

Contents

CHAPTER ONE The conceptual framework

I. Thesis: Biological Considerations are Necessary for an Understanding of Behavior	1
II. Form and Function in Ontogeny	4
(1) Mutual influence in the development of nervous and other tissue	4
(a) Trophic relationships	4
(b) Mechanical relationships	6
(2) The embryology of behavior	8
III. Behavioral Specificity and the Problem of Plasticity	10
(1) The problem	10
(2) Central regulatory mechanisms of motor coordination	12
(3) Developmental history of the central regulatory mechanism	15
IV. Genetic Foundations of Behavior	21
V. Relationship between Form and Behavior	23
VI. Conclusion	27

CHAPTER TWO Morphological correlates

I. Introduction	33
II. Periphery	34
(1) Face, lips and mouth	34
(2) Topographical anatomy of oral cavity, pharynx and hypopharynx	39
(3) Intrinsic anatomy of the larynx	44
(4) Relationship between peripheral anatomy and speech sounds	50
III. Central Nervous System	52
(1) Functional significance of form in the central nervous system	52
(2) The cortex	54
(a) Histological maps	54
(b) Behavioral maps	56
(c) Summary: language and cortex	61
(3) Subcortical structures	62
(4) Lateralization	66

	(5) Relative size of the brain	67
IV.	Conclusion	71
CHAPTER THREE	Some physiological correlates	75
I.	Aim of Physiological Discussions in this Monograph	75
II.	Respiration	76
	(1) Respiratory adaptations in general	76
	(2) Respiratory adaptations to speech	77
	(3) Other motor changes indirectly related to respiratory adaptations	85
III.	Speech Production	89
	(1) Discrete articulatory events	89
	(2) Rate of articulatory events	90
	(3) Ordering of articulatory events	93
IV.	Problems Arising from Rate and Ordering	98
V.	The Problem of the Organizing Principle: Rhythm	107
	(1) The rhythmic nature of articulation	109
	(a) Delayed feedback	109
	(b) Signal switching between right and left ear	112
	(c) Rate of interruptions	113
	(d) Rate of syllable production	115
	(e) Psychological correlates	116
	(f) Neurological correlates: EEG	116
	(g) Neurological correlates: pacing of speech during thalamic stimulation	117
	(2) Final comments on speech rhythmicity (cultural, individual, and biological variations)	118
VI.	Summary	119
CHAPTER FOUR	Language in the context of growth and maturation	125
I.	Characteristics of Maturation of Behavior	125
II.	Emergence of Speech and Language	127
	(1) Regularity of onset	127
	(2) Relation of the environment to the age of onset	135
	(3) The role of utility in the onset of speech	139
	(4) The importance of practice for the onset of speech	140
	(5) "Wolf Children"	141
III.	Age Limitations to Language Acquisition	142
	(1) Age and recovery from traumatic aphasia	142
	(2) Age of lateralization of speech function in the brain	150

(3) Hemispherectomy (effect of removal of an entire hemisphere)	152
IIIa. Preliminary Summary	153
(4) Arrest of language development in the retarded	154
(5) The effect of sudden deafness on language at various ages	155
IV. Concomitants of Physical Maturation	158
(1) Structural changes in the brain	162
(2) Changes in chemical composition of the brain	164
(3) Electrophysiological changes	166
(4) Summary	168
V. Growth Characteristics of the Human Brain and their Possible Relationship to Language Acquisition	170
VI. Further Comments on the "Critical Period" for Language Acquisition	175
VII. Summary and Conclusion	178
 CHAPTER FIVE Neurological aspects of speech and language	 188
I. Clinical Symptoms of Speech and Language Disorders	188
(1) General characteristics of the patient with aphasia	188
(2) Receptive disorders	191
(3) Expressive disorders	191
(a) Subfluency	191
(b) Superfluency	192
(c) Semantic disturbances	192
(d) Difficulty in word finding	193
(e) Paraphasic disturbances	193
(f) Fixation on phrases	194
(4) Disorders of manner of production	194
(a) Errors of order	195
(b) Dysarthria	195
(c) Discoordinations	197
(5) Other language-related disorders	198
II. The Underlying Pathology	199
(1) Localized lesions	199
(a) Cerebro-vascular accidents	199
(b) Tumor	202
(c) Abscess	204
(d) Trauma	204
(e) Other focal lesions	204
(2) Diffuse lesions	205
III. Clinical Syndromes	205
IV. Theoretical Interpretations	206

(1) Interference vs. "loss"	206
(2) The problem of neurological correlates	208
(a) Connections and associations	209
(b) Perceptions	211
(c) Storage	213
(d) Processing	215
(3) Relevance to language	217
(4) Time, the most significant dimension in language physiology	218
(a) Aphasic symptoms as temporal disorders	218
 V. Postscript on Innate Mechanisms for Perception and Production	 220
 VI. Conclusion	 222
 CHAPTER SIX Language in the light of evolution and genetics	 227
I. Limitations on Inferences from Animal Comparison	227
(1) Continuity theory <i>A</i> : Straight line evolution of language with only quantitative changes	228
(2) Continuity theory <i>B</i> : Straight line evolution of complexity by stepwise accretion (with missing links)	230
(3) Justification for a discontinuity theory of language evolution	234
(a) The search for true antecedents	234
(b) Phylogenetic change	235
(c) The sharing of traits	237
 II. Are Biological Theories of Language Development Compatible with Concepts of Genetics?	 239
(1) Genes and ontogenetic development	239
(2) Relative growth	241
(3) Transformations of form and function	246
 III. Evidence for Inheritance of Language Potential	 248
(1) Family histories	249
(2) Twin studies	252
(3) Miscellaneous evidence	253
(4) The Darlington-Brosnahan hypothesis	254
 IV. Limitations on Reconstruction and "dating" of the History of Language	 255
(1) Arguments based on the history of the brain and skull	255
(a) Comparison with brains of contemporary animals	255
(b) Relevance of the history of the skull	257
(2) Arguments based on other skeletal features	261
(3) Racial diversification and the emergence of language	261
(4) Cultural status as evidence for language	263
 V. Summary	 264

CHAPTER SEVEN	Primitive stages in language development	271
I.	The Problem	271
II.	Prelanguage Development	276
III.	Evolution of Language in the Healthy Child	279
(1)	Phonology	279
(2)	Primitive one-word utterances	280
(3)	Theoretical considerations	284
(a)	Understanding-speaking	284
(b)	How mature speakers understand sentences	286
(4)	Structural characteristics of children's primitive sentences	292
(5)	General comments on the genesis of phrase-structure, nested dependencies, and recursiveness	294
(6)	General comments on the genesis of transformations	296
(7)	The development of some specific syntactic mechanisms	302
(a)	Questions and negations	302
(b)	Inflectional endings	303
IV.	Further Elucidation of Language Acquisition through the Study of Defective Children	304
(1)	Language acquisition in the absence of speech production	305
(2)	Language development in mongoloid children	309
(3)	Language acquisition in the congenitally deaf	320
V.	Summary and Conclusion	324
CHAPTER EIGHT	Language and cognition	329
I.	The Problem	329
II.	Toward a Biological Conception of Semantics	331
(1)	Words as labels for categorization processes	332
(2)	Differentiation of categories	334
(3)	Interrelating of categories (transformations)	335
(4)	Preliminary conclusions	336
III.	The Empirical Study of Naming: The Language of Experience	337
(1)	Description of referents	337
(2)	Referent spaces	338
(3)	Names mapped into referent spaces	339
(4)	Contextual determinants in common naming	343
IV.	Naming and Cognitive Processes	346
(1)	General strategies	346
(2)	Acuity of discrimination	348
(3)	Memory and recognition	350
(4)	Concept formation	355

(5) Cognition in deaf children	357
(6) Recent experiments in psycholinguistics	363
V. Postscript to So-Called Language Relativity	363
VI. Summary	365
CHAPTER NINE Toward a biological theory of language development (general summary)	371
I. Five General Premises	371
II. A Concise Statement of the Theory	374
III. Explanatory Power of the Theory	379
IV. Biological Foundations of History and Distribution of Natural Languages	380
(1) Theoretical Foundations	380
(a) Source, inhibitors, and determinants of change	381
(b) Variance in capacity for latent and realized structure	383
(c) Tolerance for variance: the mechanism of all changes	383
(2) Direction and Rate of Historical Changes	387
(3) Distribution	389
(4) A Note on Adaptive Value	390
V. Innate Mechanisms	393
APPENDIX A Noam Chomsky: The formal nature of language	397
APPENDIX B Otto Marx: The history of the biological basis of language	443
CREDITS	470
INDEX	471