Systematic Exploration of Schenkerian Reduction

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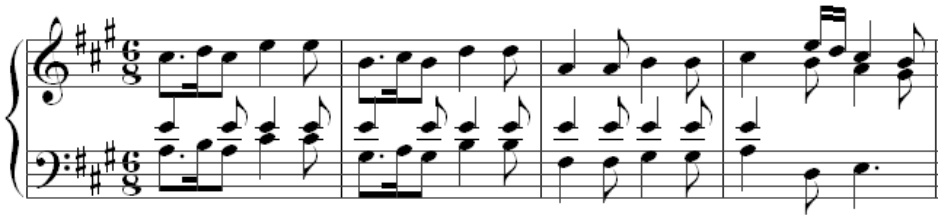
Empirical Musicology, 3 Apr. 2008

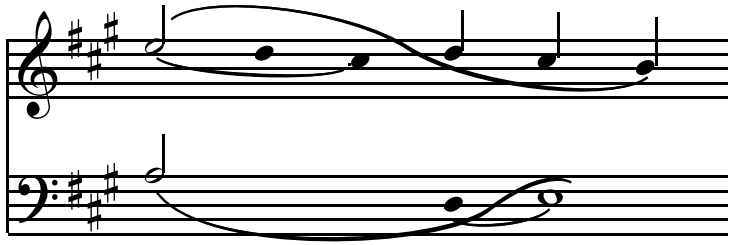
Schenkerian Analysis

Progressively reduces a score, removing less essential features, to reveal the ‘background’ structure.

Mozart:

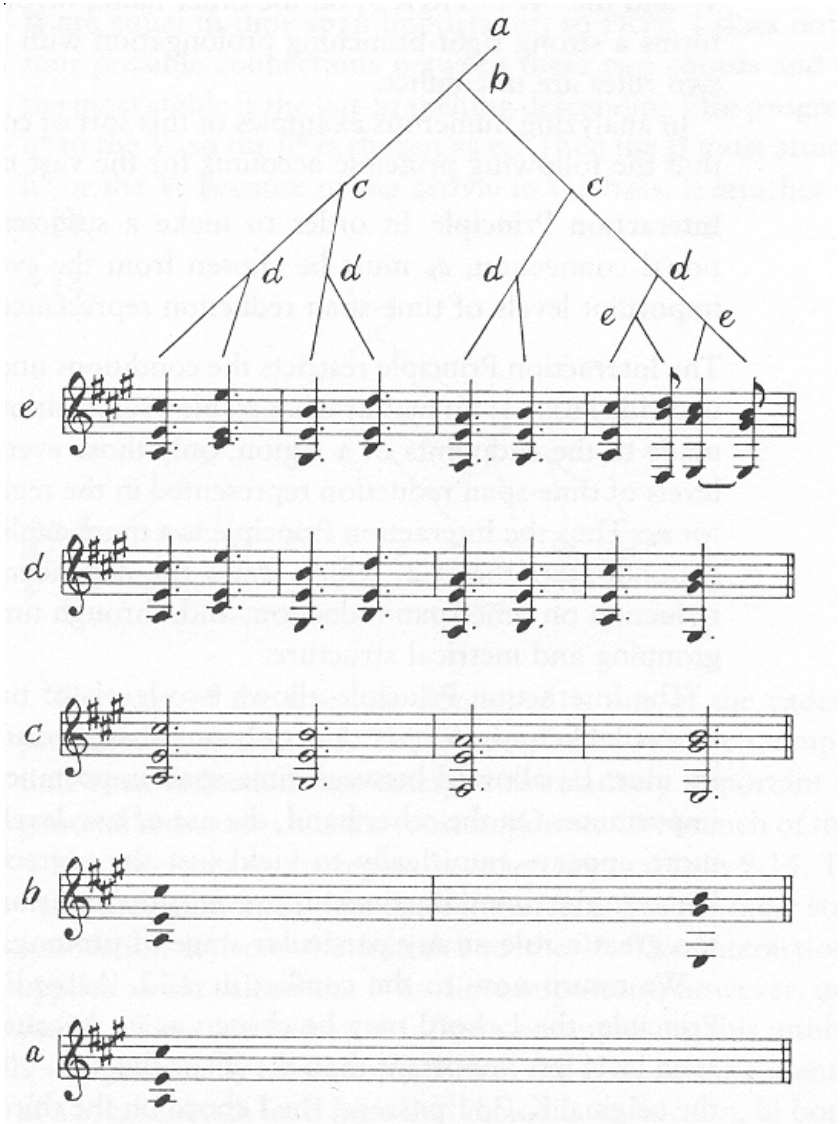


Schenker:



Lerdahl & Jackendoff GTTM

F. Lerdahl & R. Jackendoff,
A Generative Theory of Tonal Music
(1983), MIT Press



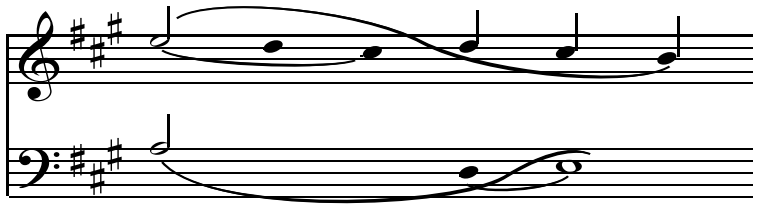
Is it Systematic?

- Schenker: ‘laws’, ‘art’, ‘secrets’.
  - a taxonomy of diminutions
  - a large set of asserted examples
- Musical ‘grammar’ (e.g., Baroni)
  - mostly demonstrated by generation of music
  - parsing often restricted to chord sequences (e.g., Steedman)
- Lerdahl & Jackendoff
  - explicitly rule-based
  - ‘preference rules’ to guide reduction
- Computational approaches
  - Kassler’s proof of correctness and completeness of Schenkerian middleground theory (1967, 1975)
  - Derivations of analyses more limited

Previous Computational Work

- Kassler (1967, 1975, 1977, 1988)
  - program which successfully analyses three-voice middlegrounds
- Smoliar et al. (1976, 1978, 1980)
  - program capable of verifying an analysis
- Mavromatis & Brown (2004)
  - demonstration of theoretical possibility of Schenkerian analysis by context-free grammar
- Hamanaka, Hirata & Tojo (2005-7)
  - implementation of Lerdahl & Jackendoff reduction with adjustment of parameters (now moving towards automatic parameter-setting)
- Gilbert & Conklin (2007)
  - probabilistic grammar for melodic reduction

The Research Problem



Millions of analyses

Rules of elaboration

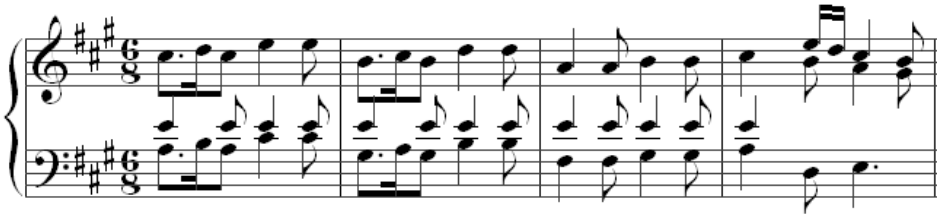
selection criteria?

music theory ?

? music theory

Rules of reduction

Millions of pieces of music



A Framework for Empirical Research

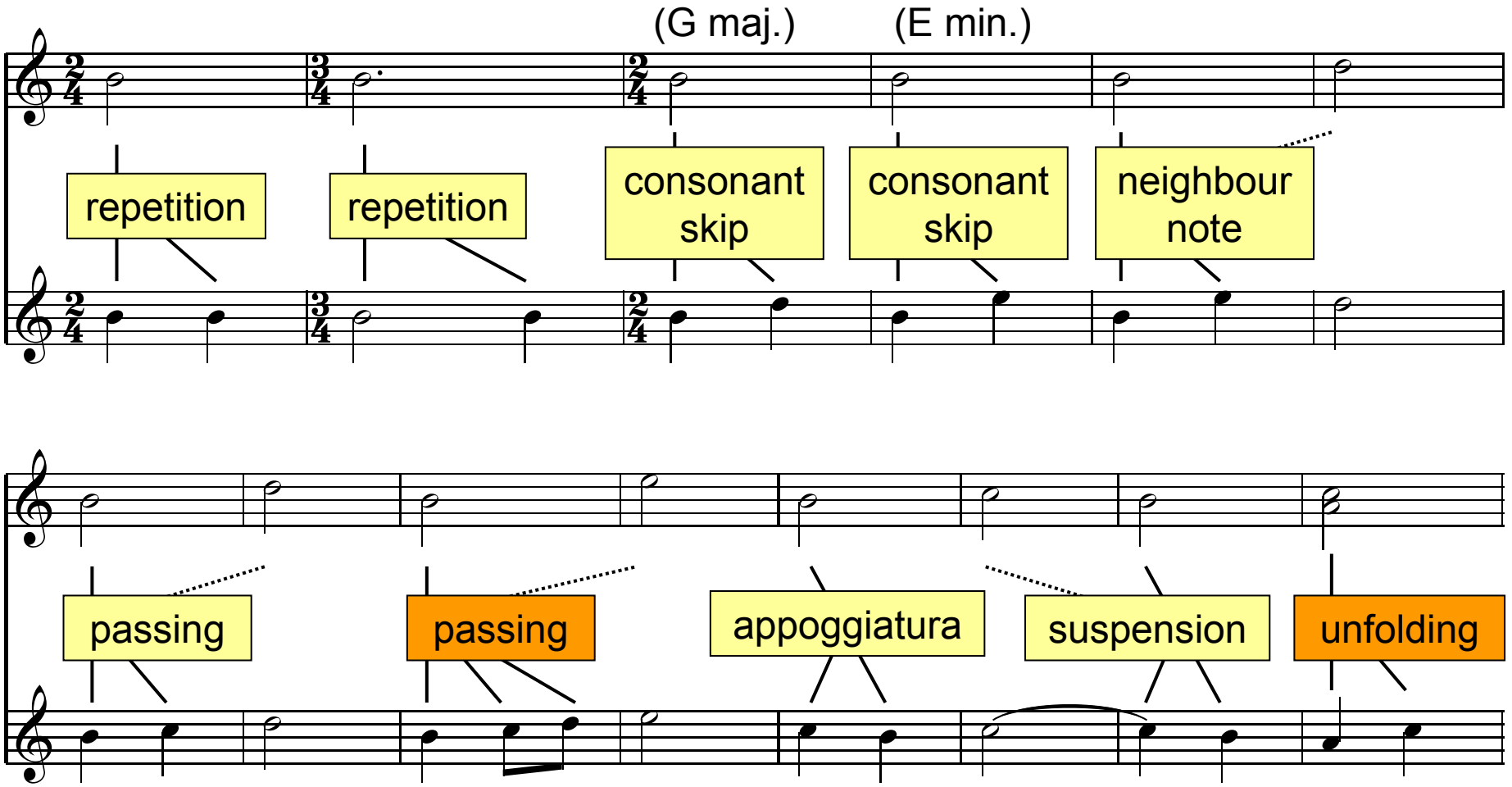
1. Formalise rules of reduction.
2. Derive all possible reductions of a fragment of music.
3. Measure certain characteristics of a sample.
4. Measure the same characteristics in ‘correct’ analyses of the same fragments.
5. Compare the distribution of values from the sample to the values from the analyses.
6. Characteristics where the analyses are consistently distinguished in the sample distribution suggest possible selection criteria.

1. Formalisation of Rules of Reduction

- See Alan Marsden, 'Generative Structural Representation of Tonal Music', *Journal of New Music Research*, 34 (2005), 409-428

1. All elaborations are binary.
   - elaborations producing more than one new note accommodated by special intermediate 'notes'
2. Elaborations generate new notes within the same time-span (cf. Lerdahl & Jackendoff, Komar).
3. Only certain kinds of elaborations are possible.
4. Elaborations have harmonic constraints.
5. Some elaborations require specific preceding or following context notes.

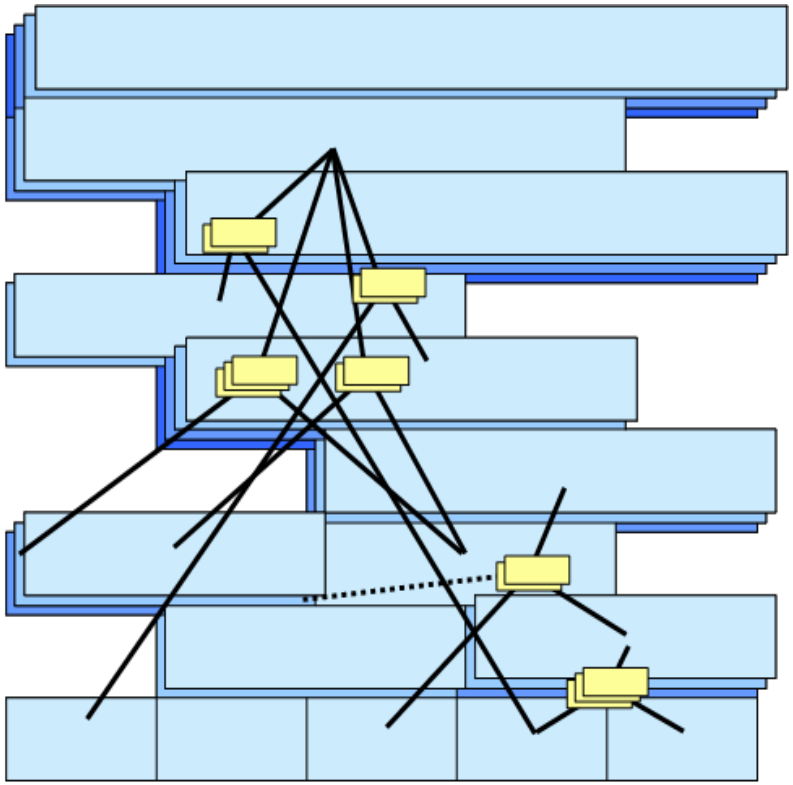
Elaborations



Further detail in Marsden, *CHum* (2001) and *JNMR* (2005).

2. Derivation of All Possible Reductions

- Not possible explicitly, because of ‘combinatorial explosion’
  - number of possible reductions related to $n!$ (where n is the length of the music)
- Derivation of a matrix of local solutions, from which all possible reductions may be derived
  - size theoretically related to n^3



Example of Reduction Matrix

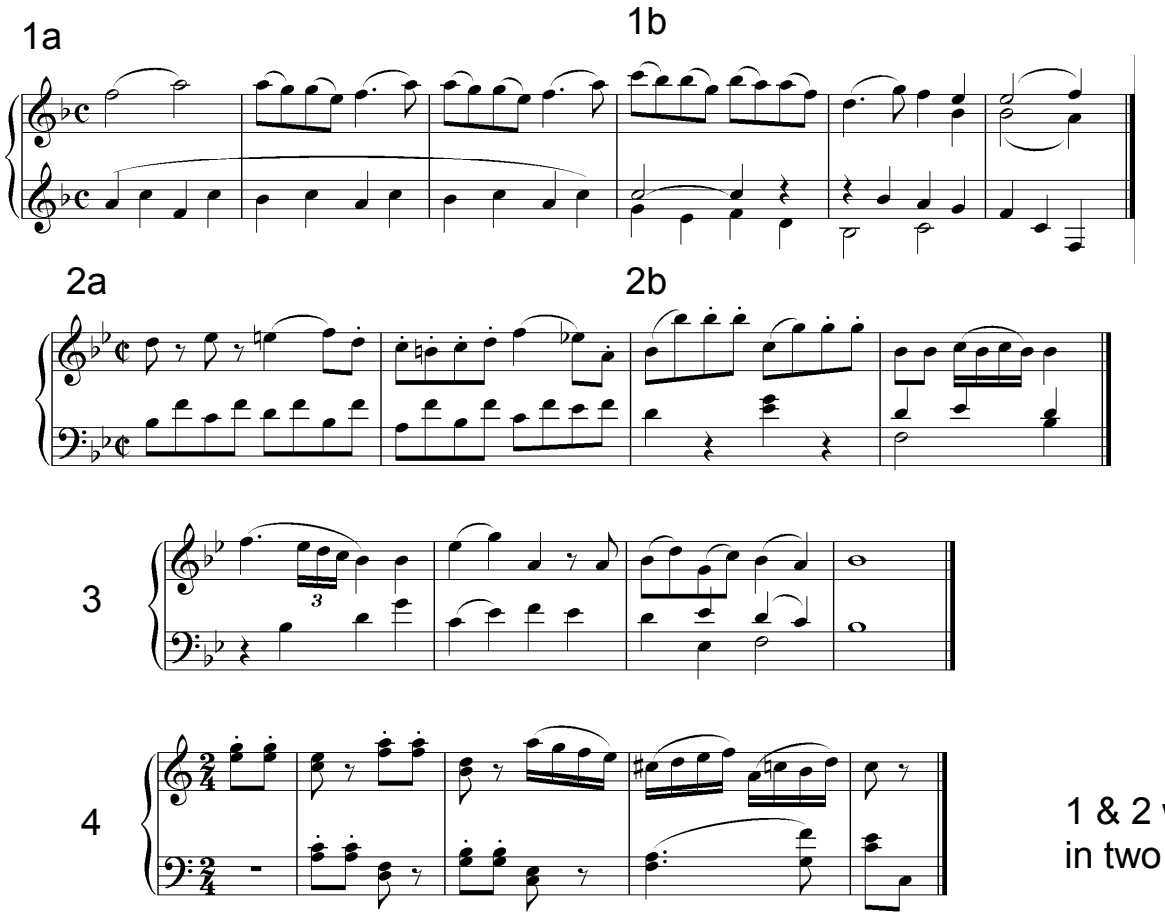
```
Row 5
0-5 6
 64 D5
 64 Bb4
 64 D4
 64 Bb3
Row 4
0-4 5        1-5 5
 67 D5        67 D5
 50 Bb4       67 Bb4
 67 D4        67 _D4
100 Bb3       67 Bb3
Row 3
0-3 4        1-4 4        2-5 4
 80 D5        20 Eb5      100 D5
 60 Bb4       40 D5       100 Bb3
 60 D4        40 Bb4
              80 _D4
             100 Bb3
Row 2
0-2 3        1-3 3        2-4 3        3-5 3
 80 D5        33 D5        67 Eb5      100 D5
 60 Bb4       50 C5        67 C5       100 Bb3
 60 D4        33 Bb4      100 Bb3
              83 _D4
              33 A3
Row 1
0-1 2        1-2 2        2-3 2        3-4 2        4-5 2
 50 C5        67 D5        50 D5        67 Eb5      100 D5
 50 Bb4       67 Bb4       50 C5        67 C5       100 Bb3
100 D4       100 _D4      100 A3       100 Bb3
Row 0
0 1          1 1          2 1          3 1          4 1          5 1
100 C5       100 Bb4      100 D5       100 C5       100 Eb5      100 D5
100 D4       100 _D4      100 A3       100 _A3      100 Bb3      100 _Bb3
```

3. Selection and Measurement of a Sample

- Selecting a random sample is not trivial
  - selecting an option at one point in the matrix affects options at other points
  - currently selects top-down giving equal likelihood to each remaining option at each point
- Which measures to try?
  - guesses based on expertise
  - suggestions from Schenkerian literature (Plum, Schachter, teaching materials)
  - Lerdahl & Jackendoff preference rules

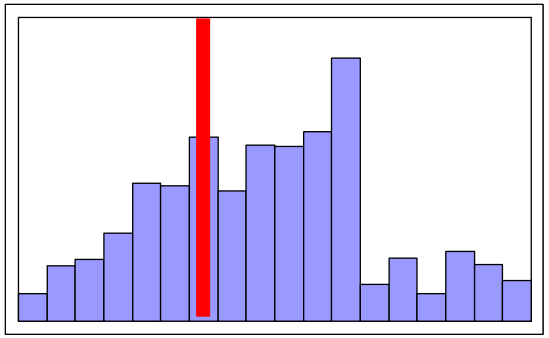
Sample Fragments

Rondo themes from Mozart piano sonatas



1 & 2 were analysed in two halves

Number of Notes



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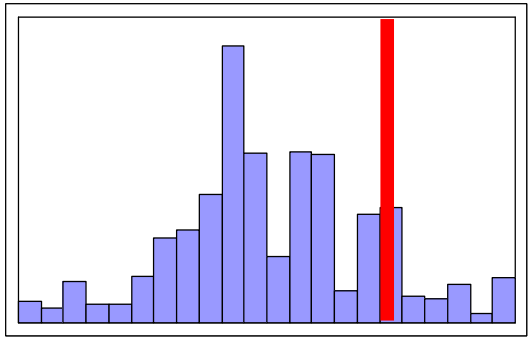

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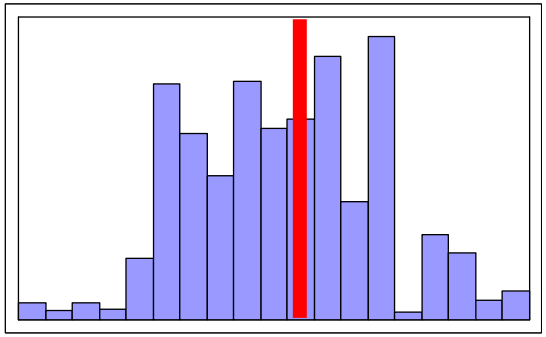

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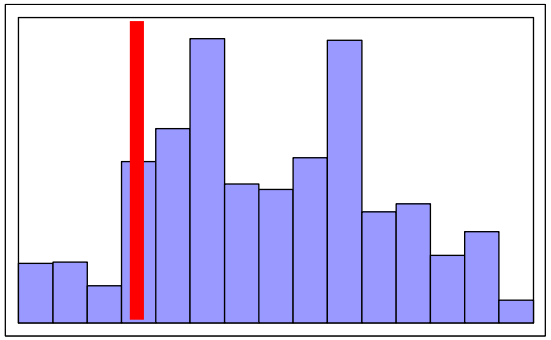

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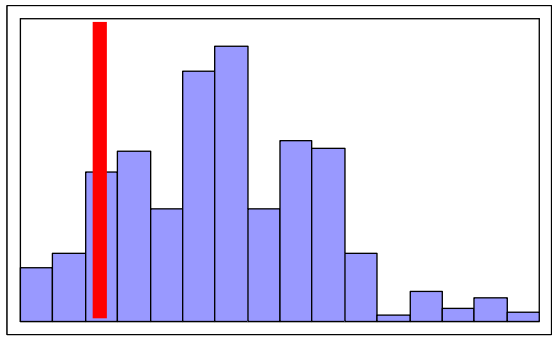

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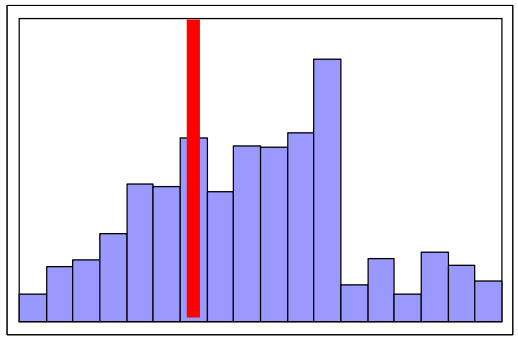

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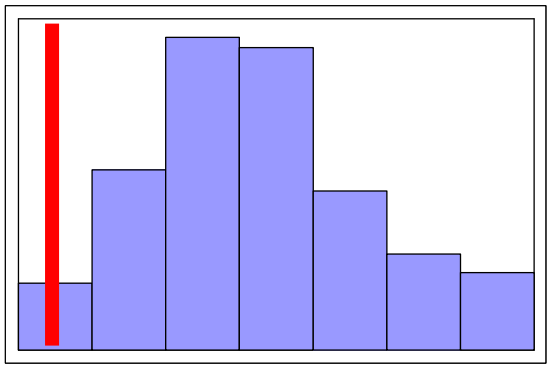
Number of Reductions with Fewer Voices



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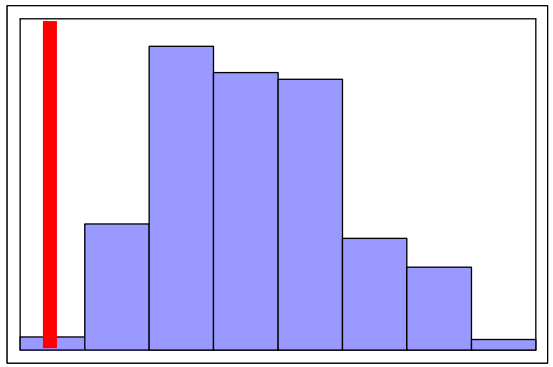

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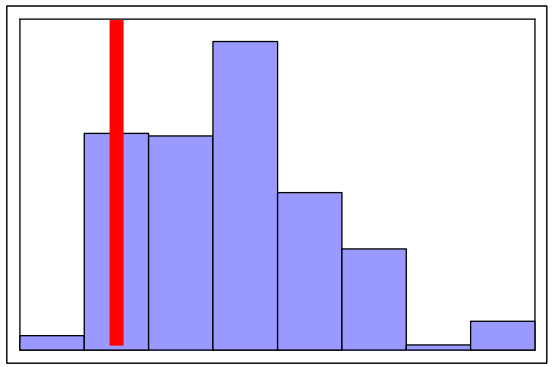

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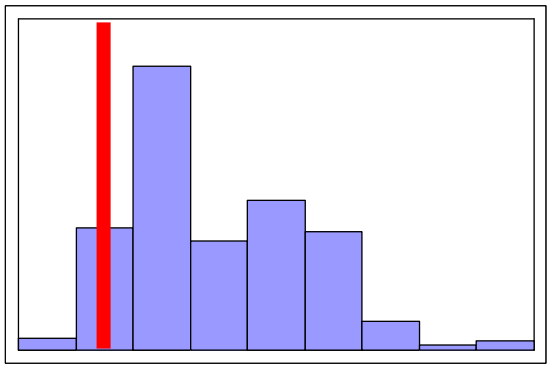

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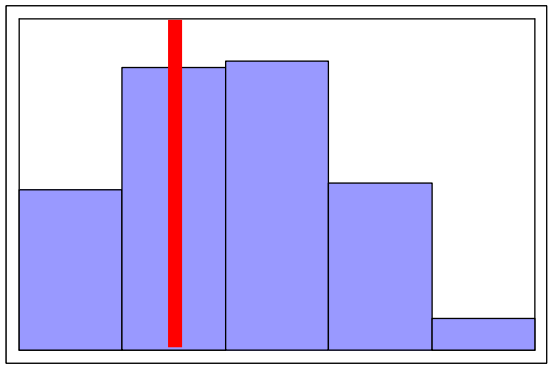

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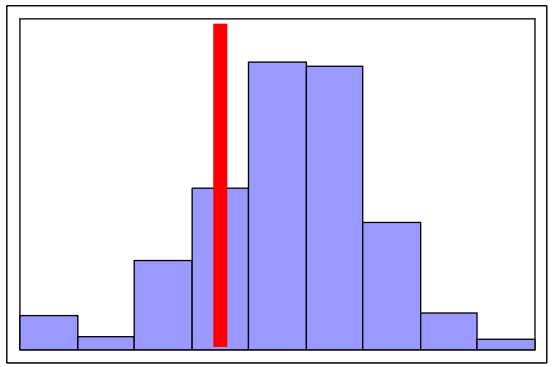

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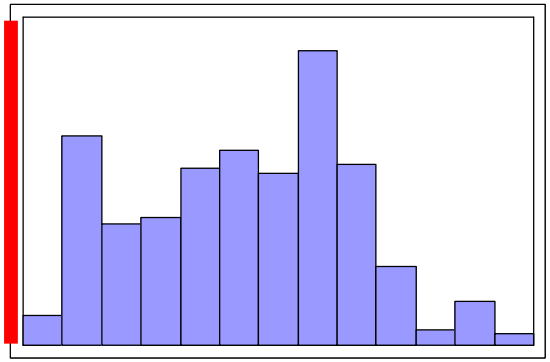
Ratio of Durations



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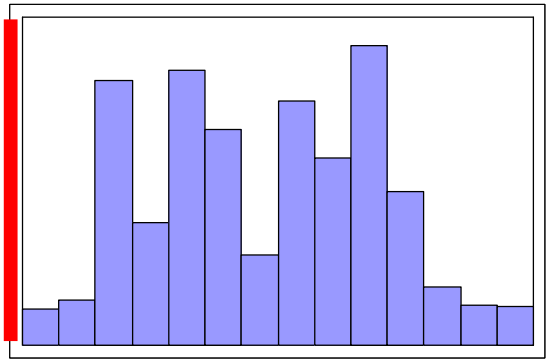

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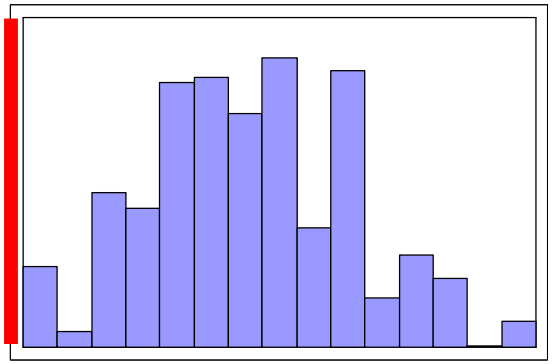

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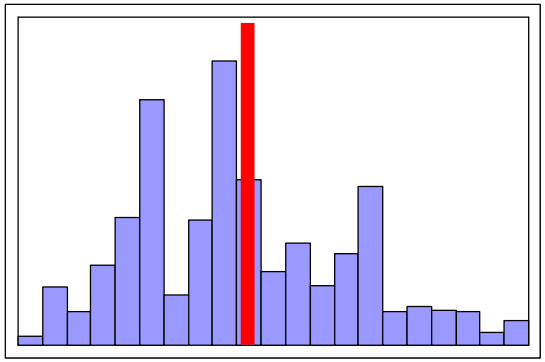

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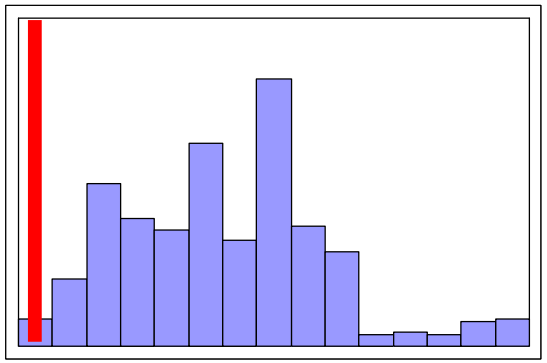

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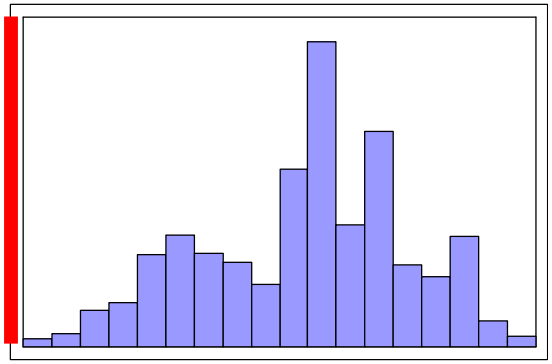

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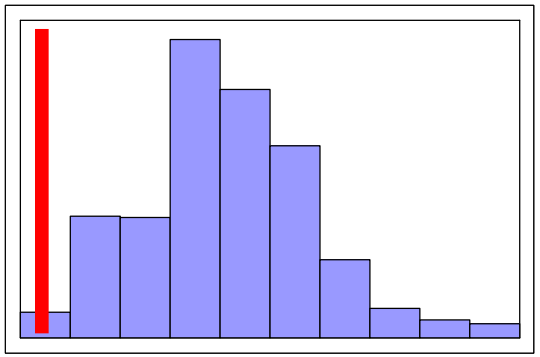
Number of Short-Long Reductions



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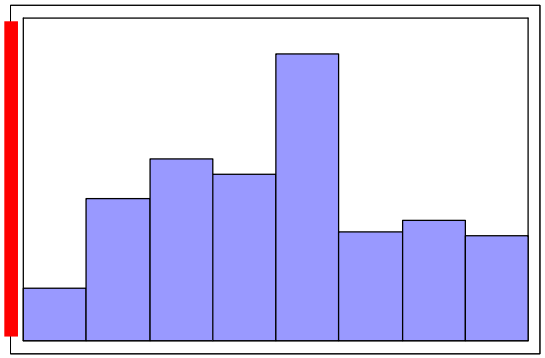

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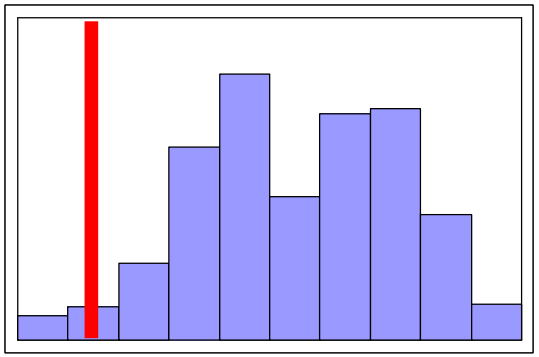

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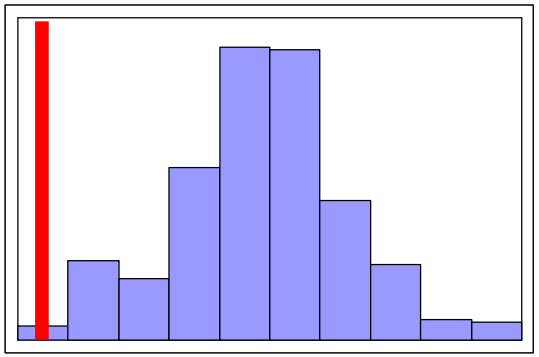

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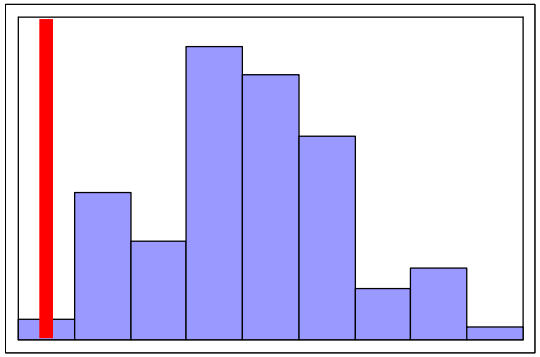

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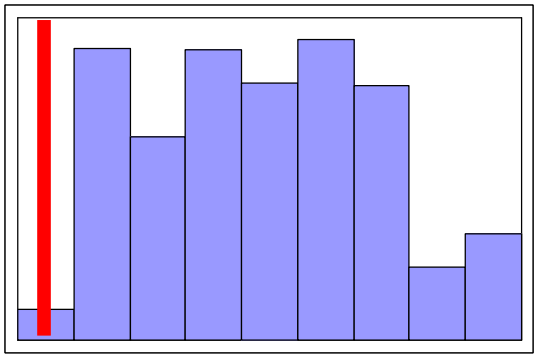

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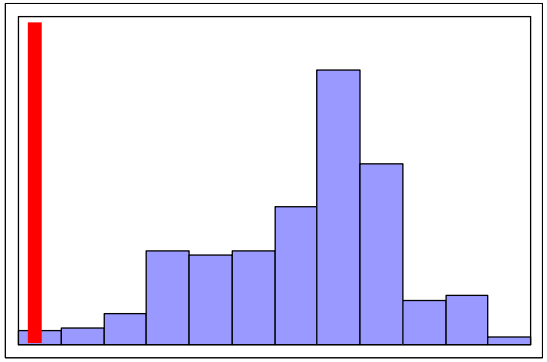
Number of Syncopations



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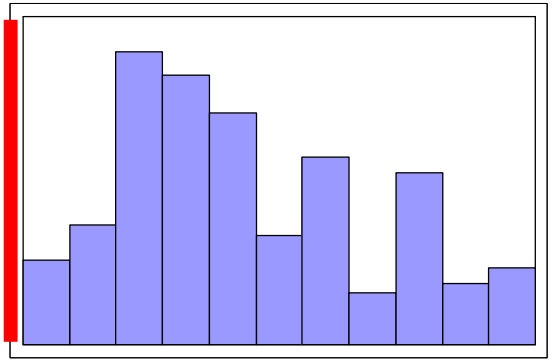

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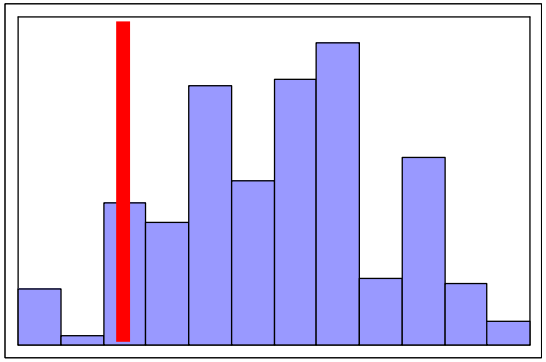

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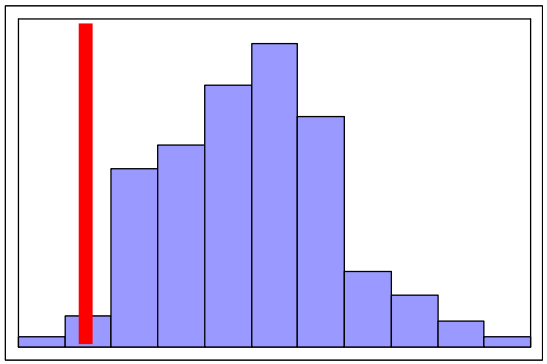

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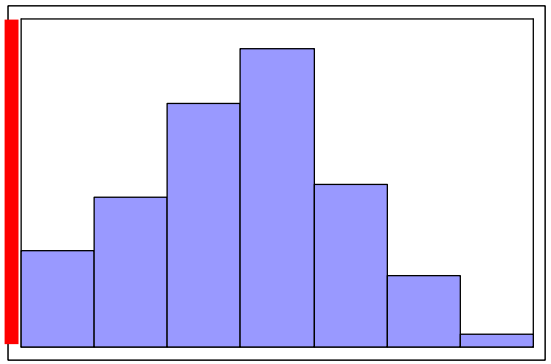

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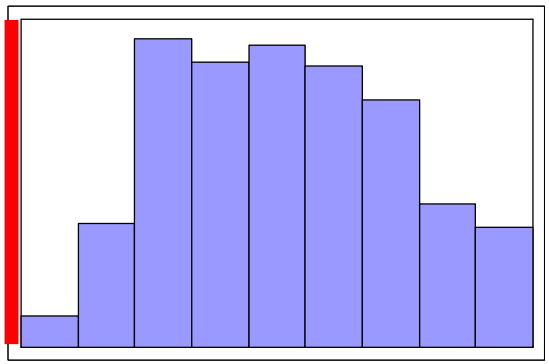

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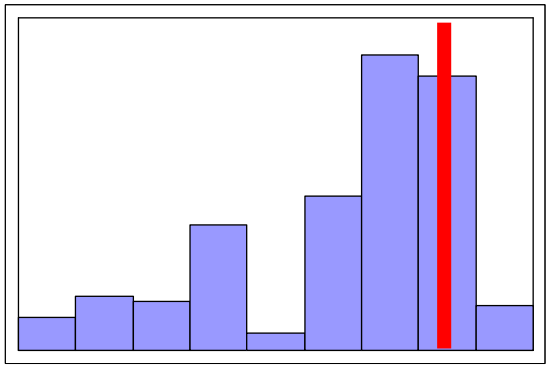
Harmonic Support



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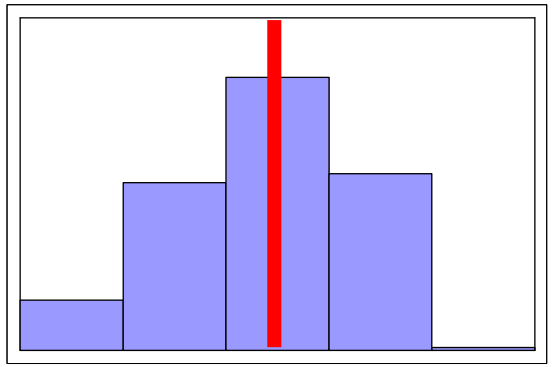

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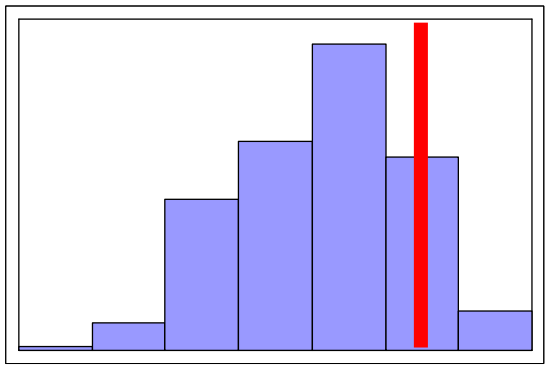

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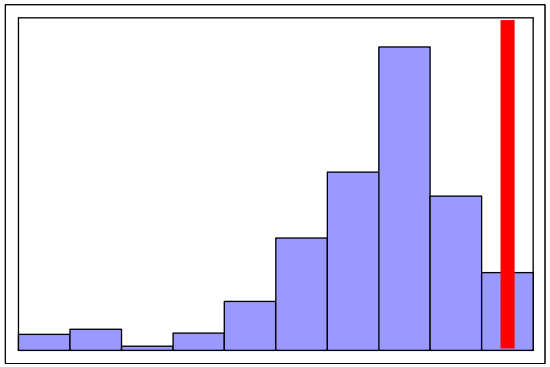

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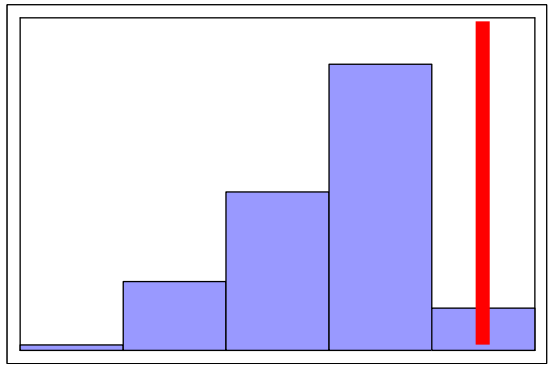

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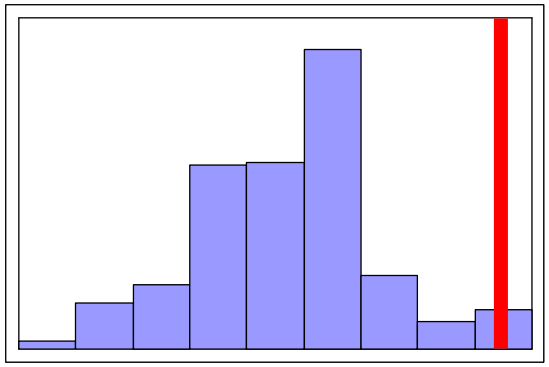

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Further Work

- Incorporation of the most obvious selection criteria to prune derivation
- Experimentation on search procedures (with Geraint Wiggins)
- Testing for derivation of published analyses
  - Oster archive (Chopin, Beethoven)
  - *Das Meisterwerk in der Musik*

Further detail at www.lancs.ac.uk/staff/marsdena/research/schenker

Supported by the Arts and Humanities Research Council (AHRC): research-leave award 'Analysing Musical Structure: Harmonic-Contrapuntal Reduction by Computer'