Musicology

ISMIR 2011 tutorial Musicology, part 1

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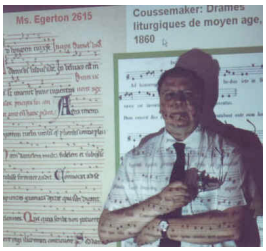
Motivation

- musicology is a ‘founding discipline’ of MIR



- musicology seems important for MIR
  - source of domain knowledge
  - provides ground thruth
  - potential power users of MIR technology
- musicologists are confusing
  - prefer music notation over sound
  - go on forever about details
  - utterly lack methodological rigour
  - never give straightforward answers

Try asking a musicologist

- what is music?
- what is the basic unit of music?
- what is a genre?
- how to distinguish good from bad music?
- what are the rules for creating good music?
- why are people moved by music?
- does music have a meaning?

So what is musicology about?

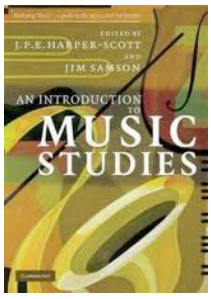
- anthropological excursion
  - explore habits, rituals and value systems
  - dangerous areas
  - hidden treasures
  - opportunities for interaction
- your guides
  - Anja Volk
    - studied mathematics and musicology
  - Frans Wiering
    - studied biology, some mathematics and musicology

Outline

- musicology (Frans)
  - positivist and new musicology
  - musicology in action
- music theory (Anja)
- music similarity (Anja)
- music and meaning (Frans)
  - final remarks (Anja and Frans)

What do we understand by musicology?

- the academic study of music
  - including music theory (unlike US)
  - excluding musicianship (unlike UK)
  - central European view
- subdisciplines discussed later



- good overview in Harper-Scott & Samson, *An introduction to music studies* (2009)

Musicology has a history

- to understand *musicologists* you need to know the history of *musicology* (a little)
- musicology emerged in Germany and Austria in the 19th century
- synthesis of
  - theory of music (since 500 BCE)
    - mathematical/speculative science
    - instruction in craftmanship
  - musical antiquarianism (since 18th century)
  - romantic aesthetics (since end of 18th century)
- important changes in late 20th century

Musicology in 1885

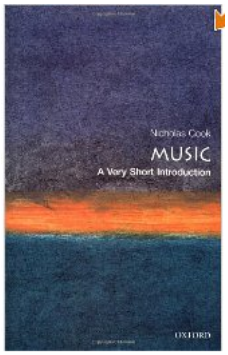
G. Adler, *Umfang, Methode und Ziel der Musikwissenschaft* (1885), translated by E. Mugglestone (1981)

Musicology in 2012

International Musicological Society Conference 2012, call for papers

What happened?

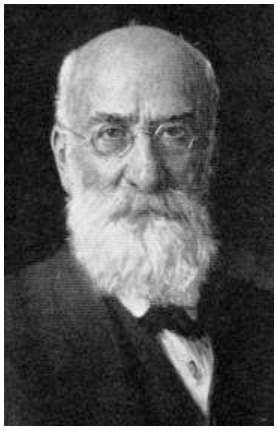
- paradigm shift
  - emergence of new/critical/cultural musicology since c. 1985
  - 'positivist' musicology marginalised



- *strongly* recommended reading
  - Nicholas Cook. *Music: a very short introduction* (1998/2000)

Guido Adler's view of musicology

- *Umfang, Methode und Ziel der Musikwissenschaft* (1885)
  - most influential musicological article ever?
  - musicology as tonal science ('Tonwissenschaft')
  - establishes facts, derives laws
  - music as an art presupposes reflection and therefore science



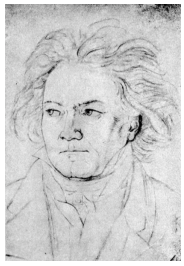
1855-1941

Umfang, Methode und Ziel

- scope
  - music as an art form ('Tonkunst')
  - study of musical art works
- method
  - *historical musicology*: notation types, musical forms, historical laws, musical instruments
  - *systematic musicology*: music theory, aesthetics, pedagogy; (comparative) musicology
  - auxiliary disciplines
- aim
  - discovery of truth and advancement of the beautiful

How did this view arise?

- musicology was literally constructed around Beethoven's 5th symphony
  - absolute, instrumental music
  - created independent of societal context, for all times
  - work of genius but incomprehensible
- urgently in need of explanation
  - E.T.A. Hoffmann's review of 1810
    - superiority of instrumental music
    - detailed description of the work's structure



http://www.youtube.com/watch?v=22wEhOdfAfA

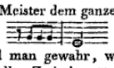
From Hoffmann's review

When music is spoken of as an independent art the term can properly apply only to instrumental music, which scorns all aid, all admixture of other arts, and gives pure expression to its own peculiar artistic nature.

Music reveals to man an unknown realm, a world quite separate from the outer sensual world surrounding him, a world in which he leaves behind all feelings circumscribed by intellect in order to embrace the inexpressible.

…only the most penetrating study of the inner structure of Beethoven's music can reveal its high level of rational awareness, which is inseparable from true genius...

translated by Martyn Clarke (in: Charlton, 1989)

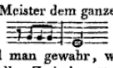
Es giebt keinen einfacheren Gedanken, als den, welchen der Meister dem ganzen Allegro zum Grunde legte  und mit Bewunderung wird man gewahr, wie er alle Nebengedanken, alle Zwischensätze, durch rhythmischen Verhalt jenem einfachen Thema so anzureihen wusste, dass sie nur dazu dienten, den Charakter des Ganzen, den jenes Thema nur andeuten konnte, immer mehr und mehr zu entfalten. Alle Sätze sind kurz, nur aus zwey, drey Takten bestehend, und noch dazu vertheilt im beständigen Wechsel

Original texts

Wenn von der Musik als einer selbständigen Kunst die Rede ist, sollte immer die Instrumental-Musik gemeint seyn, welche, jede Hülfe, jede Beymischung einer andern Kunst verschmähend, das eigenthümliche, nur in ihr zu erkennende Wesen der Kunst rein ausspricht.

Die Musik schliesst dem Menschen ein unbekanntes Reich auf; eine Welt, die nichts gemein hat mit der äusseren Sinnenwelt, die ihm umgiebt, und in der er alle durch Begriffe bestimmbaren Gefühle zurücklässt, um sich dem Unaussprechlichen hinzugeben.

…so entfaltet auch nur ein sehr tiefes Eingehen in die innere Structur Beethovenscher Musik die hohe Besonnenheit des Meisters, welche von dem wahren Genie unzertrennlich ist…

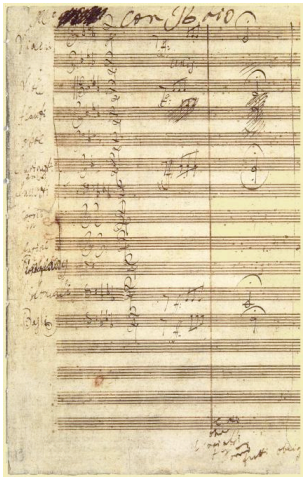
Es giebt keinen einfacheren Gedanken, als den, welchen der Meister dem ganzen Allegro zum Grunde legte  und mit Bewunderung wird man gewahr, wie er alle Nebengedanken, alle Zwischensätze, durch rhythmischen Verhalt jenem einfachen Thema so anzureihen wusste, dass sie nur dazu dienten, den Charakter des Ganzen, den jenes Thema nur andeuten konnte, immer mehr und mehr zu entfalten. Alle Sätze sind kurz, nur aus zwey, drey Takten bestehend, und noch dazu vertheilt im beständigen Wechsel

Tasks for musicology

- generally, to take the new aesthetics of music into account
- to define music as an independent art
  - in particular, no longer dependent on *language*
- to explain how music reached this state of perfection
- to provide (instrumental) music with explanatory discourse to reveal hidden logic
  - …as the word was eliminated from music, it began to fill the space *around* music (Cook 2000, 37)
- to do so in an objective, scientific way
  - later called *positivist* musicology

Positivist musicology: some answers

- what is music?
  - tonal art (Adler)
  - *tönend bewegte Form* (Hanslick 1854)
  - art, autonomy, tones, structure
- what is the basic unit of music?
  - the work
  - timeless object (in 2 ways)
  - a *text*, rendered by the score
- what is a genre?
  - a musical *form*, characterised by ensemble composition, technical features and architectural patterns
  - examples: symphony, string quartet, sonata, fugue, song, opera, dance



How to distinguish good from bad music?

- good
  - inspired
  - concentration
  - original
  - structure
  - transcendent beauty
- typical example
  - German symphony, Beethoven

- bad
  - commissioned
  - facility
  - banal
  - empty virtuosity
  - expressing the outer world
- typical example
  - Italian opera, Rossini

Not created by a romantic genius

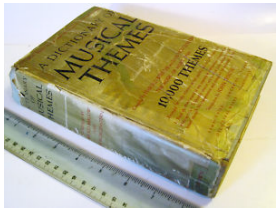
http://www.youtube.com/watch?v=B6kBkYyeOto

More positivist answers

- rules for creating good music
  - internalise music theory (harmony, counterpoint)
  - observe forms
  - originality, specially of musical *themes*
  - create (thematic) unity
- why are people moved by music?
  - human capacity of aesthetic appreciation
  - aesthetic judgement itself considered subjective, outside science
- does music have a meaning?
  - resides in structure (→formalism)
  - transcendent and sublime

The work concept in musicology

- central concept in positivist musicology
  - positivist musicology is about autonomous musical works represented by scores
  - applied to all music (old, vocal, traditional)
  - creation of *canon of masterworks*

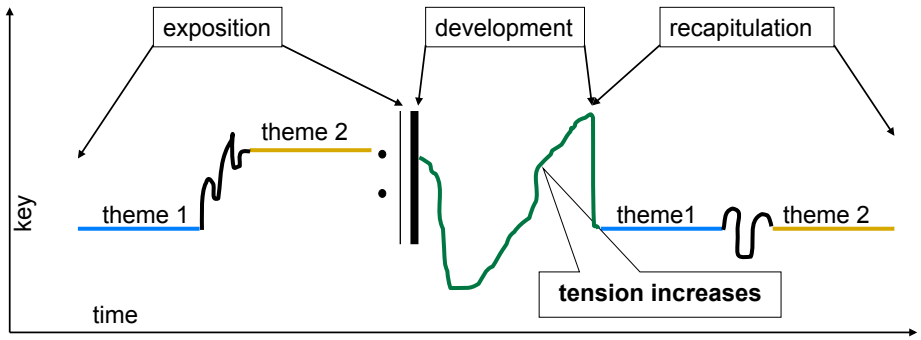


Barlow & Morgenstern 1949

Perspectives on the work

- *historical musicology* perspective
  - editing music becomes core activity of musicology
  - scholarly editing establishes true intentions of composers
- *systematic musicology* perspective
  - music analysis develops methods to demonstrate masterwork status
  - thematic unity (e.g. Reti)
  - tonal structure (e.g. Schenker)
  - formal coherence through architectural patterns
  - example: sonata form

Example pattern: sonata form



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http://en.wikipedia.org/wiki/Sonata_form

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Sonata form, the bare essentials

- binary form
  - exposition
    - establishes 2 keys (Tonic, followed by Dominant or Parallel)
    - presents theme(s); usually 2, with a different character
  - development and recapitulation
    - development
      - modulation, themes changed and combined in various ways
    - recapitulation
      - repetition of exposition materials in Tonic key
  - allows for endless variation of the basic pattern
- most important form of classical period (1770-1810)
  - described only in 19th century: Reicha 1826, A.B. Marx 1848
    - emphasis on thematic process
    - D'Indy (1909) describes masculine 1st and feminine 2nd theme (Cook 2000, 109)
- lots of theory (and history) surrounding sonata form, e.g. Charles Rosen, *Sonata forms* (1980)

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Positivist musicology in the 20th century

- new developments
  - lots of new theory (Schoenberg, Schenker, Forte)
  - comparative musicology → ethnomusicology
  - music sociology, psychology, cognition emerge
  - computational approaches
- ideology
  - historical musicology at the centre
  - minor disciplines around it
  - positivist ideals best exemplified by Arthur Mendel, *Evidence and explanation* (1962)
- practice
  - musicology spreads over the entire Western world
  - gradual fragmentation of the discipline
  - pop music treated as a pathological phenomenon

Outcomes of positivist musicology

- espcially after WW2, urgency was felt to preserve musical heritage
- large-scale collaborations
  - scolarly editions of major composers
    - *Neue Bach-Ausgabe* particularly impressive (1950-2007), 114 vols.
  - encyclopedias
    - *Musik in Geschichte und Gegenwart* (1949-68, revised 1994-2007)
    - *New Grove Dictionary of Music and Musicians* (1980, revised 2001)
      - accessible to subscribers through http://www.oxfordmusiconline.com/

Crisis

- Joseph Kerman, *Contemplating music: Challenges to musicology* (1985)
  - defining moment in musicology
  - *importance of subjectivity, criticism, value judgements*
- starting-point of wave of critical approaches, e.g.
  - music and meaning
  - cultural and political context of music (ethnomusicology)
  - music and identity
  - popular music studies
  - music and power
  - gender and sexuality
- 'positivist musicology' discredited
  - shown to be the product of a repressive ideology
  - loaded with implicit value judgements

Ritual murder

- remember Adler's aim:
  - discovery of thruth and advancement of the beautiful
- Susan McClary's interpretation of Beethoven's 9th symphony, 1st mvt.
  - roughly 7'00"-9'00"
  - context of sonata form
  - development -> recapitulation
  - stereotyped discourse about themes, tonality
- nearly always quoted out of context
  - a female composer searching for new ways of structuring her compositions

The point of recapitulation in the first movement of the Ninth is one of the most horrifying moments in music, as the carefully prepared cadence is frustrated, damming up energy which finally explodes in the throttling murderous rage of a rapist incapable of attaining release. (McClary 1987, revised in 1991)

 http://www.youtube.com/watch?v=3SZ9QzGg95g

Victim 1: music as autonomous art

- specific to Western culture
- related to capitalist economic model (after Cook 2000, 15)
  - production – distribution – consumption
  - composing – performing – listening/appraising
- related to bourgeois subjectivity
  - individual appreciation
  - different from public, shared expressivity of 17th-18th c. (vocal) music
- autonomy not even true for most Western music
  - primacy of text (early and religious music)
  - occasional and functional music
- instead: study of musical behaviour, distinction of *musics*

Victim 2: the work concept

- not a natural concept, but a historical phenomenon
  - Lydia Goehr, *The imaginary museum of musical works*, 1992
- creation and performance often not strongly separated
  - adaptability of music, improvisation
  - score not a full specification
  - is music an object or a process? recipe or dish?
- *contextual* determination of music (vs. authorial intention)
  - occasion, patronage, ideology, identity
  - *the music itself* becomes taboo concept
- bad fit with late 20th-21th century music culture
  - weak separation of creator and performer in most popular genres
  - strong dependence on text ('song' replaces 'work')
  - glorification of performer
  - disinterested aesthetic contemplation marginalised
    - ubiquity of music, music as commodity
    - music as expression of identity or lifestyle

New musicology

- a.k.a. critical musicology, cultural musicology
  - founded on postmodern philosophical theories
- now dominant musicological approach
  - culture, context, gender, identity…
  - *subjectivity*: disposition to engage in specific social and historical practices (Kramer 2003)

Value system of new musicology

- important
  - *subjectivity*
  - interesting, controversial ideas
  - rhetorical persuasion
  - maximise interpretation
- less important
  - *objectivity*
  - facts
  - argumentation, plausibility
  - 'incremental' research, collaboration

Example of critical musicology: mediation

- based on Antoine Hennion (2003)
- music is *mediated* through performance
  - moment when all the musical 'potential' becomes irreversibly fixed
- mediation happens in many different ways
  - stage, record, internet
- case: passage from rock to rap
  - rock stage idols lose credibility
  - rap happens where you hang out
  - function of recording changes
    - rock: recreation of performance
    - rap: cheap medium of distribution
- development in rap
  - first, escape from the big stage and media
  - later, music seized back by industry
- *domestication* of an art form

Possible postmodern answers (1)

- what is music?
  - there is no universal concept of music, only musics
- what is the basic unit of music?
  - depends on cultural context
  - defined by performance, listening
- what is a genre?
  - social construction: type of music with an audience (MIR-like!)

Possible postmodern answers (2)

- how to distinguish good from bad music?
  - by analysing the ideologies that shape the music
- what are the rules for creating good music?
  - authenticity, no such thing as 'hit song science'
- why are people moved by music?
  - association, emotion, immersion
- does music have a meaning?
  - yes; it emerges in the act of listening and depends on the listener's context and background

Summing up

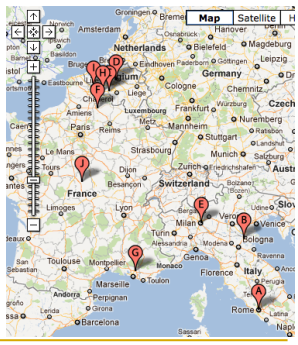
- positivist musicology
  - \+ lots of carefully collected data and facts
  - – questions of context and value evaded
  - – focus on Western classical music
- paradigm shift was inevitable
  - but it was very messy
- new musicology
  - \+ focus on all the world's musics
  - \+ context and value acknowledged
  - – weakly connected to data and facts
- today, storm is more or less over
  - but it's time for a next step
  - data-rich musicology?

Musicology in action

- case 1: Josquin
  - historical musicology: editing, works
- case 2: Alan Lomax
  - development of ethnomusicology
  - activism, sociology
- computational approaches

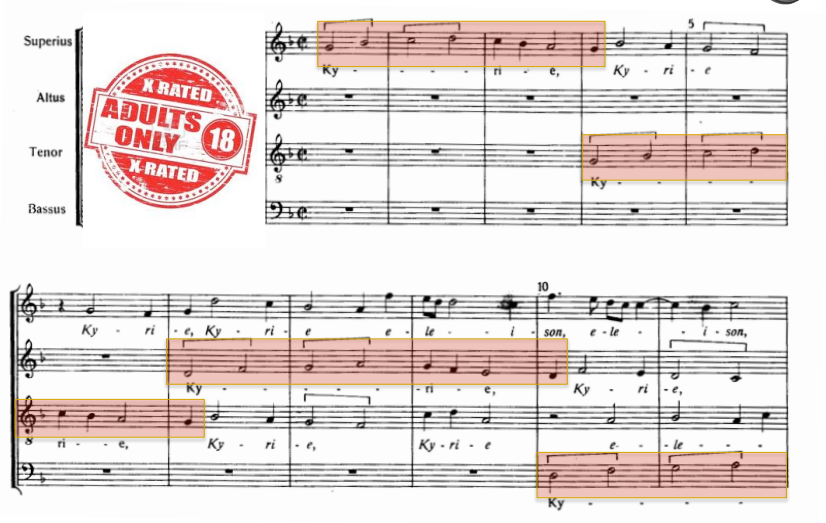
Who the hell…

- Josquin des Prez (c. 1450/55-1521)
- international career in Low Countries, France and Italy
- author of c. 150-200 compositions
- first single-author music print ever featured Josquin
  - *Misse Josquin*
  - published by Ottaviano Petrucci, 27 September 1502
- reputation of his music survived long after his death, especially in Germany
  - Josquin is the master of the notes, which must do as he wishes, while other composers must follow what the notes dictate (Martin Luther)
  - never entirely forgotten
- best known for:
  - masses, motets, chansons
  - pervading imitation



 source: http://maps.thefullwiki.org/Josquin_des_Prez

Example: Missa de Beata Virgine

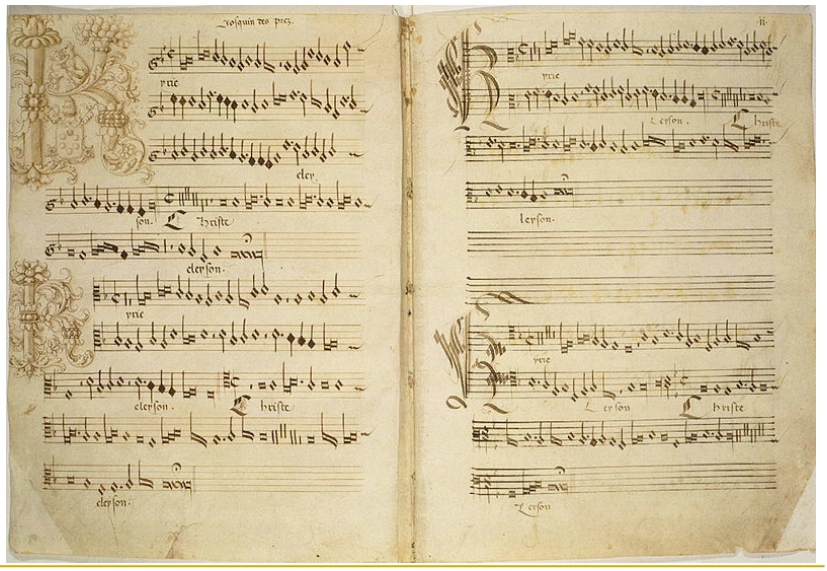


http://www.youtube.com/watch?v=QEoM08WR8Mg

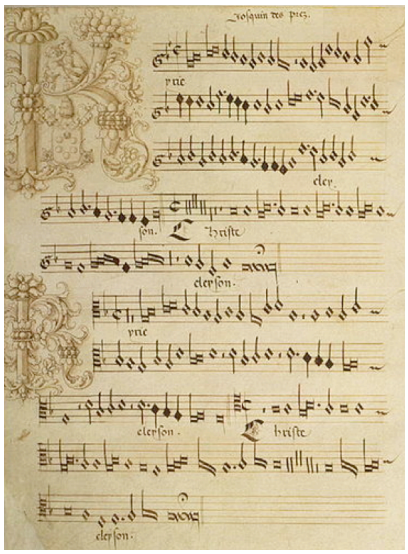
Positivist musicology and Josquin

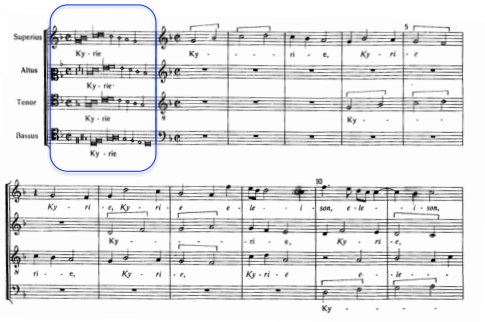
- a genius, and strongly in need of a complete edition
- first of several attempts: *Werken van Josquin des Près*, ed. A. Smijers and others (Amsterdam, 1921–69)
- how to create a body of musical works out of the surviving evidence?
- major challenges
  - dealing with the original notation
  - underspecification
  - chaos of sources
- methods developed by trial and error
  - Smijers preferred printed sources (anachronistic reasons!)
  - methods from textual philology
  - rules based on music theory of 16th century
- outcome: 'domesticated' works
  - problem—the music could be domesticated in many different ways
    - Smijers began 2nd edition already before 1st was completed

Roma, Biblioteca Apostolica Vaticana, MS Cappella Sistina 45



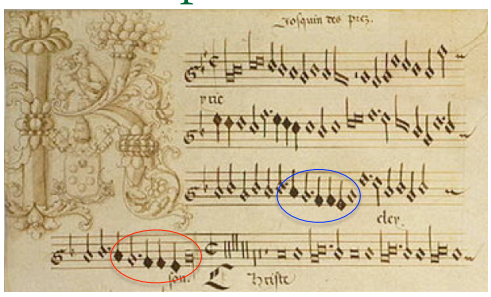
Dealing with the original notation



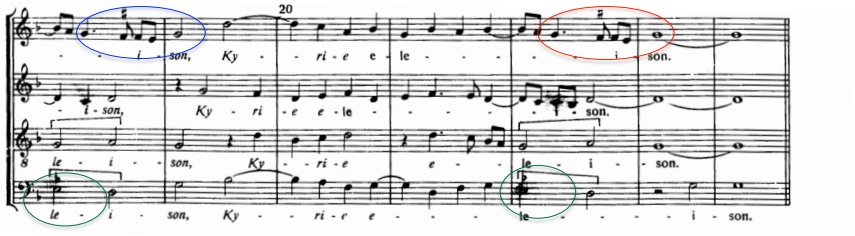


- source transcription
  - voices → score
  - modern notes, values reduced, ligatures resolved
  - clefs changed
  - bar lines added
  - *incipits*: indications of original notation
- mechanical process or interpretation?
  - source optimised for *performance practice*
  - score optimised for *work study*

Underspecification

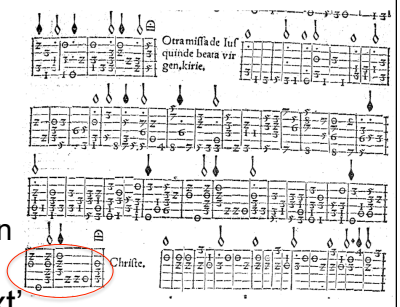


- added:
  - lots of text (*italic*)
  - editorial sharps and flats *(musica ficta)*
- additions may misrepresent fluidity of performance practice
- danger of adaptation to modern ears



Chaos of sources

- *Missa de Beata Virgine* has symphonic proportions
  - 5 movements, 30 minutes
- 69 known sources
  - 27 more or less complete
  - 13 contain 1-4 movements
  - 10 contain section of movement
  - 2 contain fragment
  - 2 music treatises contain a section
  - 15 lute intabulations of a section
- no two sources have same 'text'
  - very many variants
  - which variants represent composer's intentions?



 tablature: Diego Pisador, *Libro de música de vihuela*, 1552

Domestication

- chaos of sources is translated into oeuvre of disciplined texts
  - compositions presented as musical creations, independent of performance and function
  - variants seen as errors in transmission → corrected
  - missing information is supplied
  - rational methodology followed
  - works are made available for study and performance
- similar strategies in nearly all editorial projects of old and new music
- a process that requires lots of expertise, diligence and time
  - establishment of best possible text of work
  - musicologists care about details
  - computational methods should respect such care, otherwise they are not acceptable

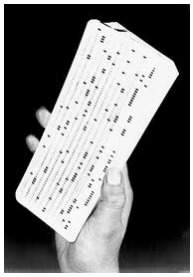
Creating discourse around Josquin

- biography
  - how many Josquins (*'Doppelmeister'*)?
  - training, employments, travels, rewards
- determining the oeuvre?
  - many works also ascribed to others
  - weak/atypical compositions
  - anonymous works possibly by Josquin
  - danger of circular reasoning
  - number of undisputed works ever decreasing
- researching the works
  - large body of stylistic/analytical literature
- outcome: Josquin canonized
- Josquin research shaped (Renaissance) musicology

portrait of Josquin(?) by Leonardo da Vinci

Josquin and MIR

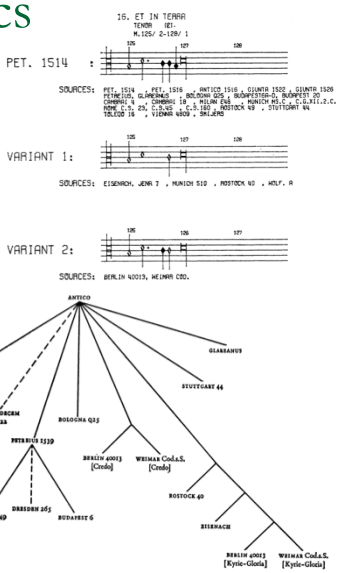
- first composer to be subjected to large-scale computational research
- all (?) works encoded in 1960s-70s for Princeton Josquin project, directed by Arthur Mendel
  - punchcards, Fast-Code
  - “simple enough to learn in five to ten minutes”
  - most encodings seem to have been lost



- applications:
  - typesetting music
  - analytical studies (e.g. dissonance treatment)
  - creating thematic indexes for searching
  - ultimate philological method: stemmatic research

Computational stemmatics

- stemmatics:
  - establish authorial text though methodic comparison of errors and variants
  - outcome: genealogical tree of source relations
- Thomas Hall (1975)
  - created software for variant detection and comparing pairs of sources
  - tested on *Missa de Beata Virgine*
  - most source relations obvious on basis computer output
  - final stemma created manually
  - ‘working on series of computer programs’



New musicology and Josquin

- how was Josquin shaped as a Beethovenian Genius
  - Paula Higgins, *The Apotheosis of Josquin des Prez and Other Mythologies of Musical Genius* (2005)
- work concept problematic
  - Josquin's 'texts' fluid in many respects
  - closely tied to tradition and performance circumstances
  - therefore, stemmatics make little sense
  - are Josquin's works best characterised as original expressions of genius?
- new edition modes needed
  - better acknowledgement of importance of variants
  - well suited for *digital critical edition*
- Computerized Mensural Music Edition (Ted Dumitrescu)
  - project *The Other Josquin*
  - compositions of "doubtful authenticity" attributed to Josquin des Prez in primary sources
  - http://www.cmme.org/

Contextualisation

- how was music domesticated in the 15th-16th century?
  - 'lasciviousness' of music; negative influence on morality
  - instrumental music particularly suspect
  - only safe to use under controlled circumstances
    - sacred texts
    - liturgical or devotional context (reflects harmony of creation)
  - emphasis on skill, not originality
- *how is music domesticated in MIR?*
  - what savage aspects of music do we prefer to ignore?

Ethnomusicology

- started as comparative musicology (Adler 1885)
  - purpose: document primitive music as a precursor of Western music
- soon becomes study of traditional music
  - e.g. because this reflects national identity
- much collecting of evidence
  - transcribe melodies in notation
  - first to work with musical audio (since c. 1900)
    - Béla Bartók, Zoltán Kodály recorded Hungarian folksongs since 1908

Ethnomusicology

- term ‘ethnomusicology’ introduced by Jaap Kunst (1950/1959)
  - study of non-Western musics for their own sake
- ethnomusicology becomes study of music in context (Merriam, *The anthropology of music*, 1964)
  - how does music interact with social practices?
  - ethnomusicological methods sometimes applied to Western music
- continuum between ‘doing’ and ‘listening’ musics (Stobart 2009)
  - Western music an extreme case of listening music
- example of doing music: jula jula (Bolivia)

Jula jula

http://www.youtube.com/watch?v=3MZpZXFA_SI&feature=related

Alan Lomax

- USA, 1915-2002
- 10000s of field recordings of traditional music since c. 1933
  - Mississippi, Texas, Louisiana
  - blues as black music
  - Italy, Spain
- recorded and interviewed legendary musicians such as Woody Guthrie, Lead Belly, Muddy Waters
- engagement
  - the folklorist's job was to link the people who were voiceless and who had no way to tell their story, with the big mainstream if musical culture
- Alan Lomax Collection now in Library of Congress
  - http://www.loc.gov/folklife/lomax/

Cover song—domestication

- many Lomax recordings covered by well-known musicians
  - field recording from 1959: http://www.youtube.com/watch?v=Ns8bum4civI
  - Ry Cooder: Jesus on the mainline http://www.youtube.com/watch?v=n2FrFBceLuY
- piece of 'doing' music becomes 'listening' music

Preserving traditions

- idea of Global Jukebox
  - database of musical diversity
  - preservation and study
  - http://www.culturalequity.org/
- Cantometrics project
  - since 1959
  - global research to relate sonic features to sociological traits through computational (statistical) analysis
  - 37 style elements (scored 1-5)
  - 400 cultures, 4000 songs
  - attained only preliminary results
    - e.g. ensemble organisation and cohesiveness/individualisation of society
  - A. Lomax, *Cantometrics: an Approach to the Anthropology of Music* (Berkeley, 1977)

Cantometrics code sheet

CODE SHEET - The Musical Situation - Source:
Group or Song: Language:

1) Vocal Gp.	1	2	3	4	5	6	7	8	9	10	11	12	13
2) Orch.Relationship	1	2	3		5	6		8	9			12	13
3) Orch. Gp.	1	2	3	4	5	6	7	8	9	10	11	12	13
4) Vocal Org.	1			4			7			10			13
5) Tonal Blend-V	1			4			7			10			13
6) Rhy. Blend - V	1			4			7			10			13
7) Orch. Org.	1			4			7			10			13
8) Tonal Blend-O	1			4			7			10			13
9) Rhy. Blend - O	1			4			7			10			13
10) Words to Non.	1			4			7			10			13

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Computational ethnomusicology

- many folk song encoding projects
  - not just Essen Folksong Collection
- digitisation of recordings
  - e.g. Onder de groene linde (Dutch folk songs)
    - http://www.liederenbank.nl/index.php?lan=en
  - Library of Congress collections
    - http://www.loc.gov/folklife/onlinecollections.html
    - includes numerous (but not all) recordings by John and Alan Lomax
  - Europeana (http://www.europeana.org)
    - links to items in national collections
    - not very user-friendly
  - not too many IP issues here
- well-established body of research into computational issues, e.g.
  - Tzanetakis et al. 2007: computational ethnomusicology
  - Kranenburg et al 2010: interdisciplinary collaboration
  - Juhász & Sipos 2010: cultural transmission
- importance of cultural context in ethnomusicology
  - MIR challenge?

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Conclusions case studies

- Josquin
  - notation orientation
  - how a work is established in scholarly editing
  - importance attached to accuracy and details
- ethnomusicology
  - audio and symbolic collections
  - doing and listening musics
    - is music a process or an object?
  - preserving traditions
  - social engagement
  - impact on contemporary culture

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Tutorial Musicology
Part 2: Music Theory

ISMIR Tutorial 2011

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Institute of Information & Computing Sciences

Universiteit Utrecht

Outline

- What is Music Theory?
- Examples
  - Theory of melody (and computational model)
  - Theory of harmony (and computational model)
  - Theory of meter (and computational model)

Music Theory: Definition

Grove Music Online (Claude Palisca)

Theory is now understood as principally the study of the **structure** of music.

This can be divided into **melody**, **rhythm**, **counterpoint**, **harmony** and **form**, but these elements are difficult to distinguish from each other and to separate from their contexts.

At a more fundamental level theory includes considerations of **tonal systems**, **scales**, **tuning**, **intervals**, **consonance**, **dissonance**, **durational proportions** and the **acoustics of pitch systems**.

Music Theory: Definition

Joseph Kerman's response: (1985)

Tuning, **rhythmic configurations**, **consonance** and **dissonance**, **chord formations** – no doubt all these fall under the capacious mantle of Palisca's term 'structure'.

When musicians use this term today, however, they generally mean the structure of total works of art – what makes **compositions** "**work**", what general principles and individual features assure the music's **continuity**, **coherence**, **organization** or **teleology**. They mean **musical form**, broadly construed to denote the shape or ordering of trains of sounds in time.

Music Theory: Definition

Joseph Kerman's response: (1985)

Theory and Analysis

It was only in the nineteenth century, then, that **theory** became wedded to **analysis**: the process of subjecting **musical masterpieces** to **technical operations**, **descriptions**, **reductions**, and demonstrations purporting to show how they 'work'. 'Theory and Analysis' became a standard joint item in the conservatory curriculum.

http://www.cam.k12.il.us/ms/6th/gillettc/ReadingManiacs.gif

Music Theory: Definition

Zbikowski: (2002)

What music theory is not:

… for music theory is, within the rolling seas of humanistic studies, a rather strange fish. Put bluntly, it is clear that much of what music theory does, as a discipline, does **not count as any sort of theory** in modern scholarship.

http://fr.toonpool.com/cartoons/THEORY%20INSURANCE%20LAB%20SCIENTIST_23447

Music Theory: Definition

Wiggins, Muellensiefen, Pearce: (2010)

What music theory is not:

… it is important to acknowledge the difference between the meanings of the word "theory" as applied in "**music theory**" and, on the other hand, in "**scientific theory**"

… instead:

Music theory … is a collection of **sets of rules** which describe the culturally determined practice of people who create music in a particular culture during a particular period. … music theorists readily acknowledge **exceptions to their rules**

Music Theory: Definition

Focused on One single piece of music:

Kerman: (1985)

For it the musicologists' characteristic failure is superficiality, that of the analysts is **myopia**. Their dogged concentration on **internal relationships** within the **single work** of art is ultimately subversive as far as any reasonably complete view of music is concerned.

http://www.thenewtasman.com/

Zbikowski: (2002)

… music theory continues to focus on details of musical discourse with an obsessiveness that is both maddening and quixotic to cultural and social theorists

Music Theory: Definition

Zbikowski: (2002)

What music theory could be:

… for **theories** are the **cognitive tools** that guide the way we reason about the things we experience. … Theories are the basic means by which we make our experience coherent and guide further action. …

I want to argue, that **music theory**, in all its diverse forms, reflects the same **basic processes** that guide our understanding of the everyday world. Theorizing about music is an activity specialized only in its domain, not in the cognitive processes involved.

Music Theory: Definition

Agawu: (2009)

What music analysis could be:

An analyst's fondest hope is that something he or she says **sends the reader/listener back** to a particular composition or to a particular moment within it. Our theoretical scaffoldings are useless abstractions if they do not achieve something like this; …

Therefore, I retain some hope in the possibility that the analytical fantasies gathered here will **inspire some readers to reach for the works again**; to see if their **previous hearings have been altered**, enhanced, or challenged in any way

Music Theory: Why care?

Grachten, Arcos & Mantaras:
Melody Retrieval using the Implication/Realization Model

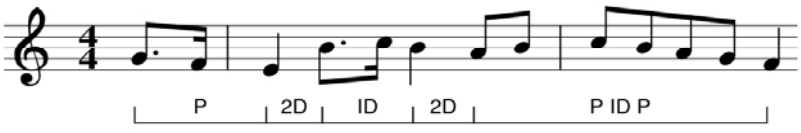
Winner of 2005 MIREX competition on melodic similarity

Based on Eugene Narmour's Implication-Realization-Model

Music Theory: Why care?

Grachten, Arcos & Mantaras: Melody Retrieval using the Implication/Realization Model

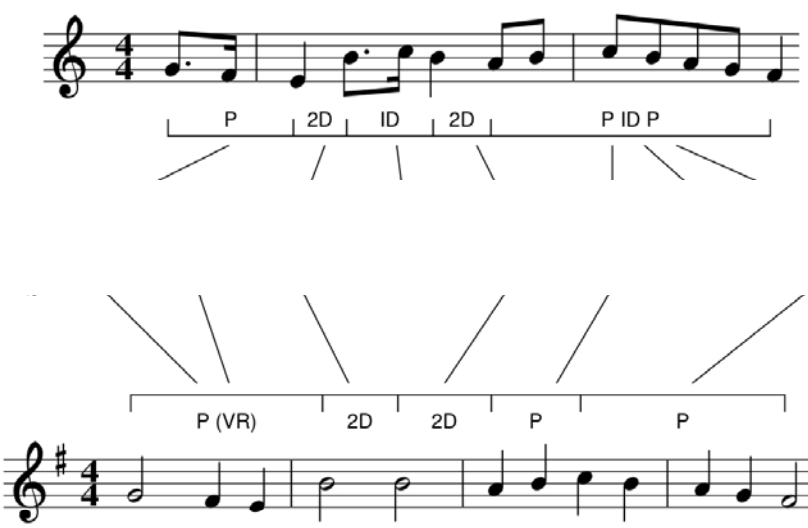
Parse melodies to obtain I-R Analyses:



Music Theory: Why care?

Grachten, Arcos & Mantaras: Melody Retrieval using the Implication/Realization Model

Edit-Distance on I-R-analyses

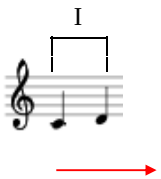


Outline

- What is Music Theory?
- Examples
  - Theory of melody (and computational model)
  - Theory of harmony (and computational model)
  - Theory of meter (and computational model)

Melody: I-R-Model

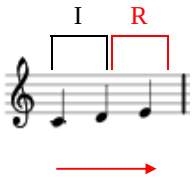
Implication: 2 dimensions: interval size and direction



I = Implication
R = Realization

Melody: I-R-Model

Implication: 2 dimensions: interval size and direction



I = Implication
R = Realization

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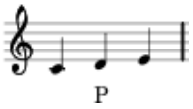
Melody: I-R-Model

Expectations: influenced by Gestalt principles of proximity, similarity and good continuation

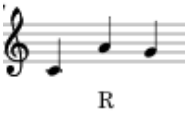
small melodic intervals imply a process P:

realized interval is in the same direction and is of similar size



large melodic intervals imply a reversal R:

realized interval is in a different direction and is smaller in size



Melody: I-R-Model

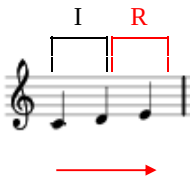
Definitions

Intervall size:
small interval: size <=P4 (perfect fourth)
large interval: size >= P5 (perfect fifth)
Tritone: ambiguous, depends on context

Intervallic difference:
equal: =
similar: diff <=M3,m3 (major, minor third)
different: diff >M3,m3

I-R-Model: Melodic Archetypes

Implication: 2 dimensions: interval size and direction



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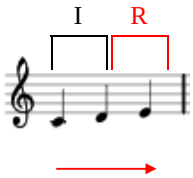
I-R-Model: Melodic Archetypes

Implication: 2 dimensions: interval size and direction



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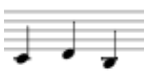

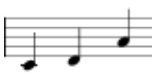

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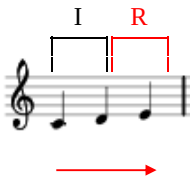
I-R-Model: Melodic Archetypes

Implication: 2 dimensions: interval size and direction



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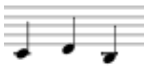

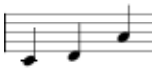

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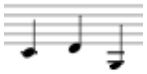

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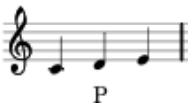
I-R-Model: Melodic Archetypes

Derivatives of Process



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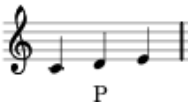
I-R-Model: Melodic Archetypes

Derivatives of Process

Derivatives of Reversal



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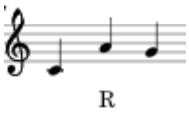
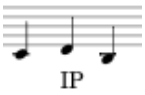
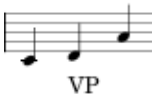


Intervallic Process

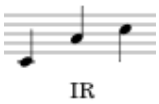


Registral Process

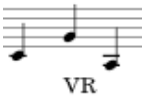


partially realized:
prospective

Intervallic Reversal



Registral Reversal



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I-R-Model: Melodic Archetypes

Derivatives of Process

Derivatives of Reversal

completely realized

P

R

Intervallic Process

Registral Process

Intervallic Reversal

Registral Reversal

partially realized:
prospective

IP

VP

IR

VR

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I-R-Model: Melodic Archetypes

Derivatives of Process

Derivatives of Reversal

(P)

Intervallic Process *Registral Process*

(IP) (VP)

(R)

Intervallic Reversal *Registral Reversal*

(IR) (VR)

I-R-Model: Melodic Archetypes

Derivatives of Process

Derivatives of Reversal

completely denied

(P)

Intervallic Process *Registral Process*

(IP) (VP)

(R)

Intervallic Reversal *Registral Reversal*

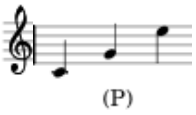
(IR) (VR)

Retrospective

x → (x): the same directional characteristics, differ from their counterpart in the size of their antecedent interval

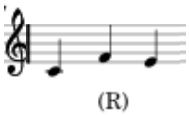
I-R-Model: Melodic Archetypes

Derivatives of Process

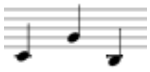


completely denied

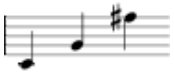
Derivatives of Reversal



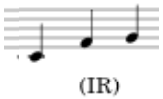
Intervallic Process



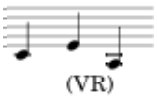
Registral Process



Intervallic Reversal



Registral Reversal



Retrospective

x → (x): the same directional characteristics, differ from their counterpart in the size of their antecedent interval

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I-R-Model: Melodic Archetypes

Category	Structure	Intervals				Direction
		Ant	Con	Ant-Con		
Processes	P	sm	sm	sim	(</= m3)	contin
	(P)	la	la	sim	(</= m3)	contin
	IP	sm	sm	sim	(</= M2)	change
	(IP)	la	la	sim	(</= M2)	change
	VP	sm	la	dif	(>/= M3)	contin
	(VP)	la	v.la	dif	(>/= M3)	contin
Dupli-cations	D	uni	uni	=	(= P1)	contin
	(D)	uni	uni	=	(= P1)	contin
	ID	sm	sm	=	(= P1)	change
	(ID)	la	la	=	(= P1)	change
Reversals	R	la	sm	dif	(>/= m3)	change
	(R)	sm	v.sm	dif	(>/= m3)	change
	IR	la	sm	dif	(>/= M3)	contin
	(IR)	sm	v.sm	dif	(>/= M3)	contin
	VR	la	v.la	dif	(>/= m3)	change
	(VR)	sm	la	dif	(>/= m3)	change

Matthew S. Royal, Music Theory Online, Vol. 1, No. 6, 1995

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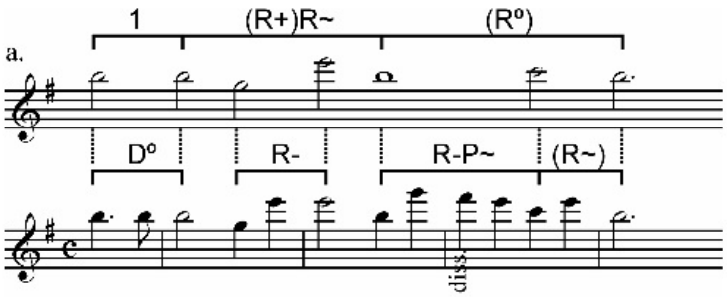
I-R-Model: Closure

With respect to the main concerns of musicology and music theory, I-R's most important contribution is **not expectation** but **closure**; closure, for example, is the concept that allows I-R to generate the reductive analyses so important in music-theoretical discourse

(A. Cramer: Beyond Expectation in the Analysis of Melody, ICMPC 2004)



I-R-Model:

"The Analysis and Cognition of Basic Melodic Structures"
Eugene Narmour, 1990
University Chicago Press

http://www.writeawriting.com/academic-writing/how-to-write-book-review/

Review of "The Analysis and Cognition of Basic Melodic Structures" and "The Analysis and Cognition of Melodic Complexity" by Eugene Narmour

Matthew S. Royal, Music Theory Online, Vol. 1, No. 6, 1995

http://free-clipart-of.com/FreeBookClipart.html

M. Pearce, G. Wiggins: "Expectation in Melody: The Influence of Context and Learning" *Music Perception*, Vol 23, 2006, pp 377-405

Outline

- What is Music Theory?
- Examples
  - Theory of melody (and computational model)
  - Theory of harmony (and computational model)
  - Theory of meter (and computational model)

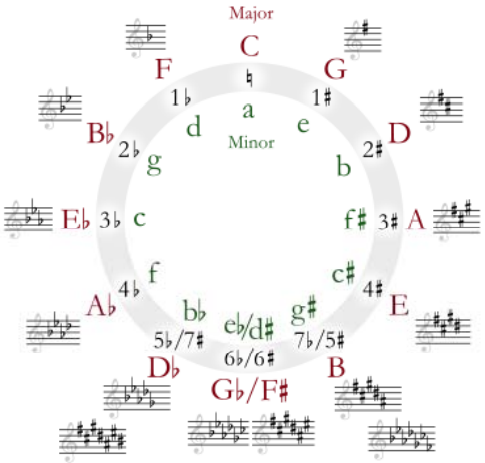
Fred Lerdahl: Tonal Pitch Space

- Tonal organization
- Distances between chords

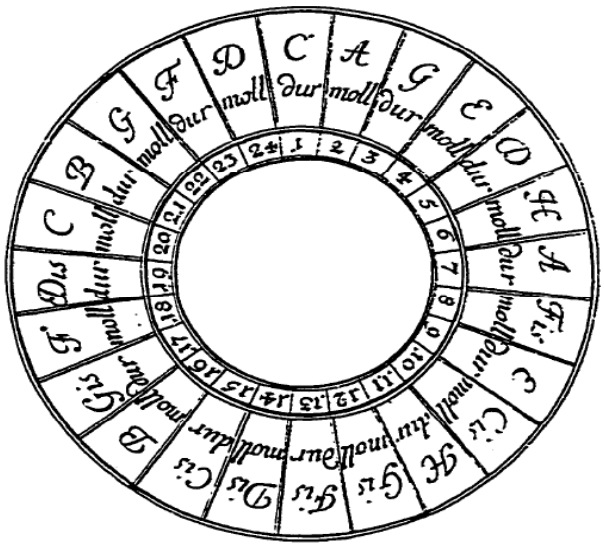
What is tonality?

- System for interpreting pitches or chords through their relationship to a reference pitch, dubbed the *tonic* (Huron, 2006, p. 143)

Tonal distances: Circle of Fifths

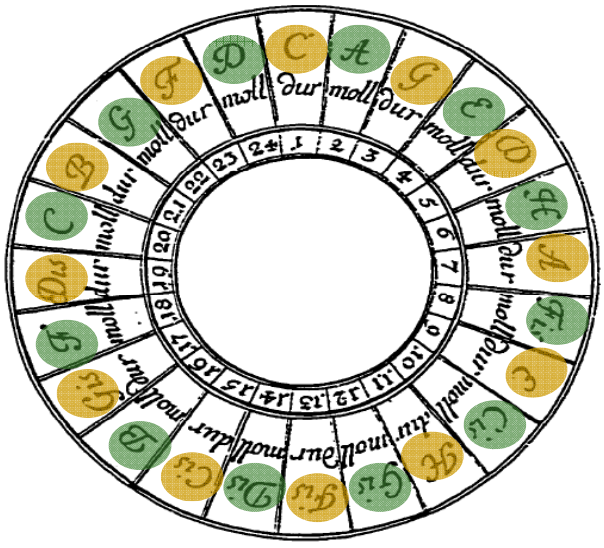


Tonal distances: Circle of Fifths



David Heinichen: Musicalischer Circul (1728)

Tonal distances: Circle of Fifths

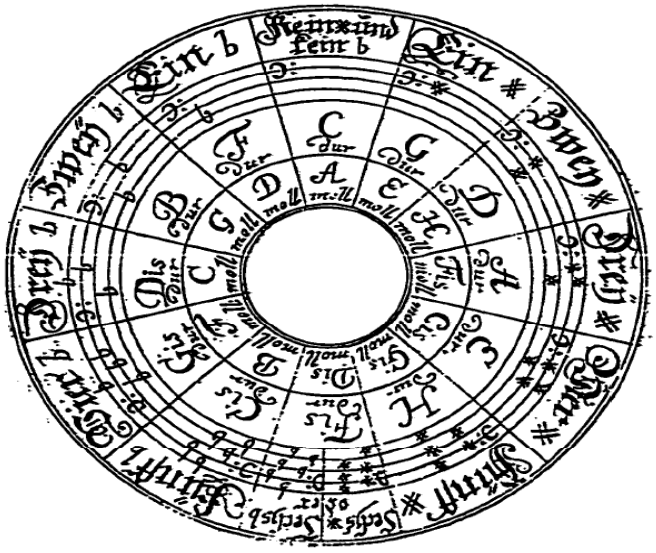


Major

Minor

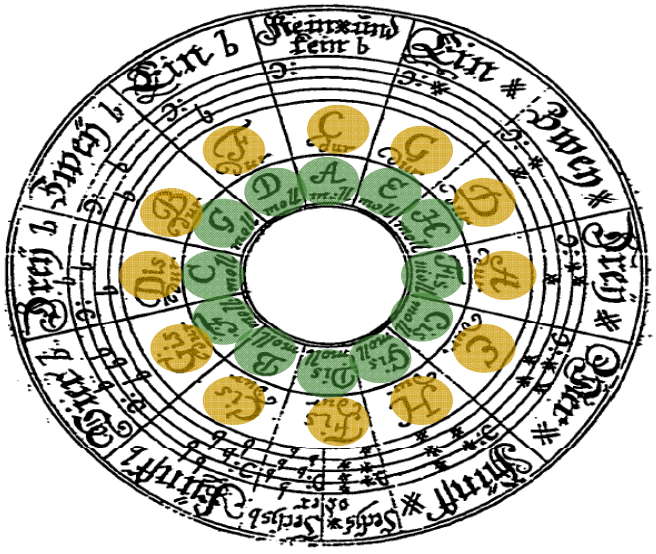
David Heinichen: Musicalischer Circul (1728)

Tonal distances: Circle of Fifths



David Kellner: Circul (1737)

Tonal distances: Circle of Fifths



Major

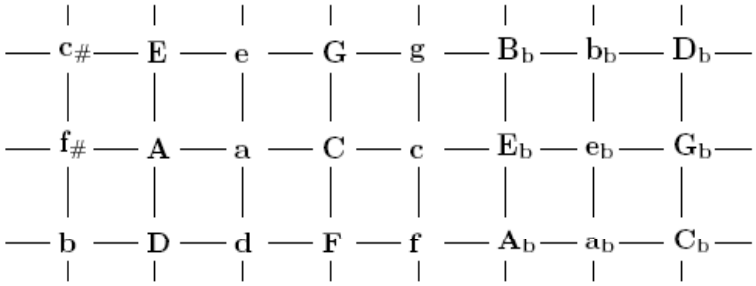
Minor

David Kellner: Circul (1737)

Circle of Fifths: modern approach

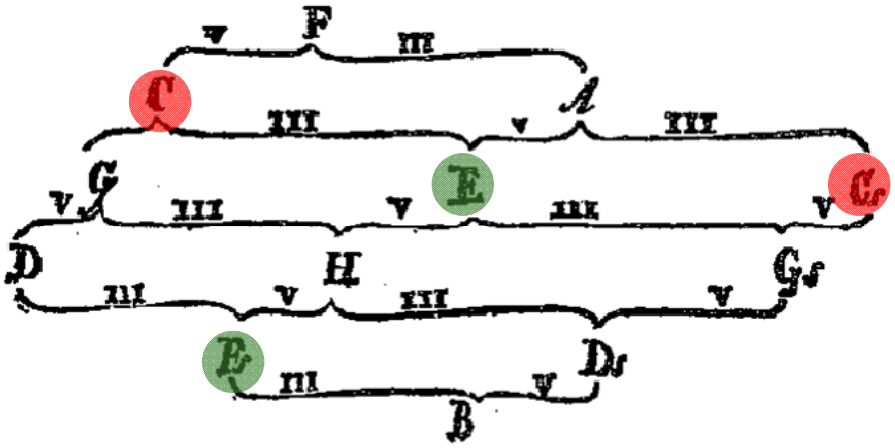
http://www.youtube.com/watch?v=EadPQxdmBlA

Chordal space



Gottfried Weber

Tonal distances: Tonnetz



Leonhard Euler: ***Tentamen novae theoriae musicae*** (1739)

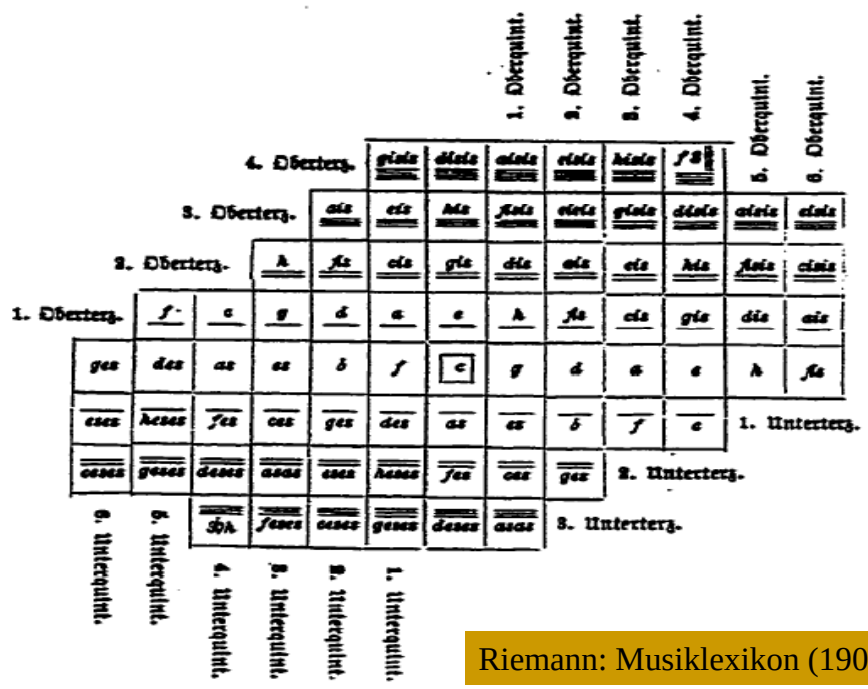
Tonal distances: Tonnetz

5^{m} 3^{n}

n:	−8	−7	−6	−5	−4	−3	−2	−1	0	1	2	3	4	5	6	7	8
m 2	c	g	d	a	e	h	fis	cis	gis	dis	ais	eis	his	fisis	cisis	gisis	disis
1	as	es	b	f	c	g	d	a	e	h	fis	cis	gis	dis	ais	eis	his
0	fes	ces	ges	des	as	es	b	f	c	g	d	a	e	h	fis	cis	gis
−1	deses	asas	eses	bb	fes	ces	ges	des	as	es	b	f	c	g	d	a	e
−2	bbb	feses	ceses	geses	deses	asas	eses	bb	fes	ces	ges	des	as	es	b	f	c

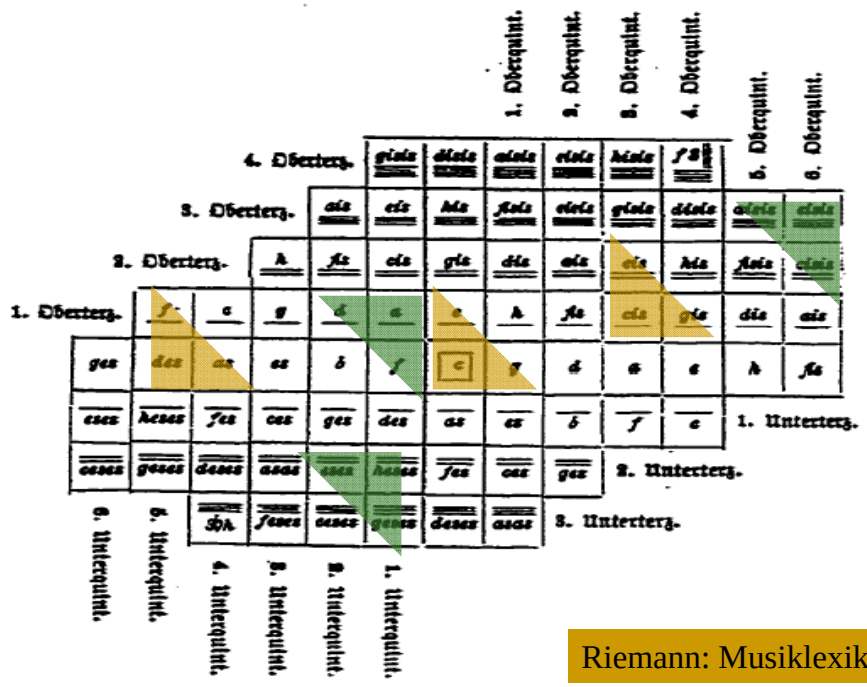
Oettingen: Harmoniesystem in dualer Entwickelung (1866)

Tonal distances: Tonnetz



Riemann: Musiklexikon (1900)

Tonal distances: Tonnetz

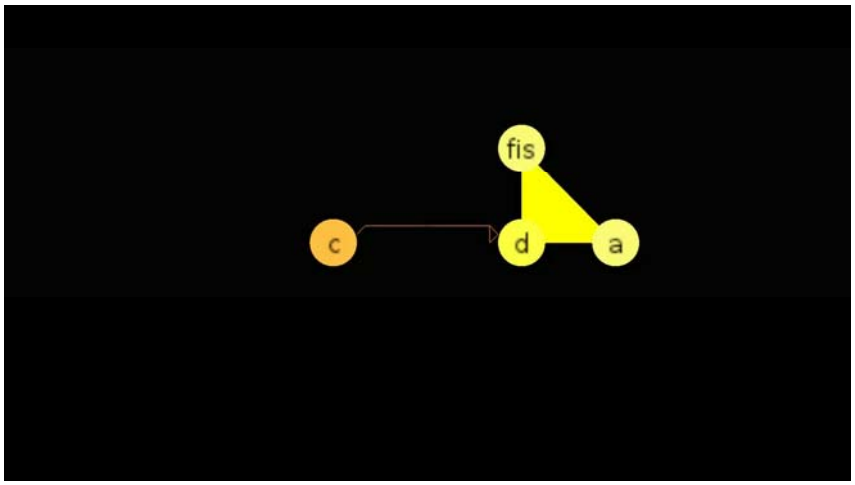


Major chord

Minor chord

Riemann: Musiklexikon (1900)

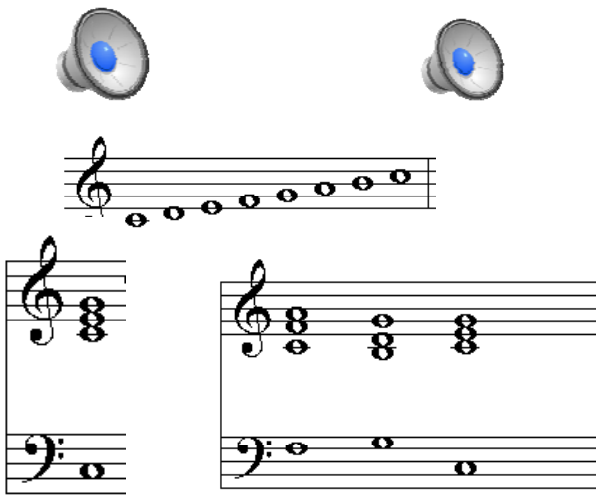
Tonnetz: Modern approach

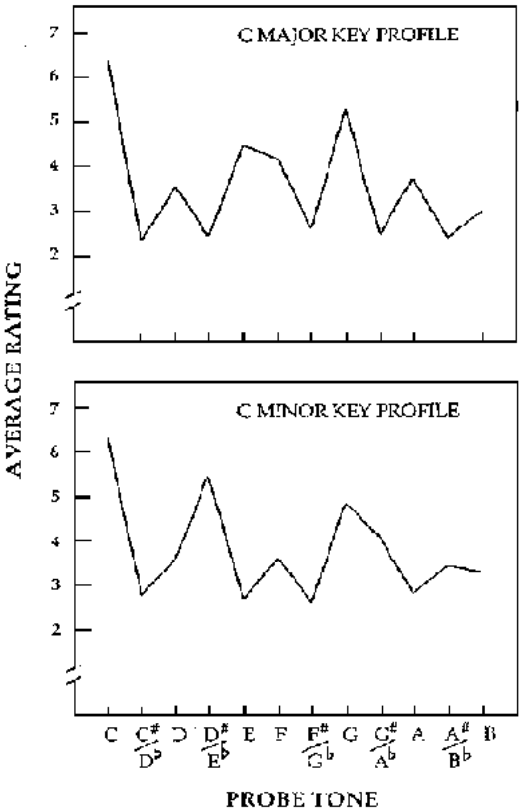


Felix Mendelssohn-Bartholdy: Paulus

http://www.youtube.com/watch?v=7nZ5h_0DTj4

Tonal distances





Carol Krumhansl:
Cognitive Foundations of Musical Pitch, 1990

Lerdahl: Tonal Pitch Space

(a)	octave (root) level:	0												(0)
(b)	fifths level:	0							7					(0)
(c)	triadic (chord) level:	0				4			7					(0)
(d)	diatonic level:	0		2		4	5		7		9		11	(0)
(e)	chromatic level:	0	1	2	3	4	5	6	7	8	9	10	11	(0)
		C	C#	D	Eb	E	F	F#	G	G#	A	Bb	B	(C)

Basic space of tonic chord in C-Major

Distance between chords (within region)

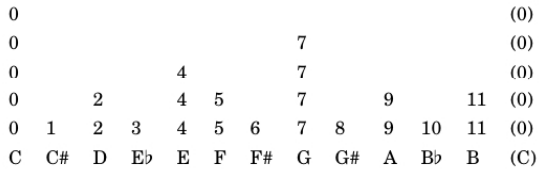
CHORD DISTANCE RULE: $d(x, y) = j+k$, where $d(x, y)$ is the distance between chord x and chord y. j is the minimal number of applications of the Circle-of-fifths rule in one direction needed to shift x into y. k is the number of distinctive pitch classes in the levels (a-d) within the basic space of y compared to those in the basic space of x. A pitch class is distinctive if it is present in the basic space of y but not in the basic space of x.

CIRCLE-OF-FIFTHS RULE: move the levels (a-c) four steps to the right or four steps to the left (modulo 7) on level d. If the chord root is non-diatonic j receives the maximum penalty of 3.

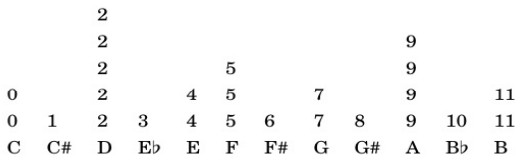
Distance between chords (short version):
Number of distinct pitch classes + Number of diatonic fifth intervals between root

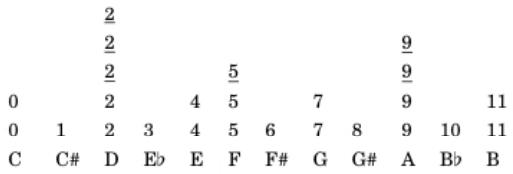
Distance between chords (within region)

C major



D minor

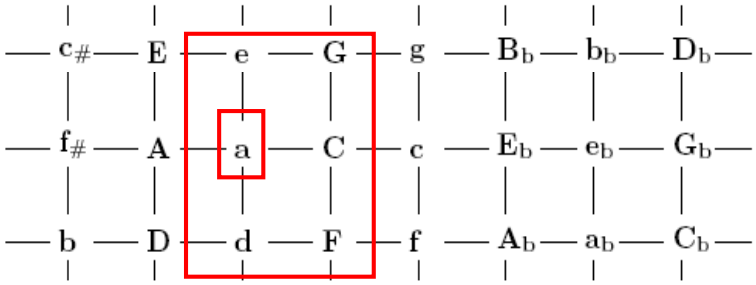


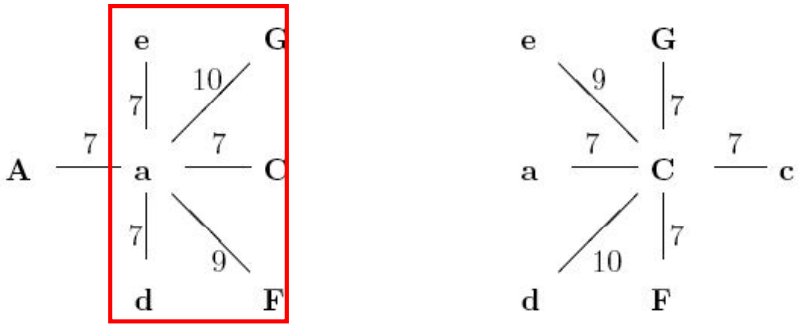


d(x,y) = k+j = 6+2 = 8

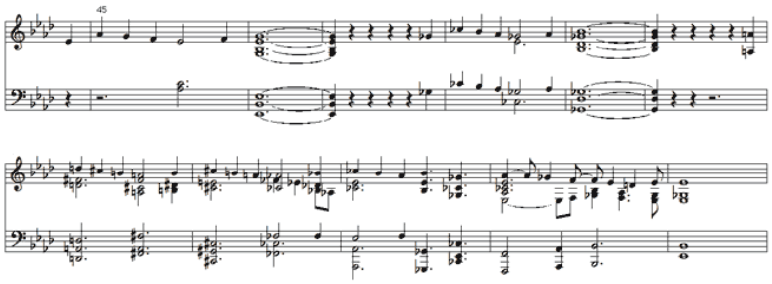
Example: distance C-major and D minor chord in C-major

Distance between chords (across regions)





Principle of the shortest path



Wagner: Parsifal bars 45-55
(Thomas Noll: Review of Tonal Pitch Space, ZGMTH, 2005)

In order to make a clear balance, we first make the following observation: The devitions between the para-pseudo-distance τ_{168} and the pseudo-distance δ_{168} are not relevant in this particular example, as there are not transitions in the chord-sequence where such deviations occur. After reduction to the distance δ_{108} the number of possible pathways reduces to $4^7 \cdot 3^4 \cdot 2^1 = 2.654.208$. Lerdahl's analysis leads to a path length 99. There are 4676 paths with the same length. Furthermore, there are 8327 paths with lengths shorter than 99 and thus representing better analyses in sense of Lerdahl's theoretical approach. There are 22 analyses representing shortest possible paths of length 89:

Noll & Garbers (2004) Harmonic Path Analysis

Problem:
too many paths of same length

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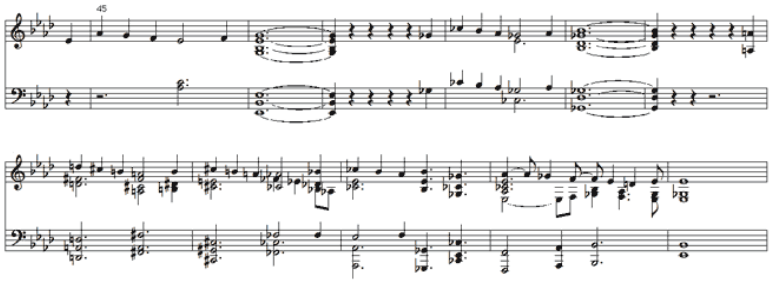
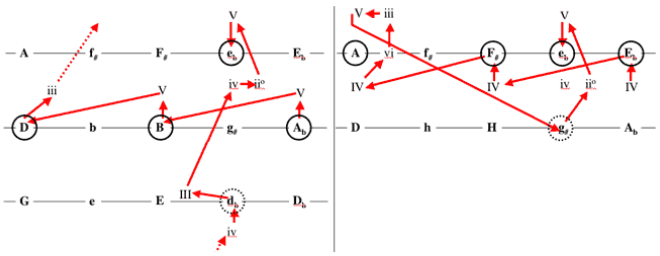
Principle of the shortest path



Wagner: Parsifal bars 45-55
(Thomas Noll: review TPS, 2008)

Lerdahl



Cohn

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Tonal Pitch Space: Critique

Emmanuel Bigand and Richard Parncutt:
Perceiving musical tension in long chord sequences
Psychological Research (1999) 62: 237-254

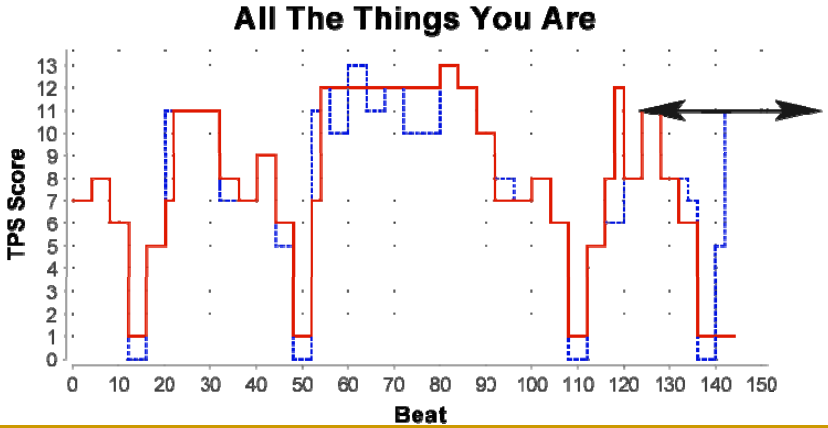
By reacting to these **local structures**, tension ratings fit quite well with a hierarchic model, even though the participants were relatively insensitive to the **global structure** of the pieces

TPS: Application in MIR

Bas de Haas, Remco C. Veltkamp, Frans Wiering:

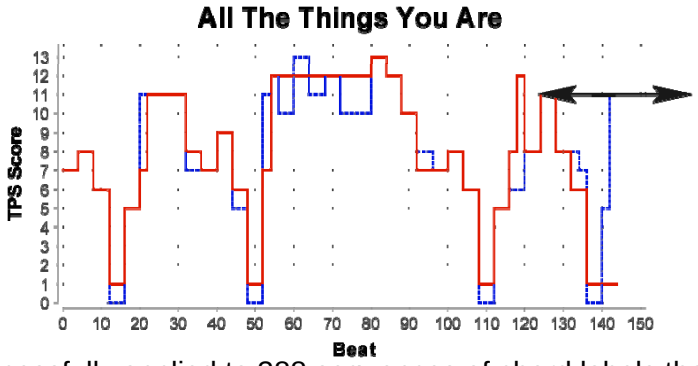
Tonal Pitch Step Distance: A Similarity Measure For Chord Progressions

ISMIR proceedings 2008



Tonal Pitch Step Distance (TPSD)

- Graph shows distance to the tonic
- Shift the graphs minimizing the area between them
- Size-of-area / length-of-shortest-song = distance

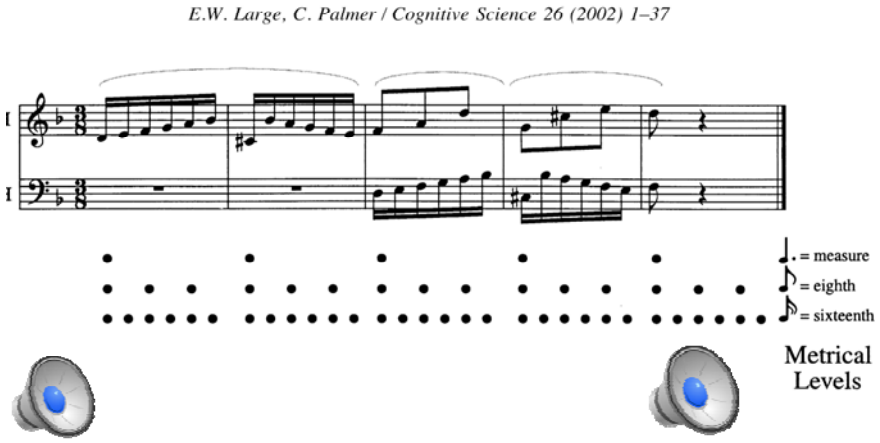


- Successfully applied to 388 sequences of chord labels that describe the chords of 242 jazz standards found in the Real Book

Outline

- What is Music Theory?
- Examples
  - Theory of melody (and computational model)
  - Theory of harmony (and computational model)
  - Theory of meter (and computational model)

Yeston/Krebs/Lerdahl & Jackendoff

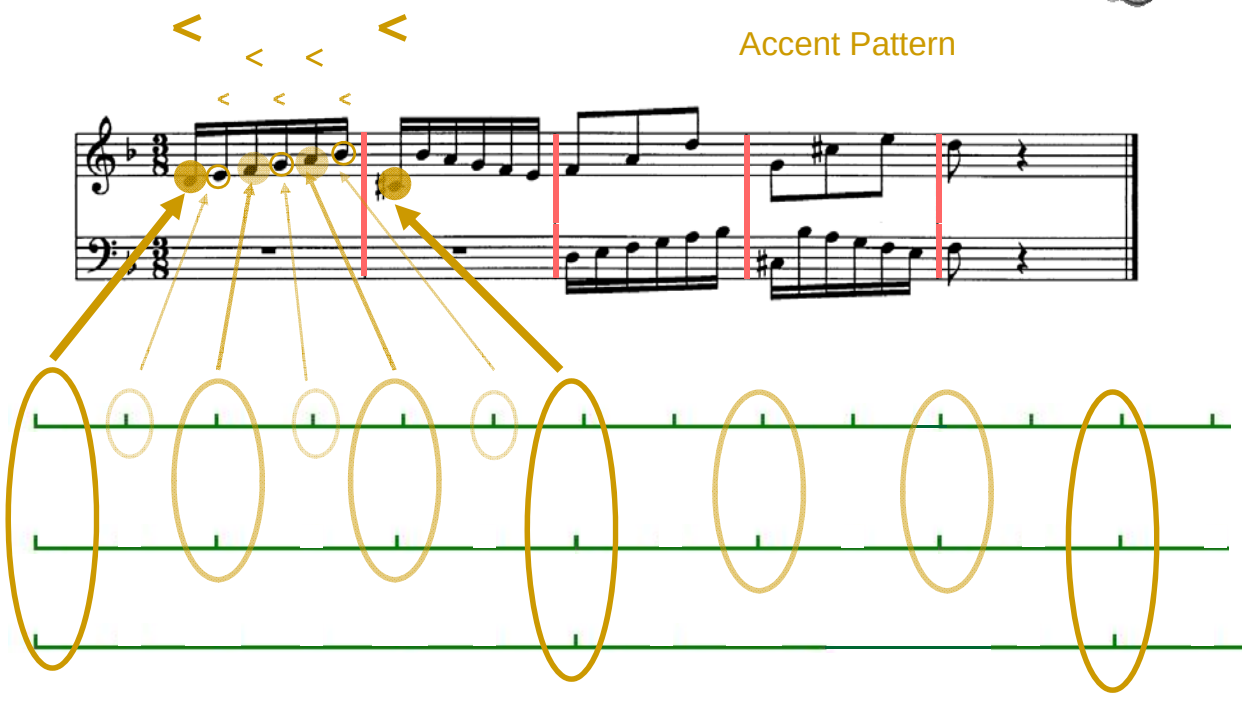


I define the meter of a work as the union of all layers of motion (i.e., series of regularly recurring pulses) active within it.

Harald Krebs

Universiteit Utrecht

Rhythm: Meter



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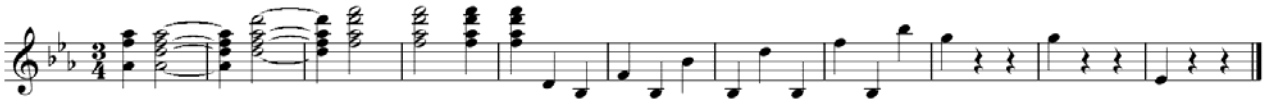
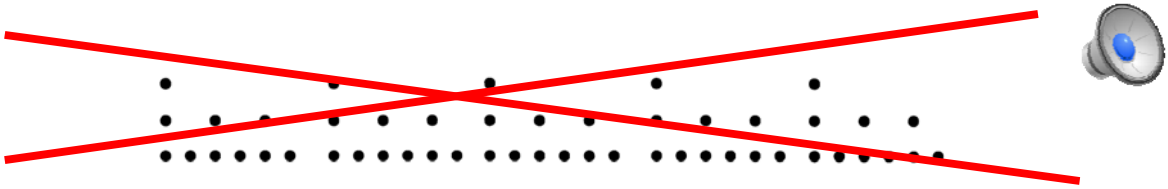
Yeston/Krebs/Lerdahl & Jackendoff



Harald Krebs: Beethoven's Eroica



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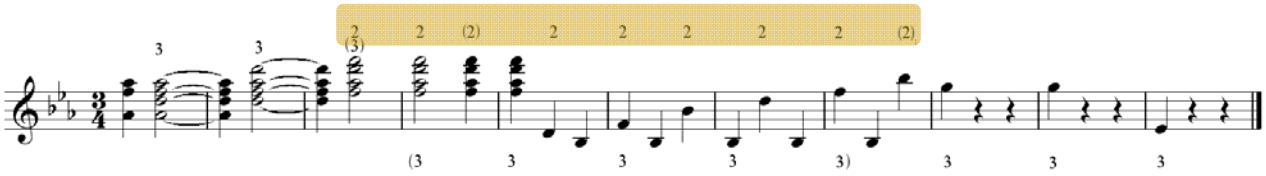
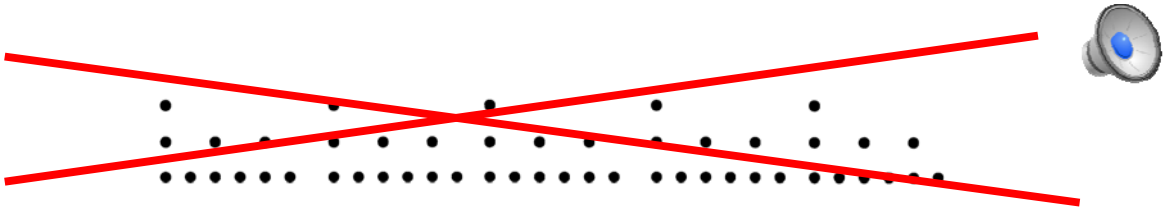
Yeston/Krebs/Lerdahl & Jackendoff



Harald Krebs



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Inner Metric Analysis

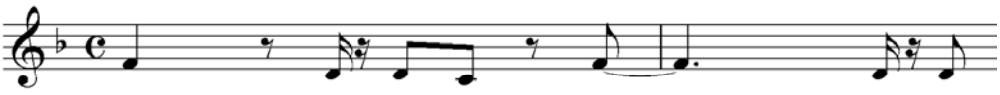
Metric Weight

I define the meter of a work as the union of all layers of motion (i.e., series of regularly recurring pulses) active within it.

Harald Krebs

Inner Metric Analysis

Metric Weight



Picture from www.ritzenhoff.de

Anja Volk, *Persistence and Change: Local and Global Components of Metre Induction using Inner Metric Analysis,* In: Journal of Mathematics and Computation in Music, 2008

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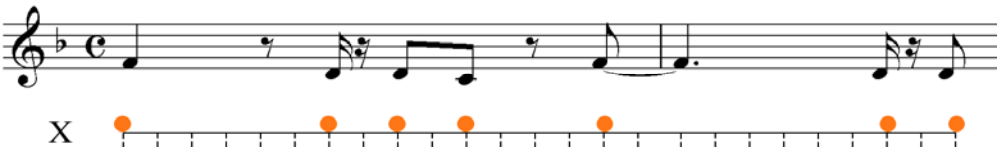
Inner Metric Analysis

Metric Weight



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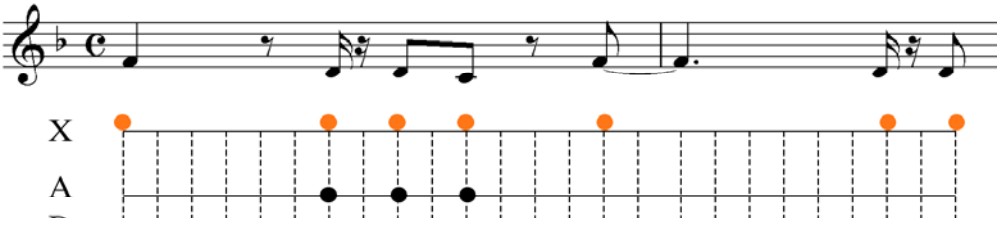
Inner Metric Analysis

Metric Weight



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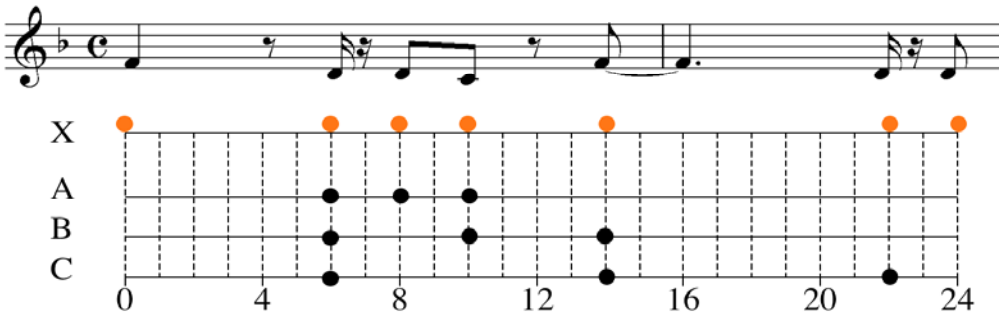

Inner Metric Analysis

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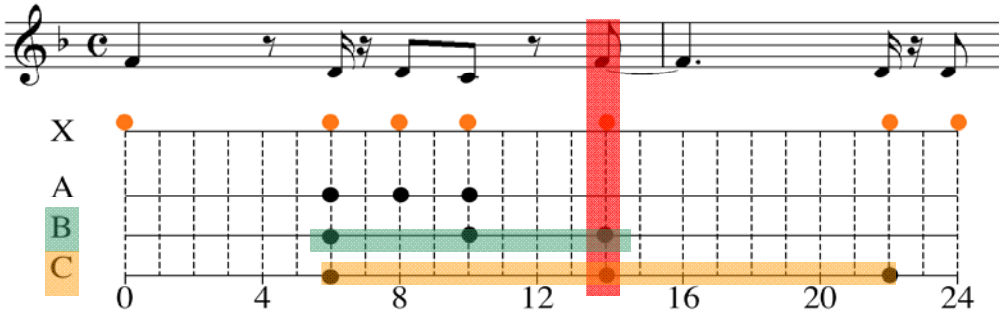
Picture from www.ritzenhoff.de



Anja Volk, *Persistence and Change: Local and Global Components of Metre Induction using Inner Metric Analysis,* In: Journal of Mathematics and Computation in Music, 2008

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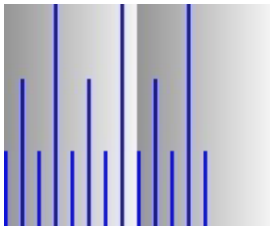
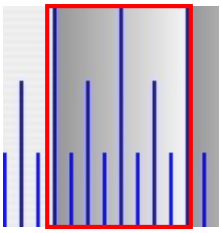
Inner Metric Analysis

Metric Weight

Picture from www.ritzenhoff.de





Anja Volk, *Persistence and Change: Local and Global Components of Metre Induction using Inner Metric Analysis,* In: Journal of Mathematics and Computation in Music, 2008

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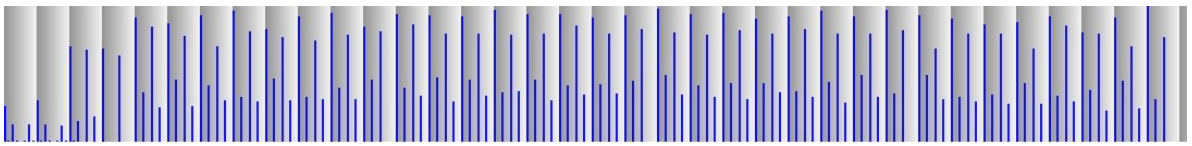
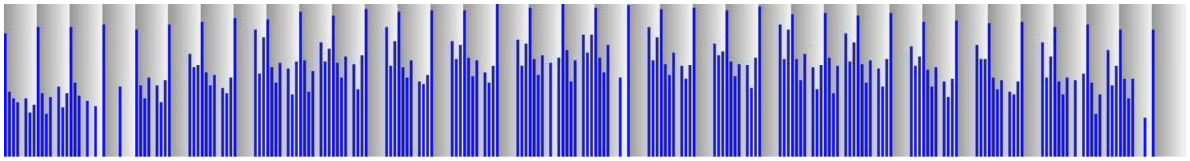
Inner Metric Analysis

- Ragtime



left hand



right hand

Anja Volk, *The Study of Syncopation using Inner Metric Analysis: Linking Theoretical and Experimental Analysis of Metre in Music,* In: Journal of New Music Research, 2008

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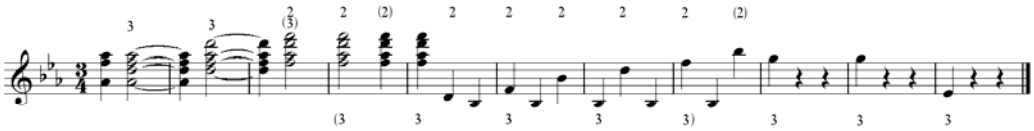
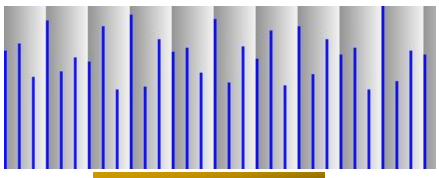
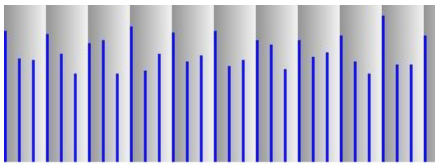


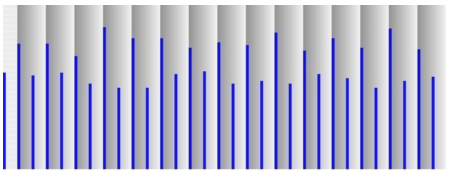
Harald Krebs



Weight profile



Weight profile without local meters of period 2



Weight profile without local meters of period 3

Anja Volk, *The Study of Syncopation using Inner Metric Analysis: Linking Theoretical and Experimental Analysis of Metre in Music,* In: Journal of New Music Research, 2008

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Similarity based on IMA

Elaine Chew, Anja Volk (Fleischer) and Chia-Ying Lee

Dance Music Classification using Inner Metric Analysis

A Computational Approach and Case Study Using 101 Latin American Dances and National Anthems

all in 4/4!

Merengue

BossaNova

Tango

Rumba

March/Anthem

Picture from www.mondolatino.it

Picture from www.ritzenhoff.de

icture from www.accomodationbsas.co.ar

Picture from www.armygermany.com

Picture from www.danceuniverse.co.kr

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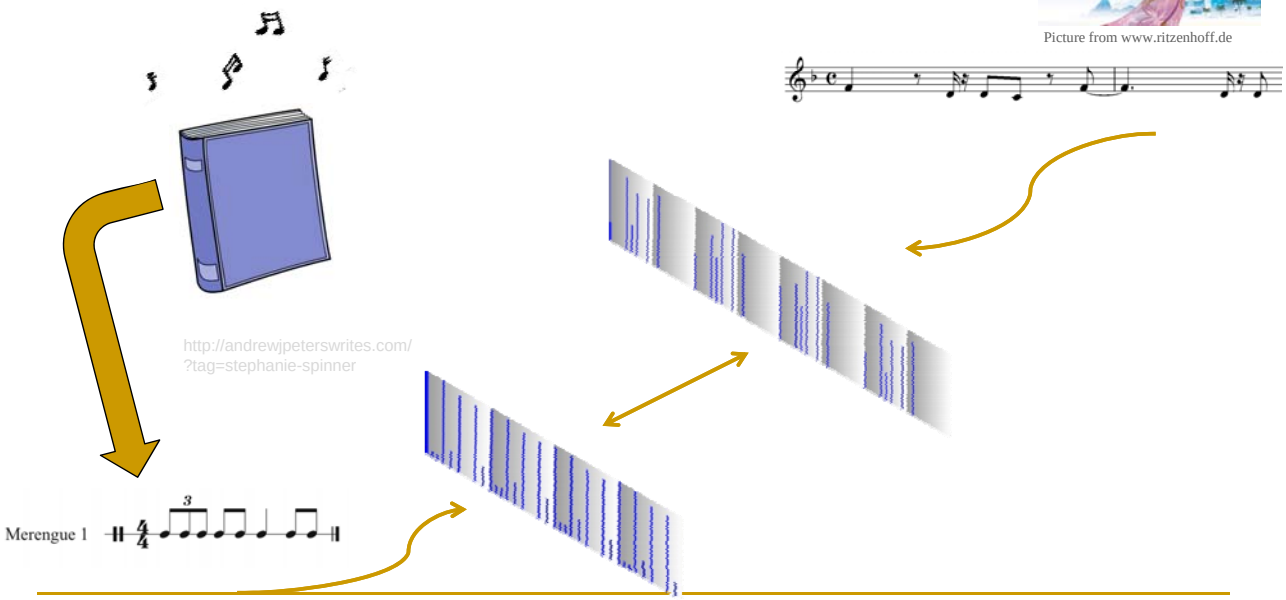
Classification

Complete Book of the Worlds' Dance Rhythm

Picture from www.ritzenhoff.de



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Similarity based on IMA

Elaine Chew, Anja Volk (Fleischer) and Chia-Ying Lee

Dance Music Classification using Inner Metric Analysis

A Computational Approach and Case Study Using 101 Latin American Dances and National Anthems

	B2	R3	B1	T1	R1	M2	M1	T2	R2	A
metric wt	0.62	0.55	0.49	0.41	0.36	0.34	0.34	0.31	0.31	0.26
spectral wt	0.62	0.61	0.44	0.33	0.37	0.45	0.54	0.31	0.31	0.30

Merengue

BossaNova

Tango

Rumba

March/Anthem

Picture from www.mondolatino.it

Picture from www.armygermany.com

icture from www.accomodationbsas.co.ar

Picture from www.ritzenhoff.de

80 % correct

Picture from www.danceuniverse.co.kr

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Summary: Why care about Music Theory?

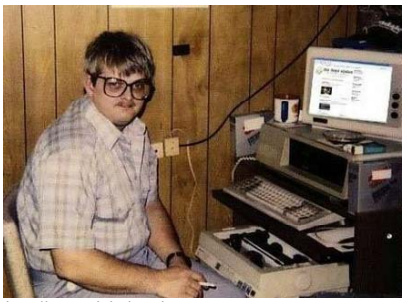
http://www.globalnerdy.com

?

http://www.info.music.indiana.edu/

- Might provide surprising insights into music
  - Even though formalization is often not the strength of music theory
- Lots of analyzed music
  - rich source of interesting musical examples
- Theories often not large-scale tested, but example-based
  - Possible contribution of MIR: data-rich approach

Interdisciplinary discourse



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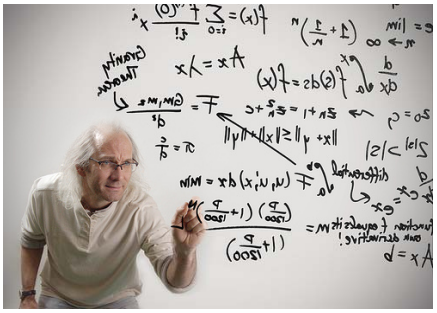

http://withfriendship.com/user/Athiv/mathematician.php

About intertwining of musicology and computing:

Achievements …
Failures …
Challenges …
Perspectives …

… of mathematical and computational approaches to music research

Alan Marsden
Guerino Mazzola
Geraint Wiggins

Guest Editors:
Anja Volk and Aline Honingh

Panel discussion MCM 2011, IRCAM, Paris: Bridging the Gap

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Tutorial Musicology
Part 3: Music Similarity

ISMIR 2011

Anja Volk & Frans Wiering, ICS, Utrecht University

Institute of Information & Computing Sciences

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Music Similarity

ISMIR 2000:

Byrd, Crawford, and Larson: “Lecture, Recital, Discussion, and Survey” session on **music similarity**

ISMIR 2009:

Downie, Byrd, Crawford: The “**similarity problem**” remains a huge challenge, not least because of the difficulty of establishing “ground-truth” in this subjective area

Musicology: Similarity

Oxford Music Online: subject entry: similarity

no result

Music similarity no research subject per se
(other than: tonality, rhythm, sonata form …)

Musicology: Similarity

Yet: many topics inherently linked to music similarity

- musical style, “early” Schubert vs. “late” Schubert
- typical harmonic chord progression
- sonata form (first and section thematic section, study of derivatives)
- study of “prototypical patterns”

no explicit model

http://weirdo-from-nowhere.blogspot.com

Musicology: Similarity

Most prominent examples of similarity studies

- Tune family
- Motivic-thematic relationships in Classical Western music

Musicology: Similarity

Most prominent examples of similarity studies

- Tune family
- Motivic-thematic relationships in Classical Western music

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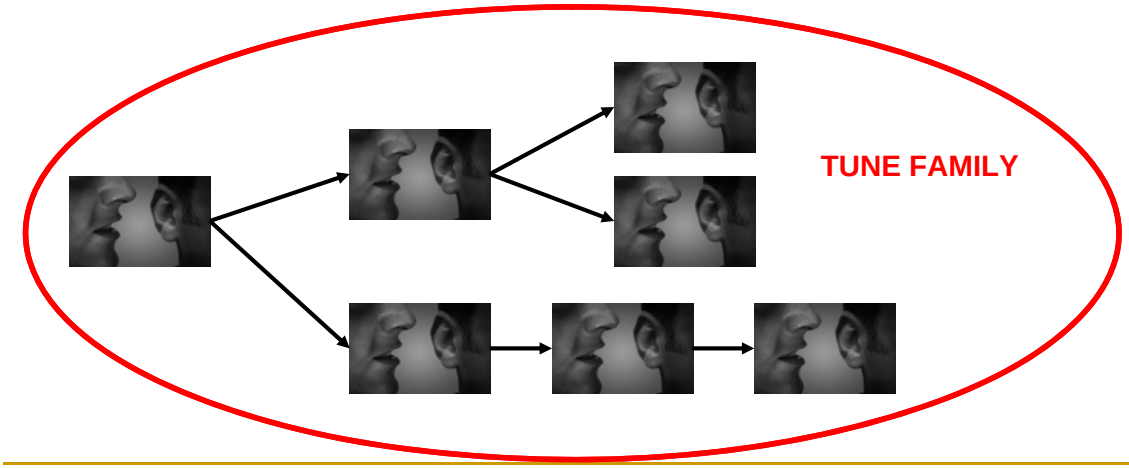
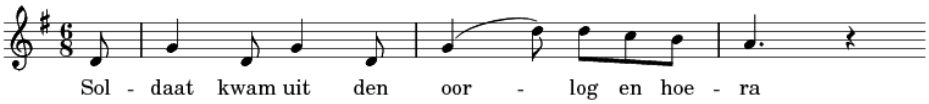
Similarity: Tune family

- Bayard 1950: tune family consists of folk songs that are supposed to have a common origin in history
- Variations introduced through oral transmission

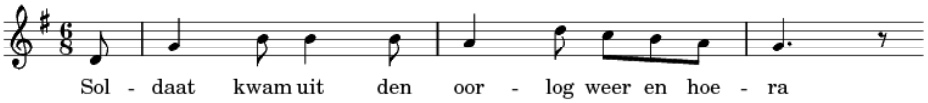


Similarity: Tune family

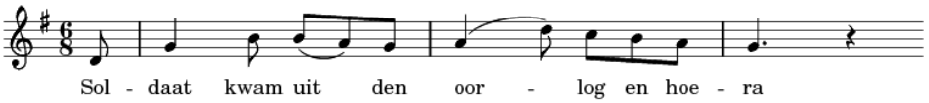
Record 72103 - Strophe 1



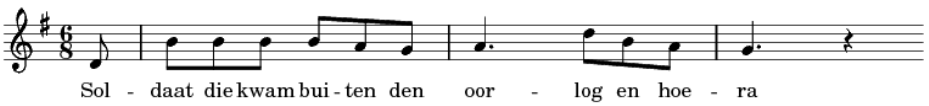
Record 72283 - Strophe 1



Record 72284 - Strophe 1



Record 72285 - Strophe 1



Similarity: Tune family

- Bayard 1950: tune family consists of folk songs that are supposed to have a common origin in history
- Variations introduced through oral transmission
- Wiora (1941): list of changes
  - Changes in contour
  - Changes in tonality
  - Changes in rhythm
  - Inserting and deleting of parts
  - Changes of form
  - Changes in expression
  - Demolition of the melody

Bronson 1950:
provides weights for some features for a corpus of British-American folksongs

Similarity: Tune family

- Cowdery 1984: not one single anchestor in history, tune families can “blend to each other”, pool of motifs

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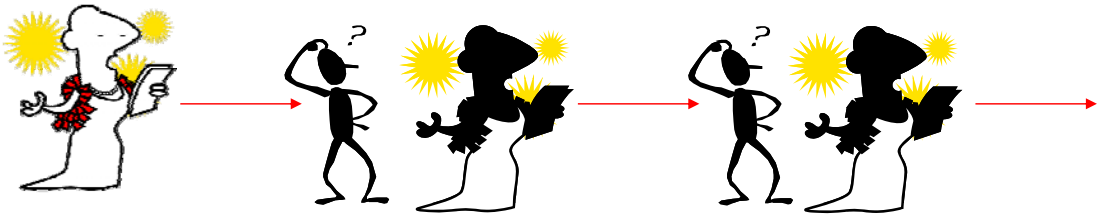
Experiment: Tune family



Klusen, Moog, Piel: Experimente zur mündlichen Tradition von Melodien, 1978

Experiment Tune family

Song variant	Text changes	Rhythm changes	Pitch changes
A	14	9	77
B	13	65	178
C	18	23	104
D	90	117	219
all	135	214	578
percentage	14,6%	23,1%	62,3%

rhythm is bound to text!

Klusen, Moog, Piel: Experimente zur mündlichen Tradition von Melodien, 1978

Study: Tune family

Annotation study:

- 360 songs out of 6000 songs of Dutch folksongs
- numerical ratings regarding contribution of similarity of single features
- Features: melodic contour, rhythm, mode, lyrics, motifs
- provided by musicological experts
- most important feature: recurring melodic motifs

↓

Cowdery 1984

A. Volk, P. van Kranenburg, J. Garbers, F. Wiering, R.C. Veltkamp, L.P. Grijp, *A manual annotation method for melodic similarity and the study of melody feature sets*, ISMIR, 2008

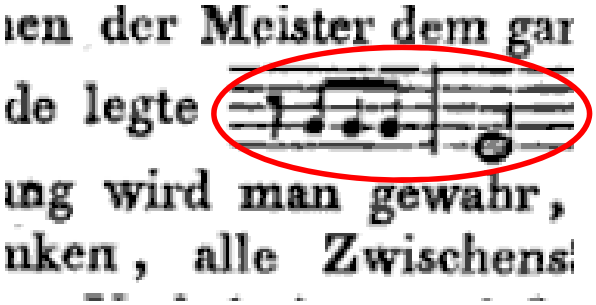
Musicology: Similarity

Most prominent examples of similarity studies

- Tune family (ethnomusicology)
- Motivic-thematic relationships in Classical Western music

Similarity: Motivic-thematic relations

- … similarity relationships give the listener the ***feeling that he understand*s** what he is listening to without having to study the compositional rules on which the music was based (Leonard B. Meyer)
- e.g. Schoenberg, Webern, Reti



Similarity: Motivic-thematic relations

- Melen & Wachsmann (2001), Koniare et al. (2001):
  - infants (6 to 10 months, 10- to 11-years-old) form categories of musical motifs (Schubert, Diabelli)
- McAdams et al (2004):
  - experts and novices build categories within a contemporary piece
- Ziv & Eitan (2007):
  - listeners build categories of motifs in Beethoven piece

↓

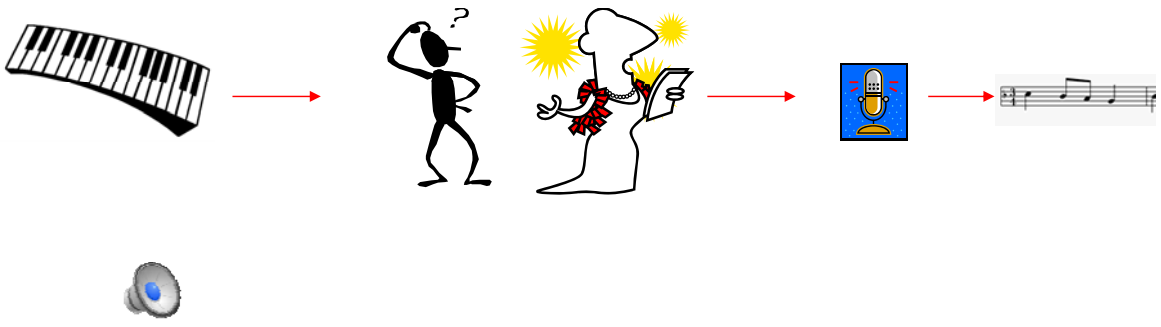
Open issue: What musical features do listeners attend to?

Discussion of surface vs. deep features

Music cognition

- Melodic similarity

Melodic Similarity



(Sloboda & Parker, Immediate recall of melodies, 1985)

Melodic Similarity

Results

The most fundamental feature that is preserved in this melody is the metrical structure ... This suggests that metre is a primary structural frame for melodic comprehension and recall.

Within the metrical phrase structure, subjects do not reproduce the exact rhythms of the original. Rather, they substitute metrical equivalents in about half of the cases.

There is evidence that harmonic structure may be coded even when exact melodic structure is lost.

Sloboda & Parker, Immediate recall of melodies, 1985

Melodic Similarity

Results

The most fundamental feature that is preserved in this melody is the metrical structure ... This suggests that metre is a primary structural frame for melodic comprehension and recall.

Even in the absence of text, time structure is the most stable element of melody!

Sloboda & Parker, Immediate recall of melodies, 1985

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Melodic Similarity

Please identify a song in as few notes as possible!

I have no idea!
Sounds familiar, but I am not sure enough
I am pretty sure that it is _____
I am sure that it is _____

Schulkind, Posner, Rubin: Musical Features That Facilitate Melody Identification, 2003

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Melodic Similarity

- Tonal Functions
  - Perceived distance to the key (tonic)
- Pitch Height
  - Number of semitones with respect to anchor
- Contour
- Interval
  - Size, direction
- Duration
- Meter
  - 3 levels
- Phrase placement
- Local patterns
  - Alternation, run, pair
- Serial Positions
  - early vs. late in the melody

Features

Schulkind, Posner, Rubin: Musical Features That Facilitate Melody Identification, 2003

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- Duration
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- Serial Position
  - early vs. late in the melody

Surprising: temporal factors contribute more than pitch factors!

Schulkind, Posner, Rubin: Musical Features That Facilitate Melody Identification, 2003

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Melodic Similarity

Results

- The placement of a note within a musical phrase was the most consistent predictor ... Identification performance was highest at phrase boundaries
- Notes that completed consecutive alternations between rising and falling pitch contours were a significant predictor in half of the regression models
- The last two musical variables that entered the best-fit models were both temporal in nature. ... Identification was most likely to occur at long notes and metrically accented locations.

Schulkind, Posner, Rubin: Musical Features That Facilitate Melody Identification, 2003

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Melodic Similarity

How effectively can the statistical properties of melodies account for listeners' similarity judgments?

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

Melodic Similarity

How effectively can the statistical properties of melodies account for listeners' similarity judgments?

Melodies from five distinct folk music styles :

North Sami yoiks,
Finnish Spiritual folk hymns,
Irish hornpipes,
German folksongs
Greek folksongs.

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

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Melodic Similarity

How effectively can the statistical properties of melodies account for listeners' similarity judgments?

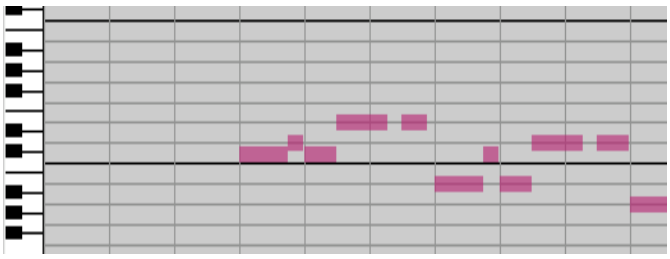
rate the similarity of pairs of melodies on a scale from 1 to corresponded to "very similar" and 9 to "very dissimilar."

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

Melodic Similarity

Similarity measures: statistical properties

distribution of the tones,
distribution of the intervals,
distribution of the tone durations,
distribution of two-tone transitions,
distribution of the interval transitions,
distribution of the duration transitions



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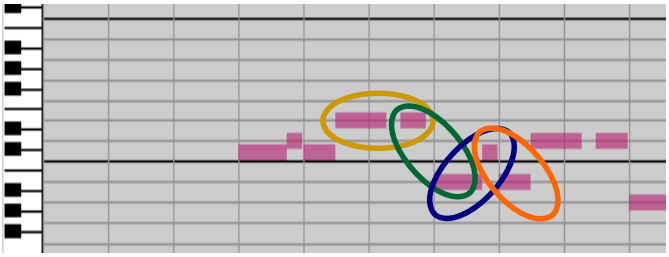

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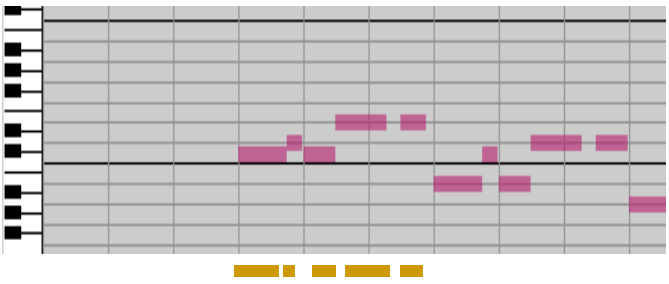

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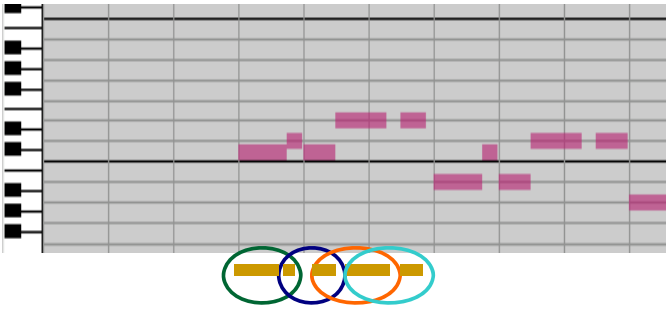

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

Melodic Similarity

Similarity measures: Descriptive variables

Tonal Stability

correlation between tone profile of the melody and the C-major probe-tone profile)

Qualities of successive intervals

mean proximity of tones,
registral return,
registral direction,
closure,
intervallic difference,
consonance

Rhythm

syncopation,
rhythmic variability,
rhythmic activity,
total number of tones

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

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Melodic Similarity

Similarity measures: Statistical Properties

The similarity measures were regressed upon the similarity ratings of the listeners for all pairs of melodies.

Only moderate success! $R^2 = .39$

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

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Melodic Similarity

Similarity measures: Descriptive Variables

6 descriptive variables could explain 62% of the variance in similarity ratings:

melodic predictability,
mean pitch,
tonal stability,
consonance,
number of tones,
closure

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

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Melodic Similarity

Conclusion

the descriptive variables were somewhat better predictors of melodic similarity than were frequency-based variables, but further research is warranted before their individual roles in similarity formation can be assessed

... most important, it is safe to assume that the events in a melody are not equally salient. The prediction rate might have been higher if the salience of individual events had considered aspects such as melodic, harmonic or contour accents.

Eerola, Järvinen, Louhivuori, & Toiviainen: Statistical Features and Perceived Similarity of Folk Melodies, 2001

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Melodic Similarity

More experiments on similarity:

18 algorithmic similarity measures tested in listening experiments

2 main dimensions that differentiate the tested 18 algorithmic measures: the incorporation of rhythmic information and the reflection of local (motivic) vs. global similarity.

Listeners have a balanced judgement with respect to local vs. global similarity, but influence of rhythm depends on the experimental context

Müllensiefen & Frieler: Modelling experts' notions of melodic similarity, 2007

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Melodic Similarity

More experiments on similarity:

The similarity judgement of experts seems to be a flexible concept that adapts to the specific experimental task or context of melodies. At the same time it seems to be a stable notion that can be very well agreed upon among experts in a given situation.

Müllensiefen & Frieler: Modelling experts' notions of melodic similarity, 2007

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Musicae Scientiae

- Special issue Similarity 2007
- Special issue Similarity 2009

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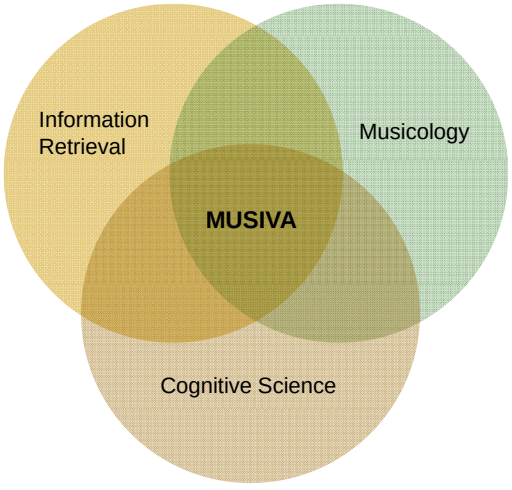
Conclusion

- Similarity is a complex notion for music cognition research
- Depending on the context similarity can be described using very different features
- Similarity is not yet sufficiently understood

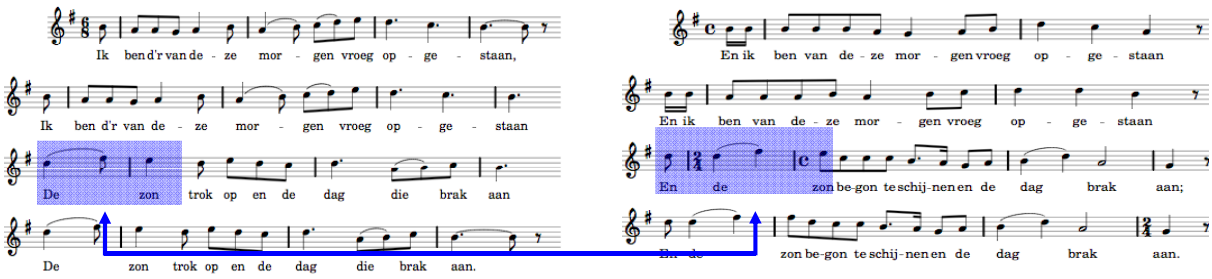
Outlook: Project *MUSIVA*



Variation principle

Modelling *MU*sical *SI*milarity over time through the *VA*riation principle

MUSIVA: Variation Principle



Relating musical patterns → *listeners experience similarity*

classical, folk and popular music

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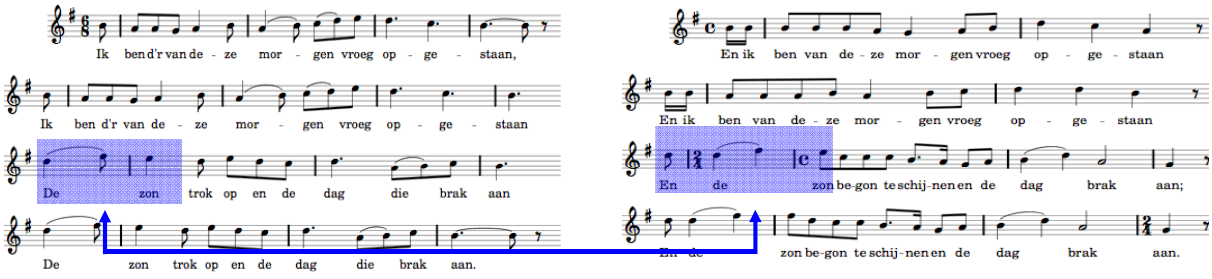
MUSIVA: Variation Principle



MUSIVA: *Computational model realizing variation*

Interaction local and global features

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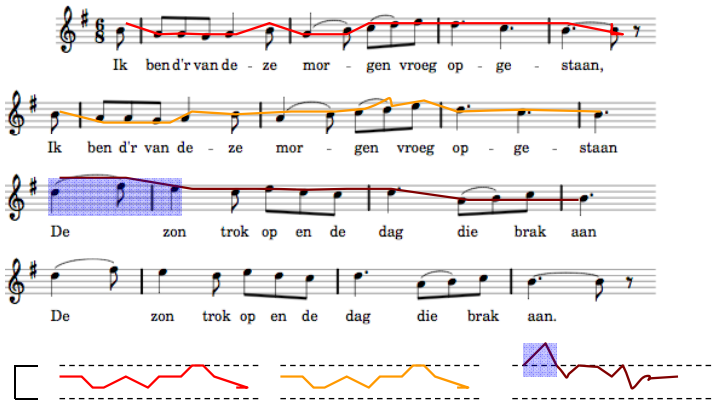
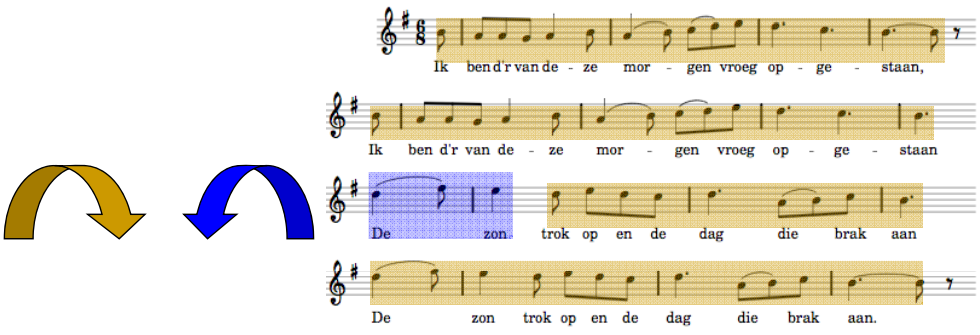
Interaction between local and global features



- General melodic line: global feature

Interaction between local and global features

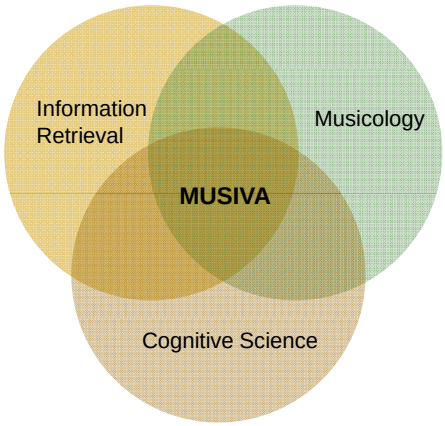


- Global feature helps to discover salient local elements

MUSIVA: 2011-2016

Anja Volk

Principal Investigator



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Music and Meaning

ISMIR 2011 tutorial Musicology, part 4

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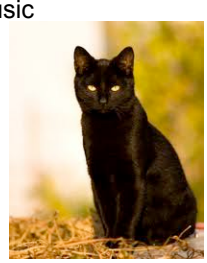
Contents

- motivation and illustration
- types of musical meaning
- theories of musical meaning
- connecting empirical and musicological approaches
- concluding remarks about entire tutorial

Motivation

- music is meaningful
  - most important reason for engaging with music
  - central concept in new musicology
  - underlies MIR research
    - motivation of the researchers
    - emotion and music
    - music industry is driven by meaningfulness of music
- music makes life more valuable
  - like for example sports, entertainment, arts, friendship, religion
- our brains are optimised for attaching meaning to *anything*



Meaning in new musicology

- musical meaning used to be taboo subject
  - positivist musicology: objective study of musical materials
  - meaning and emotion considered subjective, private and irrational
- addressed in 'new musicology'
  - Kerman's criticism (1985) centred around questions of value and meaning
    - ultimate motivation for research
  - with notable precursors
    - 'hermeneutic' interpretations (Kretschmar 1887-1890)
    - Leonard Meyer (1956)

Generation of meaning

- Lawrence Kramer, *Musicology and meaning* (2003)
  - new musicology = cultural musicology
  - aim: understanding musical subjectivity in history
  - subjectivity: disposition to engage in specific social and historical practices
  - new musicology is 'first and foremost about musical meaning'

- meaning is
  - a product of *action* rather than structure
  - *emergent*, resulting from a *negotiation process* involving musical text and context
  - musical structure has *potential meaning*

Musical meaning an intractable problem?

Is meaning entirely mediated by culture, or are there identifyable universals? Is meaning communicable from one person to another, given the vagaries of subjective response? For music to communicate, must it also be beautiful? Does music convey anything at all beyond its play of sounds? What, indeed, does "meaning" mean? What methodological tools are appropriate? Is music like a language, a natural object, an article of faith? Or is meaning more like a subjective confession, an idiosyncratic recognition of meaningful patterns? Is there any common ground at all on which to lay a foundation for a theory of meaning?

(Pearsall & Almén 2006, 1)

Desperate housewives, season 7 trailer

http://www.youtube.com/watch?v=nxvMgCpgiYM

- play without / with sound
- what is it the music adds?

Desperate housewives

- what is it the music adds?
- story line depends on music
- meaning through allusion
  - *The Good, the Bad and the Ugly*
  - 'hook' in particular
  - there's a new girl in town, and she's dangerous
- question remains: what makes this an effective piece in the first place?

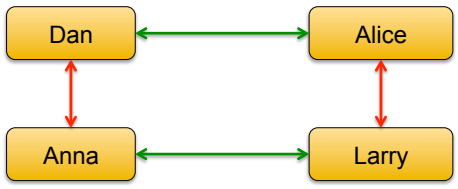
Closer (2004)

http://www.youtube.com/watch?v=QIyqGmPXgBI

- movie trailer; scene at 0'42" is same as in analysis, but with different music
- music suitable for romantic drama

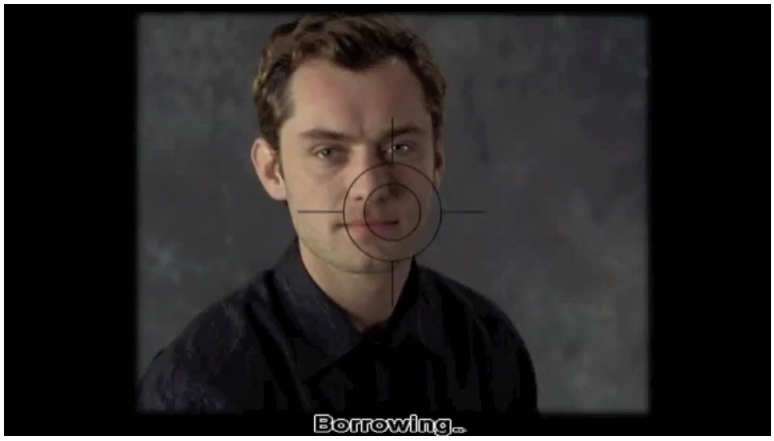
Closer (2004)

- two couples
  - Dan (Jude Law) and Alice (Natalie Portman)
  - Anna (Julia Roberts) and Larry (Clive Owen)
- play 'ultimate game of partner swap'



- scene: first encounter between Dan and Anna
  - what is the role of the music here?

Photo shoot



- relevant scene is 9'56"—14'57"

Photo shoot–the music

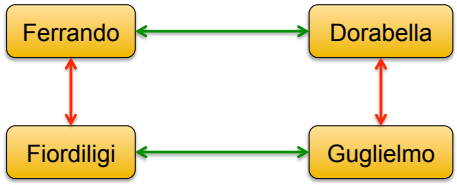
- the music is played during the photo shoot
  - Anna and Dan hear the music
  - switched off at the end
- music creates two layers of meaning
- does the music follow the action, or the action the music?
  - near-perfect synchronisation of musical and erotic gesture
  - acting follows dynamics of the music
  - or is it set in motion by it?
  - →Davies' contour theory
- what is being played?
  - Mozart, *Così fan tutte*
  - part of the farewell scene

Così fan tutte, Soave sia il vento

http://www.youtube.com/watch?v=9ixCRu9FwHg

Farewell scene

- what's going on here?
  - two couples
  - two men have joined the army
  - fiancees stay behind, supported by elderly friend



- why?
  - love as a high-risk game

Back to Closer

- two layers of musical meaning
  - expression of passionate love
  - specific information about the plot through reference to opera
  - not just emotion
- Mozart's music is effective under different circumstances
  - farewell (opera) and encounter (movie)
- musical structure allows for range of meanings
  - meaning as an emergent property (→ Cook, Kramer)

150th anniversary of Italian unification

- http://www.youtube.com/watch?v=gaXE0v0bJoE&feature=related
- why this sad music?

Expressing what cannot be said

- from Verdi, *Nabucco*
  - Babylonian captivity
  - Va pensiero: longing for return to Israel
- context of creation an early reception (1842-1870)
  - Italy oppressed by foreign powers
  - censure, no freedom of speech
- longing for independence and unity expressed through this opera, this scene
  - VERDI = Vittorio Emmanuele Re d'Italia
  - powerful political meaning
  - but see http://www.gresham.ac.uk/lectures-and-events/verdi-and-milan for a myth-busting view (Roger Parker)
- other examples
  - USSR, Reformation…
- censorship shows reality of musical meaning

Expressing what cannot be said

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- other examples
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Important types of musical meaning

- expression, emotion
- multimedia
  - advertising
  - film
  - video games (cf. Joris de Man, ISMIR 2010)
    - ambience, game state, interaction
- social meaning
  - ritual (cf. jula jula)
  - bonding (nursery songs)
  - identity (hiphop, rap, metal…)
  - power / oppression / torture
    - music of the Sistine Chapel (Rome), San Marco (Venice)
    - Panamese dicatator Noriega driven out of Vatican Embassy, allegedly by means of hard rock music

Patel's taxonomy of musical meaning

1. structural interconnection of musical elements
2. expression of emotion
3. experience of emotion
4. motion
5. tone painting
6. musical topics
7. social associations
8. imagery and narrative
9. association with life experience
10. creating and transforming the self
11. musical structure and cultural concepts

Patel 2008, ch. 6

- about meanings attached to instrumental music
- note that 2 are about emotion, and 9 about other meanings
- rather weak on social meanings
- positivist musicology best represented by (1)
- ethnomusicology by (7) and (11)
- also recommended: Cross & Tolbert (2008)

Music and semantics

- some authors deny the existence of musical meaning
- formal theories of semantics
  - aspects of semantics are
    - reference—ability to denote
    - sense—terms can be related
    - capability of making true and false propositions
  - music does not have these properties
  - so music cannot have semantics (or express meaning)
  - see Cross & Tolbert 2008; Wiggins 1998
- semiotic theories of meaning are better suited to music
- relationship music—language is important (but skipped…)
  - music as language particularly strong in 17th-18th century theory (see e.g. Cook & Dibben 2010)
  - intermediate forms. e.g. silbo (whistling language)
  - widely studied from biological perspective (e.g. Fitch 2006)

Theories of musical meaning

Philosophical approach to meaning

- Stephen Davies. *Emotions expressed and aroused by music* (2010)
- puzzles in the expressiveness of instrumental music
  1. how can music express emotions? such expression properly belongs to sentient beings.
  2. mirroring responses to music's expressiveness
  3. negative responses. why do people enjoy sad music?
- assumptions
  - listener familiar with the repertoire
  - a catalog of musical features is not the answer
    - how do they work?
  - musical emotions felt are the same as felt elsewhere
    - listeners are not mistaken in experiencing sadness in music

Cognitive theory of emotion

- emotions help us survive
- emotions involve
  - sensation
  - physiological change
  - *are object oriented*
  - categorisation of objects
  - attitudes
  - behaviours

Philosophical approach to meaning

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- puzzles in the expressiveness of instrumental music
  1. how can music express emotions? such expression properly belongs to sentient beings.
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1. How can music express emotions?

- problem: music is not a sentient being, so it cannot have an emotion
- various explanations rejected
  - through conventional signs
    - cannot induce sensation (dinner bell→no taste)
  - represents emotion of a human being
    - composer, artist
    - not necessarily experiencing emotion in creation/performance
    - persona imagined in music (various problems)
  - arousal theory
    - properties induce sensations
    - grass induces sensation of greenness
    - not enough consistency in perception

Contour theory

- behaviours, comportments, physiognomies are experienced as expressive
  - The car and the puppet are happy looking and the dog and the weeping willow are sad-looking. These attributions apply to the appearances the depicted items present, not to occurent emotions.
- music presents emotional *characteristics,* not emotions
  - property of music itself
  - unfolding in time, dynamic pattern
  - such patterning is *manipulated* in compositions
- cf. David Huron's raccoon experiment at ISIMIR 2011

2. Mirroring responses

- response to expression often mirrors that expression
  - e.g. sad music → experience of sadness
  - lacks usual beliefs (e.g. unfortunate event happened)
- sadness is a feeling, not an emotion
  - no emotional object
  - appropriate reaction to *appearance* of sadness
  - 'emotional contagion'

Schubert, Das Wirtshaus (Winterreise)
http://www.youtube.com/watch?v=Iw8NmTWKkeE

3. Negative responses

- negative expression is echoed in feeling
  - then why not evade such feelings
- rejected explanations
  - compensated by other properties (e.g. beauty)
  - better understanding of emotions
- Davies' explanation
  - negative often integral to the whole
  - common experience in our life stories
    - training, education, career
  - negative feelings present no special problem as they are part of the reward

How to proceed from here?

- emotion resides in high-level patterns
- same probably true for other forms of musical meaning
- some theories of musical meaning involving high-level patterns and structures
  - Meyer: expectation
  - Brower: embodiment
  - Cook: potential meaning
- many studies about role of mid-level features
  - e.g. Gabrielsson & Lindström 2010

How to proceed from here?

- emotion resides in high-level patterns
- same is probably true for other forms of musical meaning
- some theories of musical meaning involving high-level patterns and structures
  - Meyer: expectation
  - Brower: embodiment
  - Cook: potential meaning

Leonard Meyer

- first important musicologist to address meaning systematically
  - distinction of 'designative' and 'embodied' meaning
  - focus is on embodied meaning: meaning within the work
  - tied secondarily to designative meaning
- *Emotion and meaning in music* (1956)
  - meaning of an event lies in the consequence to which it points
  - failure of habitual response → emotion and/or meaning

Theory of musical expectation

- music displays patterns of antecedent-consequent structures
  - e.g. melodic phrases
  - chord progressions: I-V→ I
  - strategies: consequent is delayed, consequent is unexpected; antecedent is ambiguous
  - composing involves manipulating these processes
- meaning arises out of these patterns
  - *antecedent* gets meaning when *consequent* is unexpected
- *Meaning in music and information theory* (1957)
  - relates meaning to Markoff models and entropy
  - important distinction
    - probabilistic models focus on *consequent* of message

Meyer's contribution

- many leads for computational methods
- possible weaknesses
  - preference for novelty: how does this work in music you know?
  - is expectation sufficient for explaining richness of emotional responses to music?
- theory extended by Narmour 1990, Huron 2006
  - see part 2: theory
- neuroscientific evidence in support of Meyer

Embodiment

- Candace Brower: *A cognitive theory of musical meaning* (2000)
- central ideas
  - all thinking is pattern matching (Howard Margolis)
  - most thinking is metaphorical: patterns are mapped between domains (Mark Johnson)
  - most basic patterns derive from immediate experience of our bodies
- embodied cognition of music
  - 'embodied' has different meaning in Meyer 1956!
- musical pattern matching through cognitive schemas

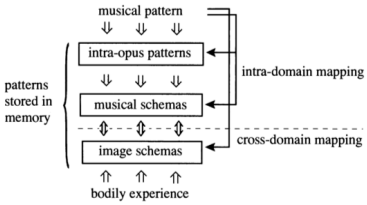
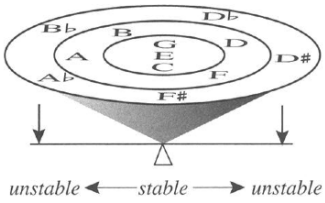
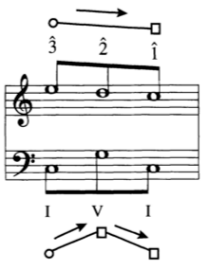


Image schemas

- schemas: categories of patterns
- embodied image schemas are e.g.:
  - container; balance;
  - center-periphery; source-path-goal
  - combinations of those
- shape our understanding of music
  - tonality
    nested container/center-periphery
  - Schenker analysis
    source-path-goal
- patterns work at many levels
  - create narrative structures
    - e.g. sonata form as a journey
- related work: Zbikowski 2002





Potential meaning

- Nicholas Cook, *Theorizing musical meaning* (2001)
  - musical meaning in new musicology is important but *untheorized*
  - how might music support, or not support the meanings ascribed to it?
- musical meaning is emergent
  - meaning is created in the act of performance
  - musical structure has *potential meaning*
  - limits the range of possible meanings
- meta-analysis of McClary
  - extreme meaning, supported by potential meaning
- potential meaning in *Closer* example
  - multiple meanings can be ascribed to Mozart's music

Universiteit Utrecht http://www.youtube.com/watch?v=3SZ9QzGg95g (7'00"-9'00")

Theories of meaning—conclusion

- many kinds of musical meaning
  - emotion important but not the only type
  - more emotions than just happy and sad
- musicology has a lot to say about meaning
  - mostly case-based
  - few generic approaches
  - deep philosophical issues, mainly classical instrumental music
- meaning probably not in music itself
  - potential meaning in structure
    - models models provded by Davies, Meyer → symbolic MIR
  - actualised in performance
    - model for perception provided by Brower → audio MIR
  - shaped by context
    - addressed by Cook, Kramer → web mining for MIR
- meaning can contribute to understanding *relevance*
  - beyond similarity
  - towards better computational models

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Connecting empirical and musicological approaches

Contrasting musicology and MIR

- data-poor approach
- philosophical, maximum interpretation
- culture of disagreement
- diversity of repertoire
- social context important
- much good data
- lots of theory, insights
- many unanswered questions

- data-rich approach
- empirical, maximum strength of evidence
- culture of collaboration
- homogeneous repertoire
- metadata important
- data-hungry
- lack of domain knowledge
- lots of computational methods

areas exist where we can help each other

Relating musicology and MIR

- placing music in context is hallmark of new musicology
  - study of context strongly suggests data-rich approaches
- issues of meaning and value occur in both disciplines
  - proposal for integrated approach in Wiering 2009
  - added value of connecting meaning-centred and structure-centred approaches (Cross 2007)
- opportunities for 'new empiricism' proposed by Huron (1999)
  - postmodernism and empiricism two sides of the same (sceptical) coin
- widely believed in musicology that it is time for something new to happen

Concluding the tutorial

Things we wanted to attain today

- give some experience of the culture of musicology
  - language, practices, values, taboos
- show range of musicological topics
  - ethnomusicology, source study, analysis, philosophy
- point out key publications
  - introductions, classics, state-of-the-art
- generally, communicate the idea that there is something worthwhile to explore out there

Musicologists: the user manual

- musicology is tribal. Musicologists often belong to a subdiscipline and tend to be hostile to other tribes
  - find out where they stand
- not much interest in objective analysis, large-scale data processing
  - don't use the M-word: 'the music itself'
- they want it all: 99% success rate is just not good enough
  - it's an ethical thing—so pragmatic arguments do not work
- interest in context, performance, culture, media, internet and popular musics
- do not assume they mean the same things with these words as you
  - learn to speak their language
- invest in trust
  - only if you show respect for their values they will share their insights
- remember, you don't bring the truth, you just belong to a tribe with a different value system

Computer scientists: the user manual

- computer scientists are not programmers
- if they do music they are passionate about it
- you can do a lot with stuff they've created that is not 100% correct
  - they love to show you how this can be done
- just skip the math stuff in their papers
  - most of them do the same thing
- they think it's easier to model the entire universe than it is to understand a particular item

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