Clap along

1

How did we know when to clap?

Tactus: A basic pulse

- Rate at which we spontaneously tap while listening to music.
- Evenly or regularly spaced.
- Typically falls in the range between 0.6 and 0.75 seconds (80 to 100 events per minute).
- Commonly coincides with the beat rate but remains an undifferentiated pulse.

Beat:

- A recurring moment when tone onsets are more expected.
- Strong - weak differentiation.
- Occurs within a repeating pattern of beats - meter.

2

How do we identify beats?

Most are highlighted or accented

- Clear onsets
- Relatively loud
- Notes played are usually harmonically important
- Low down in the texture, the bass line is bringing them out

- Quick

3

Hoochie Coochie Man
Muddy Waters

Tap along

We readily insert additional beats and form a metrical structure

Even when the rest of the information doesn't match/support it

Our tapping is not merely responsive

4

How do we know it's the beginning of the bar?

- Repetition / Parallelism
- Loudest
- Longest
- Lowest
- Strong base notes

Strong beat early

- Cadences
- Suspension (on strong beat)
- Alternating strong / weak

Formalised in Lerdahl and Jackendoff

5

Human perception of musical structure

Computer Music
Dr Neta Spiro
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How do we recognise the metrical structure?

- Build on first beat identification
- Hierarchy of beat strength in the bar
  - e.g. binary vs. ternary
- Relationship between bars

7

Temporal Awareness

How are we aware that time has passed?

→ Through the perception of CHANGE

8

Temporal Awareness

Change may be:

- External: aware of events occurring in the environment (Heraclitus, Plato)
- Internal: aware of changes in our own proprioceptive state (James 1890)
- Mental: psychological awareness of duration (Bergson 1911, Langer 1953)

9

Temporal Awareness

Or "Events are perceivable; time is not"

(Gibson 1975)

→ The events that are most salient in music perception are sound onsets.

10

Some constraints on our experience of things (music) happening in time

- Temporal resolution
- Engagement
- Amount of processing
- Predictions
- Schemata
- Memory
- Complexity
- Similarity

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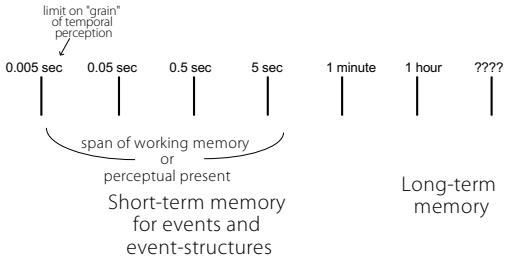
Time and Memory

The perception of time



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Time and Memory

"The experience of a duration of a [time] interval is a construction formed from its 'storage size' - as storage size increases the experience of duration increases."

Ornstein, 1969, p. 42

Ornstein, R.E., (1969), On the Experience of Time, (Harmondsworth: Penguin).

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Time and Memory

- "Storage size"
  - Rate of events
  - Attentiveness
  - Other events

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Time and Memory

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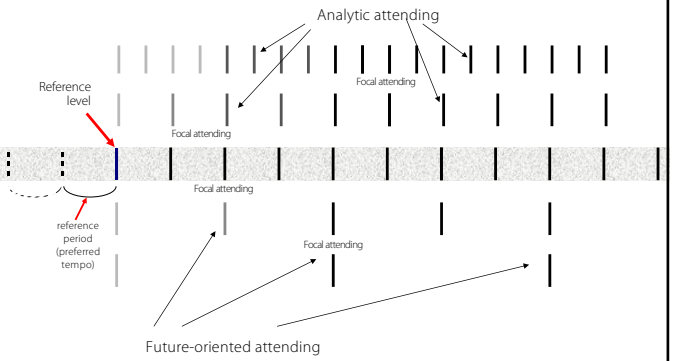
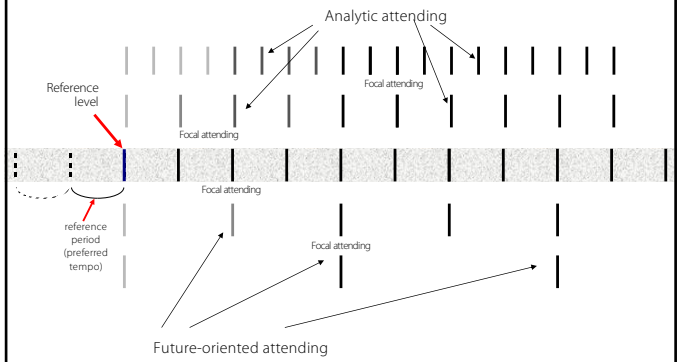
Dynamic Attending



(Jones 1986, Jones and Boltz 1989)

16

Metre



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Four 'levels of analysis' Lerdahl and Jackendoff

- Metrical
  - Based on principles of binary & ternary hierarchy
  - Strictly limited in terms of the levels to which the hierarchy might extend
- Grouping
  - Structure largely predicated on events at the level of the musical surface
  - Includes groups of many sizes, including the "phrase"
  - Chunking

18

Four 'levels of analysis'

- Metrical and Grouping Rules
  - Largely derived from musical surface
  - More determined by the musical stimulus and general aspects of our perceptual systems than by any specifically (schematically learned) musical considerations,
  - Though musical considerations can play a role (esp. in grouping)

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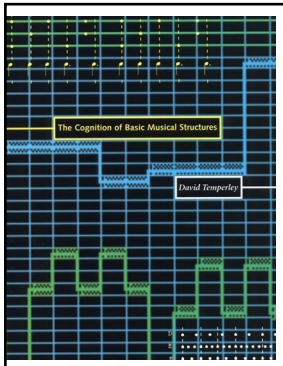

Temperley

Framework for the description of musical styles based on preference rule systems

Explores the relevance of preference rule systems to higher-level aspects of music,
such as musical schemata, narrative and drama, and musical tension.

20

Rhythm and time
Summary

- We readily (and quickly) hear and respond to a pulse in music (and other information)
- We readily hear a metrical structure in music (and other information)
- For both of these we use cues in the music
- Together they are part of a multi-levelled structure
- We can generate our own pulse independently of music or with it
- Theorists have summarised patterns of behaviour (e.g., Jones and Lerdahl and Jackendoff)

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Musical pitch in cognition

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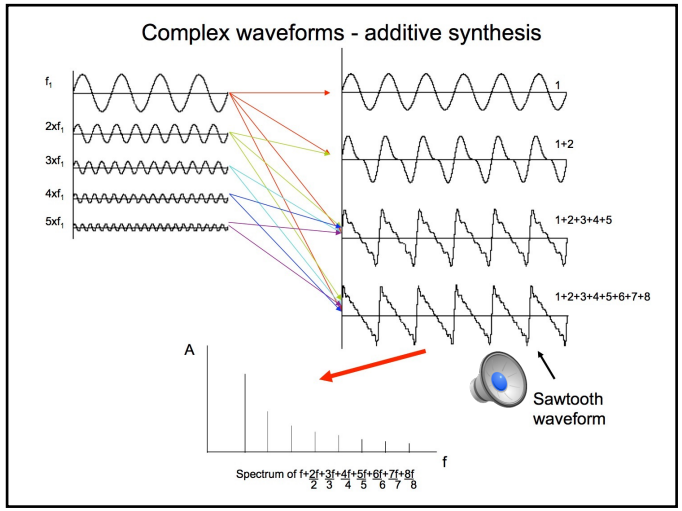

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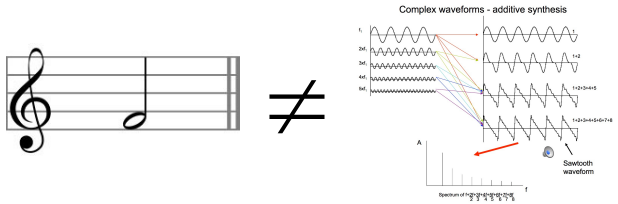
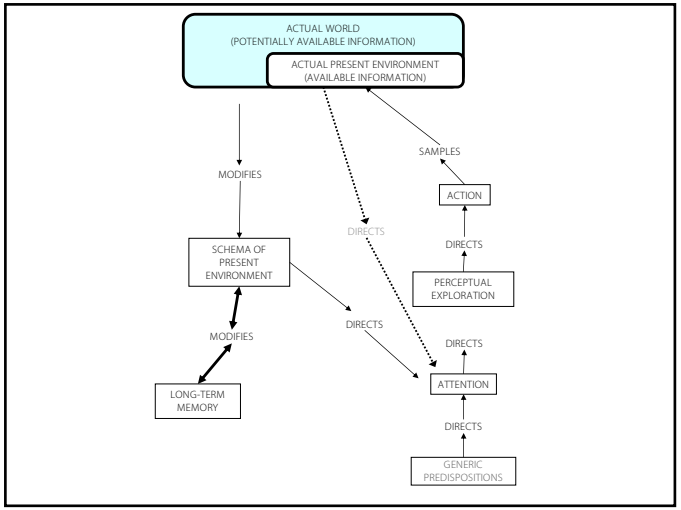


24

- How do we learn pitch relationships and functions?
  - Inherent characteristics of the frequencies we hear?
  - Proportion of time we hear pitch relationships and associated functions?
  - Long term memory?
  - Short term and on the fly?

25



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Auditory Scene Analysis

- What do we do when we hear something as a melody?

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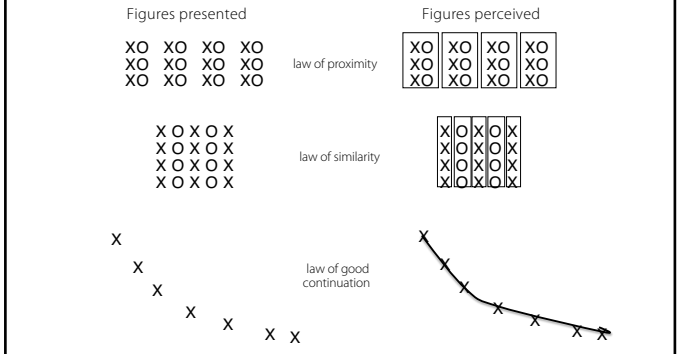

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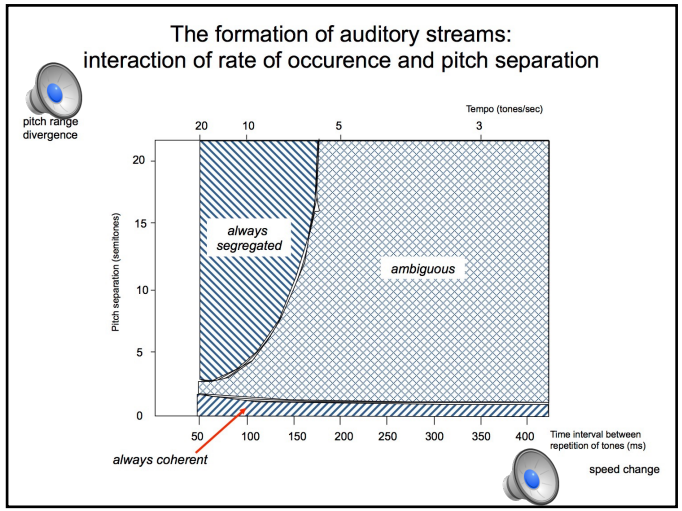

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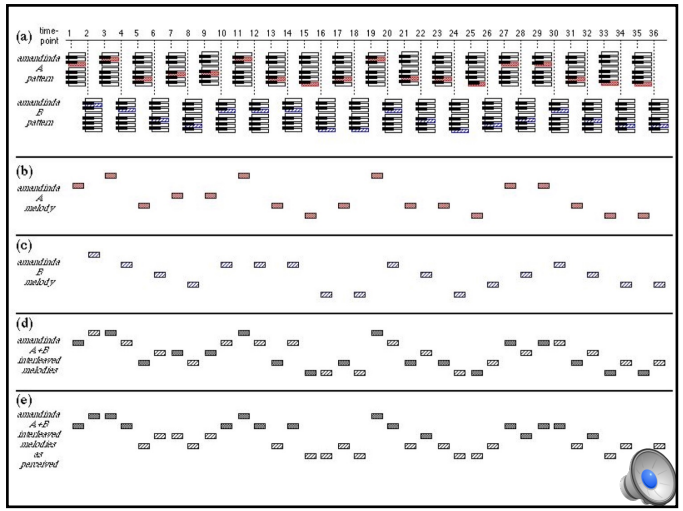

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Auditory scene analysis

- '…is the process whereby all the auditory evidence that comes, over time, from a single environmental source is put together as a perceptual unit' (Bregman, 1993).

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Auditory scene analysis

- Acoustical
- Psychological
  - Psychoacoustical: primarily concerned with the ways in which our auditory sensory apparatus (outer, middle and inner ear and associated neural structures) transforms acoustical information into the 'language of the brain', neural impulses.
  - Cognitive: more concerned with the ways in which this neural information comes to have a functional significance for us.

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Cognitive approaches to pitch
Cognitive structuralism

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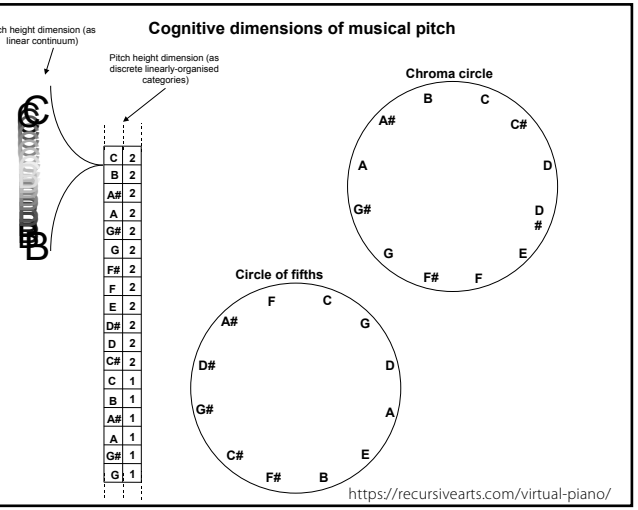

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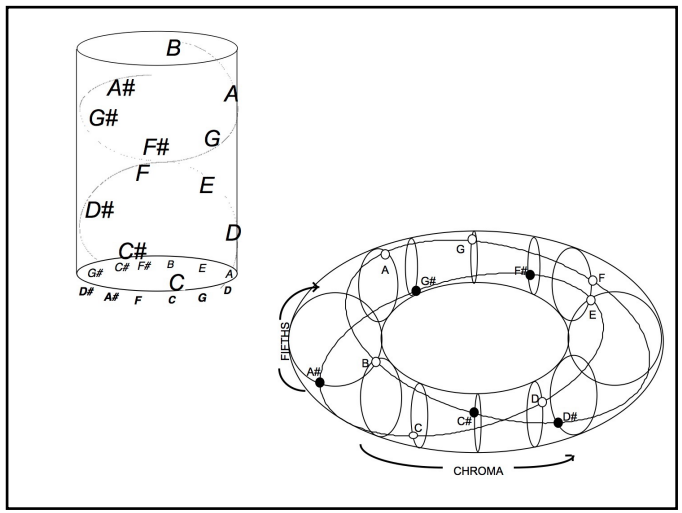

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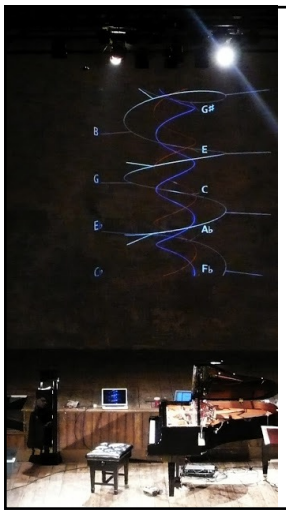

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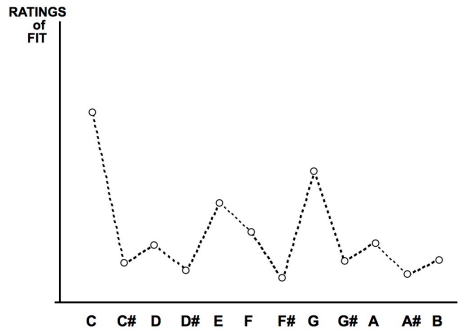

after Krumhansl, 1990

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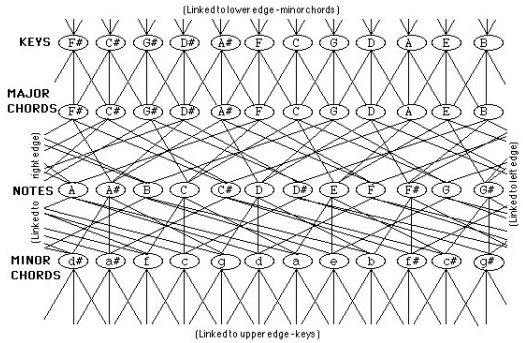

Units and links in Bharucha's MUSACT system

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Cognitive approaches to pitch
Intervallic rivalry theory

- Long term vs. short term memory
- Dynamic vs. static attributes of tonal structure

39

- Intervallic rivalry model
  - Centres on processes of key discovery,
- Cognitive-structuralist account
  - Centres on processes of reinforcement of tonal function.
- Both necessary for a listener to follow tonal music in real time.

40

- "psychology of ear training"
  - not
- "psychology of music"

Cook 1994

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Summary

- It's likely that all these processes –
  - of auditory scene analysis, of the abstraction and schematicisation in long-term memory of regularities of musical pitch organisation, (as well as of the abstraction of the 'virtual roots' and relative stabilities of chords)
- play significant and determinant roles in our experience of pitch organization in music.

Cross 1997

42

What would a theory of our perception of musical pieces take into account?

- Several theories have been proposed.
- Don't have a comprehensive theory that deals with all the different processes that seem to be going on when we experience a piece of music.

43

Self report
Questionnaire
Interview
Focus group
Experience Sampling

Neuro

Physiological

Music analysis

- Pitch
- Rhythm
- Time
- Phrasing
- Movement
- Language
- Emotion
- Development
- Performance (improvisation)
- Musicians' health
- Brain
- Body
- Evolution
- Health & wellbeing
- Daily life

Observation
Video
Audio

Task based

Comparison groups

Modelling

44

Perception

Production

Lab

Beyond

- Pitch
- Rhythm
- Time
- Phrasing
- Movement
- Language
- Emotion
- Development
- Performance (improvisation)
- Musicians' health
- Brain
- Body
- Evolution
- Health & wellbeing
- Daily life

Solo

Social
- Duo
- More

- Entrainment
- Two-person neuroscience

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Language and linguistics

Computer Science & AI

Anthropology

Neuroscience

Psychology

Child development
Education

Medicine

Music Therapy

- Pitch
- Rhythm
- Time
- Phrasing
- Movement
- Language
- Emotion
- Development
- Performance (improvisation)
- Musicians' health
- Brain
- Body
- Evolution
- Health & wellbeing
- Daily life

Musicology

Ethnomusicology

Performance

Dance / Dance psychology

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Some reading

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