



Harmony and tonality
The vertical dimension

HST 725 Lecture 11
Music Perception &
Cognition

(Image removed due to copyright considerations.)

Upcoming topics

Thursday, March 18 (Cariani)

Term project topic presentation & discussion (Stephan)

Melody

Reading: Handel (Chapter 10); Deutsch (Pitch sequences)

Hand out problem set (due April 8th)

Tuesday, March 30 (Cariani)

Presentation on automated music recognitions (Tristan)

Rhythm I: Rhythm perception and production

Reading: Handel (Chapter 11); Deutsch (Clarke chapter)

Also begin looking at Snyder, Music & Memory

Upcoming topics II

Thursday, April 1 (Cariani)

Grouping and expectation

- Time perception, event structure, and temporal expectations
- Auditory spectral and temporal integration; chunking of segments
- Auditory scene analysis and organization of voices
 - Grouping of sounds – onset, harmonicity, rhythm
 - Sound streams (Bregman, Deutsch), polyphony
 - Grouping processes and musical structure
- *Reading: Snyder, Music & Memory; Handel, Ch. 7 Stream Segreg*

Tuesday, April 6 (Cariani)

Music, speech and language: parallels and contrasts

Presentation on tonal languages and music (Stephan)

- *Reading: Bigand chapter in Thinking in Sound*

Upcoming topics III

Thursday, April 8 (Cariani)

Emotion and meaning in music

Musical semantics, music and pleasure

Music and long-term memory

Musical style recognition (Victor)

Problem set due

Tuesday, April 13 (K. Howland, music therapist)

"Clinical applications of the neuropsychology of music." Guest speaker Kathleen M. Howland Ph.D., MT-BC, CCC-SLP.

Thursday, April 15 (Oxenham)

Clinical issues. Music exposure and hearing loss.

Music perception: hearing impaired listeners & cochlear implant users

Upcoming topics III

Thursday, April 22 (Tramo)

Effects of cortical lesions on music perception & cognition

Music and cortical function: Janata paper (Victor)

Auditory agnosia: Peretz paper (Stephan)

Music therapy: clinical problems and prospects

Tuesday, April 27 (Cariani)

Developmental psychology of music

Thursday, April 29 (Cariani)

A question of origins: comparative & evolutionary
psychology of music

Reading: McDermott & Hauser; other readings TBA

Upcoming topics III

Tuesday, May 4 (Cariani)

Music performance. Organization and timing of movement.

Thursday, May 6

Special topics: absolute pitch, synesthesia, etc.

Synthesis: What would a unified theory of music perception & cognition look like?

Tuesday, May 11

Student Term Project Presentations

Thursday, May 13 (Cariani)

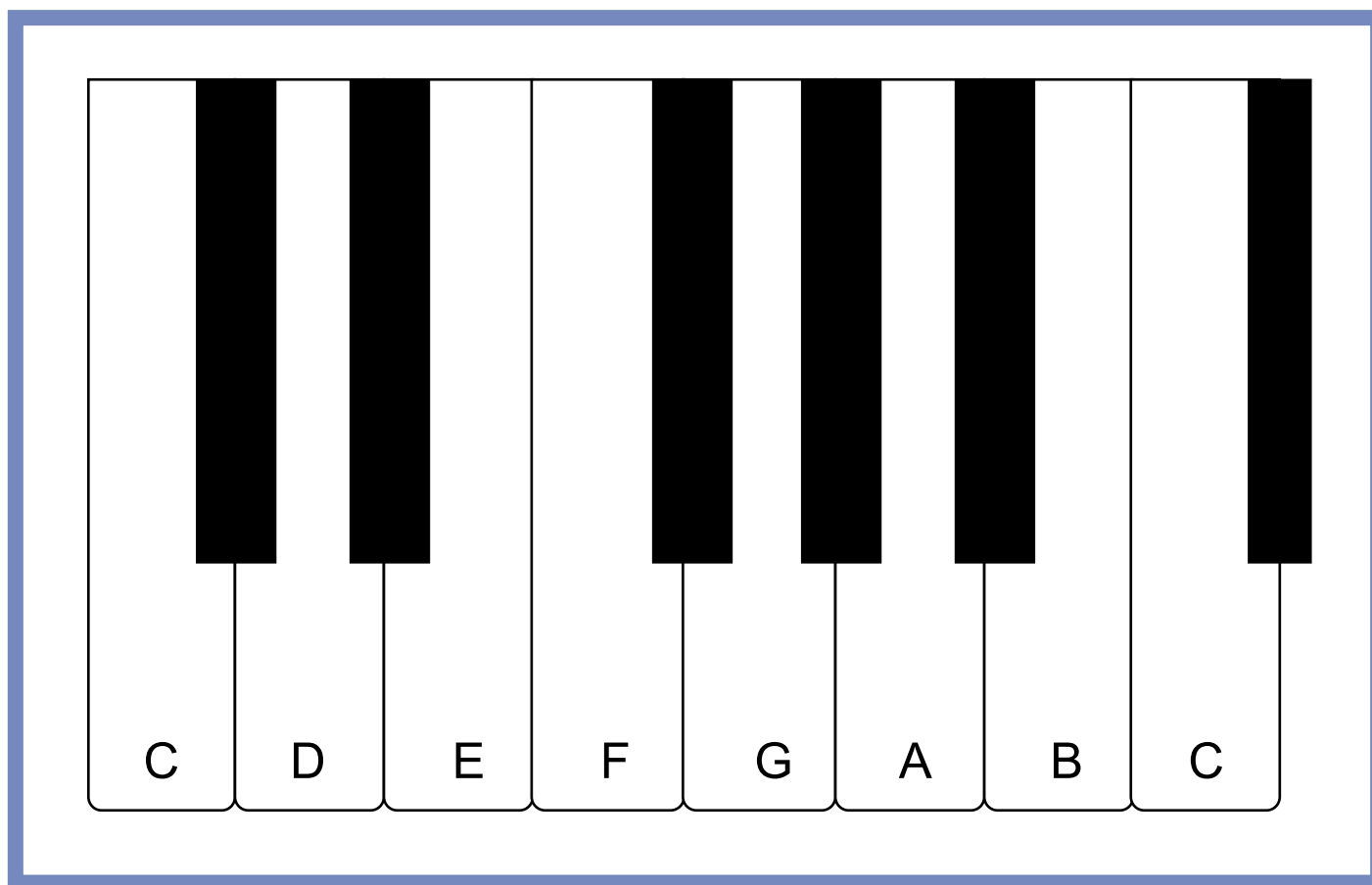
Overview and recap of major themes;

Monday, May 17 All term projects due, noon.

Tonality and harmony

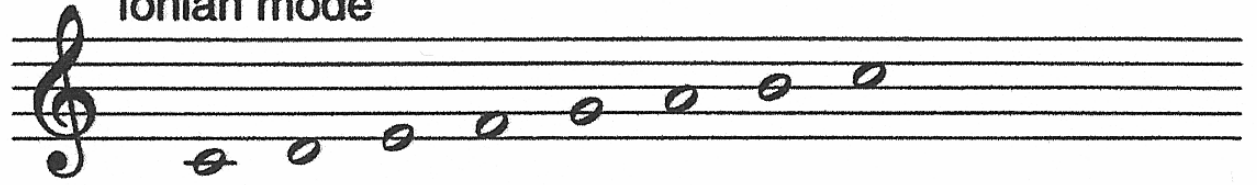
- **Harmony: concurrent sounds, vertical dim.**
- **Tonality: relating to a tonic (pitch)**
- **Keys formed by different tonics & scales**
- **Piston: tonality: note; modality: scale**
- **Triads, inversions, and degrees**
- **Krumhansl's probe-tone studies**
 - **Structure of note-note & note-key similarities**
 - **Is it just note frequency? Common harmonics?**
 - **Pitch memory & establishment of tonal centers**
- **Chord progressions, harmonic distances**
- **Key modulations, harmonic movements**
- **Tension-relaxation dynamics & pitch stability**

C-Major diatonic scale

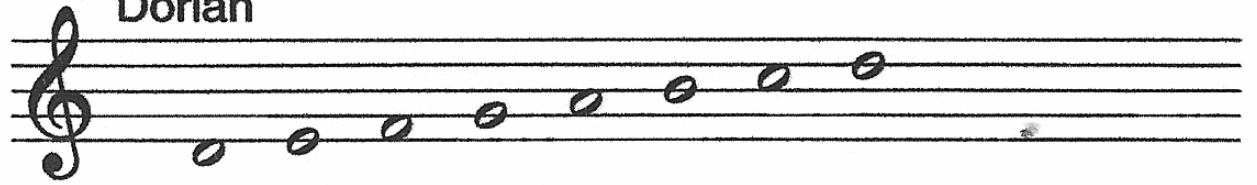


Modes

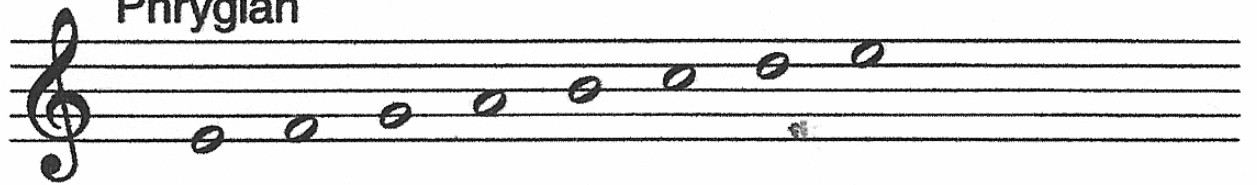
Ionian mode



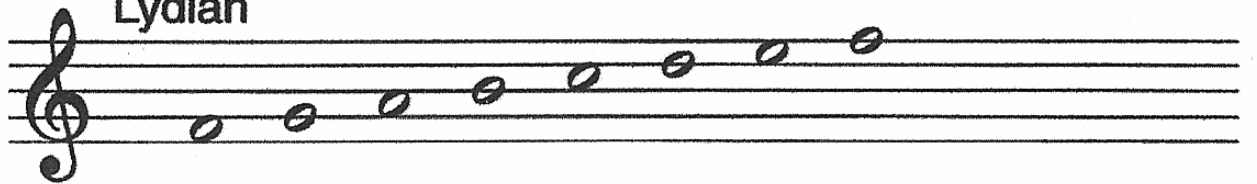
Dorian



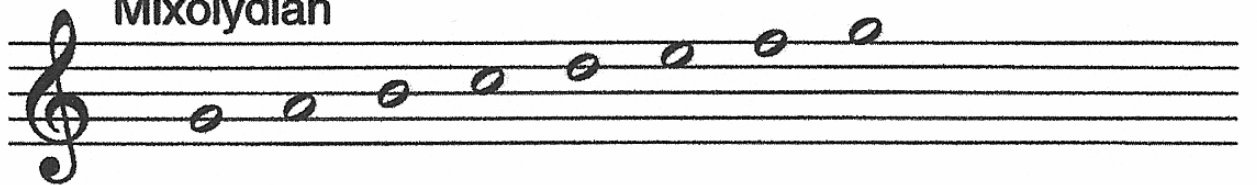
Phrygian



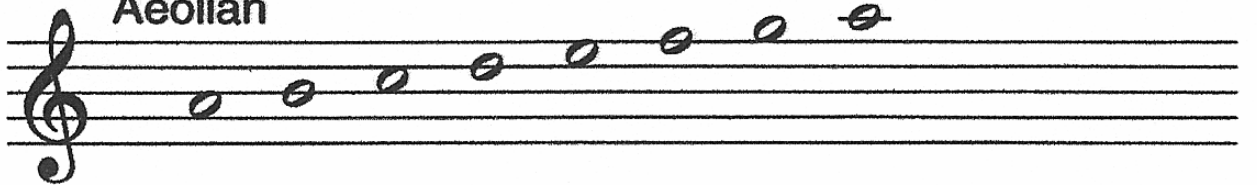
Lydian



Mixolydian



Aeolian



**Ascending and descending scale intervals
(different notes for different directions
"melodic context"
e.g. melodic minor scale)**

EX. 2

major scale

I II III IV V VI VII I VII VI V IV III II I

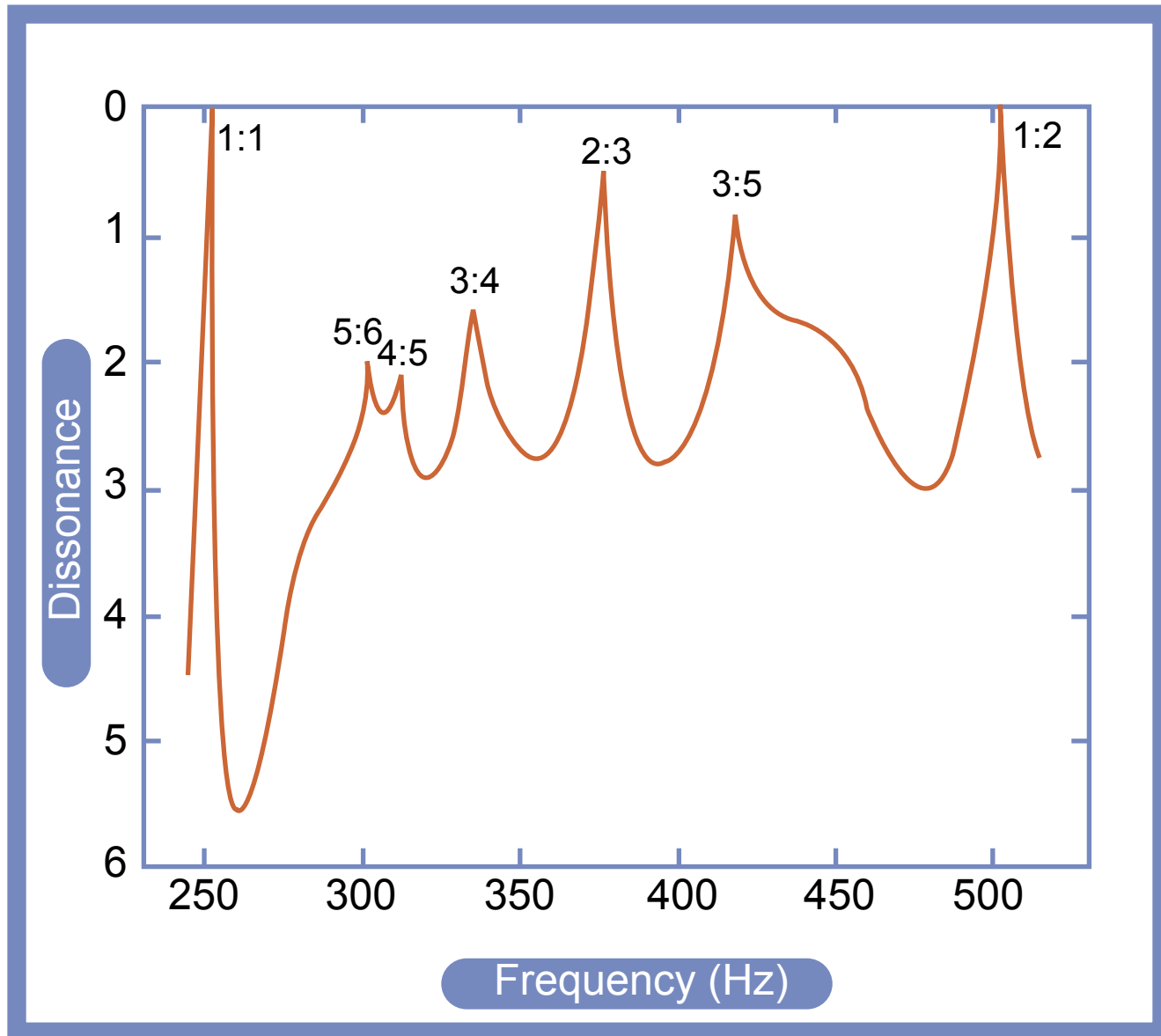
harmonic minor scale

I II III IV V VI VII I VII VI V IV III II I

melodic minor scale

I II III IV V VI VII I VII VI V IV III II I

Dyads: interactions between pairs of tones



Tonal system schematic (Bigand)

see also

<http://www.musictheory.net>
for introduction to keys

Please see Figure 8.1 in McAdams, and Bigand. *Thinking in Sound: The Cognitive Psychology of Human Audition*. Oxford University Press. 1993.

Triads, inversions, and degrees

Major: root-major third-fifth

Minor: root-minor third-fifth

Please see Piston, Walter. *Harmony*. 3rd ed. New York, W. W. Norton. 1962.

Establishment of the tonic (tonal system, tonality)

- First note (most salient)
- Last note (most salient in memory)
- Most frequent or longest duration note
- Note pattern may imply a tonic
- Perception of tonic may be influenced by melodic and harmonic context
- Key-finding algorithms have been developed, but these can make errors (i.e. no strict rules apply)
- What does the existence of the tonic imply about pitch memory? about melodic order?

Triads, inversions, and degrees

Major: root-major third-fifth

Minor: root-minor third-fifth

Please see Piston, Walter. *Harmony*. 3rd ed. New York, W. W. Norton. 1962.

Probe tone profiles for related keys

Please see Figure 2.5 in Krumhansl, Carol L. *Cognitive Foundations of Musical Pitch*.
New York: Oxford University Press, 1990.

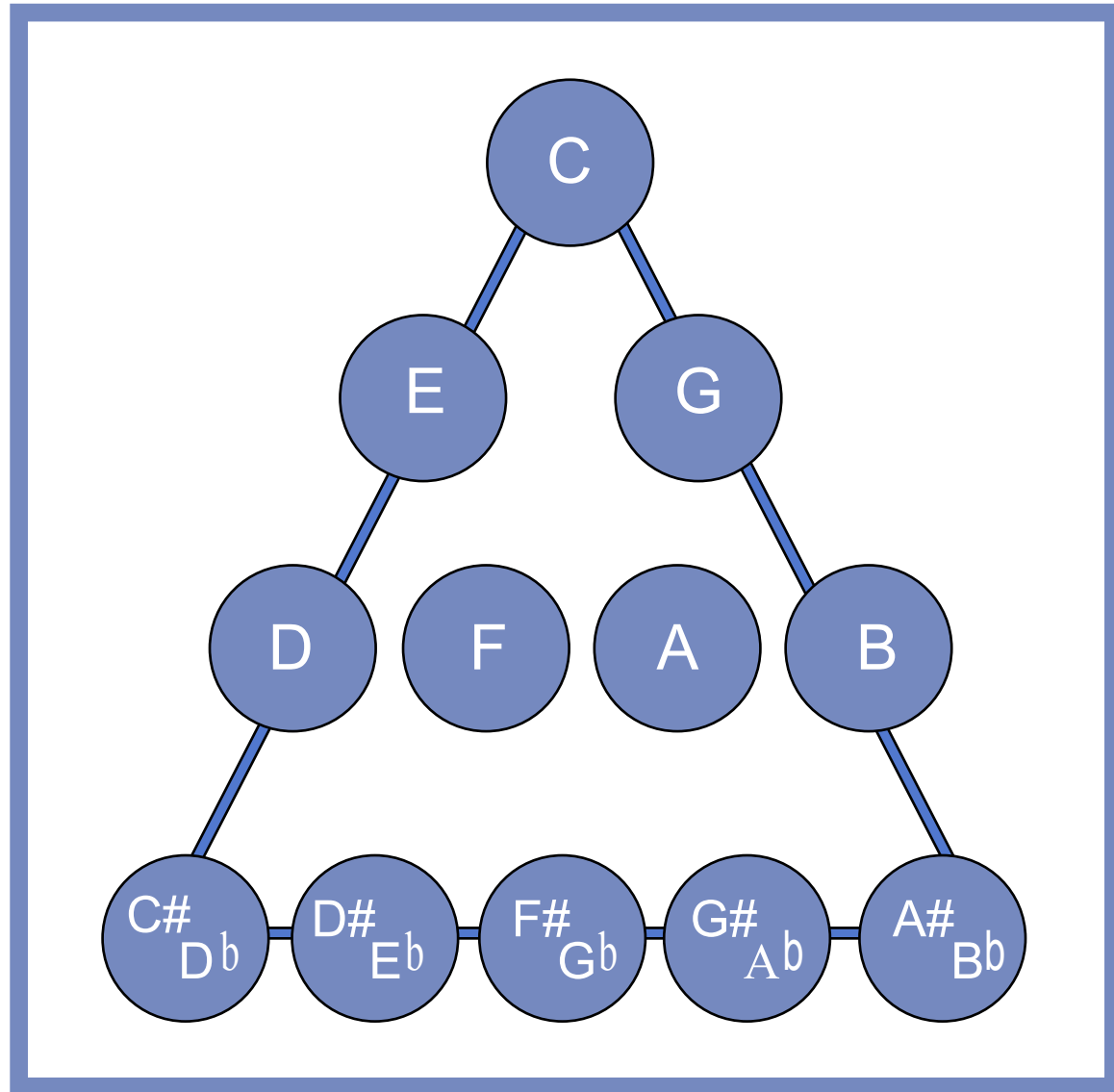
Note-key relations

**Probe tone studies:
how well does a given
pitch "fit in" with a previously played
chord or scale?**

**Measure of similarity
or compatibility**

Please see Figure 2.3 in Krumhansl, Carol L. *Cognitive Foundations of Musical Pitch*.
New York: Oxford University Press, 1990.

**Ranking:
similarity
to the
tonic**



**Frequency of notes
and pitch similarities**

**Statistics of pitches in
Romanticist music**

**Debate over the
meaning of the probe
tone studies**

**Role of short term
& long term memory
internalized schemes or
tonal grammars?**

Please see Figure 3.3 in Krumhansl,
Carol L. *Cognitive Foundations of
Musical Pitch*. New York: Oxford
University Press 1990.

INTERVAL DISTRIBUTIONS AND OCTAVE SIMILARITY

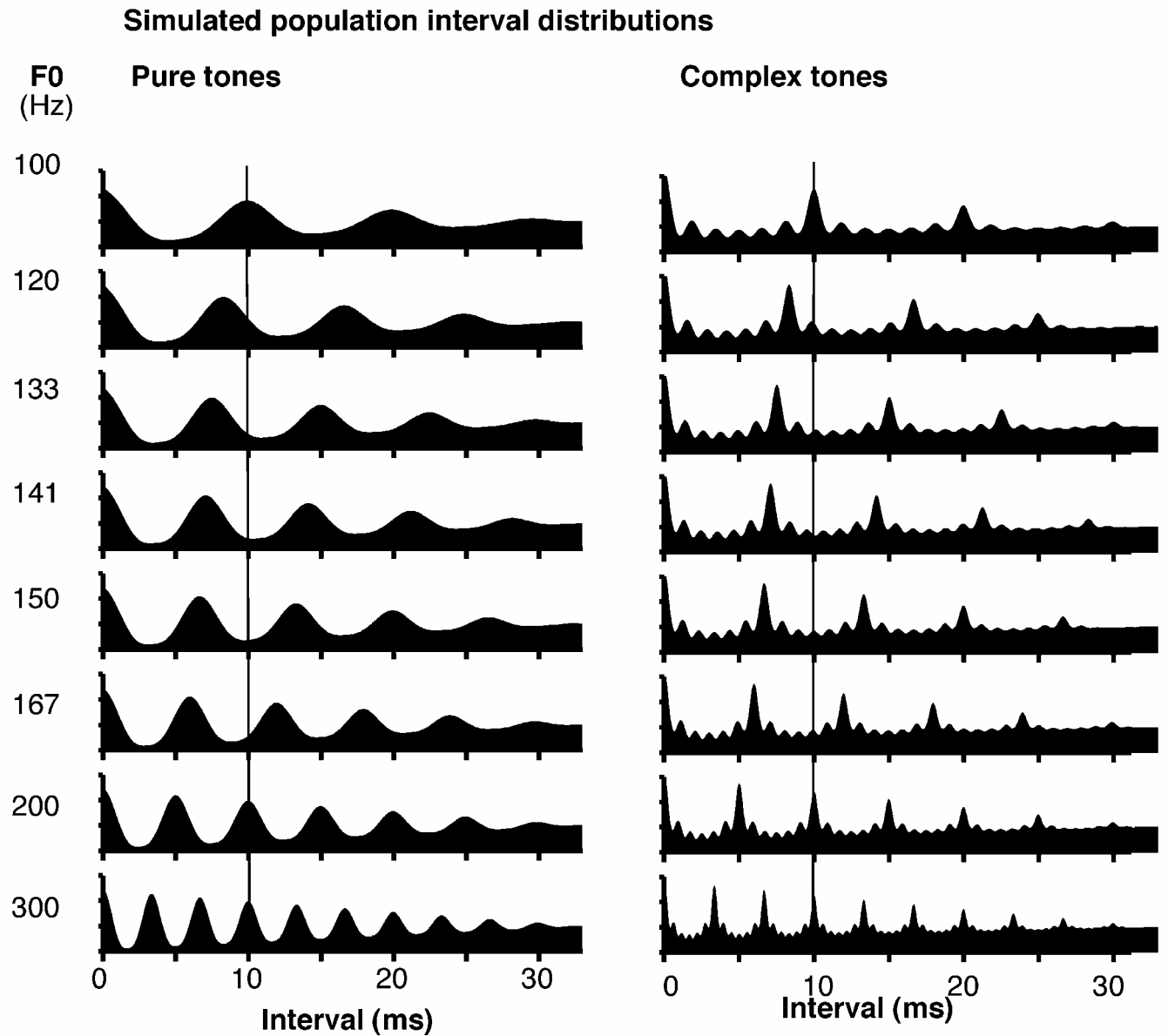


Figure 4. Similarities between population-interval representations associated with different fundamental frequencies. Simulated population-interval distributions for pure tones (left) and complex tones (right) consisting of harmonics 1-6.

Octave similarity

Please see Cariani, Peter. *Journal of New Music Research*. 30, no. 2 (2001): 107-135.

Note-chord relations (Harms 1-12)

Please see Cariani, Peter. *Journal of New Music Research*. 30, no. 2 (2001): 107-135.

Key-key relations

Please see *J Exp Psychol Hum Percept Perform* 8, no. 1 (Feb, 1982): 24-36.

Perceived harmonic structure of chords in three related musical keys.

Krumhansl C L, Bharucha J J, Kessler E J.

Circle of Fifths

Which diatonic scales share the same notes (common pitches)

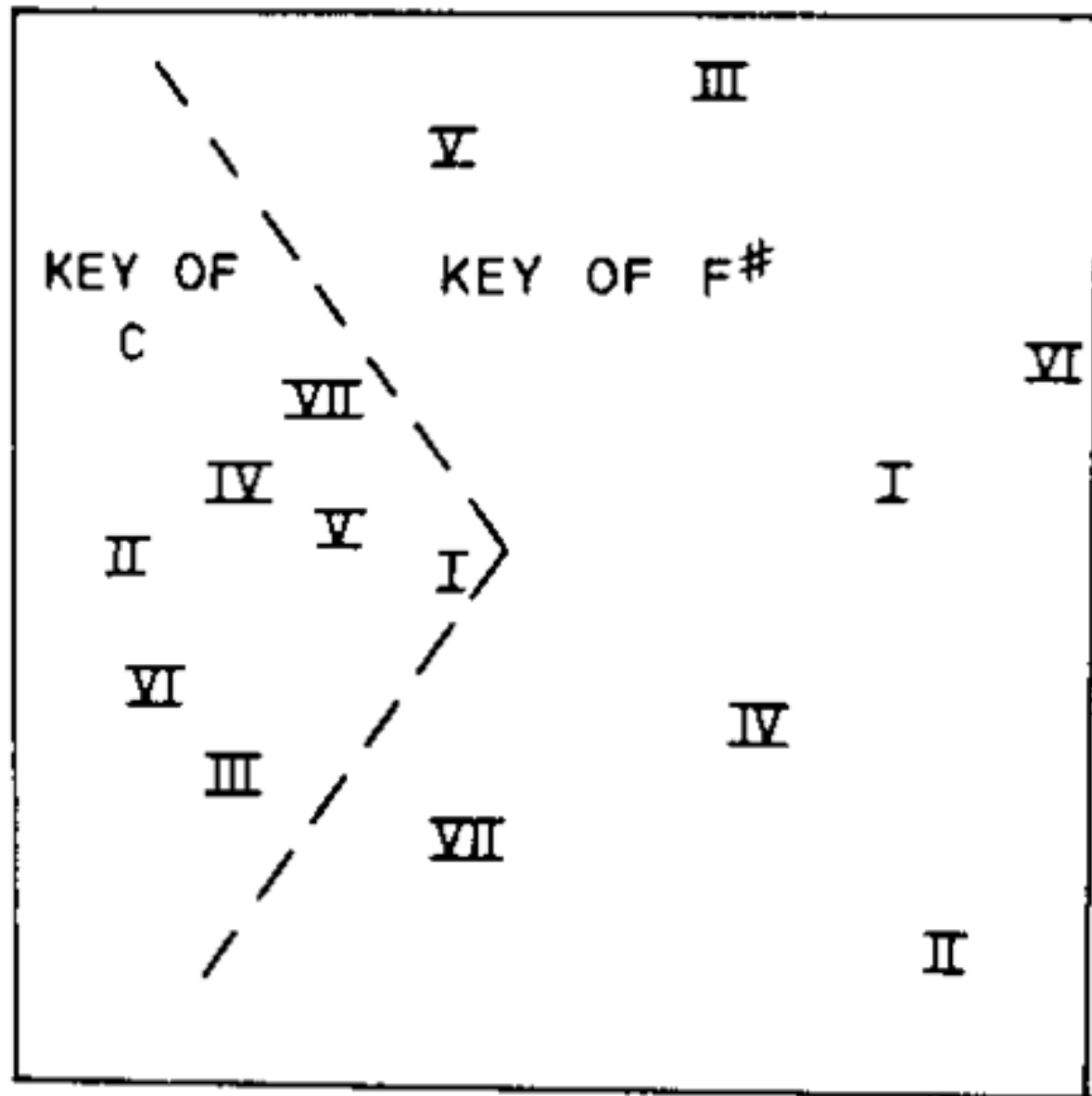
Please see Figure 10.5(b) of Zuckerkandl, Victor. *The Sense of Music*. Princeton, N. J., Princeton University Press, 1959.

Relatedness of chords within a key

Please see Figure 10.19 in Bharucha J., and Krumhansl C. L. "The Representation of Harmonic Structure in Music: Hierarchies of Stability as a Function of Context." *Cognition* 13, no. 1 (Jan, 1983): 63-102.

**Similarity relations
between chords in
the key of C**

C MAJOR CONTEXT



Leman & Carreras (1997): Self-organizing neural nets & key relations

Please see Figures 1, and 4 in Carreras, F. "Schema and Gestalt: Testing the Hypothesis of Psychoneural Isomorphism By Computer Simulation." In Leman's *Music, Gestalt, and Computing: Studies in Cognitive and Systematic Musicology*. Marc Leman, ed. Berlin, New York: Springer, 1997.

Chord progressions

"cadences": (ending) sequences of chords

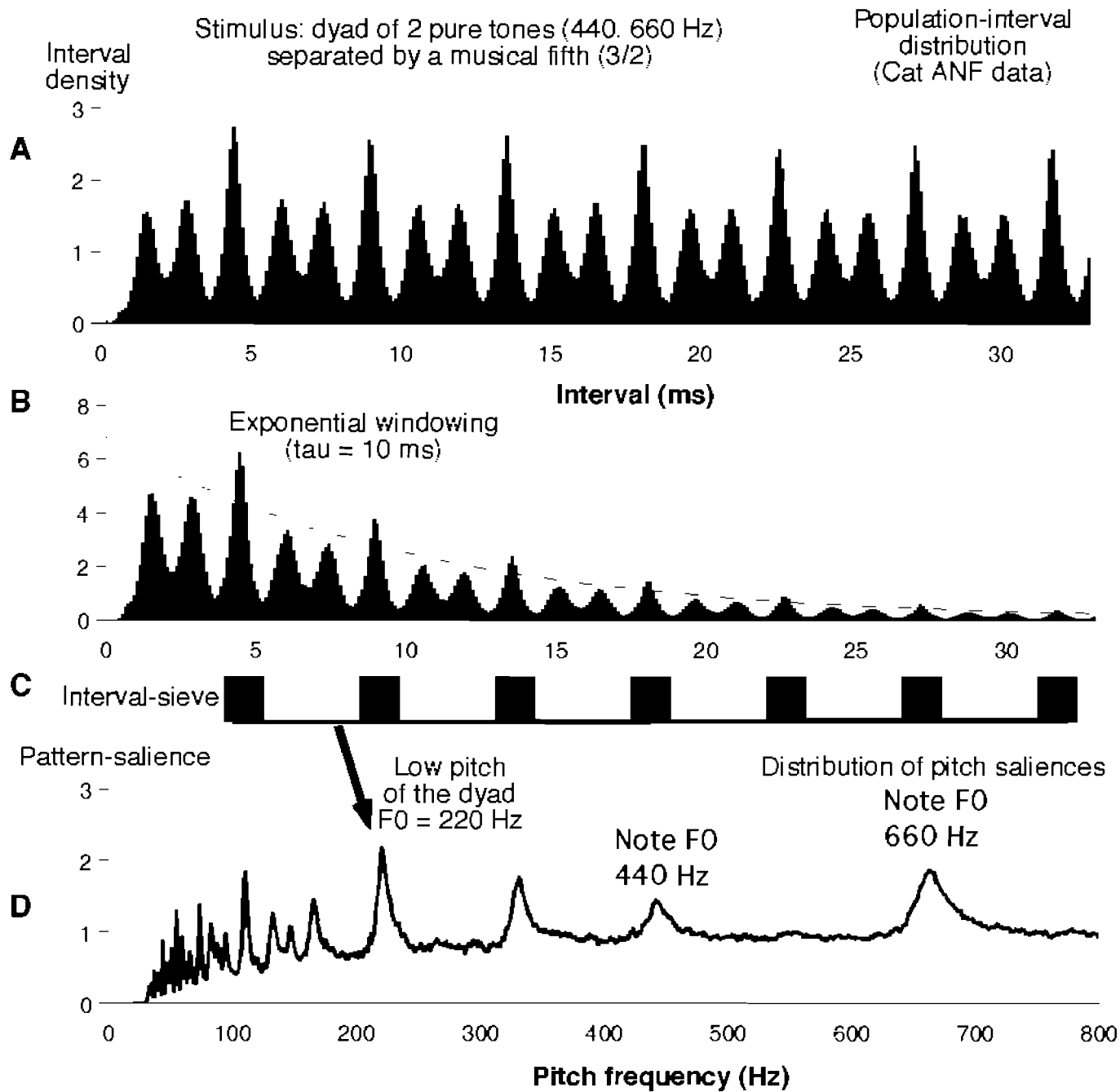
tension & relaxation instability-stability

Please see Figure 10.7 in Zuckerkandl, Victor. *The Sense of Music*. Princeton, N.J., Princeton University Press, 1959.

cadences<http://www.musictheory.net/load.php?id=55>

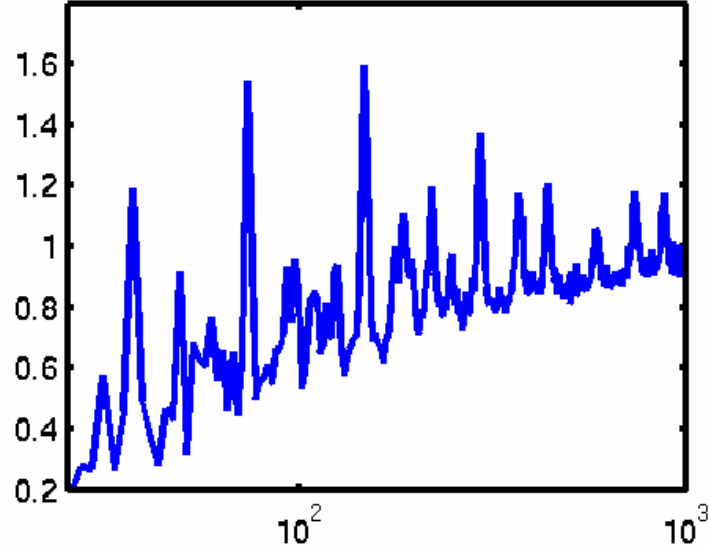
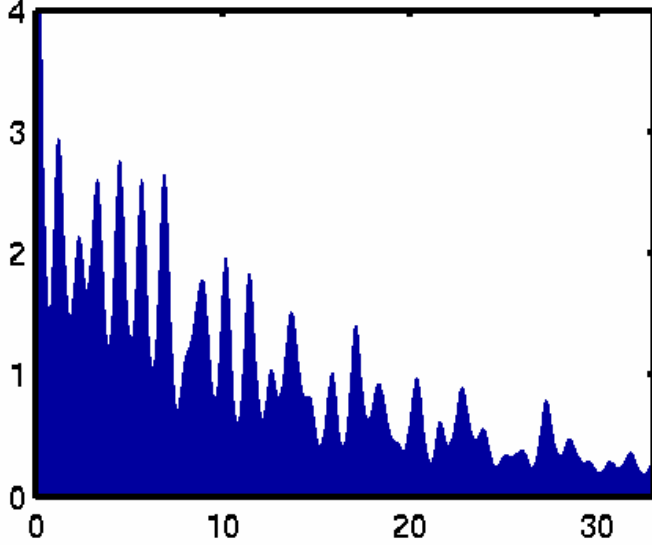
Tonal hierarchies

Please see Figure 8.3 in McAdams, and Bigand. "Contributions of Music to Research on Human Auditory Cognition." In *Thinking in Sound: The Cognitive Psychology of Human Audition*. Oxford University Press.1993, 231-277.



Pitch-stability of major and minor triads: a basis for tension-resolution?

C-Major Triad



CMinor Triad

