what he called acataphasia, which he contrasted with aphasia. He suggested that the problem in aphasia was at the lexical level (a word memory retrieval problem), whereas in acataphasia it is at the sentence level: an inability to make sentences, rather than poor memory for words. Forty years later, Arnold Pick (1851–1924) took up the mantle with his work on the development of agrammatism. Indeed, most of this pioneering work came from German-speaking Europe. Pick (1913) too believed that the developments in psychology and linguistics should form the basis for a new theory of aphasia:

> Not only does the backwardness of the still authoritative psychology for aphasia theory urgently demand a revision, it is also the enormous progress that psychology itself has made. . . . [T]he situation in terms of linguistic science presents itself similarly to that of psychology . . . of which even the most recent presentations of aphasia theory have not taken notice. (p. 9)

In modern terms, Pick was advocating, as Steinthal had, a psycholinguistic perspective. In his monograph, *Agrammatic Language Disorders: Studies on the Psychological Foundation of Aphasia Theory* (1913), he developed a staged model of language production that shares many features with current models (e.g., the contemporary models of Garrett [1980] and Levelt [1989]).

In Pick's model, a mental schema develops that includes pragmatic and emotional components, which today we would call an intention to communicate, or a preverbal message. Subsequently, a sentence schema is activated, which takes place before word choice. The choice of a word, Pick stated, is determined only by the position it takes in the sentence, so it must occur following sentence formulation. Likewise, word ordering and intonation precede word choice. Then, grammatical and lexical words are built into the sentence schema; thus, the specification of grammatical words (function words and inflections) precedes the specification of content words.

Agrammatism for Pick was the core aphasic symptom, and he described separate forms associated with impairments to the different stages of production. To explain function word omissions in telegraphic speech, Pick supposed that the individual employs an economy of effort in the context of a severely impaired system—the word is omitted because it is the semantically least useful in the sentence. He also discussed in detail the idea of "emergency language," a form of adaptation of the system to brain damage: "the whole mental language apparatus accommodates itself . . . extraordinarily fast with the situation created by the illnesses" (Pick, 1913, p. 156). Similar views would later also be developed by Isserlin (1922).

In 1914, Karl Kleist (1878–1960) described an impairment he called paragrammatism, a second word order disorder distinct from agrammatism. Kleist stated:

> So far we have only spoken of agrammatism. We retain the term agrammatism for one of these two . . . word order disorders. The basic trait of agrammatism is the simplification and coarsening of word sequences. Complicated compound sentences (subordination of clauses) are not built. The patients only speak in small, primitive mini-sentences, if they continue to create sentences at all. All less necessary words, especially pronouns and particles, are reduced or eliminated . . . Conjugation thereby also degenerates . . . But also the changes occurring in the words themselves, through conjugation, declination, and comparison (flexions in the narrower sense), are more or less omitted. (pp. 11–12)

In contrast to this pattern, in paragrammatism:

> [T]he ability to create word orders is not abolished, but phrases and sentences are often wrongly chosen and thereby amalgamate and contaminate each other . . . . Phrases and sentence constructions are not completed . . . . The spoken expression is not simplified overall; instead, also conditioned by a strong over-production of word sequences, it swells to confused sentence monsters. (p. 12)

Kleist considered a mixed agrammatic-paragrammatic symptom pattern to be the rule, and pure cases to be rare. He was very clear with regard to the anatomical basis (Kleist, 1914, p. 12): "We will not go wrong if, contrary to frontal agrammatism, we localize paragrammatism in the temporal lobe or its immediate neighbourhood."

Later, Kleist (1916, p. 170) modified his position and concluded that the cause of agrammatism was "a loss or lowering of excitability of sentence and phrase formulae," which approximately corresponds to Pick's sentence schemata, and in paragrammatism, "sentence and phrase formulae . . . are aroused incorrectly." So, for Kleist (1916, p. 198), paragrammatism is caused "by an incorrect arousal of acoustic sentence formulae." Kleist was another of Wernicke's many assistants, and Wernicke had a significant influence on him. Kleist was also an ultra-localizationist, and his brain map went beyond even the phrenological maps of Spurzheim in its detail.

Russian linguist Roman Jakobson (1896–1980) is sometimes considered the first to strongly apply linguistics in aphasiology, although, as noted above, Steinthal may be more worthy. Jakobson was a founding member of the Linguistic Circle of Prague established in 1926. When the Nazis entered Czechoslovakia, Jakobson fled, first to Denmark, Norway, and Sweden and then to the United States in 1941, where he eventually became professor at Harvard and the Massachusetts Institute of Technology. In his 1941 monograph, *Child Language, Aphasia, and Phonological Universals* (English translation, 1968), Jakobson describes parallels between language acquisition and aphasia and proposed a regression hypothesis, which states that we can observe the same processes in both developing child speech and the impairments