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

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Western music history

- Assumption
  - Scores → tonal syntax → development

- Method
  - Statistical analysis of scores

- Results
  - Prevalence of pitch-time patterns

- Example
  - major and minor triads \(\rightarrow OHP\)
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
  - Hierachical

- 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

*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
### More stable | Less stable

#### In a chord:
- **Root** | Third, fifth
- **Consonant tones** | Dissonant tones
- **Harmonic tones** | Non-harmonic tones

#### In a major or minor tonality:
- **Tonic** | Third, fifth
- **Tones of tonic triad** | Leading tone
- **Diatonic tones** | Chromatic tones

#### In a piece:
- **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…+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 \( \rightarrow OHP \)
  - Pitch-salience profile of tonic triad \( \rightarrow OHP \)

- Assumption: Tonic is triad (not tone)
  - Corr. stability (Krumhansl) \( \sim 0.95 \) \( \rightarrow OHP \)

- Problems
  - Salience depends on voicing
    - octave-generalisation „internalised“
  - Role of history unclear
    - pc-salience profiles „internalized“
    - emergence of tonality
Pitch-saliency model: Detail

- Two stages of pitch perception (Terhardt)
  - Peripheral: frequency discrimination (spectral pitch) \(\rightarrow\) OHP
  - Central: harmonic pattern recognition (virtual pitch) \(\rightarrow\) OHP x2

- Octave-generalised theory
  - Harmonic template \(\rightarrow\) OHP
  - Circularity \(\rightarrow\) OHP
  - Pitch salience
    - Chord-root candidates
    - Implied pitches and scales \(\rightarrow\) 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

<table>
<thead>
<tr>
<th>Pretonal</th>
<th>12th Century</th>
<th>13th Century</th>
<th>14th Century</th>
<th>15th Century</th>
<th>16th Century</th>
<th>17th Century</th>
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<tr>
<td></td>
<td>2-part counterpoint, discant improvisation</td>
<td>3- and 4-part counterpoint, 3rds &amp; 6ths imperfect consonances</td>
<td>Ars Nova (Vitry, Machaut)&lt;br&gt;Double-leading-tone cadence (also 13th c.)&lt;br&gt;Parallels forbidden but tolerated</td>
<td>Dunstable, Dufay, Ockeghem&lt;br&gt;Falling fifth cadence in 3 and 4 parts&lt;br&gt;<strong>Fauxbourdon</strong>: parallel 6/3 triads&lt;br&gt;<strong>Falsobordone</strong>: chains of root positions</td>
<td>Palestrina, Lassus&lt;br&gt;Most sonorities are major and minor triads&lt;br&gt;Final fifth replaced by triad; <strong>tierce de Picardie</strong></td>
<td>Theory of triads and inversions&lt;br&gt;Seventh chords, SDT progressions</td>
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**Legend**:
- **Pretonal**
- **Emergence of tonality**
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)

Perceptual universals

Stylistic or compositional norms (statistical regularities)

Music perception (expectations)

History of ideas

Rules of composition
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