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## INTRODUCTION TO BASIC FUNCTIONS OF LANGUAGE, READING, AND READING DISABILITY.

The past decade has seen enormous growth in our knowledge of the basic functions of language processing as well as their disorders. Theoretical, behavioral and neurophysiological, as well as neuroanatomical studies have helped to advance our knowledge in the field. On the one hand, the development of different methodologies and their application to the investigation of normal and impaired language processing has lead to new insights into the underlying mechanisms. On the other hand, it appears that novel data have forced the reconceptualization of some of the existing views.

The selection of the chapters in the present book was intended to provide a broad overview of the most relevant, sometimes controversial, issues and theories discussed in the field of language and language disorders. A particular emphasis is given to reading and reading disabilities since this research domain has received considerable attention during the recent years. Papers on lexical and syntactic processes in the adult and the developing language system provide complementary information necessary to create an adequate picture of the basic mechanisms of language. The picture we present in this book is by no means complete. However, it sketches the most important aspects of the system under investigation.

### 1. THE STRUCTURE OF THE BOOK

The book consists of four sections. The paper by Friederici and Lachmann in the introduction section aims to introduce in the topic of the book and seeks to point out that reading comprehension is the end product of the coordination of a number of subfunctions which involve the mediation from visual input to phonological representation and processes of language comprehension modulated by aspects of working memory and attention. It is argued that to understand the phenomenon of reading disability, it is necessary to understand the nature of these subfunctions and their coordination in normal reading (see also Rayner, 1993). In general, the language system is seen as primary, as reading optimally builds on spoken language (Perfetti & Sandak, 2000). Following this line of argumentation, the second section presents papers on basic functions of language acquisition and language comprehension. The third section deals with principle aspects of normal reading,

followed by papers of the fourth and biggest section, which tries to cover different theoretical approaches and empirical studies to reading disability.

## 2. BASIC FUNCTIONS OF LANGUAGE ACQUISITION AND LANGUAGE COMPREHENSION

This section contains a selection of compelling papers which investigate basic mechanisms of lexical and syntactic processes during language comprehension and production in the adult and the learning system. The paper by Swinney and Love provides an integrative view of lexical access and lexical integration during auditory sentence comprehension in adults. Special emphasis is given to each hemisphere's contribution to language processes: while the left hemisphere is considered to be responsible for fast on-line language processes, the right hemisphere is thought to support slower processes involving contextually guided and repair processes. The paper by Saddy and Beim Graben investigates the processing of morphosyntactic information during adult sentence comprehension in German using electrophysiological measures. Applying new and innovating analysis techniques, they are able to demonstrate the brain's response to morphosyntactic markers in each of three time windows predefined by a current neurocognitive model of language comprehension. The paper by Dominey applies computational modeling as an approach to investigate the use of word order and function word to assign thematic roles during comprehension. It is demonstrated that the inability to comprehend non-canonical sentences is due to a failure of the application of abstract transformational rules - be it in natural or artificial grammars. The paper by Weissenborn presents convincing data in support of the view that basic syntax parameters are already installed early during language acquisition. He demonstrates that children as young as two years old are in control of the knowledge of verb placement in German main and subordinate clauses. The paper by Powers also uses data from language acquisition to show that particular mechanisms assumed by linguistic theory, namely the mechanism Merge (Chomsky, 1995), is at work in early childhood and can thus be considered as one of the most basic mechanisms of language.

## 3. BASIC FUNCTIONS OF READING

The third section deals with principle aspects of reading. The first paper describes the complex processes underlying normal reading. Starr, Kampe, Miller, and Rayner provide a complete overview of eye movement studies during sentence reading uncovering the main cognitive processing underlying reading performance. The two following papers evaluate the influence of attention on reading and reading comprehension. Radach, Inhoff and Heller provide a critical overview of different models describing the role of visual selective attention during reading. Particular emphasis is given to the time course of linguistic processing and oculomotor control during the reading process. The paper by Osaka and Osaka evaluates the mechanisms underlying the well known reading span test (Daneman & Carpenter,

1980) applied in numerous studies on sentence processing. They show that a variation in the focus of attention on a particular word can influence reading span.

#### 4. BASIC FUNCTIONS OF READING DISABILITY

The fourth and biggest section presents a collection of theoretical and empirical papers discussing or testing the most influential causal hypotheses of reading disability.

##### *4.1 Theoretical Approaches*

In the paper by Lachmann, it is argued that reading disability results from a failure in learning to optimize the coordination of the subfunctions involved in reading with the consequence of errors or delays in integrating reading related information. Within this multicausal model, so-called reversal errors, for instance, are reinterpreted as a functional coordination deficit. In this respect, it is argued that learning to read implies learning to treat graphemes as symbols instead of objects, and thus to suppress visually symmetrical information in the representation of visual symbols (Brendler & Lachmann, 2001). A failure in this suppression produces ambiguous relations between visual and phonological information and disturbs the functional coordination, and thus may cause problems in learning to read.

Stein presents his theory of dyslexia which holds that reading difficulties are the consequence of the impaired development of magnocellular neurons in the human brain. This impairment causes behavioral deficiencies which are not solely confined to reading, but also to other cognitive domains.

In his paper, Galaburda advances the theory that children who fail to learn to read suffer from a specific type of brain anomaly affecting low level auditory and/or visual processing, as well as linguistic processing. As this brain anomaly is the result of inappropriate neural migration to the cerebral cortex during development, the paper discusses possible genetic and epigenetic influences acting during the period of neuronal migration.

The chapter by Talcott and Witton presents a specific view on reading development. It is called a sensory-linguistic approach, as it focuses on the interface between orthographic and phonological information in the text, and the visual and auditory skills necessary to extract higher level information from lower level information computed by the auditory and visual systems. They hold that capacities of the latter processes constraint reading comprehension.

The paper by Jimenez investigates reading disabilities in a language which, in contrast to English, has a transparent orthography. A comparison of empirical studies in English and Spanish suggests that the relevant factor for the definition of dyslexic is a phonological rather than an orthographic one.

Fawcett advances a theory which considers a dysfunction of the cerebellum as an underlying cause of dyslexia. The observed correlation between problems in articulation, i.e. the timing of articulatory gestures, which may be caused by a cerebellar deficit and problems in reading, are taken to support this theory.

#### 4.2 *Empirical Studies*

The chapter by Witruk, Ho and Schuster discusses three experiments conducted with Chinese and German dyslexics. The conceptual differentiation of these studies is based on the Baddeley's working memory model (Baddeley, 1995), with its specific modalities for incoming and maintaining information, on Cowan's model (1995), with regard to automatic versus controlled executive functions, as well as on the neurophysiological approach of Goldman-Rakic (1998). The central issue of this chapter is to discuss the importance and extent of assumed working memory impairments in dyslexic children with the focusing on the generality versus the specificity of these impairments. The results show the dependency of working memory performance in dyslexic children on the language system, on the specific type of modality, and on a specific kind of material.

Uhry presents a longitudinal study in English-speaking kindergarten children in which phonological awareness and rapid serial naming is evaluated as a predictor for reading and spelling abilities in Grade 2. Both measures, taken at Kindergarten, were shown to make major contributions to later word-reading abilities and thus serve as a good predictor.

The paper by Dahlgren Sandberg takes an interesting approach to investigate the role of phonological recoding in reading. Children with severe expressive speech impairment are examined in different verbal and non-verbal tasks. It is conducted that the inability to articulate is an important factor in the reading and spelling difficulties observed in these children.

Gregg, Coleman, Stennett, Davis, Nielsen, Knight and Hoyet present empirical data on several language tests including spelling and reading in three groups of English speaking adults, which suffer either from a learning disability or from an attention deficit / hyperactivity disorder, or both. Particular factors which predict reading abilities in these groups are discussed.

The paper by Kujala finally focuses on the neurophysiological parameters of auditory dysfunction in dyslexia. A particular electrophysiological marker, i.e. the mismatch negativity is proposed as an object index of auditory dysfunction in dyslexia. The advantage of this measure lies in the fact that it can be applied very early in life, that is, long before dyslexia occurs.

#### 5. SUMMARY

The present collections of papers provide an interesting view on a human ability which with the emergence of writing systems has become two-layered, namely language. The primary language domain is auditory. It is through auditory input that a native language is learned. Interestingly, the complex syntactic and lexical aspects of language establish quite early during language acquisition and are shown to have a relatively specific neuronal basis. Reading and writing is clearly secondary. Learning of these skills is obviously accompanied by special difficulties. It appears that most researchers in the field of dyslexia agree that the interface between time based phonological processes and the visual system is the focus of difficulty, although they might disagree on the underlying neuronal cause. It may not come as

a surprise that recent brain imaging studies have demonstrated an increased involvement of Broca's area, i.e., a brain area known to support phonological processes, during reading comprehension compared to auditory comprehension (e.g., Poldrack et al., 1999).

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