

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

Allegretto Beethoven, 7th Symphony

p

Other combos

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

Allegretto

p

A: I V ----- I
Harmonic rhythm

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?

Mozart, Symphony K. No.550

The image displays five systems of musical notation for Mozart's Symphony K. No. 550. Each system consists of a piano (p) part on the left and a violin (v) part on the right. The first system includes dynamic markings 'p' and 'mf p'. The notation includes various musical symbols such as notes, rests, and bar lines, illustrating the harmonic structure of the piece.

Riemann (Riemann-esque analysis)

Chordal progressions in tonal music

The image displays a musical score for piano, marked 'Allegro' and 'p' (piano). The score is written in treble and bass staves. The first system shows a melodic line in the treble staff and a bass line in the bass staff. The second system continues the melody and bass line, with a 'cresc.' (crescendo) marking. The third system shows a melodic line in the treble staff and a bass line in the bass staff, with a 'p' (piano) marking. The Riemann analysis labels are placed below the first system of the score: I, V, I, IV, I, V, V7, I.

Allegro

p

tr

cresc.

p

I V I IV I V V7 I

Metrical reductions



Harmonic evaluation

Computer-based analysis

- Sapp
- Temperley

► Musical texture:

- interval of assessment
- bald spots

The image displays three staves of musical notation, likely from a piano score, used for harmonic analysis. The top staff is marked 'Allegro' and 'p' (piano). It features a treble and bass clef. Two large blue arrows point down to the first and second measures of the top staff. The middle staff shows a treble and bass clef with a 'cresc.' (crescendo) marking. The bottom staff also shows a treble and bass clef. A red rectangular box highlights a section of the bottom staff, containing a sequence of notes marked with 'p' (piano) and 'f' (forte) dynamics.

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 computable

- Six levels of harmonic rhythm

- Phenomenal rhythm
- Bass-pitch rhythm
- Root analysis
- Within-key analysis
- Density
- Harmonic function
- Interpretation

Ex. 4-1. Corelli, Concerto op. 6, no. 8, III, mm. 9-14.

Allegro

Tex.
Phen.
Bass pitch

These are the famous three levels of harmonic rhythm.

Schenker (Schenkerian analysis)

Foreground/
background

BACH: Brandenburg No 2, Movement No. I, bars 111 - 113
Reduction

112.

VI₇ II₇ V₇

α α

Example 3.16.

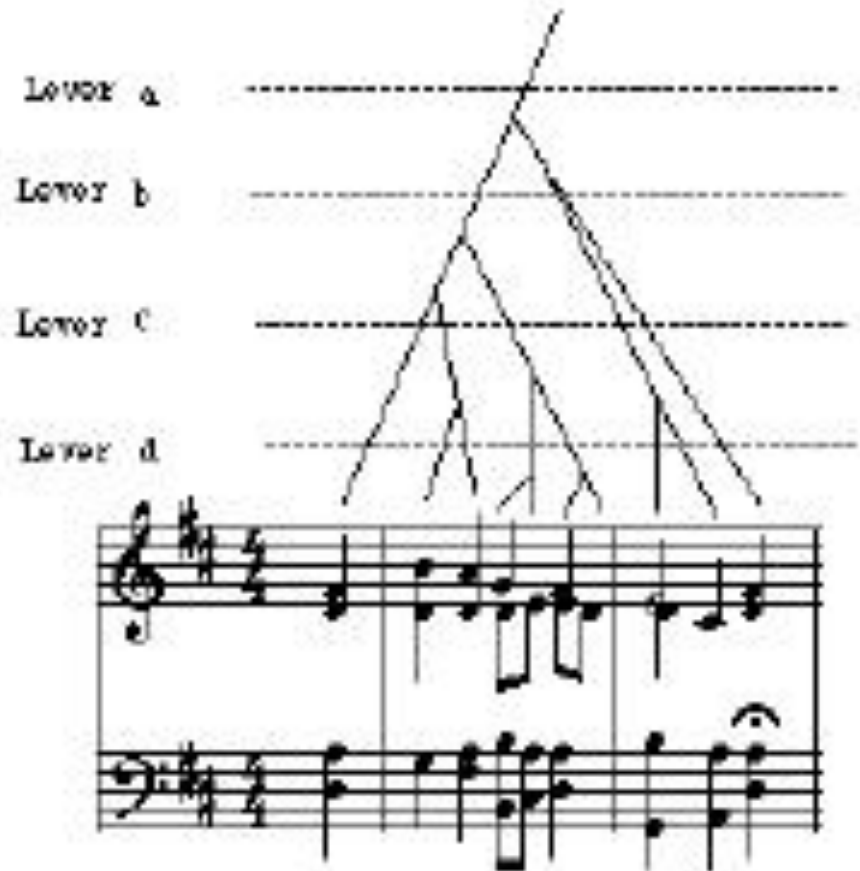
Lerdahl (Gestalt readings)

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

The image displays a musical score for piano, spanning measures 1 through 5. The music is written in 2/4 time and the key of D major, indicated by two sharps (F# and C#) in the key signature. Measures 1-3 are marked with a forte (*f*) dynamic and feature triplets in the right hand. Measures 4-5 are marked with a piano (*p*) dynamic and feature a crescendo (*cresc.*) marking. The score includes various musical notations such as notes, rests, and dynamic markings.

Lerdahl, Krumhansl (2007), 1

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

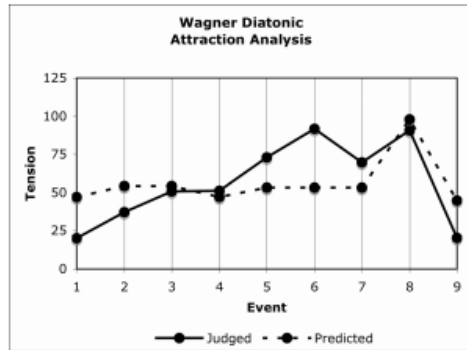


FIGURE 18. Attraction analysis of the Grail theme.

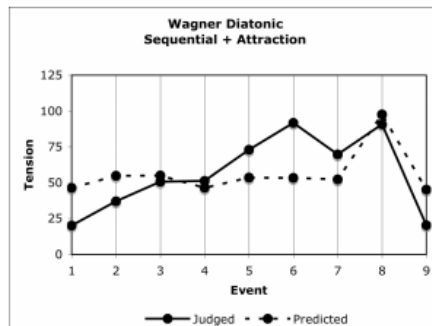


FIGURE 19. Combined sequential + attraction analysis of the Grail theme.

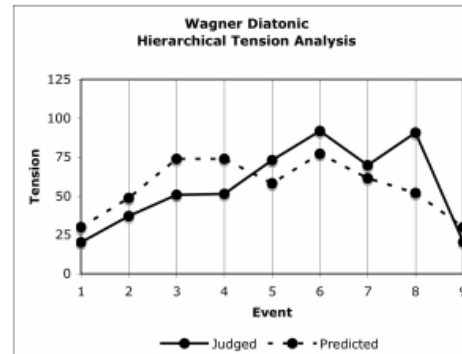


FIGURE 20. Tension graph for the theoretically preferred hierarchical analysis of the Grail theme.

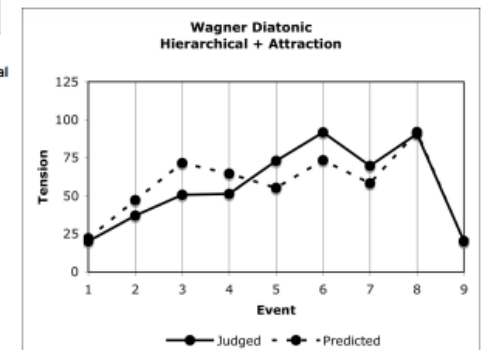
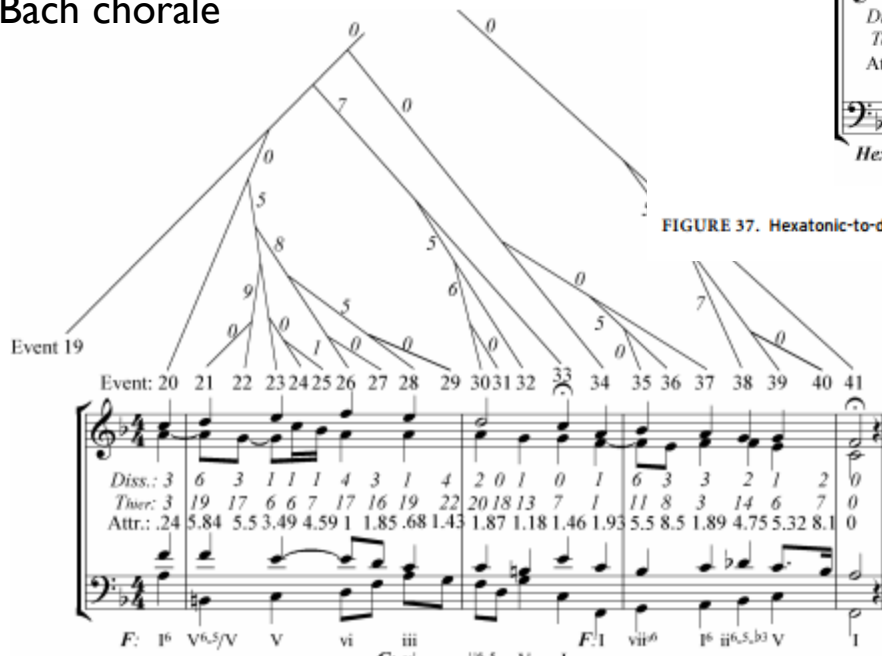


FIGURE 21. Combined hierarchical (theoretically preferred) + attraction analysis of the Grail theme.

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

Lerdahl, Krumhansl (2007), 2

Bach chorale



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

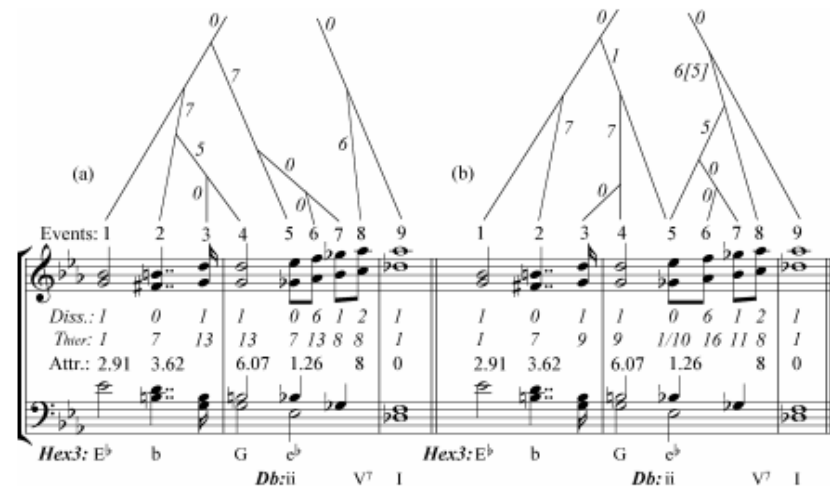


FIGURE 37. Hexatonic-to-diatonic analyses of the chromatic version of the Grail motive: (a) right-branching interpretation; (b) TPS interpretation.

Wagner “Grail” motif.

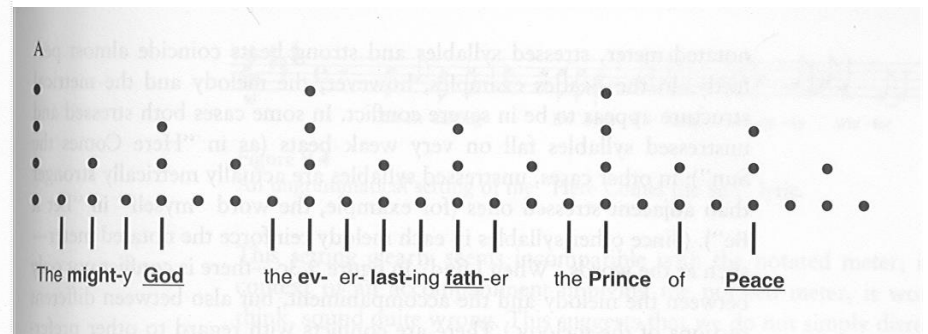
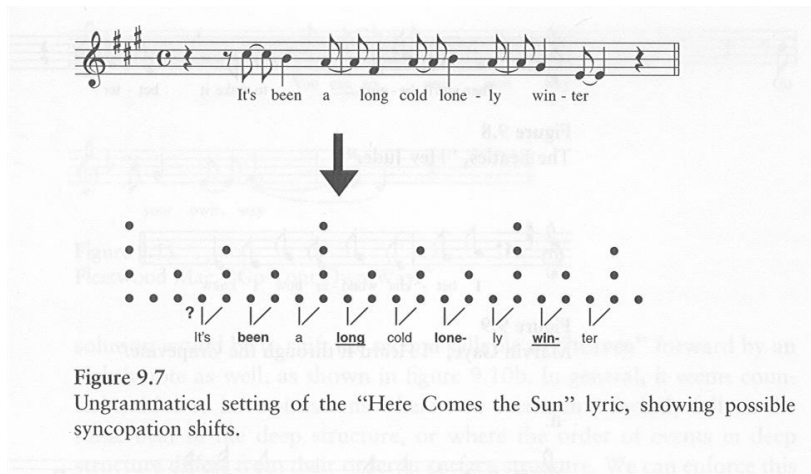
Temperley (2003), 1

Music Cognition:

The Cognition of Basic Musical Structures (2003)

Areas covered:

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



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 by Daniel Sleator

[cf on KernScores]

Temperley (2006), 1

- Music and Probability (2006)**

