

**Western music history,
pitch salience,
key profiles,
and the origins of tonality**

Richard Parncutt


Department of Musicology
University of Graz
parncutt@uni-graz.at




Western music history

- Assumption
 - ◆ Scores → tonal syntax → development
- Method
 - ◆ Statistical analysis of scores
- Results
 - ◆ Prevalence of pitch-time patterns
- Example
 - ◆ major and minor triads → *OHP*

Pitch salience

- 
- Assumption
 - ◆ Physical \neq experiential reality
 - Everyday musical experience
 - ◆ Hearing tones within sonorities \rightarrow *OHP*
 - Definitions of pitch salience
 - ◆ Probability of noticing a tone
 - ◆ Clarity or strength of tone sensation

Key profiles

- 
- Assumption
 - ◆ Cognitive representation of tonality
 - Method
 - ◆ Cadence or triad → probe tone
 - ◆ Goodness of fit ratings → *OHP*
 - Results
 - ◆ Measure of music-theoretical stability

Origins of major-minor tonality

- Tonality
 - ◆ Variation in stability of scale steps

- Major-minor tonality (MmT)
 1. Major and minor scales
 2. Major and minor tonic triads
 3. Harmonic functions (S, D, T)

- „Emergence“ of MmT
 1. ~ 15th Century
 2. ~ 16th Century
 3. ~ 17th Century

Motivation

- Prevalence of major-minor tonality
 - ◆ Most western styles:
 - ☞ baroque, classical, romantic, jazz, rock, pop, folk, religious, national anthems...
 - ◆ A definitive aspect of music!?
 - ☞ e.g. Schenker):
- Aim of scientific music theory:
 - ◆ generate tonal syntax from finite set of clear axioms?



Structure of talk

- Tonality
 - ◆ A broad definition
 - ◆ Role of perception
 - ◆ Interdisciplinarity
 - ◆ Role of tuning and spelling
- The „importance“ of a pitch class (pc)
 - ◆ Stability
 - ◆ Prevalence
 - ◆ Salience
- Pc stability profile (Krumhansl)
 - ◆ Roughness model
 - ◆ Prevalence model
 - ◆ Salience model
- More...



Tonality: A broad definition

- Pitch relationships
 - ◆ All
 - ◆ Hierarchical
- Variations in stability of
 - ◆ Tones (scale steps)
 - ◆ Sonorities (functions)
 - ◆ Events (points in time)
- Kind of music
 - ◆ Any or Western
 - ◆ Monophonic or polyphonic
 - ◆ Major-minor or other tonality

Tonality: Role of perception

Richard Norton (1984)

Tonality in western culture (pp. 10.11)

- Assumption:
 - ◆ „Ego“ „creates and cognizes“ tonality
- Aim of research:
 - ◆ „Ontology of tonality as a human endeavor“
- Approach:
 - ◆ subject (ego) ⇔ object (tonality)
- Relevant disciplines:
 - ◆ physics and neurophysics
 - ◆ psychology and sociology
 - ◆ acoustics and psychoacoustics
 - ◆ politics and economics

Tonality: Definitions of terms

- Pitch class (pc) or chroma
 - ◆ Octave-generalized pitch; „C“ not „C4“
- Sonority
 - ◆ Tone simultaneity (*Klang*)
- Stable tone or sonority
 - ◆ Little or no tendency to move
- Tonic
 - ◆ Most stable pc or sonority
- Leading tone
 - ◆ Unstable tone 1 sem from stable tone
- Cadence
 - ◆ Closing gesture from less to more stable

<i>More stable</i>	<i>Less stable</i>
<i>In a chord:</i>	
Root	Third, fifth
Consonant tones	Dissonant tones
Harmonic tones	Non-harmonic tones
<i>In a major or minor tonality:</i>	
Tonic	Third, fifth
Tones of tonic triad	Leading tone
Diatonic tones	Chromatic tones
<i>In a piece:</i>	
Background	Foreground



Tonality versus tuning

- Tuning, temperament, intonation
 - ◆ small frequency adjustments
- 12-tone chromatic scale
 - ◆ Approximately equally tempered
 - ◆ Idea dates to ancient Greece
- Categorical perception of pitch
 - ◆ Tuning does not affect scale-step identity
 - ◆ A scale step is a „pc category“
 - ☞ octave-generalized
 - ☞ Categorical/zonal (range of tuning)
- Perceptual status of frequency ratios
 - ◆ not directly perceptible

Tonality versus spelling

- Enharmonic spelling (e.g. F# vs Gb)
 - ◆ Depends on tonal context
 - ◆ Rules are pragmatic (ease of reading, writing)

- Tonal context is
 - ◆ Relative to chromatic scale

- Tonal context influences
 1. Enharmonic spelling
 2. Tonal meaning, stability etc.
 3. Intonation in performance

- Relationships 1 ↔ 2 ↔ 3 are indirect



„Importance“ of a scale step

1. Stability (music theory)

- ◆ Absence of tendency to move
- ◆ Tonicization, reference point
- ◆ No. of hierarchical levels containing pc


2. Prevalence (statistics)

- ◆ Frequency of occurrence (no. of notes)
- ◆ Total duration

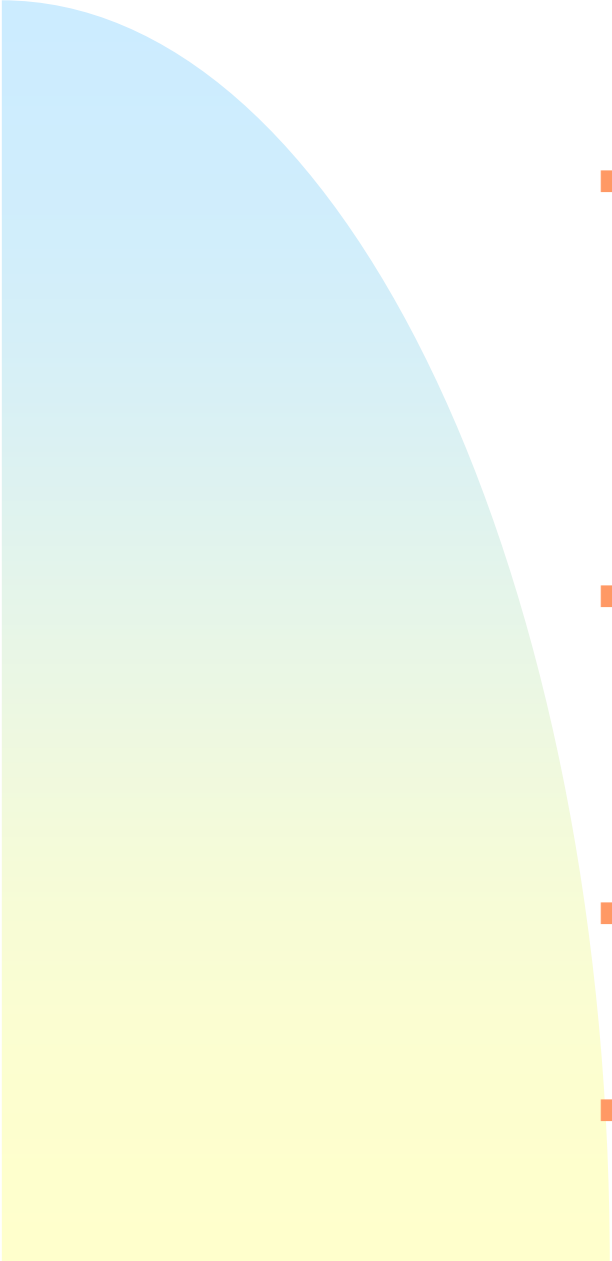
3. Salience (psychoacoustics)

- ◆ Probability of noticing a tone
- ◆ Clarity or strength of tone sensation

Pc stability profile (Krumhansl)

- 
- Experiment
 - ◆ Stimulus: context → probe tone
 - ◆ Listener's task: goodness of fit rating
 - ◆ Design: all 12 pcs
 - ◆ Result: „tone profile“ or „key profiles“
 - Interpretation of result
 - ◆ Cognitive representation of tonality
 - Problem (or virtue?)
 - ◆ Ignores voice leading
 - Origin
 - ◆ Exposure to tonal music

Roughness model

- 
- Roughness
 - ◆ Physiological aspect of dissonance
 - ◆ Limited frequency resolution of ear
 - ◆ Fast beating
 - Hypothesis
 - ◆ Stable scale steps consonant relative to tonic
 - Correlation = $+0.4 \dots +0.9 \rightarrow OHP$
 - Theoretical problem
 - ◆ Simultaneous vs successive

Prevalence model

- Theoretical basis
 - ◆ Exposure to tonal music
- Data
 - ◆ Krumhansl: classical scores → *OHP*
 - ◆ Järvinen: jazz improvisation → *OHP*
- Corr. with stability (Krumhansl) = 0.8...0.95
- Theoretical problem
 - ◆ Origin of prevalence patterns

Hierarchical depth model

- Lerdahl's (1993) *tonal pitch space*
 - ◆ Tonality as specific hierarchy of pcs
 - ◆ Predictor: hierarchical depth profile
 - ◆ Corr. with stability (Krumhansl) = ~ 0.95
- Problems
 - ◆ Psychological reality of hierarchy
 - ☞ Empirical method?
 - ☞ Hierarchy or network?
 - ☞ Separation and importance of levels?
 - ◆ Origin of hierarchy

Pitch salience model

- Chord-root model (Parncutt, 1988)
 - ◆ Experiment using octave-complex (Shepard) tones → *OHP*
 - ◆ Pitch-salience profile of tonic triad → *OHP*
- Assumption: Tonic is triad (not tone)
 - ◆ Corr. stability (Krumhansl) ~ 0.95 → *OHP*
- Problems
 - ◆ Salience depends on voicing
 - ☞ octave-generalisation „internalised“
 - ◆ Role of history unclear
 - ☞ pc-salience profiles „internalized“
 - ☞ emergence of tonality

Pitch-salience model: Detail

- Two stages of pitch perception (Terhardt)
 - ◆ Peripheral: frequency discrimination (spectral pitch) → *OHP*
 - ◆ Central: harmonic pattern recognition (virtual pitch) → *OHP x2*
- Octave-generalised theory
 - ◆ Harmonic template → *OHP*
 - ◆ Circularity → *OHP*
 - ◆ Pitch salience
 - ☞ Chord-root candidates
 - ☞ Implied pitches and scales → *OHP*

Implication-realisation at cadences

- Theory:
 - ◆ Fulfilment of expectation
= „Realisation“ of „implication“ (I-R)
→ Emotion (Meyer, 1956)
- Example: melody
 - ◆ Implication: rising leap
 - ◆ Realisation: stepwise descent
- Example: chord progression
 - ◆ Implication: prevalence profile
 - ◆ Realisation: salience profile
- Further I-R effects at cadence
 - ◆ Falling fifth between roots
 - ◆ Resolution of leading tone
 - ◆ Resolution of seventh above dominant

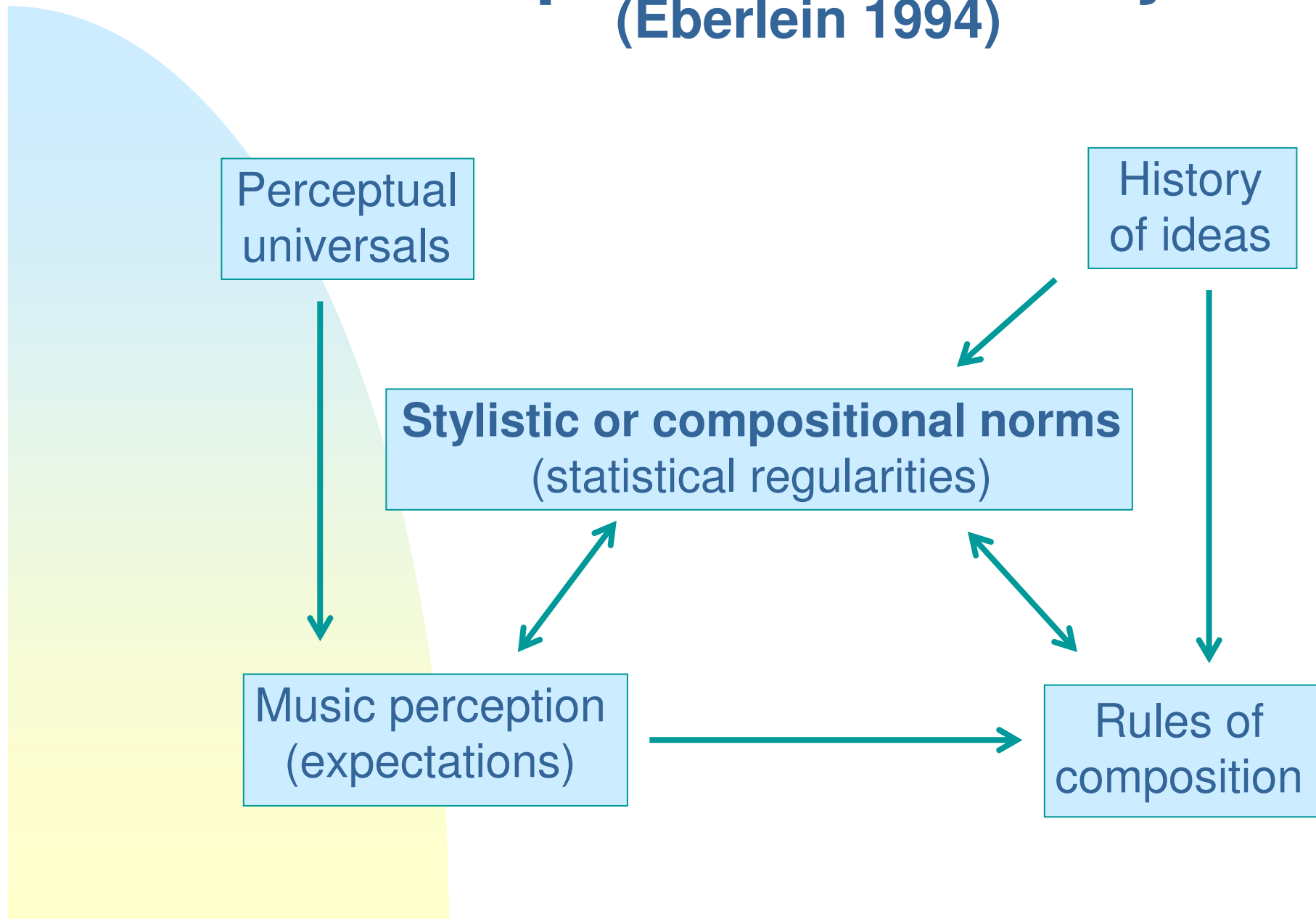
History of western tonal syntax

pretonal	12th	<ul style="list-style-type: none"> 2-part counterpoint, discant improvisation
	13th	<ul style="list-style-type: none"> 3- and 4-part ctpt, 3rds & 6ths imperf. cons.
	14th Cent	<ul style="list-style-type: none"> Ars Nova (Vitry, Machaut) Double-leading-tone cadence (also 13th c.) Parallels forbidden but tolerated
„emergence“ of tonality	15th Cent	<ul style="list-style-type: none"> Dunstable, Dufay, Ockeghem Falling fifth cadence in 3 and 4 parts <i>Fauxbourdon</i>: parallel 6/3 triads <i>Falsobordone</i>: chains of root positions
	16th Cent	<ul style="list-style-type: none"> Palestrina, Lassus Most sonorities are major and minor triads Final fifth replaced by triad; <i>tierce de Picardie</i>
	17th Cent	<ul style="list-style-type: none"> Theory of triads and inversions Seventh chords, SDT progressions

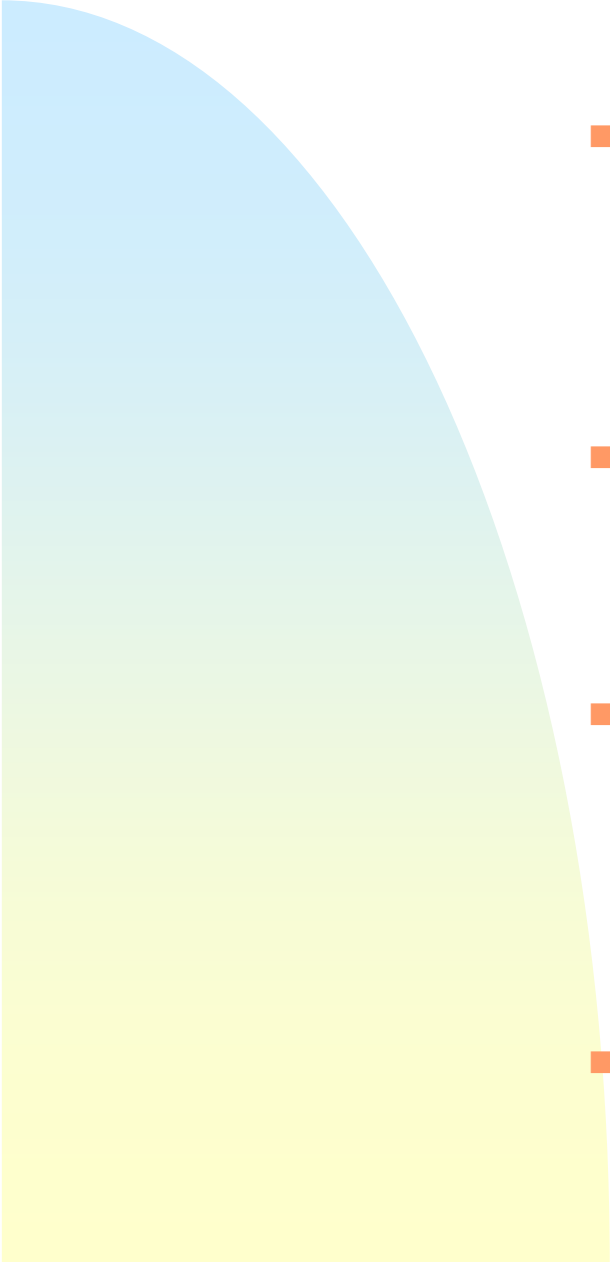
Thirds, triads, and tonality

- Historical prevalence
 - ◆ Harmonic thirds: 1000→1500
 - ◆ Major & minor triads: 1300→1600
 - ◆ Final triads: 1500→1700
- Theory of gradual „emergence“
 - ◆ Perceptual familiarity of each stage
 - prerequisite for next stage
 - ◆ Perception of tonality
 - depends on history of tonal syntax

Development of tonal syntax (Eberlein 1994)



Why major and minor?

- 
- Questionable
 - ◆ Frequency ratios 4:5:6, 10:12:15
 - ◆ Complex mathematical treatments
 - Consonance
 - ◆ Smoothness, fusion, familiarity
 - Triads as pc-sets
 - ◆ Only 2 of 19 „triad types“ have
 - ☞ Perfect fifth (fusion)
 - ☞ No seconds (smoothness)
 - Scales
 - ◆ Tonic triad: salient pitches (OR no tritones)
 - ◆ Leading tone

Leading tone

Upper tone of melodic second is more stable. Why?

Prevalence of Gregorian chant modes

- Theory
 - ◆ scale steps ~ harmonic series above final
 - salience and stability of final
 - prevalence of mode
- Examples
 - ◆ most prevalent modes: G, D
 - ◆ F more prevalent than E
 - ◆ C more prevalent than B



Pitch salience model: Implications

- Tonic sonority → harmonic tonality
 - ◆ Ferguson & Parncutt (RITM, 2005)
- A new music-theoretic paradigm?
 - ◆ Root, implied scale
 - ◆ Melodic and harmonic relationship
 - ◆ Voice leading
 - ◆ Tonality
- Phenomenology in musicology
 - ◆ Humanities meet sciences