Harmonic Models

CS 275B/Music 254

General questions

- Can harmony be separated from pitch and rhythm?
- Should harmony be computed top-down or bottom up?
- How should harmonic change be segmented?
- How can harmonic information best be communicated?

Krumhansl on Rhythm and Pitch Organization

Psychological Bulletin (2000). 126/1, 159-179.

Rhythmic phenomena

- Periodic pulse
- Grouping
- Objective rhythmicization
- Ratios of durations
- Patterns of duration (rather than absolute values) of primary psych importance (*motoric involvement*)

Pitch phenomena

- Discreet frequencies
- Musical intervals
- Consonance, dissonance
- Pitch patterns

Bottom-up approach

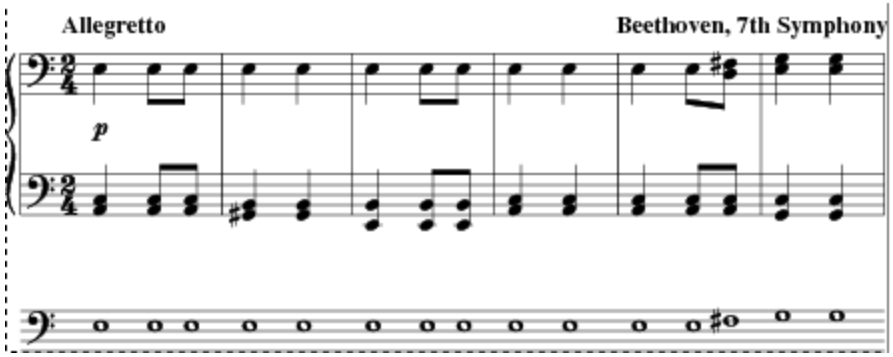
Krumhansl (2): Pitch aspects of harmony

- Categorical perception of pitch (intervallic sizes)
- Tonal hierarchies
- Key estimation
- Virtual pitch (missing fundamental)
- Transposition (not always recognized)
- Modulatory distance (circle-of-fifths)
- Large-scale musical form

- *Conclusion:* musical patterns organized into hierarchies of events

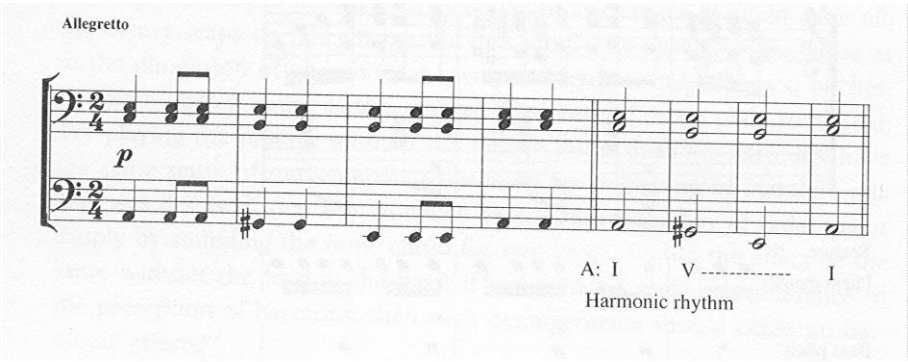
Melodic change vs. Harmonic change

1. Same melody, changing harmony

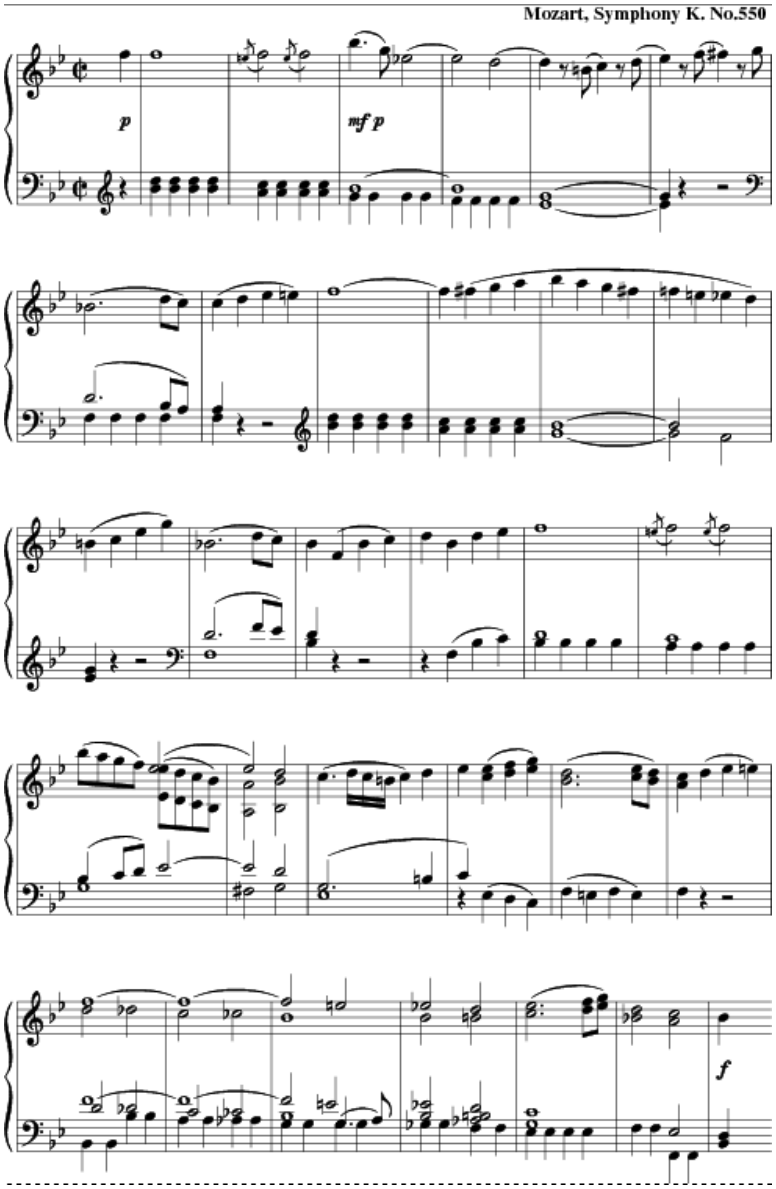


Other combos

- Same melody, changing rhythm
- Same harmony, changing melody
- Same harmony, changing rhythm etc.



Harmonic dynamics of structure

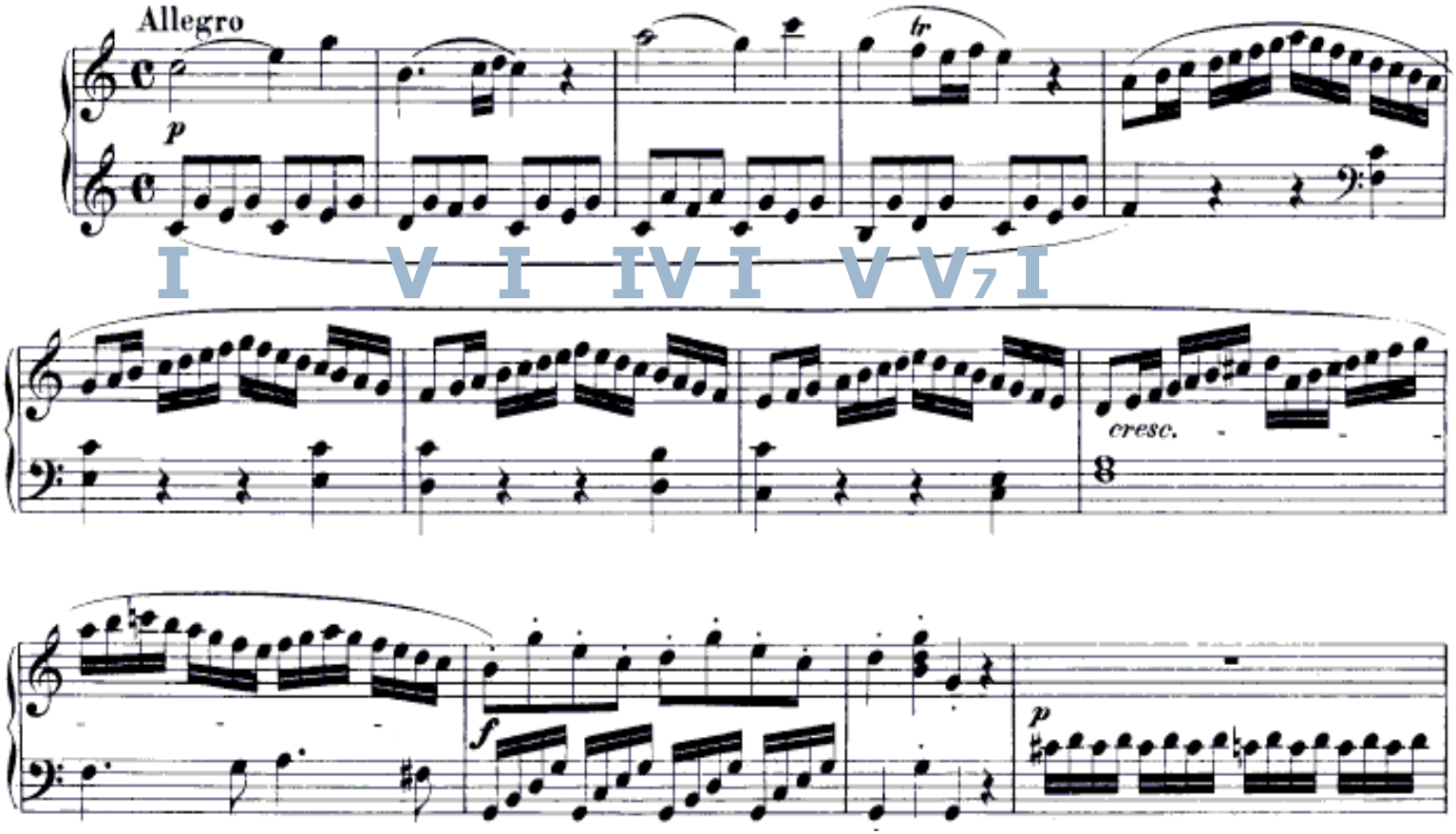


In regular circumstances

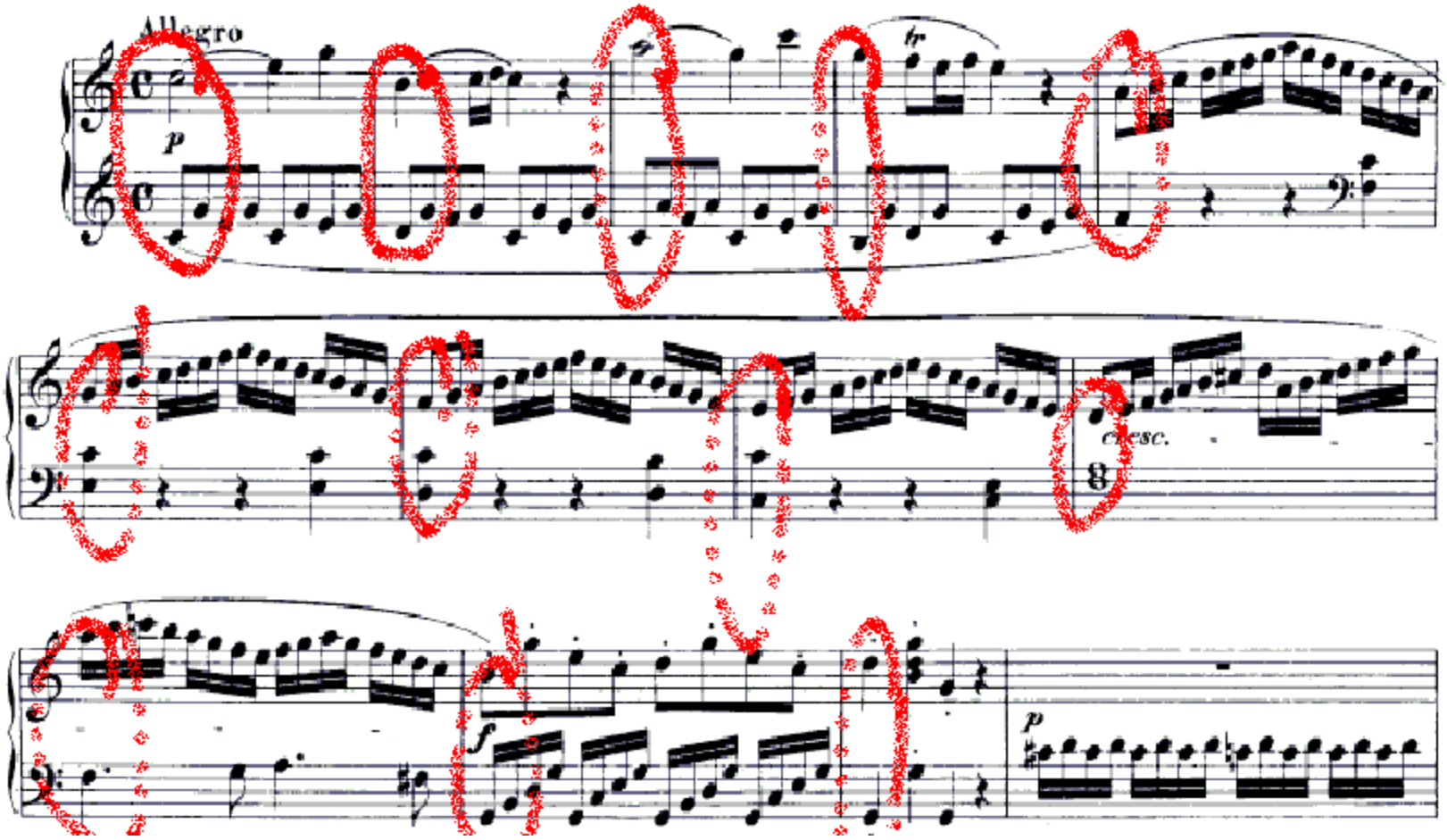
- How many times is the theme (re)stated?
- How many times is the melody the same?
- How many times is the harmony the same?

Riemann (Riemann-esque analysis)

Chordal progressions in tonal music



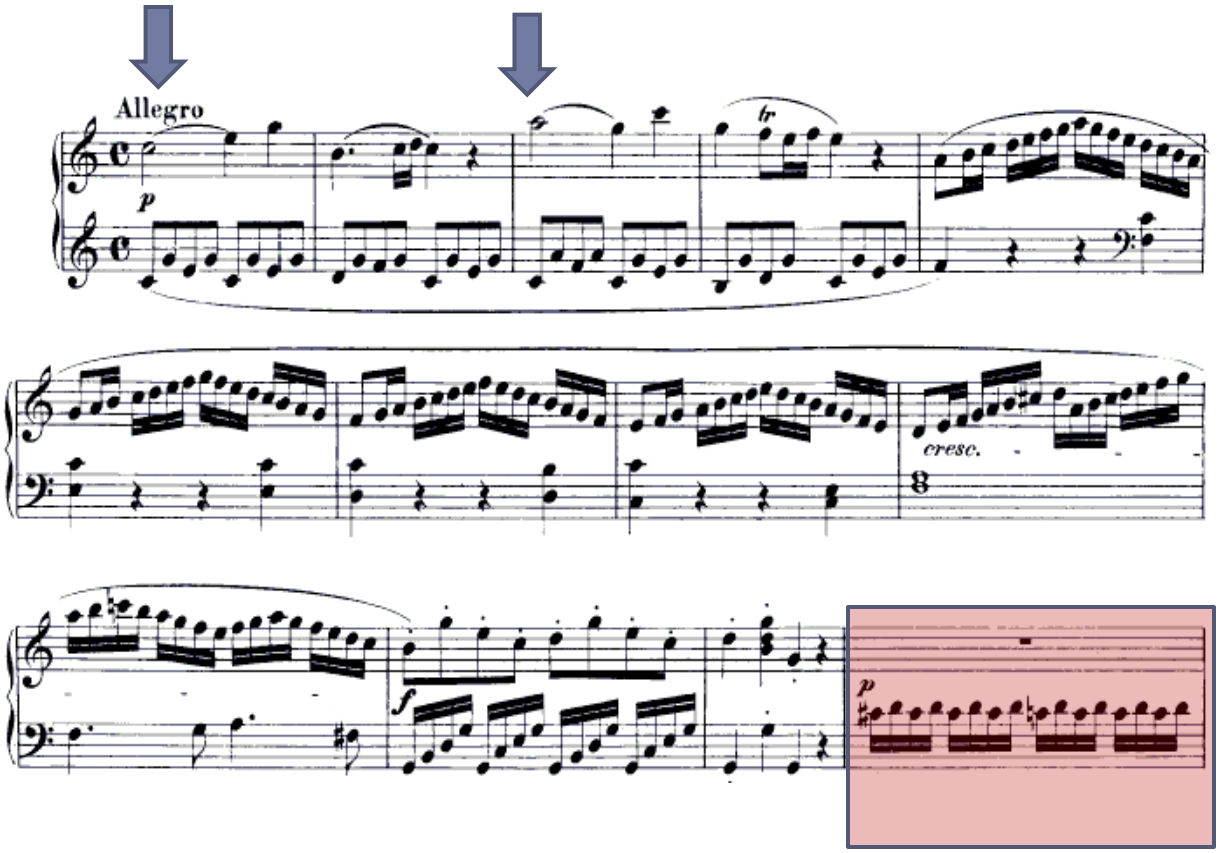
Metrical reductions



Harmonic evaluation

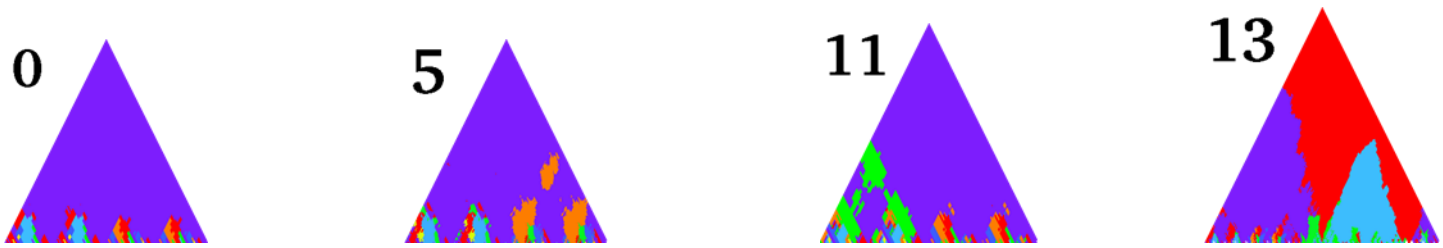
Computer-based analysis
- Sapp
- Temperley

- Musical texture:
  - interval of assessment
  - bald spots



Evaluation and detection (Sapp)

- Riemannesque analysis: root-based chord analysis
  - kern > eval > new spine > gmn
  - chord quality tool (Sapp)
- Visualization of chord root/quality > key (Sapp)

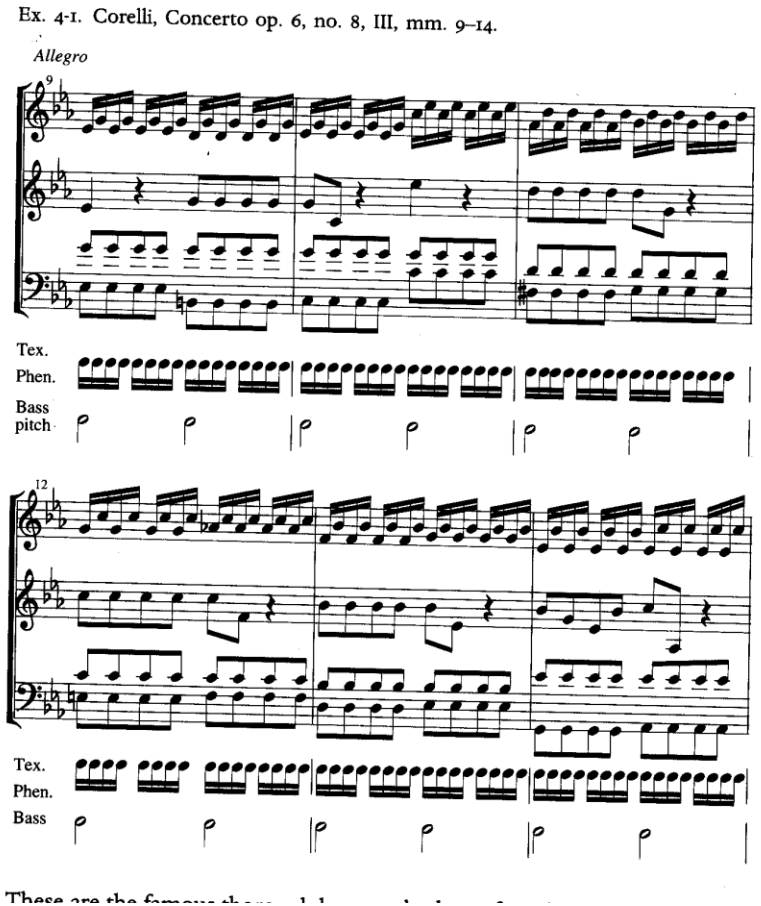


Schubert: Piano Variations D 576

Joseph Swain: *Harmonic Rhythm* (1998)

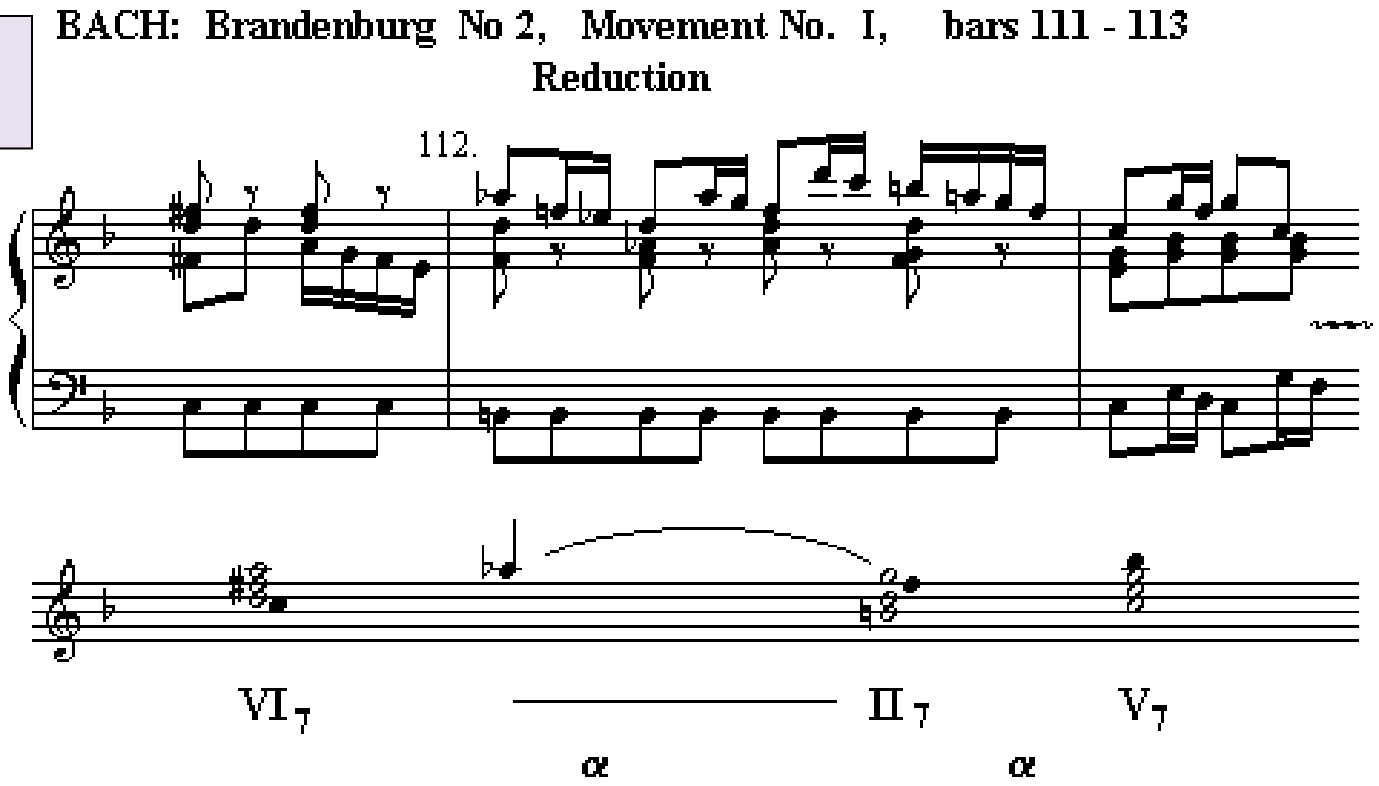
Most concepts conputable

- Six levels of harmonic rhythm
  - Phenomenal rhythm
  - Bass-pitch rhythm
  - Root analysis
  - Within-key analysis
  - Density
  - Harmonic function
  - Interpretation



Schenker (Schenkerian analysis)

Foreground/ background



Example 3.16.

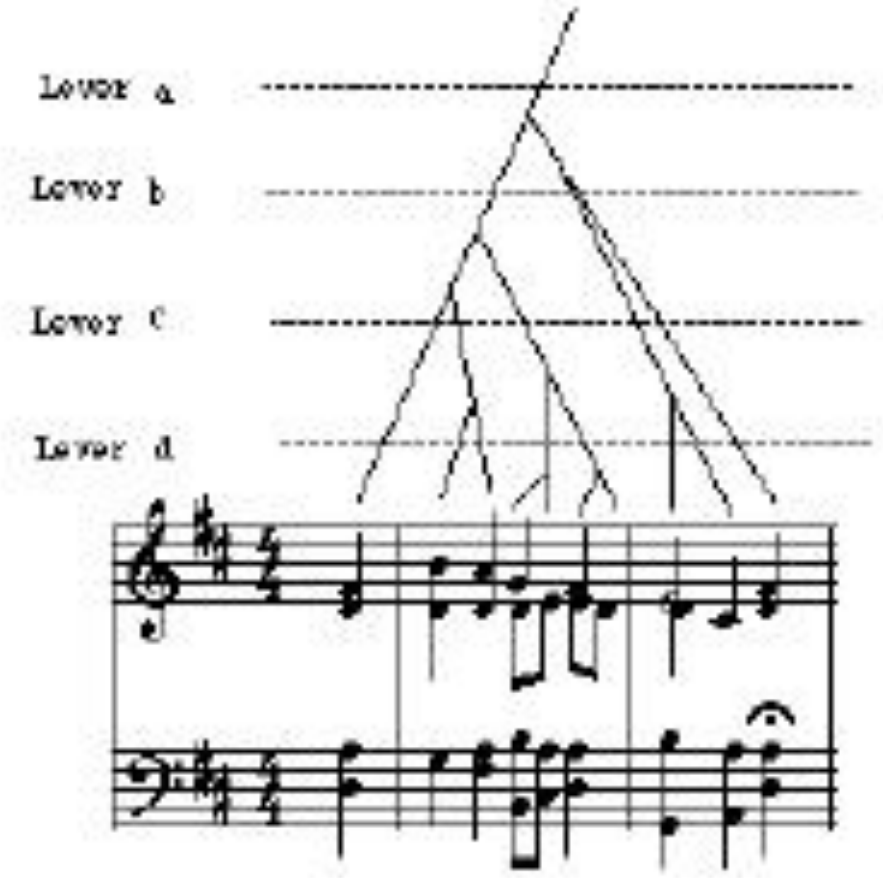
Lerdahl (Gestalt readings)

Lerdahl & Jackendoff:

Generative Theory of Tonal Music (MIT, 1983)

Grammatical structures

- Grouping structures
  - Motives, phrases
- Metrical structures
  - Strong, weak beats
- Time-span reductions
  - Tree structures
- Prolongational reductions
  - Psychological awareness



Bach chorale

Lerdahl: *Tonal Pitch Space* (2001)

GTTM rules

1. Well-formedness rules (structure)
2. Preference rules (listener-based)
3. Transformational rules (grouping, deceptive situations)

Preference rules

1. Harmonic tension
2. Melodic attraction
3. Attraction, expression

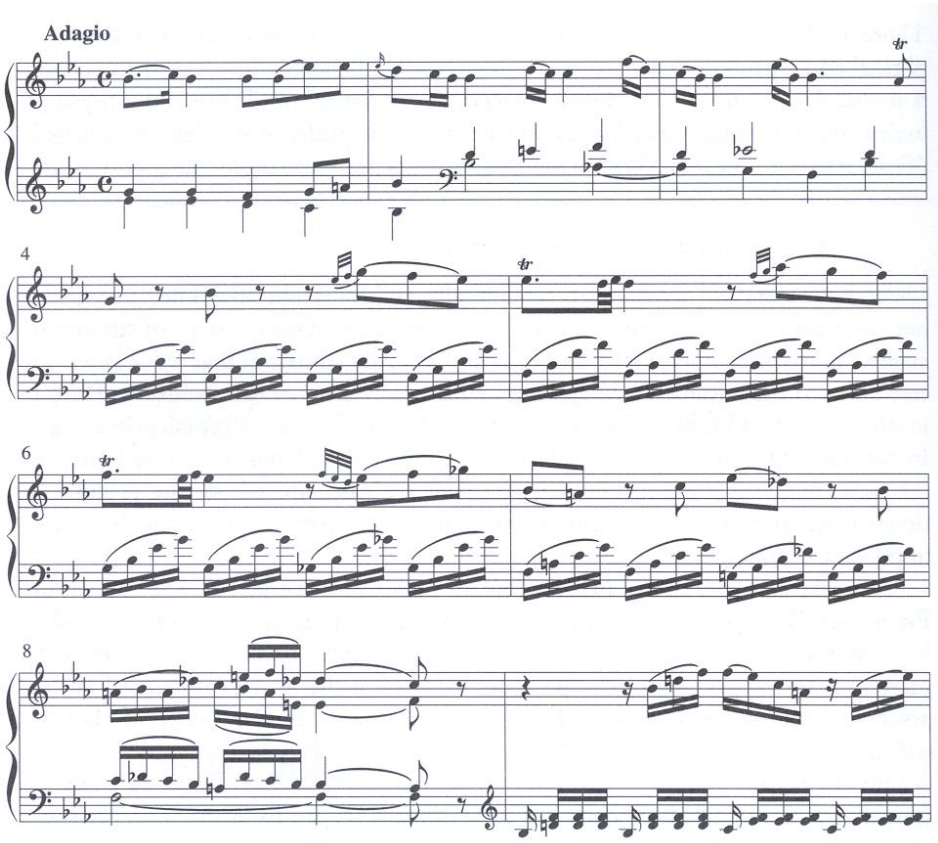
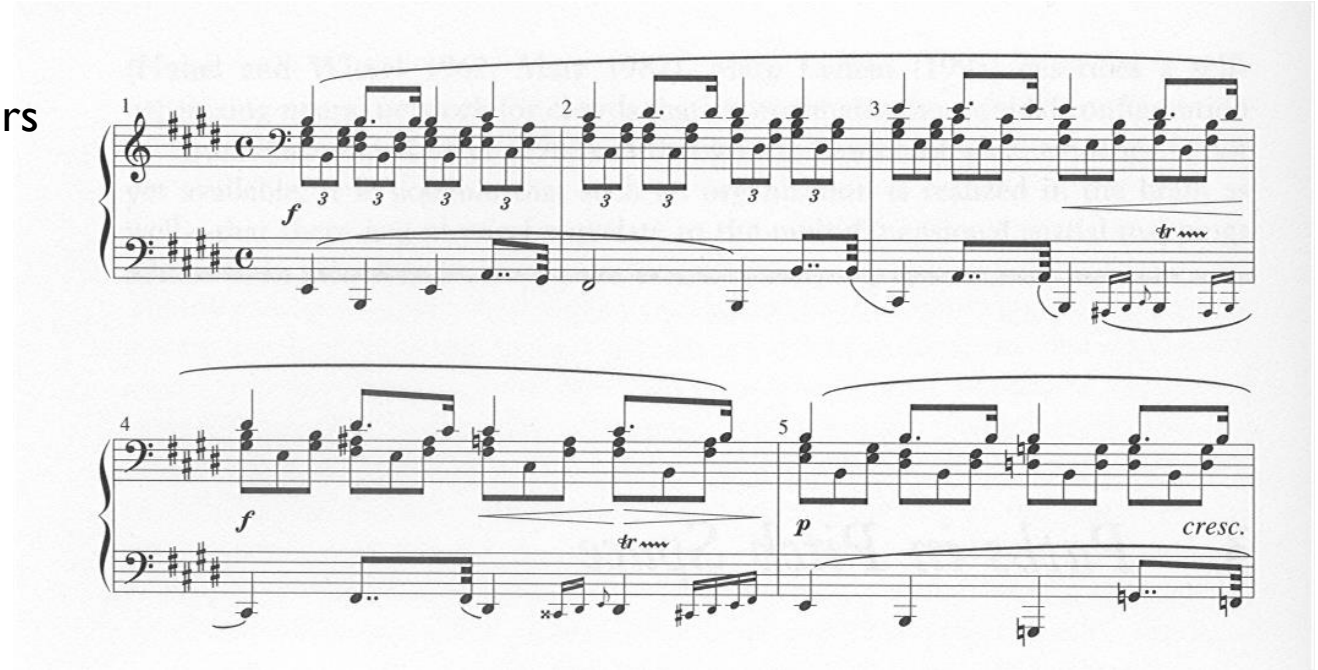


FIGURE 4.1 Mozart's Sonata, K. 282, I, bars 1–9.

Lerdahl: Tonal Pitch Space (2001)

Riemannian functions
Octatonic vs hexatonic spaces
Chromatic spaces
Whole-tone spaces

Metrical attractions
Psychoacoustical factors



Lerdahl, Krumhansl (2007), 1

"Modelling Tonal Tension," *Music Perception* 24, 329-366 (2007)

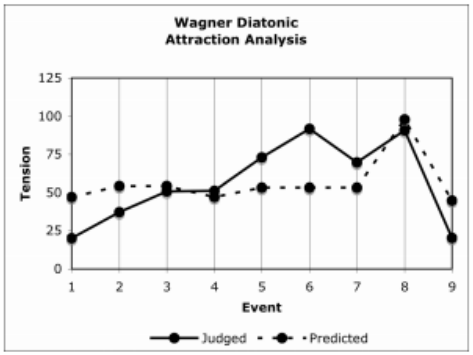


FIGURE 18. Attraction analysis of the Grail theme.

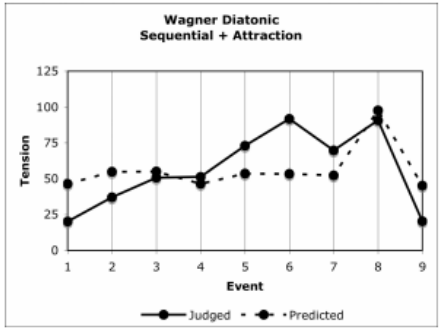


FIGURE 19. Combined sequential + attraction analysis of the Grail theme.

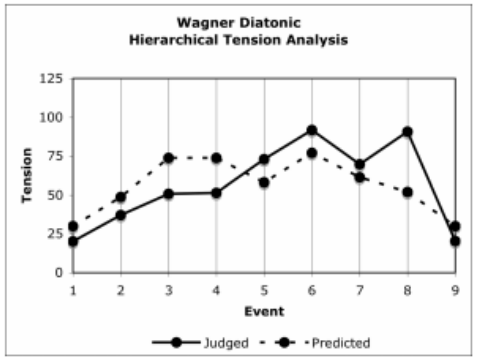


FIGURE 20. Tension graph for the theoretically preferred hierarchical analysis of the Grail theme.

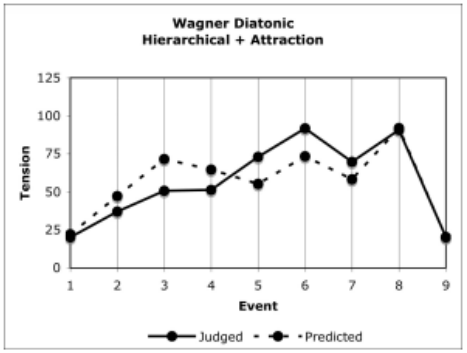


FIGURE 21. Combined hierarchical (theoretically preferred) + attraction analysis of the Grail theme.

Principles: Prolongational structure, pitch-space model, surface-tension model, attraction model--Experimental results

Lerdahl, Krumhansl (2007), 2

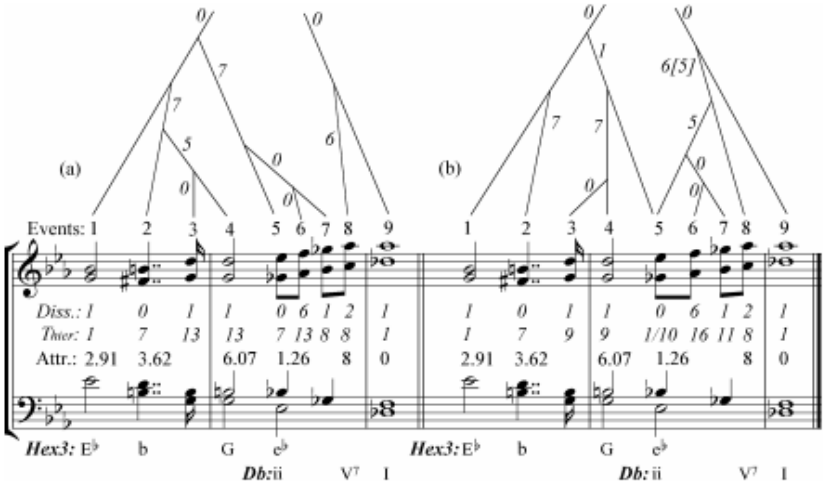
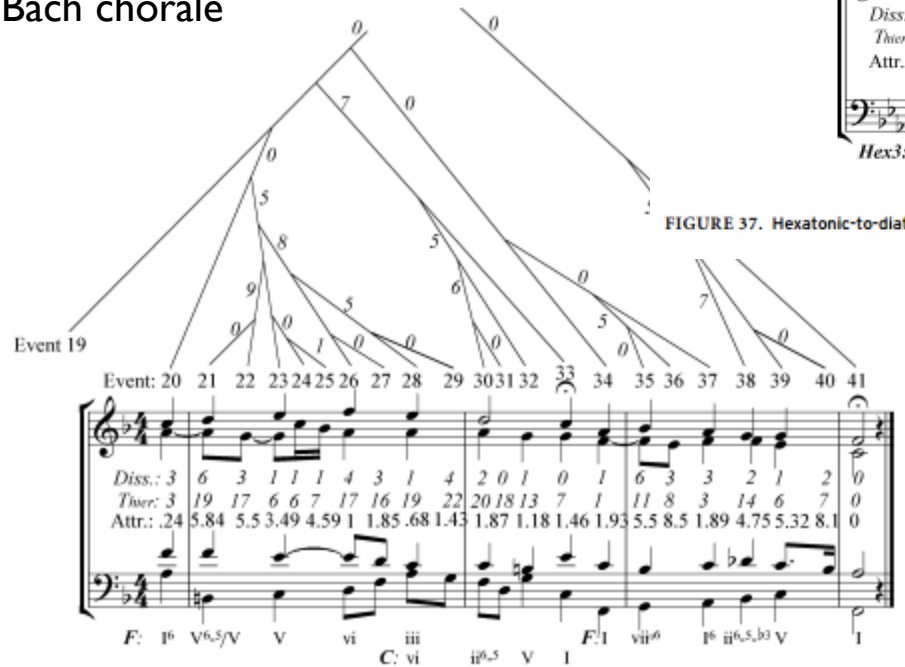


FIGURE 37. Hexatonic-to-diatonic analyses of the chromatic version of the Grail motive: (a) right-branching interpretation; (b) *TPS* interpretation.

Bach chorale



Wagner "Grail" motif.

6. Analysis of the Bach chorale, phrases 3-4.

Temperley (2003), 1

Music Cognition:

The Cognition of Basic Musical Structures (2003)

Areas covered:

- Metrical structure
- Phrase structure
- Melodic phrase structure
- Contrapuntal structure
- Harmonic structure
- Key structure

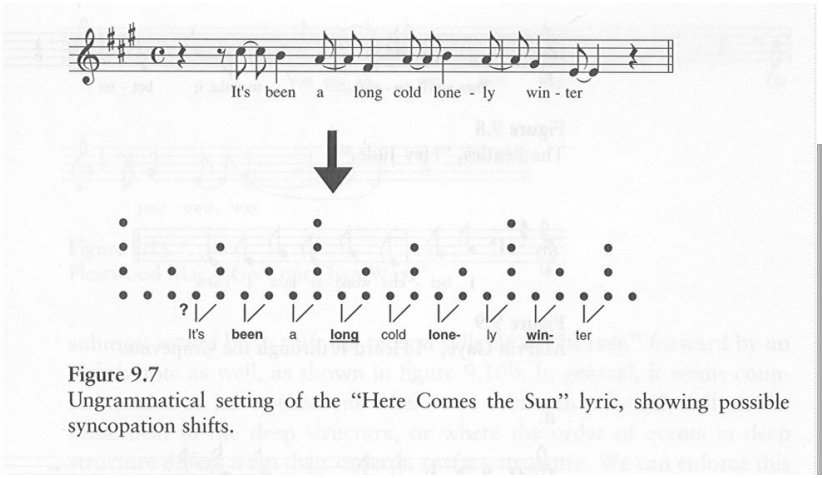
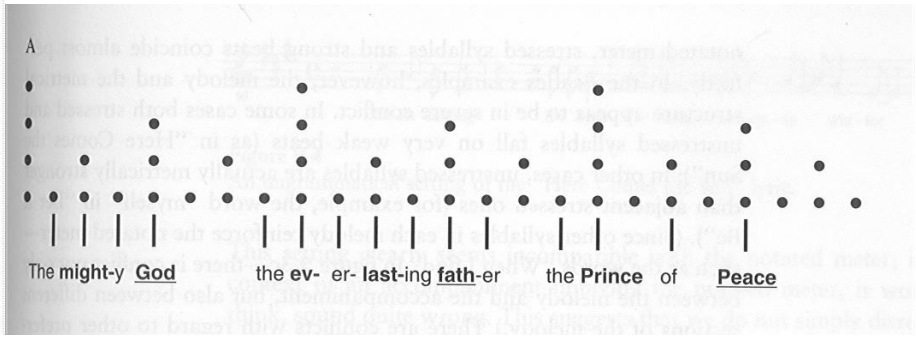


Figure 9.7
Ungrammatical setting of the "Here Comes the Sun" lyric, showing possible syncopation shifts.



Temperley (2003), 2

- Repertories and perspectives
  - Ambiguity
  - Rock
  - African music
  - Generative processes
  - Non-metrical music
  - Arbitrariness

Method: mainly based on GTTM and extensions to it

Software: (*Melisma*): mainly written my Daniel Sleator

[cf on KernScores]

Temperley (2006), 1

- ***Music and Probability* (2006)**

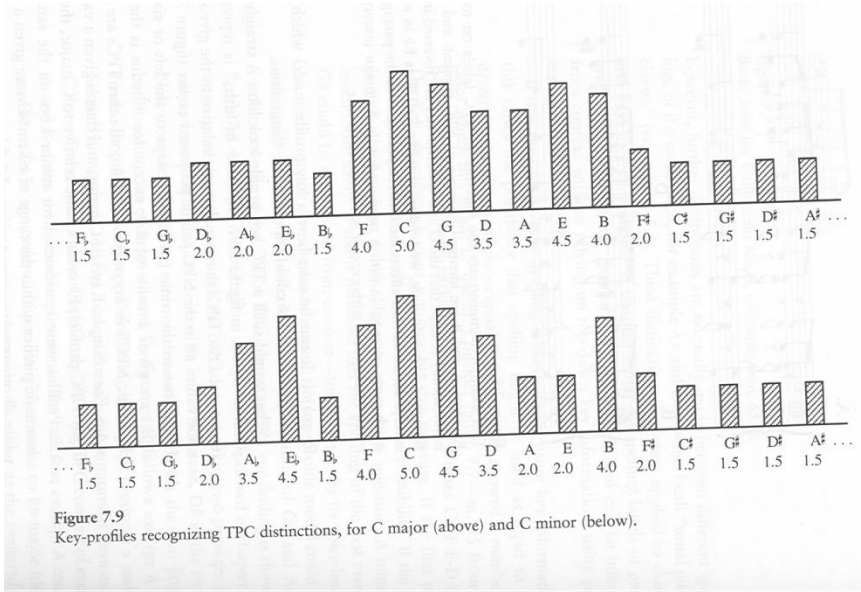


Figure 7.9
Key-profiles recognizing TPC distinctions, for C major (above) and C minor (below).

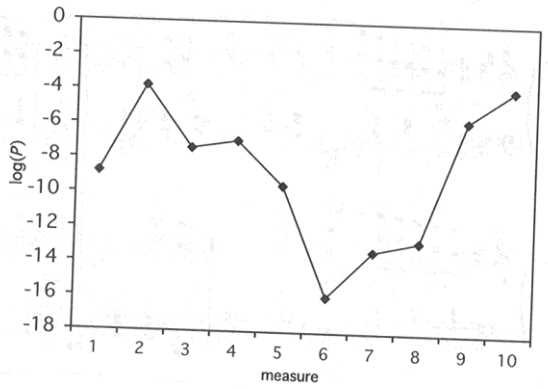


Figure 7.7
The model's probability scores for the Chopin Mazurka excerpt in figure 7.6.

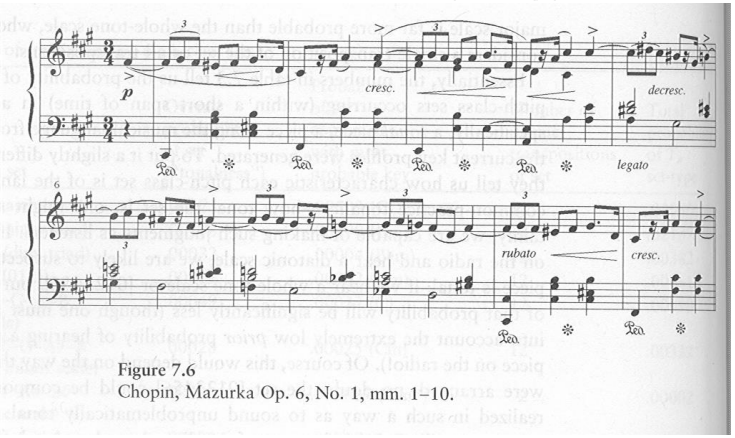


Figure 7.6
Chopin, Mazurka Op. 6, No. 1, mm. 1–10.