

Contents

Preface	ix
Part I Introductory Chapters	1
1 Ear and Hearing	3
1.1 The ear	3
1.2 Auditory brainstem and thalamus	6
1.3 Place and time information	8
1.4 Beats, roughness, consonance and dissonance	9
1.5 Acoustical equivalency of timbre and phoneme	11
1.6 Auditory cortex	12
2 Music-theoretical Background	17
2.1 How major keys are related	17
2.2 The basic in-key functions in major	20
2.3 Chord inversions and Neapolitan sixth chords	21
2.4 Secondary dominants and double dominants	21
3 Perception of Pitch and Harmony	23
3.1 Context-dependent representation of pitch	23
3.2 The representation of key-relatedness	26
3.3 The developing and changing sense of key	29
3.4 The representation of chord-functions	30
3.5 Hierarchy of harmonic stability	31
3.6 Musical expectancies	35
3.7 Chord sequence paradigms	36

4	From Electric Brain Activity to ERPs and ERFs	40
4.1	Electro-encephalography (EEG)	43
4.1.1	The 10–20 system	43
4.1.2	Referencing	45
4.2	Obtaining event-related brain potentials (ERPs)	45
4.3	Magnetoencephalography (MEG)	48
4.3.1	Forward solution and inverse problem	49
4.3.2	Comparison between MEG and EEG	49
5	ERP Components	51
5.1	Auditory P1, N1, P2	51
5.2	Frequency-following response (FFR)	53
5.3	Mismatch negativity	54
5.3.1	MMN in neonates	57
5.3.2	MMN and music	57
5.4	N2b and P300	59
5.5	ERP-correlates of language processing	59
5.5.1	Semantic processes: N400	60
5.5.2	Syntactic processes: (E)LAN and P600	63
5.5.3	Prosodic processes: Closure Positive Shift	67
6	A Brief Historical Account of ERP Studies of Music Processing	70
6.1	The beginnings: Studies with melodic stimuli	70
6.2	Studies with chords	74
6.3	MMN studies	75
6.4	Processing of musical meaning	76
6.5	Processing of musical phrase boundaries	77
6.6	Music and action	77
7	Functional Neuroimaging Methods: fMRI and PET	79
7.1	Analysis of fMRI data	81
7.2	Sparse temporal sampling in fMRI	84
7.3	Interleaved silent steady state fMRI	85
7.4	‘Activation’ vs. ‘activity change’	85
Part II Towards a New Theory of Music Psychology		87
8	Music Perception: A Generative Framework	89
9	Musical Syntax	98
9.1	What is musical syntax?	98
9.2	Cognitive processes	102

9.3	The early right anterior negativity (ERAN)	109
9.3.1	The problem of confounding acoustics and possible solutions	113
9.3.2	Effects of task-relevance	120
9.3.3	Polyphonic stimuli	121
9.3.4	Latency of the ERAN	127
9.3.5	Melodies	127
9.3.6	Lateralization of the ERAN	129
9.4	Neuroanatomical correlates	131
9.5	Processing of acoustic vs. music-syntactic irregularities	133
9.6	Interactions between music- and language-syntactic processing	138
9.6.1	The Syntactic Equivalence Hypothesis	145
9.7	Attention and automaticity	147
9.8	Effects of musical training	149
9.9	Development	151
10	Musical Semantics	156
10.1	What is musical semantics?	156
10.2	Extra-musical meaning	158
10.2.1	Iconic musical meaning	158
10.2.2	Indexical musical meaning	159
	Excursion: Decoding of intentions during music listening	161
10.2.3	Symbolic musical meaning	162
10.3	Extra-musical meaning and the N400	163
10.4	Intra-musical meaning	170
	Excursion: Posterior temporal cortex and processing of meaning	166
10.4.1	Intra-musical meaning and the N5	171
10.5	Musicogenic meaning	177
10.5.1	Physical	177
10.5.2	Emotional	179
10.5.3	Personal	180
10.6	Musical semantics	181
10.6.1	Neural correlates	181
10.6.2	Propositional semantics	182
10.6.3	Communication vs. expression	182
10.6.4	Meaning emerging from large-scale relations	183
10.6.5	Further theoretical accounts	184
11	Music and Action	186
11.1	Perception–action mediation	186
11.2	ERP correlates of music production	189

12	Emotion	203
12.1	What are 'musical emotions'?	204
12.2	Emotional responses to music – underlying mechanisms	207
12.3	From social contact to spirituality – The Seven Cs	208
12.4	Emotional responses to music – underlying principles	212
12.5	Musical expectancies and emotional responses	216
12.5.1	The tension-arch	218
12.6	Limbic and paralimbic correlates of music-evoked emotions	219
12.6.1	Major-minor and happy-sad music	225
12.6.2	Music-evoked dopaminergic neural activity	226
12.6.3	Music and the hippocampus	227
12.6.4	Parahippocampal gyrus	231
12.6.5	A network comprising hippocampus, parahippocampal gyrus, and temporal poles	232
12.6.6	Effects of music on insular and anterior cingulate cortex activity	232
12.7	Electrophysiological effects of music-evoked emotions	233
12.8	Time course of emotion	234
12.9	Salutary effects of music making	235
13	Concluding Remarks and Summary	241
13.1	Music and language	241
13.2	The music-language continuum	244
13.3	Summary of the theory	249
13.4	Summary of open questions	258
	References	267
	Index	303