

CONTENTS

Acknowledgments	x
Glossary	xi

1 Introduction 1

<i>Definition of numerical cognition – a multidisciplinary endeavor</i>	1
<i>Neuroimaging of cognition</i>	4
<i>Mental representation – a key concept</i>	5
<i>Memory – how do we remember things?</i>	7
<i>Numerical cognition from an evolutionary perspective</i>	8
<i>Summary</i>	9
<i>Further readings</i>	9
<i>References</i>	9

2 The forms – we encounter and represent numerical quantities in manifold ways 11

<i>The triple code model of number processing</i>	14
<i>The approximate number system</i>	16
<i>Subitizing</i>	26
<i>Symbolic numbers</i>	28

<i>Automatic processing of numbers</i>	30
<i>Spatial-numerical associations</i>	31
<i>Does the intraparietal sulcus host an abstract number system?</i>	34
<i>Fractions</i>	36
<i>Summary</i>	40
<i>Further readings</i>	41
<i>References</i>	41

3 The origins – numerical competencies in evolution 49

<i>Behavioral evidence for numerosity sensitivity</i>	50
<i>Neuronal mechanisms of numerosity perception</i>	56
<i>Evolutionary origin of number-space associations</i>	60
<i>Approximate arithmetics in animals</i>	62
<i>Nature or nurture – numerical competencies in the absence of formal mathematical education</i>	65
<i>Summary</i>	68
<i>Further readings</i>	69
<i>References</i>	69

4 Mental arithmetic – how we solve arithmetic problems 73

<i>How do we retrieve the solution of a given arithmetic problem?</i>	73
<i>Arithmetic and language</i>	75
<i>Word problems</i>	75
<i>Neurocognitive perspective</i>	78
<i>How is arithmetic fact knowledge stored in long-term memory?</i>	81
<i>Network-retrieval model</i>	81
<i>Network-interference model</i>	83
<i>Interference from feature overlap</i>	86
<i>Interacting neighbors model</i>	88
<i>The role of spatial processing for mental arithmetic</i>	91
<i>Spatial attention</i>	93
<i>Summary</i>	102
<i>References</i>	103

5	The development of numerical cognition	111
	<i>Numerosity perception</i>	112
	<i>Counting and the meaning of number words</i>	115
	<i>The symbol grounding problem</i>	121
	<i>Number line task</i>	126
	<i>Ordinality</i>	128
	<i>Development of order processing</i>	130
	<i>Development of mental arithmetic and its neural underpinnings</i>	136
	<i>Summary</i>	138
	<i>Further readings</i>	139
	<i>References</i>	139
6	Developmental dyscalculia	147
	<i>Diagnosis</i>	148
	<i>Dyscalculia and other difficulties – related or independent?</i>	151
	<i>Etiology – what are the underlying mechanisms of developmental dyscalculia?</i>	151
	<i>The core deficit hypothesis</i>	152
	<i>Access deficit hypothesis</i>	155
	<i>Systemic models of DD</i>	157
	<i>Treatment of developmental dyscalculia</i>	160
	<i>Multiple skill programs</i>	161
	<i>Interventions targeting core numerical skills</i>	166
	<i>Summary</i>	168
	<i>Further readings and resources</i>	169
	<i>References</i>	170
	Index	176