



Melody & Harmony:
combinations and sequences of
pitches unfolding in time

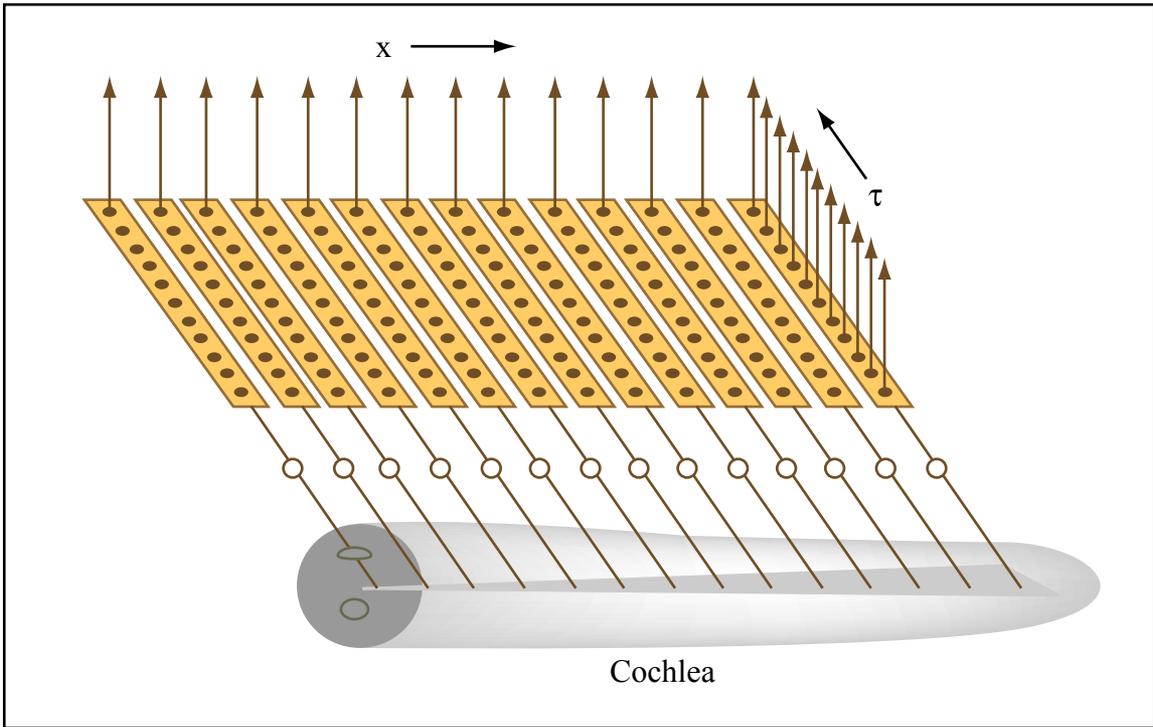


Image by MIT OpenCourseWare.

Melody (Wikipedia)

In [music](#), a **melody** (from [Greek](#) *μελωδία* - *melōidía*, "singing, chanting"[\[1\]](#)), also **tune**, **voice**, or **line**, is a [linear](#) succession of musical tones which is perceived as a single entity. In its most literal sense a melody is a sequence of [pitches](#) and [durations](#), while more figuratively the term has occasionally been extended to include successions of other musical elements such as tone color.

Melody: note sequences unfolding over time

- **Melody: sequences of sounds, vertical dim.**
- **Tonality: relating to a tonic (pitch)**
- **Existence region: tone durations** Ivor Cutler “Go and sit upon the grass”
- **Intervals vs. contour vs. absolute pitch vs. scale**
- **Tonal vs. atonal sequences**
- **Invariance over key transpositions**
- **Multiple melodic lines: polyphony**
- **Hierarchical structure: phrases**
- **Repetition & change**
- **Formation of expectation & its violation**
- **Melodic memory**
- **Musical preferences: personality, style**

Style analysis (La Rue, Guidelines for Style Analysis)

- Sound (texture)
 - timbre, combination, contrast
 - range, gaps, special effects, idiom
- Harmony (functions: color & tension)
 - tonal structure: linear & modal, unified, polycentric, atonal, serial, etc
 - Movement relationships: progressions, modulations
 - Part exchange, counterpoint, imitation
- Melody
 - Range, mode, vocal/instrumental
 - Motion: stepwise, skipping, leaping, chromatic, active/stable, articulated/continuous
 - Patterns: rising, falling, sawtooth, undulating, etc.
 - Peaks and lows

Style analysis, cont. (La Rue)

- Rhythm
 - Surface rhythm, vocabulary & frequency of patterns
 - Meter, tempo, module (fraction, pulse, motive, phrase, sentence, larger groupings)
 - Patterns of change: stress, lull, transition
 - Fabrics: homorhythmic, polyrhythmic, variant rhythmic density
- Growth
 - systematic movements in musical dimensions, tempos, dynamics, meters, etc
 - Movement: structural/ornamental
- Text influence (lyrics, lyric functions)

Style analysis, cont. (La Rue)

- Don't Fence Me In (Cole Porter)

Fred Hersch

Willy Nelson/Leon Russell

Greatest Cowboy Songs

Louie Armstrong

David Byrne

Composing melodies

Melody first: Note trajectories

Key: From a set of notes in a scale

Phrases & phrase structure

(pattern, similarity/proximity, timing)

Chords first: From chord progressions

Melody (Wikipedia)

- Melody is said to result where there are interacting patterns of changing events occurring in time."[\[1\]](#)Change is necessary for events "to be understood as related or unrelated." Melodies often consist of one or more musical [phrases](#), [motifs](#), and are usually repeated throughout a [song](#) or [piece](#) in various forms.
- Melodies may also be described by their [melodic motion](#) or the pitches or the [intervals](#) between pitches..., pitch range, [tension](#) and release, continuity and coherence, [cadence](#), and shape. "Many extant explanations [of melody] confine us [sic] to specific stylistic models, and they are too exclusive."[\[1\]](#)

Establishment of the tonic (tonal system, tonality induction)

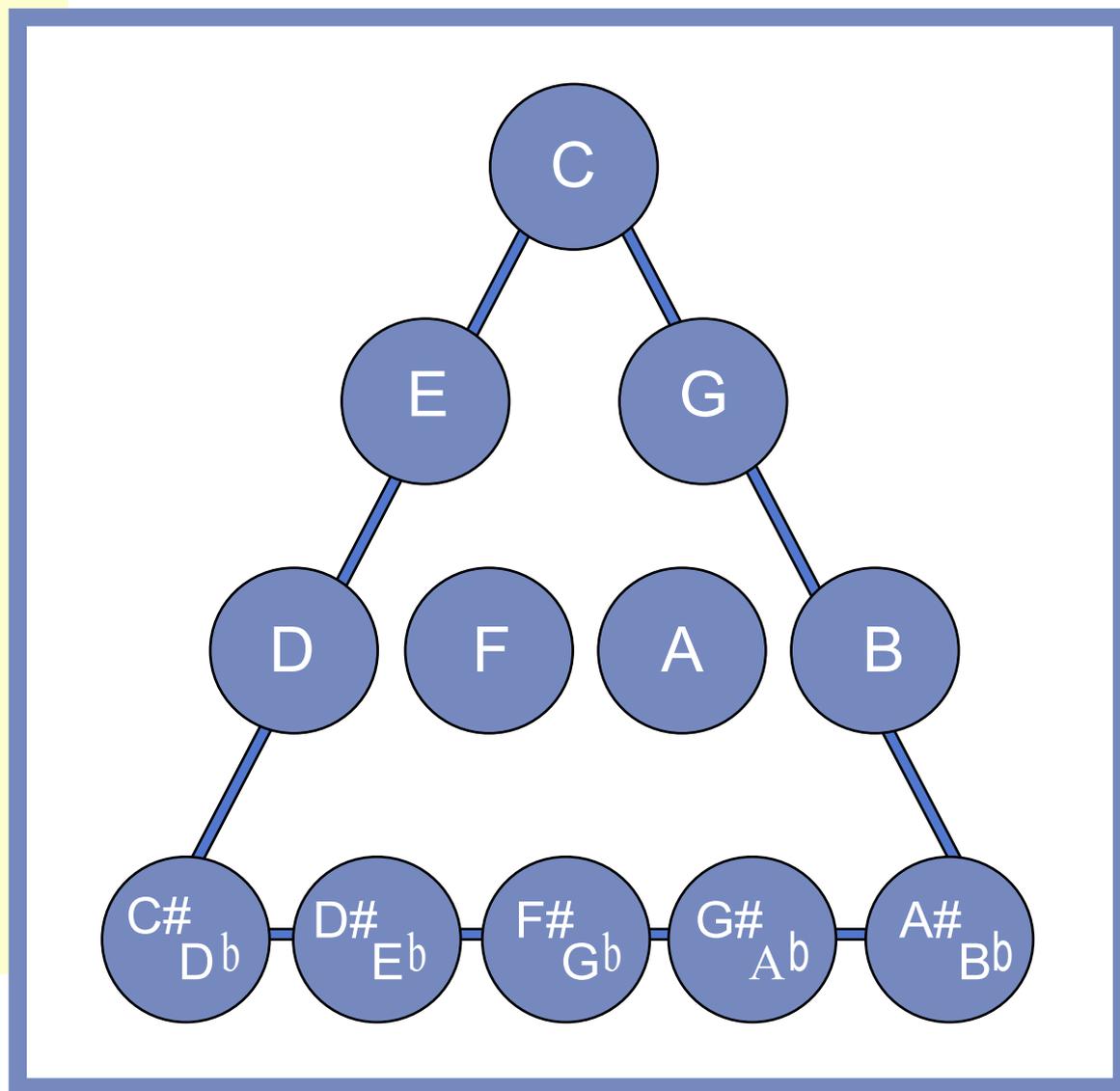
- First note (most salient)
- Last note (most salient in memory)
- Most frequent or longest duration note
- Note pattern may imply a tonic
- Perception of tonic may be influenced by melodic and harmonic context
- Key-finding algorithms have been developed, but these can make errors (i.e. no strict rules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

Tonal hierarchy of notes within the key of C

Ranking:
similarity to the tonic

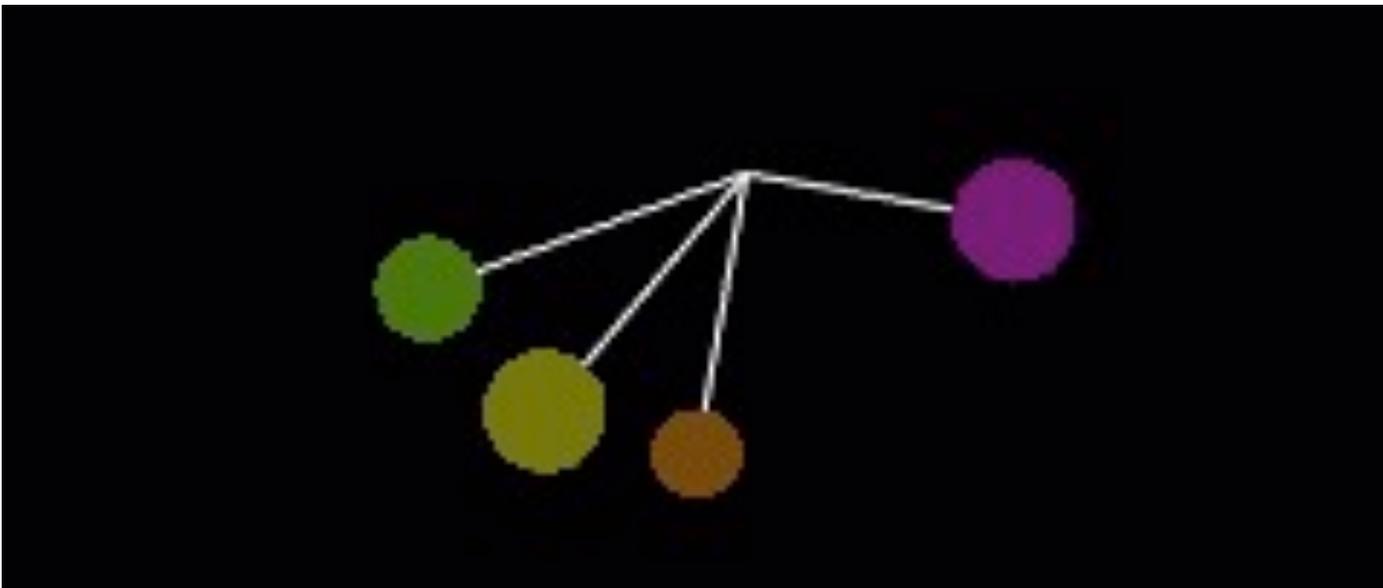
Notion of distance
from tonic in
pitch-similarity space

Melody as trajectory
away from and toward
the tonic and/or other
points in space



Butler

Figure by MIT OpenCourseWare.



Courtesy of Stephen Malinowski. Used with permission.

Music Animation Machine HARMONIC COMPASS

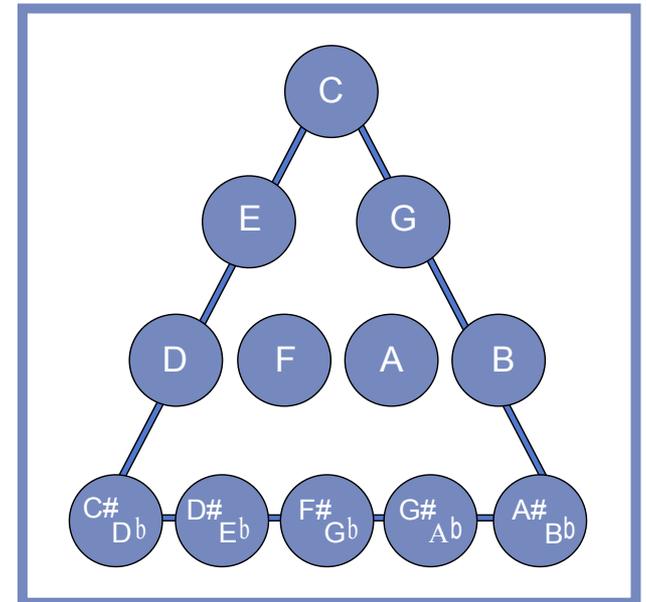


Figure by MIT OpenCourseWare.

Tonal system

see also

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

from Bigand chapter

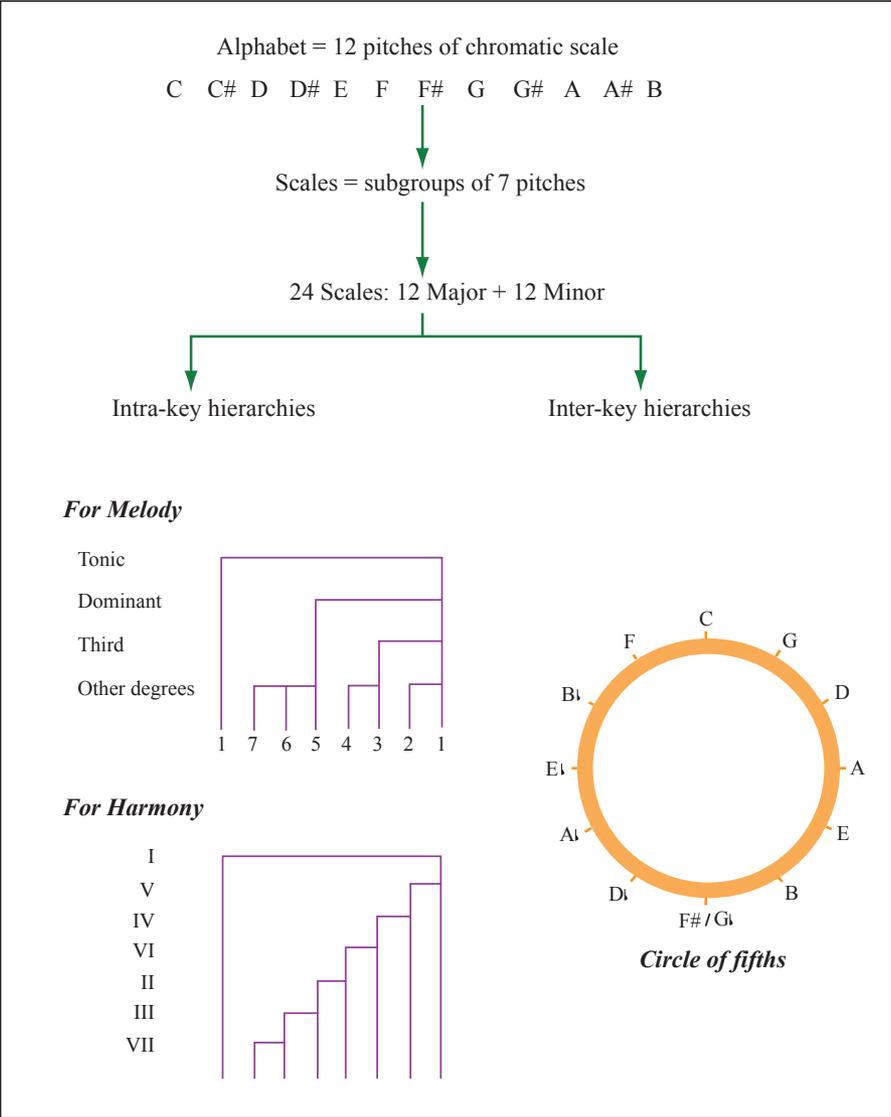


Figure by MIT OpenCourseWare.

Pitch distances

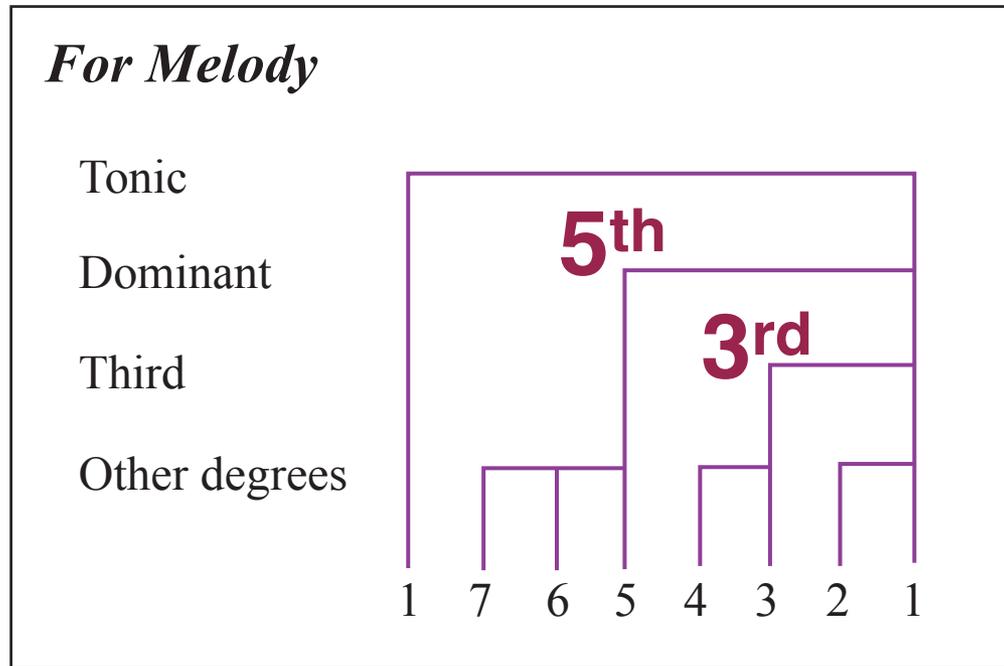


Figure by MIT OpenCourseWare.

Home

Near

Far away

Melodic groupings, pitch hierarchies, and musical tension

Image removed due to copyright restrictions. See Fig. 8.2 in Bigand, E., and S. McAdams.
Thinking in Sound. New York, NY: Oxford University Press, 1993. ISBN: 9780198522577.

What makes a melody a recognizable pattern?

What is the representational essence of melody such that it can be recognized

- 1) if notes are transposed (all shifted by the same frequency ratio)?**
- 2) if notes are played faster or slower (tempo invariant)**

is it contour? : up/down changes in pitch

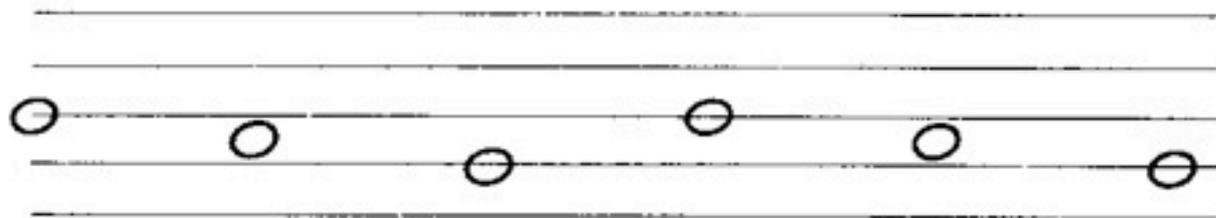
does it depend on musical intervals?:

as relative distances in pitch space

absolute pitches?: note

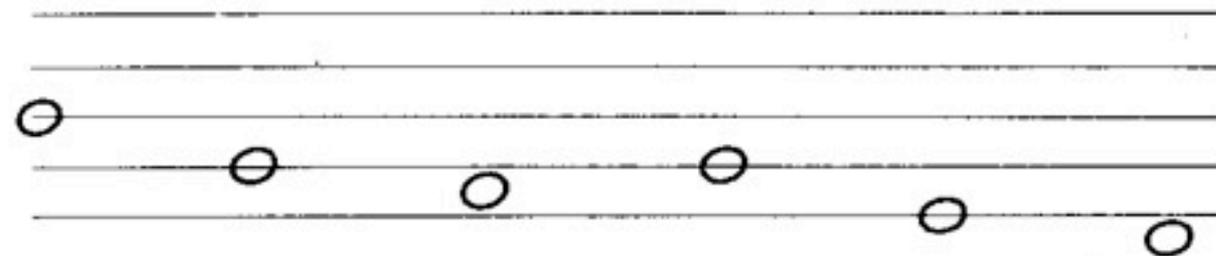
scale position?: re tonic

(a)



	-	-	+	-	-		CONTOUR
	-2	-2	4	-2	-2		INTERVAL
B	A	G	B	A	G		NOTE
7	6	5	7	6	5		SCALE POSITION

(b)



	-	-	+	-	-		CONTOUR
	-4	-2	+2	-3	-2		INTERVAL
B	G	F	G	E	D		NOTE
7	5	4	5	3	2		SCALE POSITION

Courtesy of MIT Press. Used with permission.

Source: Handel, S. *Listening: An Introduction to the Perception of Auditory Events*. MIT Press, 1989.

Melody and Note Durations

Too short:
Weak
Pitches

Too long:
Lack of
interaction
between
pitches

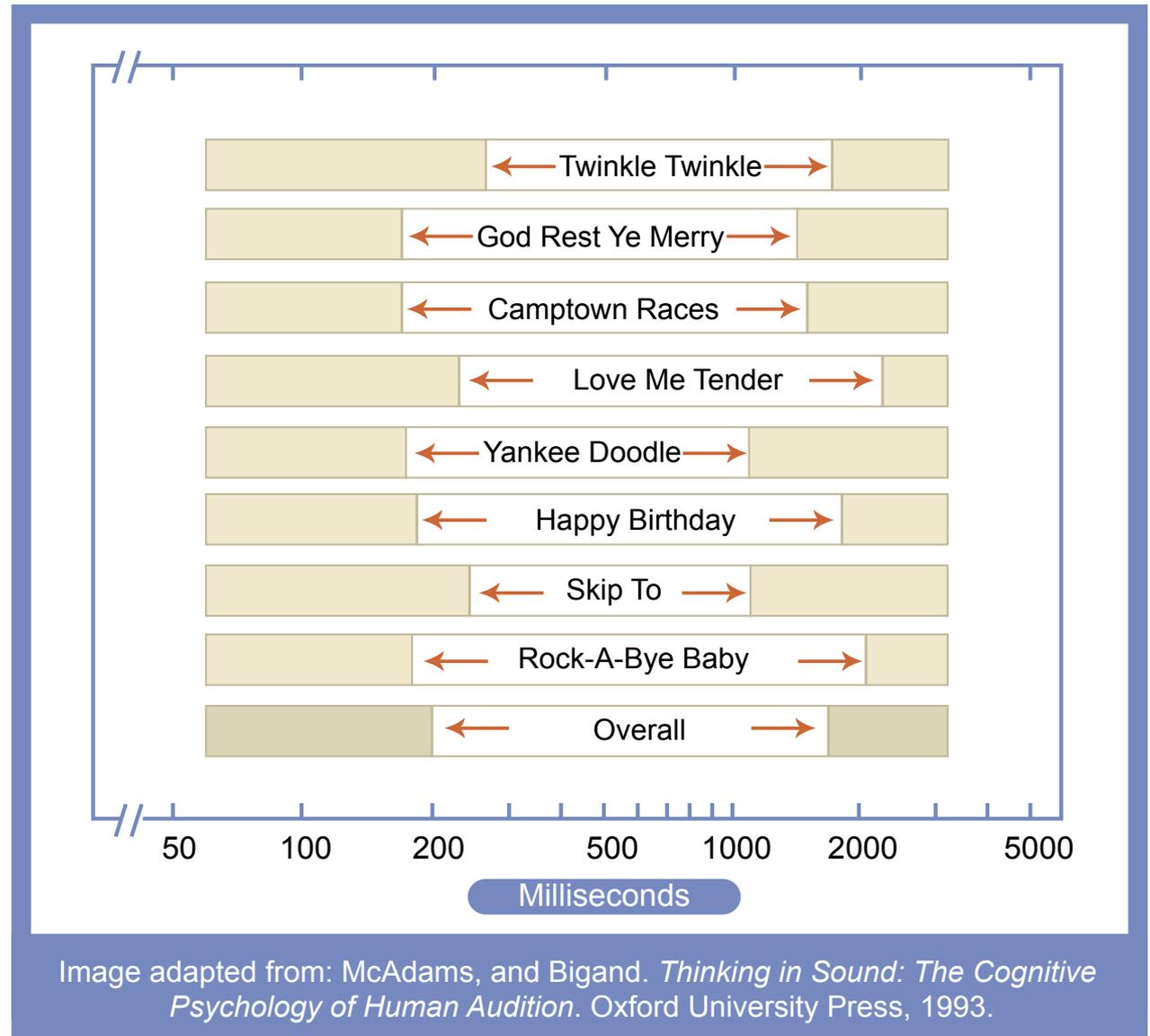


Image adapted from: McAdams, and Bigand. *Thinking in Sound: The Cognitive Psychology of Human Audition*. Oxford University Press, 1993.

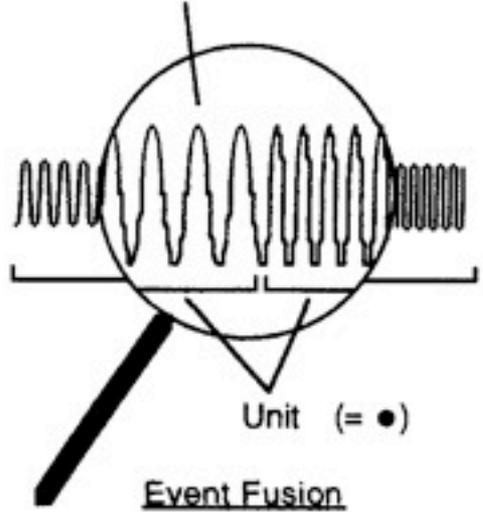
Figure by MIT OpenCourseWare.

From *Thinking in Sound*
McAdams, Bigand eds.

Music & memory

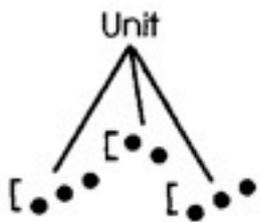
ECHOIC MEMORY and EARLY PROCESSING

Waveform: Rapid Variations in Air Pressure: Each event = 1/20 to 1/20,000 sec



Event Fusion
(Units formed by change in frequency of vibration, loudness level, or timbre)

SHORT-TERM MEMORY

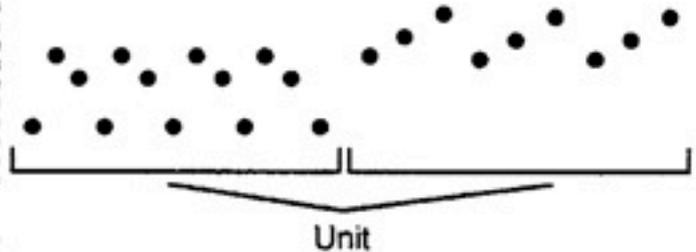


Melodic grouping
Units formed by breaks in pitch contour)



Rhythmic Grouping
(Units formed by longer duration, higher intensity, etc.)

LONG-TERM MEMORY



Formal Sectioning
(Units formed by changes in overall patterning)

Source: Synder, B. *Music and Memory*.
Cambridge, MA: MIT Press, 2000.
Courtesy of MIT Press. Used with permission.

What makes a "good" or memorable melody?

Coherence of pattern

Balance between order & chaos (surprise)

U-shaped preference curve

Related physiological assumptions:

**Relations (Gestaltists) ~ correlation-based
representations**

vs.

local features (associationists)

atomistic feature detectors, machine vision

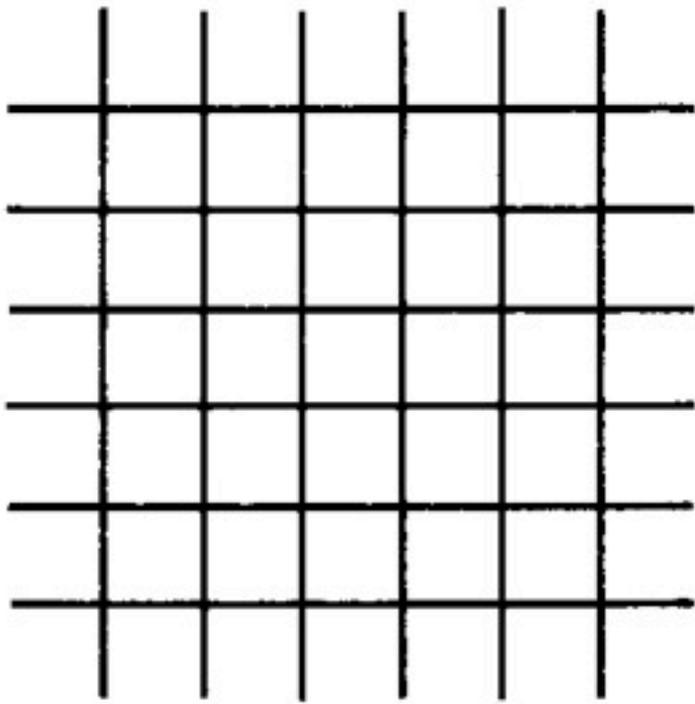


FIGURE 2.12. REPOSE

Figures from *A Primer of Visual Literacy* by Donis A. Dondis.
Cambridge, Mass., MIT Press [1973]. Used with permission.

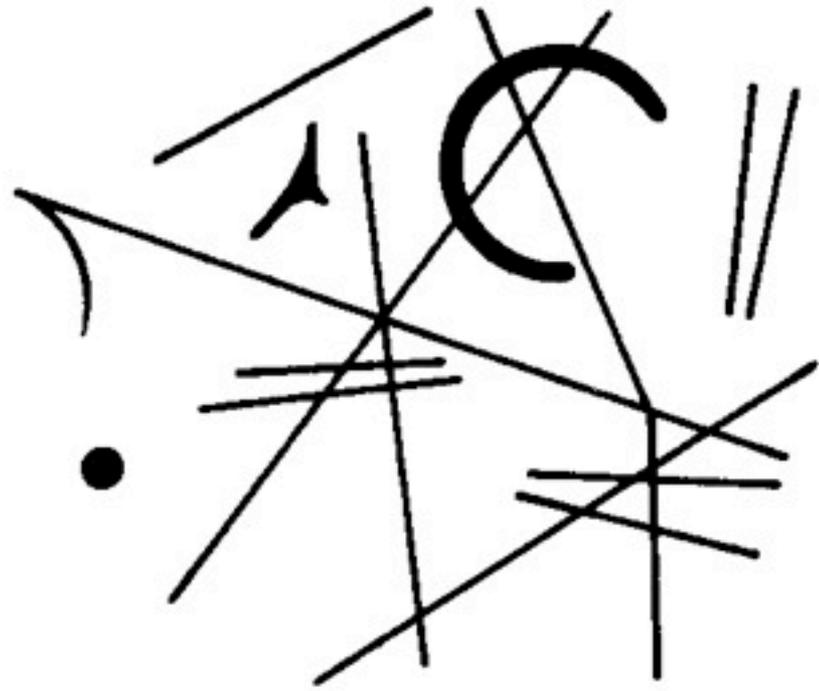


FIGURE 2.13. STRESS

A Primer of Visual Literacy
Donis Dondis, MIT Press, 1973

Tension-relaxation

Implication-realization (implication-expectation)

(from Meyer, 1956, *Emotion & Meaning in music*)

cf. Namour's application to melody

Distance from tonic, patterns of stress and relaxation

Patterns Illustrating Gestalt Organization

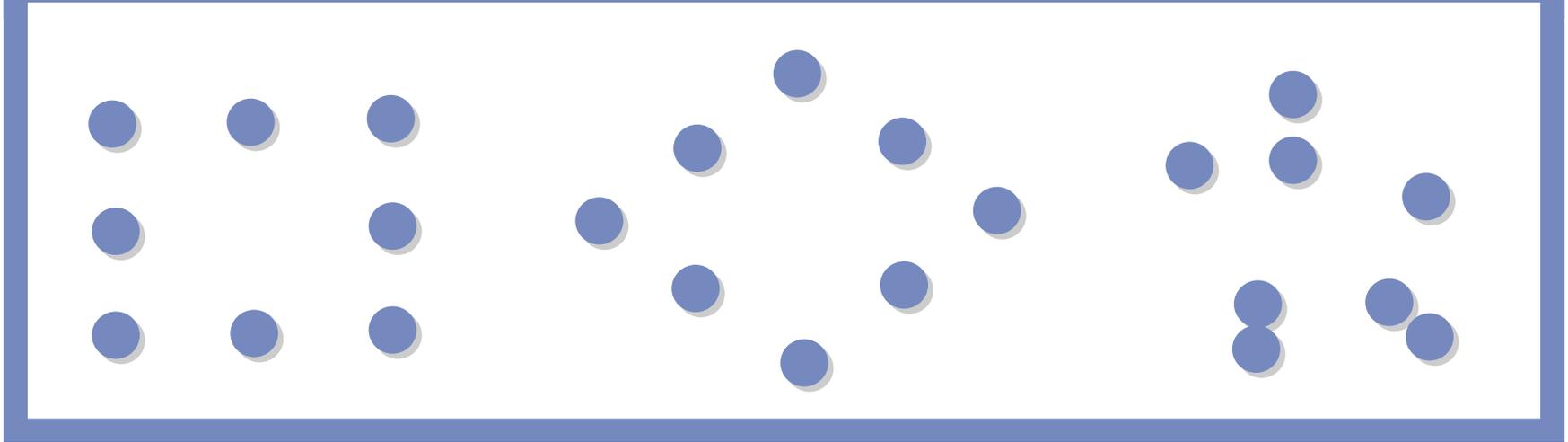


Figure by MIT OpenCourseWare.

Gestaltist principles

Relations rather than perceptual atoms

Intervals (relations between notes, re: tonic) as relations

Notion of strong vs. weak organization

Principles of simplicity, similarity, proximity, inclusiveness, common fate, closure

Gestalt principles (Jay Dowling, in Aiello)

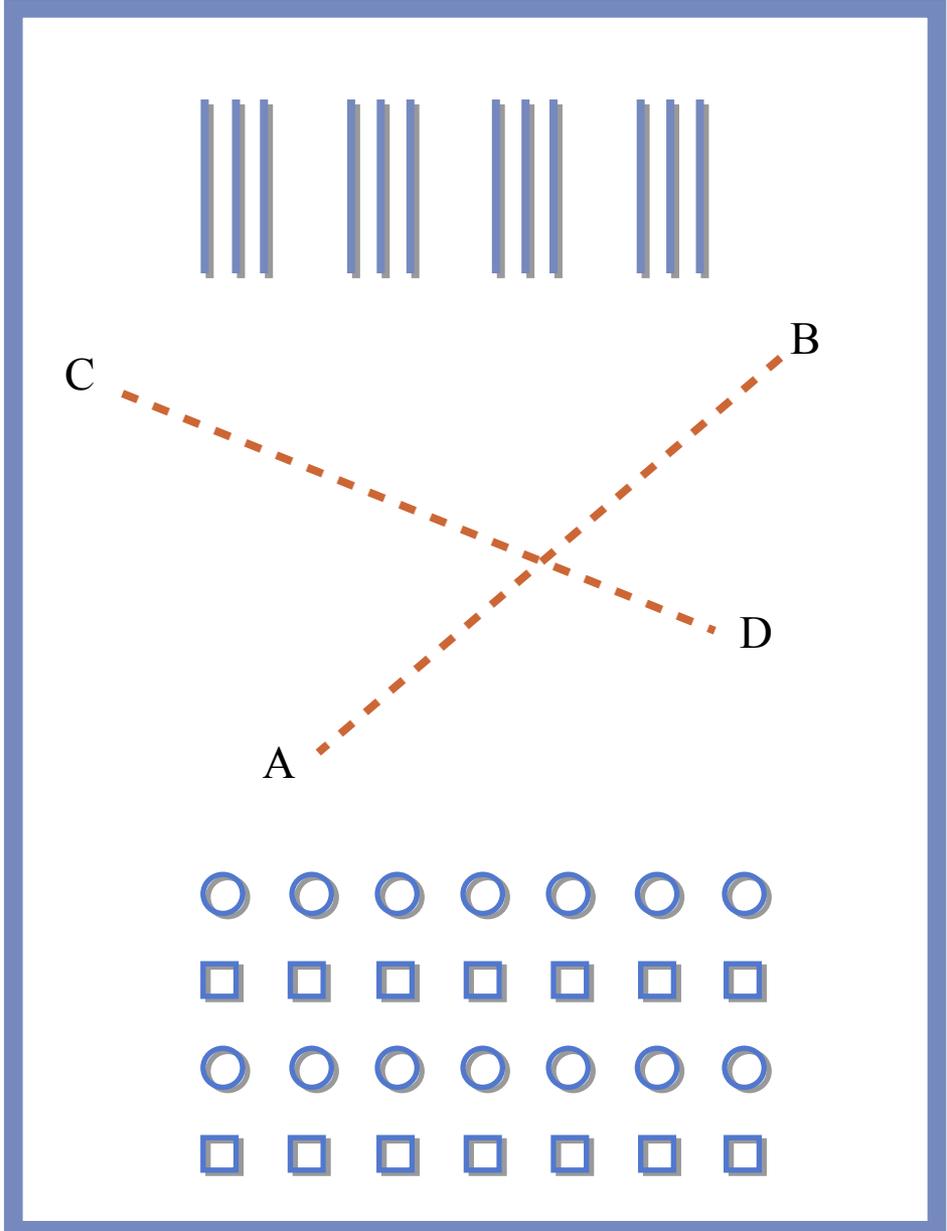


Figure by MIT OpenCourseWare.

Melody Probe-melody studies

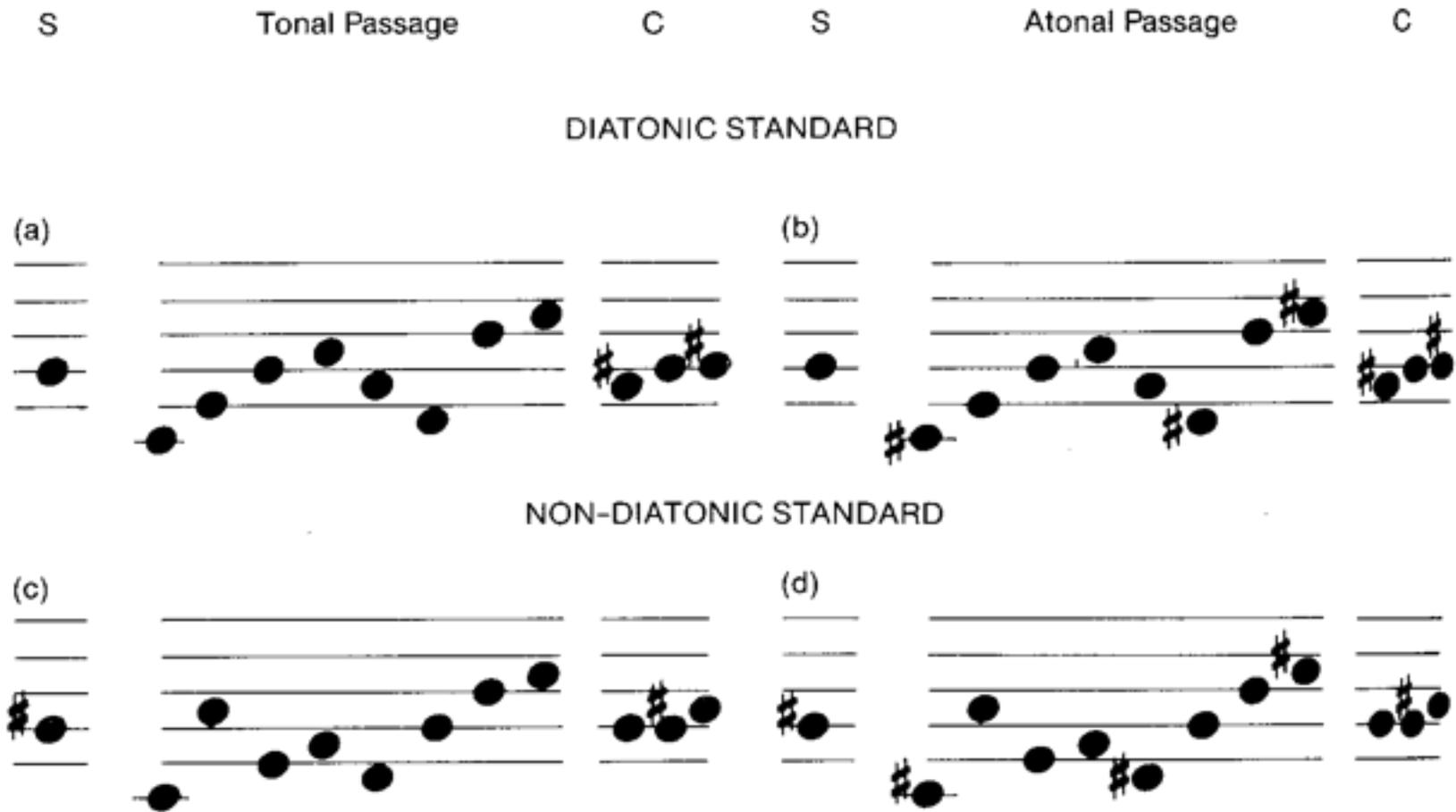


Figure 10.13

Identification of notes within tonal and atonal contexts. On each trial, subjects were presented the standard (S), a short eight-note passage, and then one of the three possible comparison notes (C). The comparison was either the same as the standard (a correct match) or was one semitone higher or lower (an incorrect match). The four variations of the standard note (diatonic vs. nondiatonic) and interpolated passage (tonal vs. atonal) are illustrated in (a)–(d). In addition, the three possible comparison stimuli are displayed (adapted from Krumhansl 1979).

Courtesy of MIT Press. Used with permission. Source: Handel, S.
Listening: An Introduction to the Perception of Auditory Events MIT Press, 1989.

Strong vs. weak organization

Patterns Illustrating Gestalt Organization

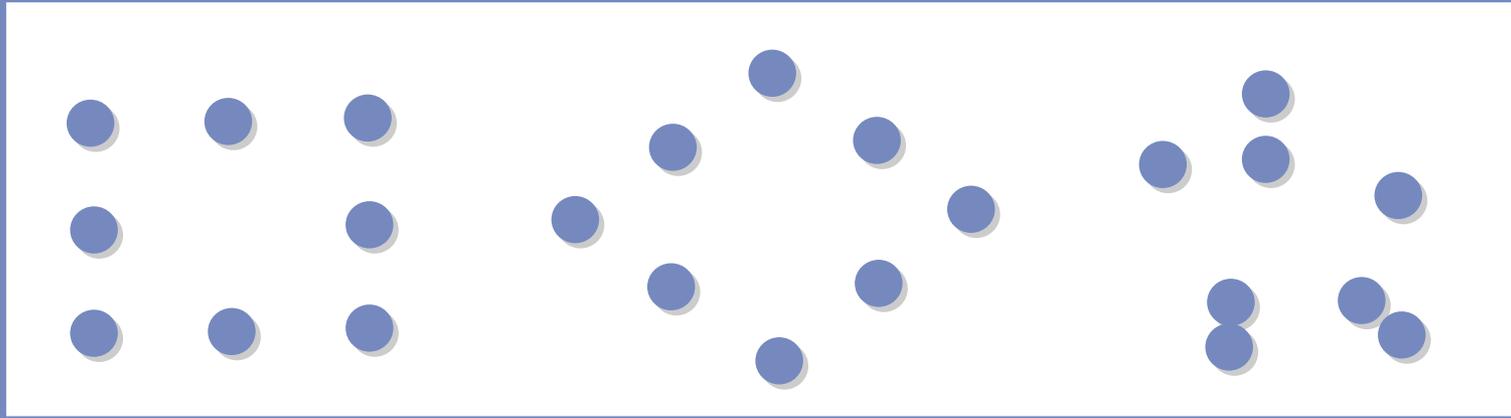
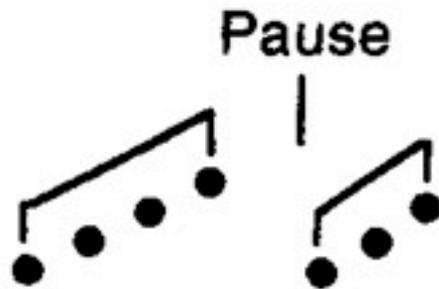
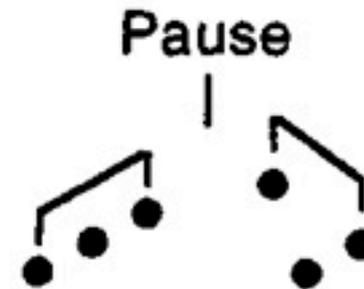


Figure by MIT OpenCourseWare.



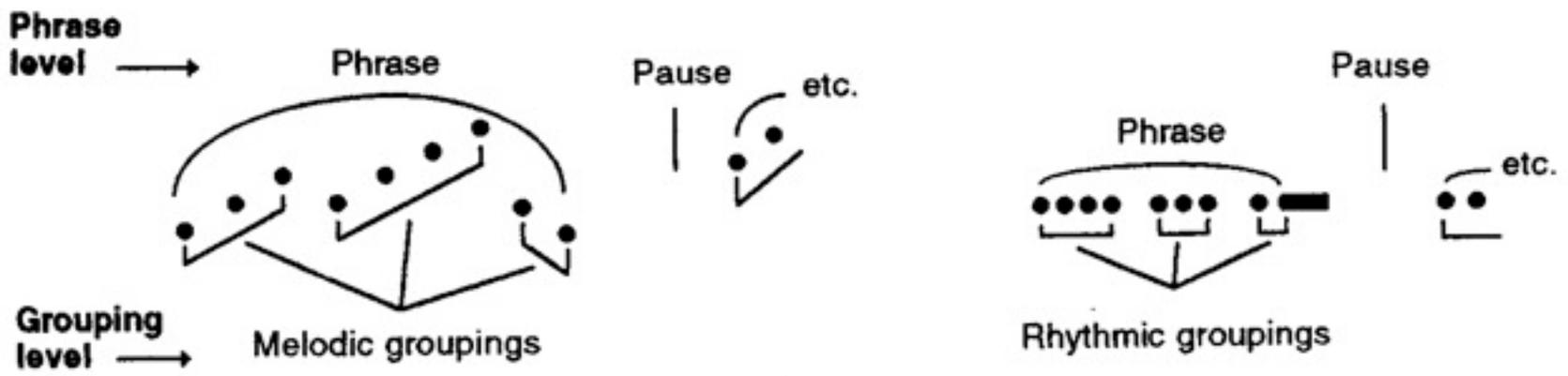
Congruence of temporal proximity and melodic leap.

Source: Synder, B. *Music and Memory*.
Cambridge, MA: MIT Press, 2000.
Courtesy of MIT Press. Used with permission.



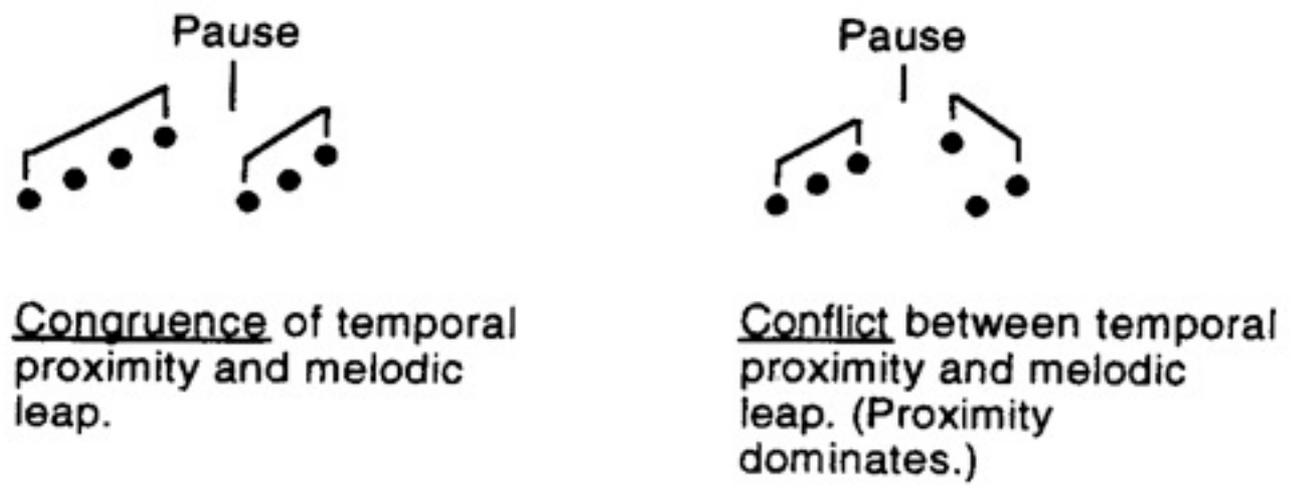
Conflict between temporal proximity and melodic leap. (Proximity dominates.)

Phrase structure from groupings



Source: Synder, B. *Music and Memory*.
 Cambridge, MA: MIT Press, 2000.
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Figure 3.3
 Melodic and rhythmic grouping.



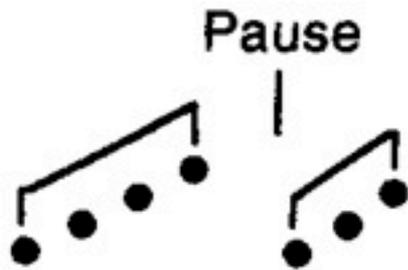
Congruence of temporal proximity and melodic leap.

Conflict between temporal proximity and melodic leap. (Proximity dominates.)

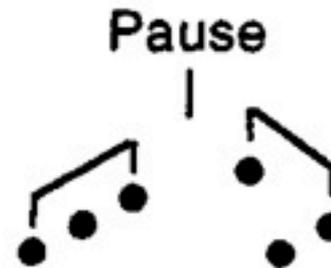


Figure 3.2
 Conflict of grouping forces.

Music & memory



Congruence of temporal proximity and melodic leap.



Conflict between temporal proximity and melodic leap. (Proximity dominates.)

Figure 3.2
Conflict of grouping forces.

Source: Snyder, B. *Music and Memory*.

Cambridge, MA: MIT Press, 2000.

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Deep structure of melodies

Even if the surface structure is altered quite a bit (as is common in jazz or any variations on a theme), the melody is recognizable. Part of this may be the result of chord progressions, and aspect of the deep intervallic harmonic and melodic structure.

Schenker pioneered a method of reducing a melody to its essentials, stripping off successive layers of ornament.

Schenkarian time-span reduction of melody (Lerdahl)

Images removed due to copyright restrictions.

Fig. 1.6 and 1.7 in Lerdahl, F. *Tonal Pitch Space*.
New York, NY: Oxford University Press, 2001.

Preview in [Google Books](#).

Schenkarian time-span reduction of melody (Lerdahl)

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Fig. 1.3 in Lerdahl, F. *Tonal Pitch Space*.
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Chord progression & harmonic groupings

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See Fig. 8.2 in Bigand, E., and S. McAdams.

Thinking in Sound. New York, NY: Oxford University Press, 1993. ISBN: 9780198522577.

Tonality and harmony

- **Harmony: concurrent sounds, vertical dim.**
- **Tonality: relating to a tonic (pitch center, “home”)**
- **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**
- **Harmonic tension-relaxation dynamics:**
 - **pitch stability (multiplicity of alt. organizations)**
 - **movement to & away from tonic (confirmation of 1 pitch framework)**

Triads: 3-note chords made up of thirds

Major: root + major third + fifth

Minor: root + minor third + fifth

Image removed due to copyright restrictions.
See Ex. 15, 16 in Piston, Walter. *Harmony*.

Chord notation: scale degrees

Chords are also distinguished and notated by the scale **degree** of their **root note** or **bass note**. For example, since the first scale degree of the C major scale is the note C, a triad built on top of the note C would be called the *one* chord, which might be notated 1, I, or even C, in which case the assumption would be made that the **key signature** of the particular piece of music in question would indicate to the musician what function a C major triad was fulfilling, and that any special role of the chord outside of its normal diatonic function would be inferred from the context.

Roman numerals indicate the root of the chord as a **scale degree** within a particular **key** as follows:

- I tonic
- ii supertonic
- iii mediant
- IV subdominant
- V dominant
- vi submediant
- vii subtonic/leading tone

Many analysts use lower-case Roman numerals to indicate minor triads and upper-case for major ones, with degree and plus signs (o and +) to indicate diminished and augmented triads, respectively.

Probe-melody studies

Listeners can use both contour (pitch height, pitch direction changes) and the interval/scale degree structure for melodic recognition.

For well-formed coherent easily remembered melodic patterns, (STRONG PATTERNS) interval alterations are highly noticeable.

For ill-formed, hard-to-remember melodies (WEAK PATTERNS), contour is used more for

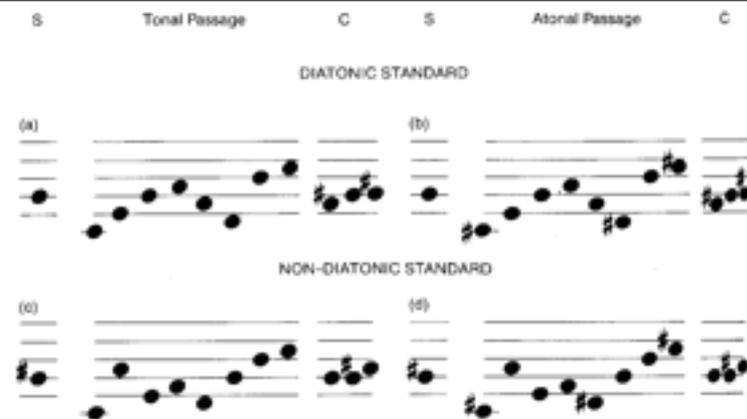


Figure 10.13 Identification of notes within tonal and atonal contexts. On each trial, subjects were presented the standard (S), a short eight-note passage, and then one of the three possible comparison notes (C). The comparison was either the same as the standard (a correct match) or was one semitone higher or lower (an incorrect match). The four variations of the standard note (diatonic vs. nondiatonic) and interpolated passage (tonal vs. atonal) are illustrated in (a)–(d). In addition, the three possible comparison stimuli are displayed (adapted from Krumhansl 1979).

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Source: Handel, S. *Listening: An Introduction to the Perception of Auditory Events*. MIT Press, 1989.

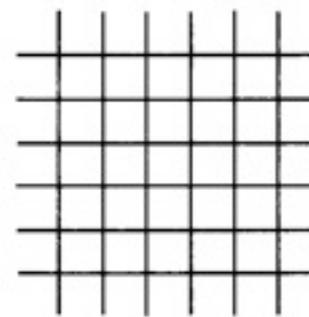


FIGURE 2.12. REPOSE



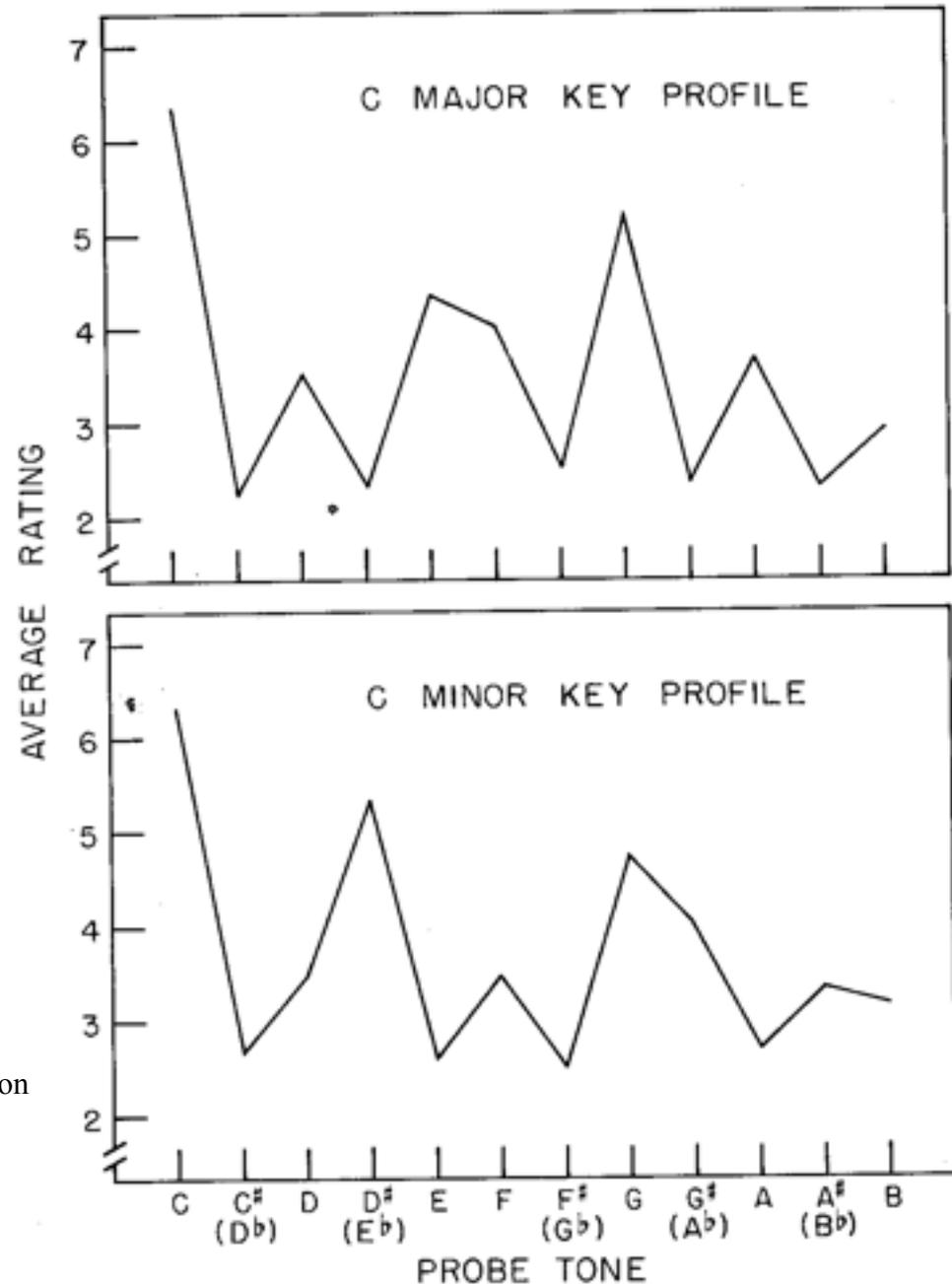
FIGURE 2.13. STRESS

Figures from *A Primer of Visual Literacy* by Donis A. Dondis. Cambridge, Mass., MIT Press [1973]. Used with permission.

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**



Source: Krumhansl, C. L., and E. J. Kessler.
"Tracing the Dynamic Changes in Perceived Tonal Organization
in a Spatial Representation of Musical Keys."
Psychological Review 89, no. 4 (July 1982): 334-368.
Courtesy of the American Psychological Association.

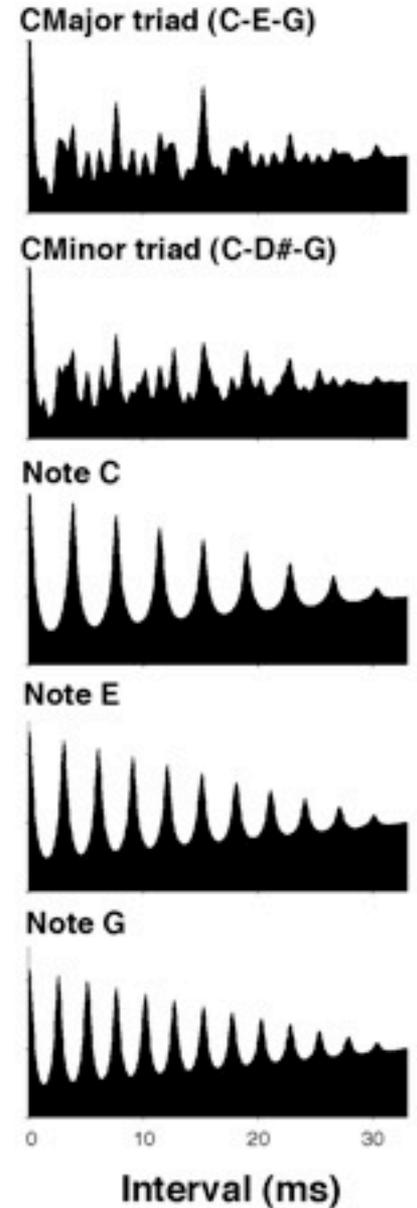
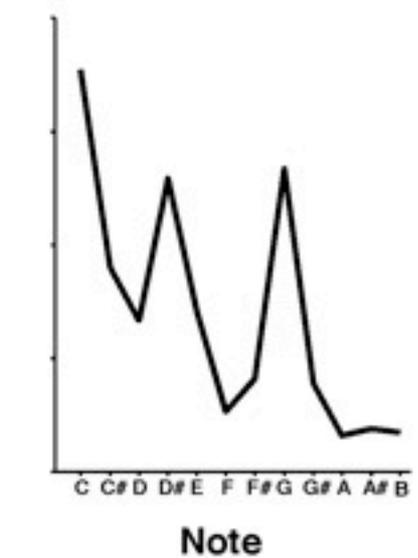
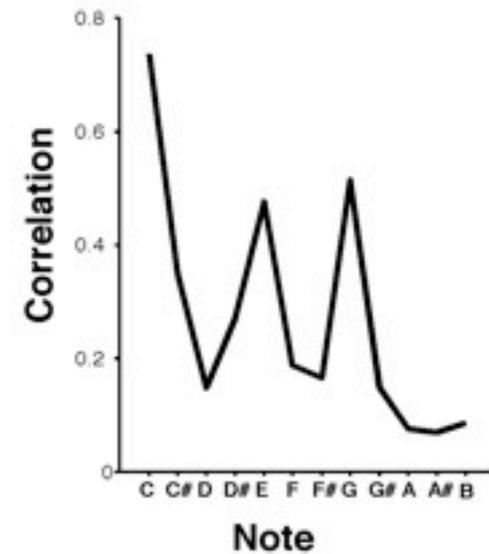
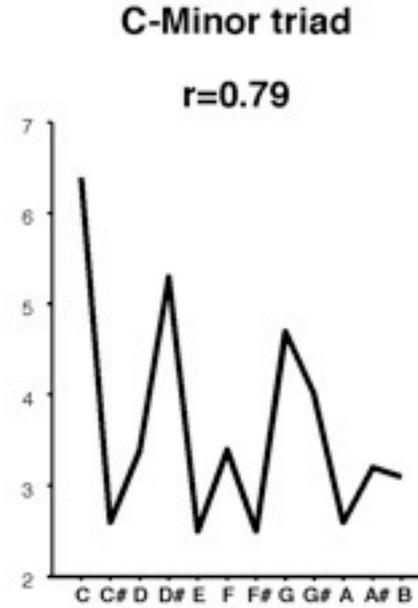
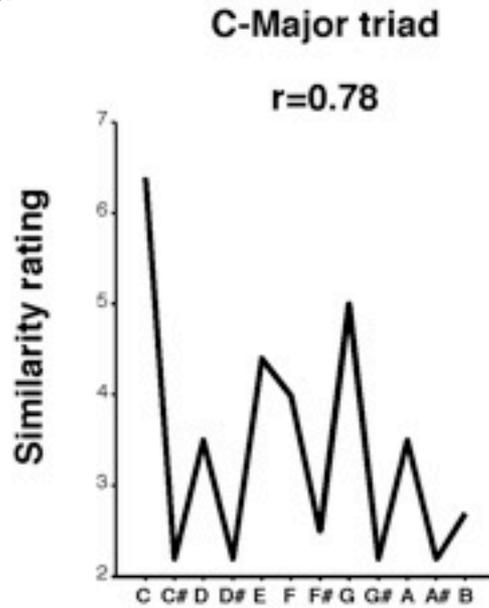
How much of the structure of tonal pitch space – perceptual distances between notes and keys and between keys and other keys – falls out of the structure of basic auditory representations?

How much of it is acquired through associative learning (culture) of pitch combinations?

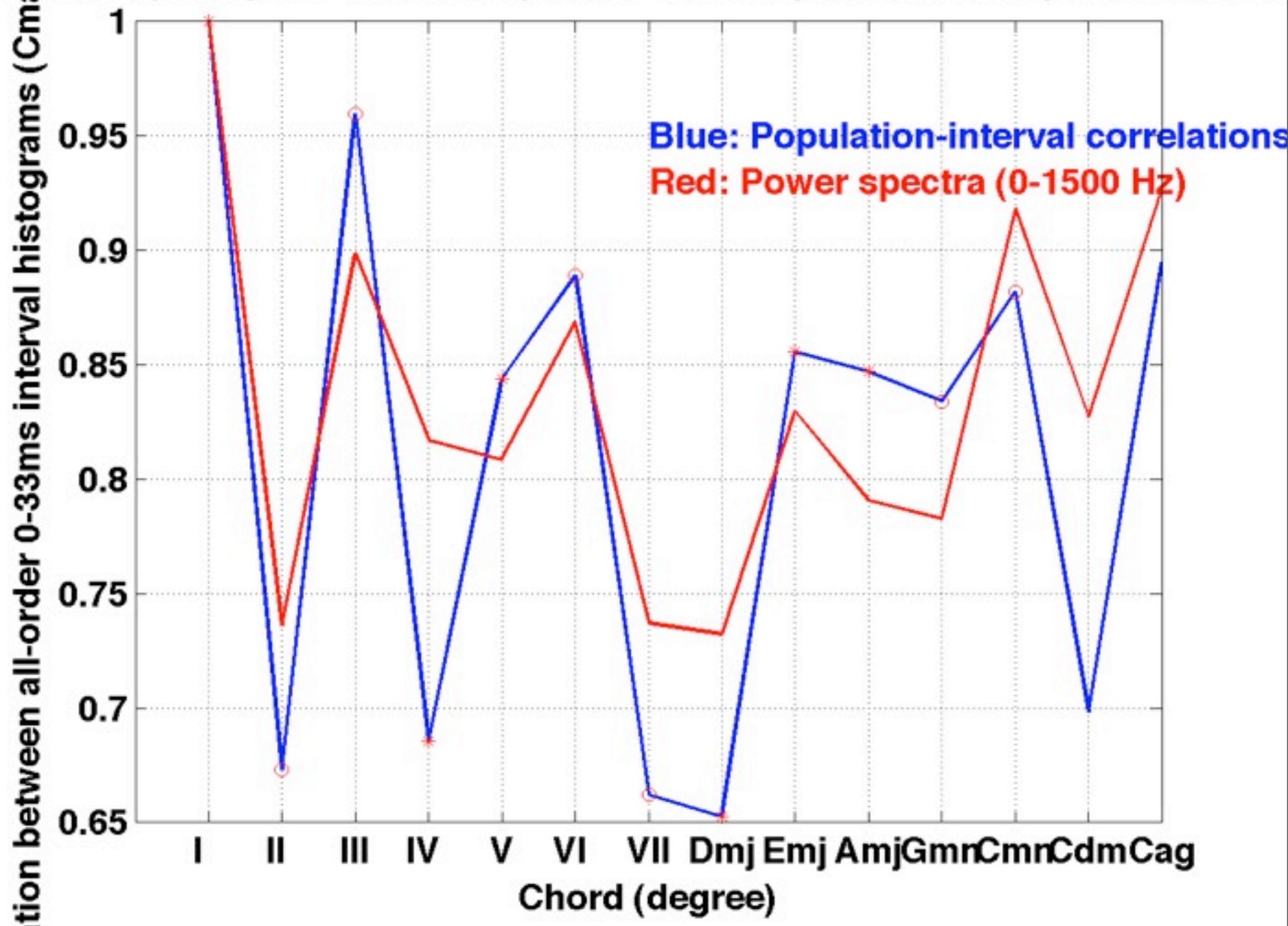
Note-chord

Krumhansl
probe tone
study

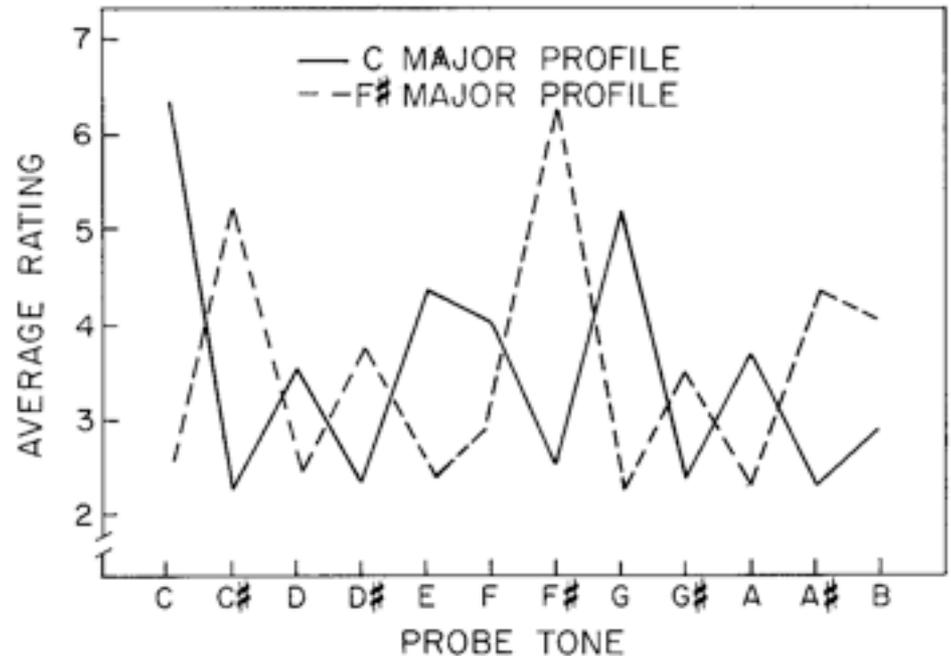
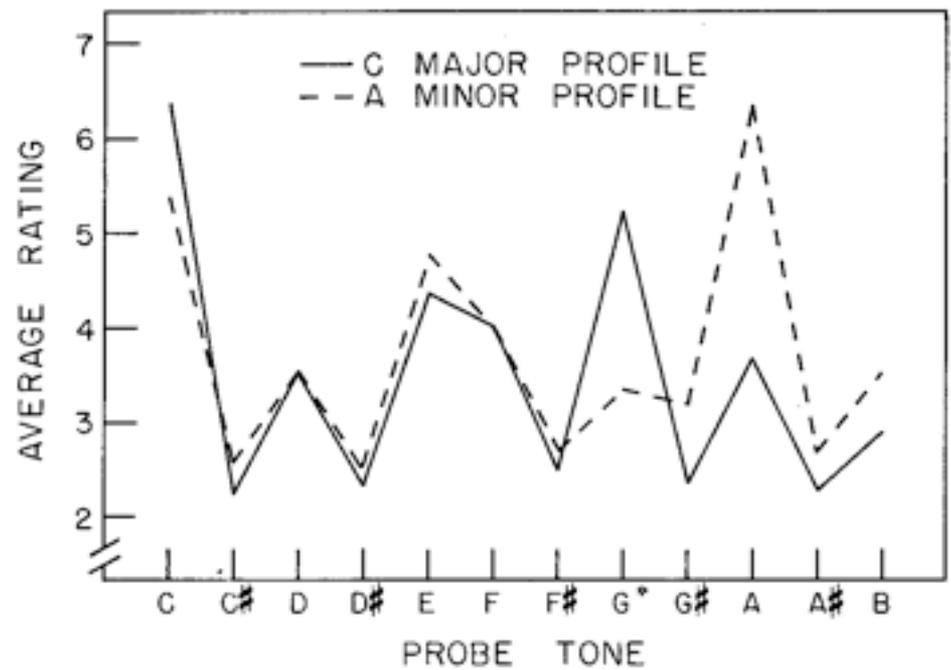
Correlations of
simulated PIDs



Predicted perceptual distance: pattern-similarity between Shepard-tone triads



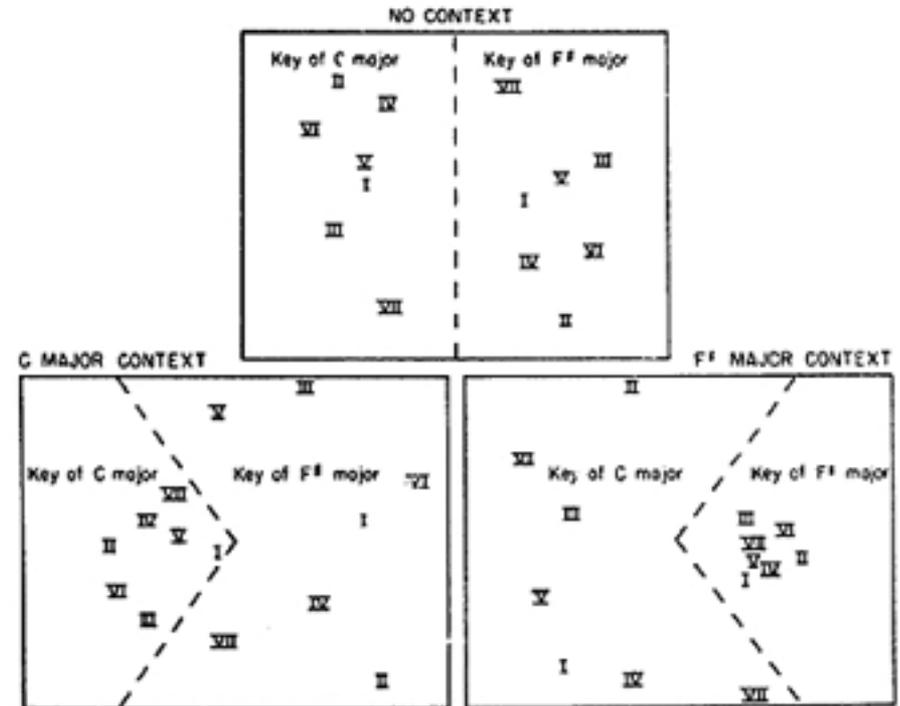
Probe tone profiles for related keys



Source: Krumhansl, C. L., and E. J. Kessler.
"Tracing the Dynamic Changes in Perceived Tonal Organization
in a Spatial Representation of Musical Keys."
Psychological Review 89, no. 4 (July 1982): 334-368.
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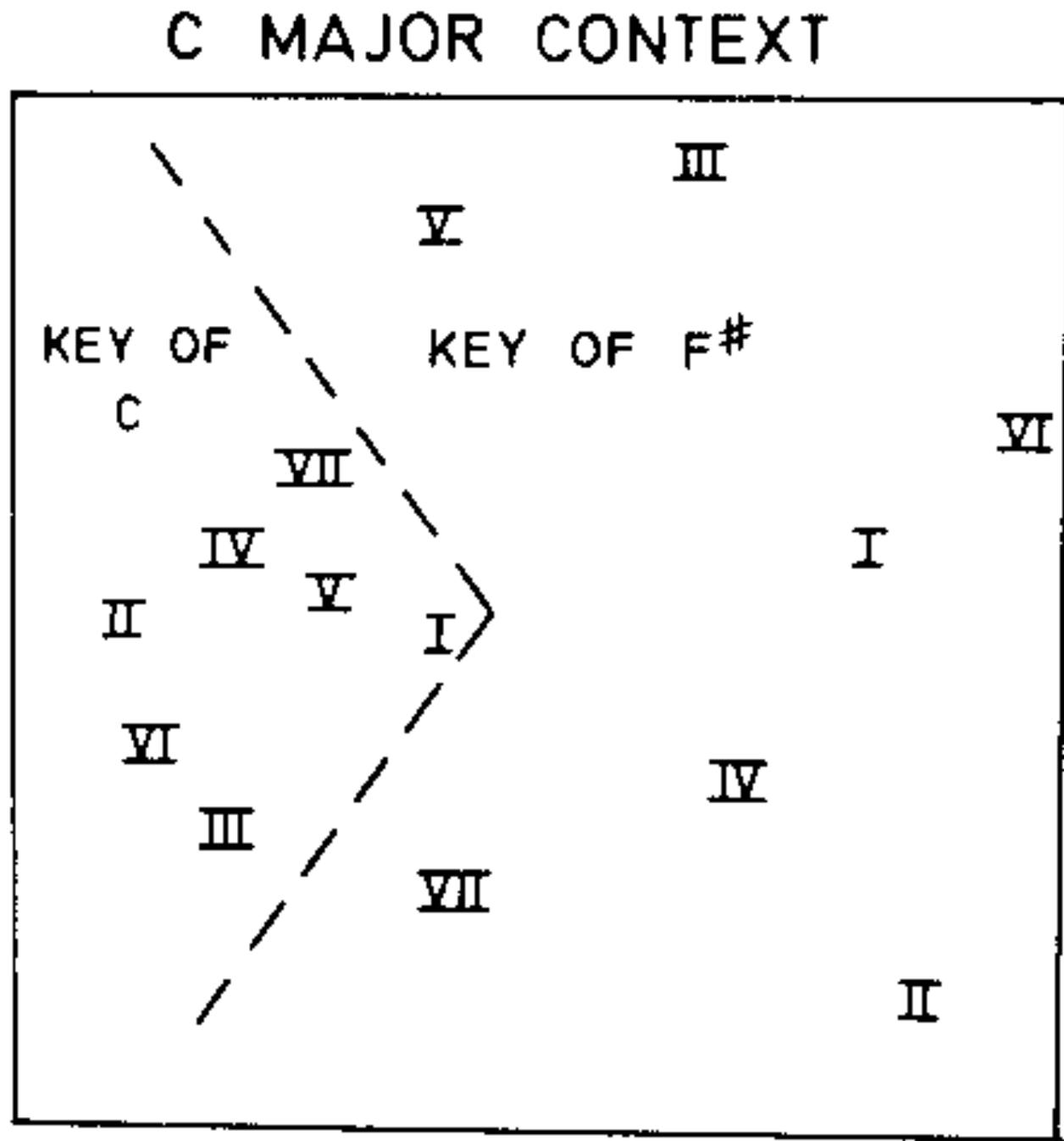
Context effects: relatedness of chords within & across keys

Figure 1. *Multidimensional scaling solutions of fourteen chords—seven from the key of C major and seven from the key of F# major. All ordered pairs of chords were judged (a) with no context (top), (b) in a C major context (left), and (c) in an F# major context (right). Chords separate according to key membership. A tonal context shrinks distances between chords in the context key, and stretches distances between chords out of the context key.*



Source: Fig. 1 in Bharucha, J. and C. L. Krumhansl.
"The representation of harmonic structure in music:
Hierarchies of stability as a function of context." *Cognition* 13, no.
1 (January 1983): 63-102. Courtesy Elsevier, Inc.,
<http://www.sciencedirect.com>. Used with permission.

Similarity relations between chords in the key of C



Source: Fig. 1 in Bharucha, J. and C. L. Krumhansl. "The representation of harmonic structure in music: Hierarchies of stability as a function of context." *Cognition* 13, no. 1 (January 1983): 63-102. Courtesy Elsevier, Inc., <http://www.sciencedirect.com>.
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Leman & Carreras (1997):

Images removed due to copyright restrictions.

See Figs. 1 and 4 in Leman, M. and F. Carreras.

"Schema and Gestalt: Testing the Hypothesis of Psychoneural Isomorphism by Computer Simulation."

In *Music, Gestalt, and Computing: Studies in Cognitive and Systematic Musicology*. Heidelberg, Germany: Springer, 1997. DOI: 10.1007/BFb0034112

Melodic groupings, pitch hierarchies, and musical tension

Image removed due to copyright restrictions. See Fig. 8.2 in Bigand, E., and S. McAdams.
Thinking in Sound. New York, NY: Oxford University Press, 1993. ISBN: 9780198522577.

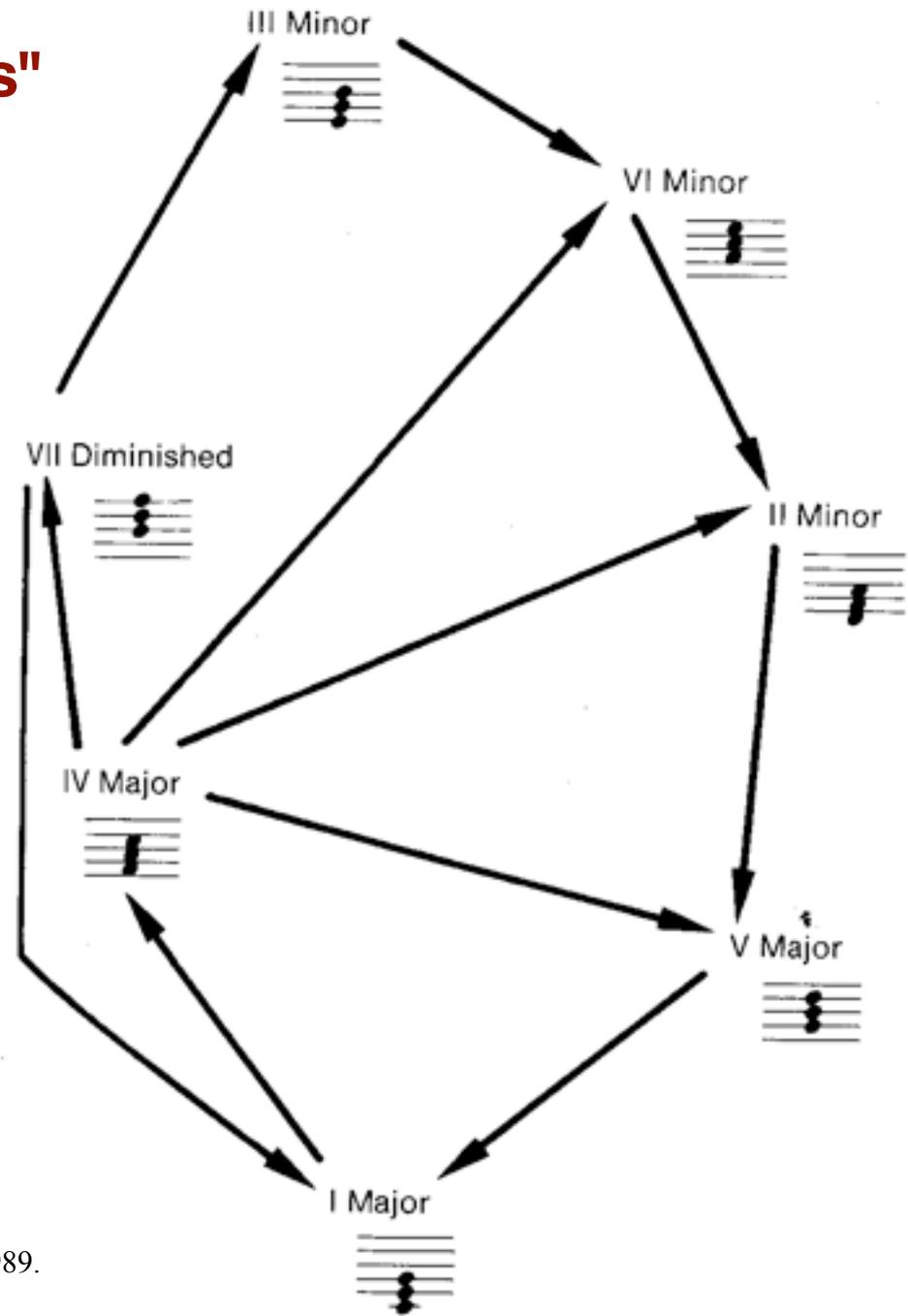
Chord progressions, "cadences"

sequences of chords

tension & relaxation
instability-stability

One of the self-conscious aims of 20th c. "atonal" music (e.g. Schoenberg) is the avoidance of tonal centers and expectations

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



Courtesy of MIT Press. Used with permission.
Source: Handel, S. *Listening: An Introduction to the Perception of Auditory Events*. MIT Press, 1989.

Common progressions

"The most common chord progressions, in the common practice period and in popular music, are based on the first, fourth, and fifth scale degrees (tonic, subdominant and dominant); see three chord song, eight bar blues, and twelve bar blues.

The chord based on the second scale degree is used in the most common chord progression in Jazz, II-V-I.

The circle of fifths progression is generally regarded as the most common progression of the common practice period (1600-1900), involving a series of descending perfect fifths that often occur as ascending perfect fourths. The circle of fifths makes up many of the most commonly used progressions, such as II6, V, I in major."

-- Wikipedia

Common progressions used in contemporary popular music

• Twelve-bar blues • I - vi - IV - V⁸:

the 50s progression • I - V - vi - IV⁸:

for example 'Dammit' (Blink-182), 'With or Without You' (U2), 'Let It Be' (The Beatles).

This progression uses the same chords as the 50s progression, in a different order.

• I - I - IV - V⁸: for example the verse of 'Good Riddance (Time of Your Life)' by Green Day.

Three chord song

"A three-chord song is a **song** whose **music** is built around three **chords** that are played in a certain **sequence**. Perhaps the most prevalent type of three-chord song is the simple **twelve bar blues** used in **blues** and **rock and roll**.

Typically, the three chords used are the chords on the tonic, subdominant, and dominant (**scale degrees** I, IV and V): in the key of C, these would be the C, F and G chords. Sometimes the **V7 chord** is used instead of V, for greater **tension**.

Three-chord songs are easy for the listener to remember, which can make them effective in **pop music**. Some of the most famous songs to use three-chord patterns are "**Louie Louie**" by **The Kingsmen** and "**Wild Thing**" by **The Troggs**. Three-chord songs like these are also easier to learn than other, more complicated songs. Among others, **country singer Hank Williams** and **folk singer Bob Dylan** have written large numbers of such songs. **Denis Leary's** song "**Asshole**" uses a three chord progression. **Punk music** very often features three-chord songs - sometimes called a 'three chord trash' (cf. **The Ramones**)."
-- Wikipedia.

Common progressions used in the common practice period (roughly 1600-1900)

I, i May progress to any other triad. May interrupt any progression.

	Major keys	Minor keys
ii	ii-V, ii-vii6°	ii6 ° ii6 °-V ii* ii-V, ii-vii6°
iii	iii-ii6, iii-IV, iii-V, iii-vi	III III-ii6 °, III-iv, III-VI
IV	IV-I, IV-ii, IV-V, IV-vii6°	iv iv-i, iv-ii6 °, iv-V, iv-VII IV* IV-V, IV-vii6°
V	V-I, V-vi	V V-i, V-VI v* v-VI
vi	vi-ii, vi-IV, vi-V, vi-iii-IV	VI VI-ii6 °, VI-iv, VI-V, VI-III-iv
vii6°	vii6 °-I, vii6°-V	vii6 °/VII vii6°-i/VII-III

* ii and IV in minor used with an ascending #6; v in minor used with a descending 7.
See Chord (music)#Quality and Triads for a brief explanation of the notation used in this table.d

Modulation (Changes in tonic, key)

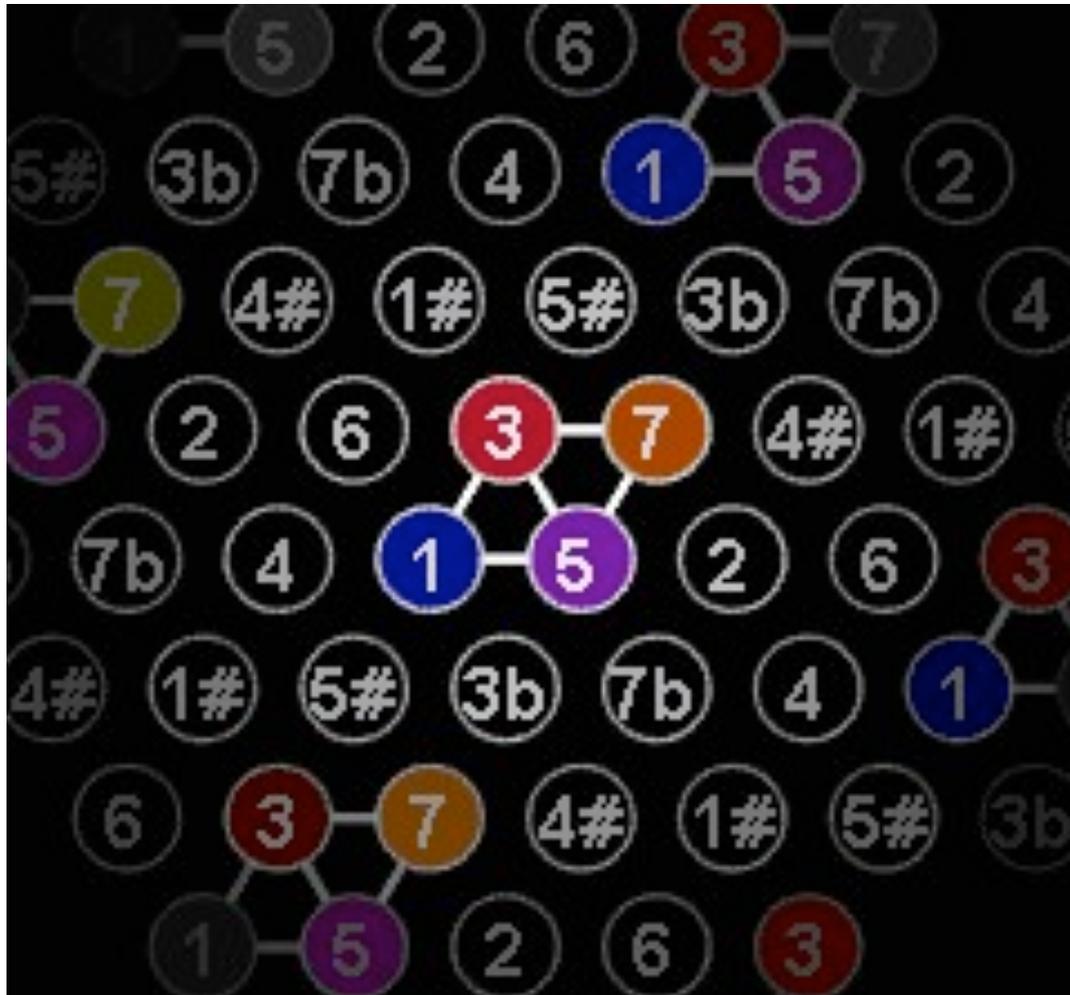
"In **music**, modulation is most commonly the act or process of changing from one **key** (**tonic**, or **tonal center**) to another. This may or may not be accompanied by a change in **key signature**. Modulations articulate or create the structure or **form** of many pieces, as well as add interest.

There are several different types of modulation -- (these) modulations may be prepared or unprepared, smooth or abrupt. It is smoother to modulate to more closely related keys than to keys further away. Closeness is determined by the number of notes in common between keys, which provides more possible pivot chords, and their closeness on the circle of fifths. A modulation is often completed by a cadence in the new key, which helps to establish it. Brief modulations are often considered tonicizations."

-- Wikipedia, music modulation.

Types of modulation (different ways of bridging the transition): common chord, common tone, chromatic, enharmonic, phrase (direct, abrupt, "truck driver's gear change", sequential.

Music Animation Machine (Triads, LATTICE)



Courtesy of Stephen Malinowski. Used with permission.

Chord groupings and musical tension

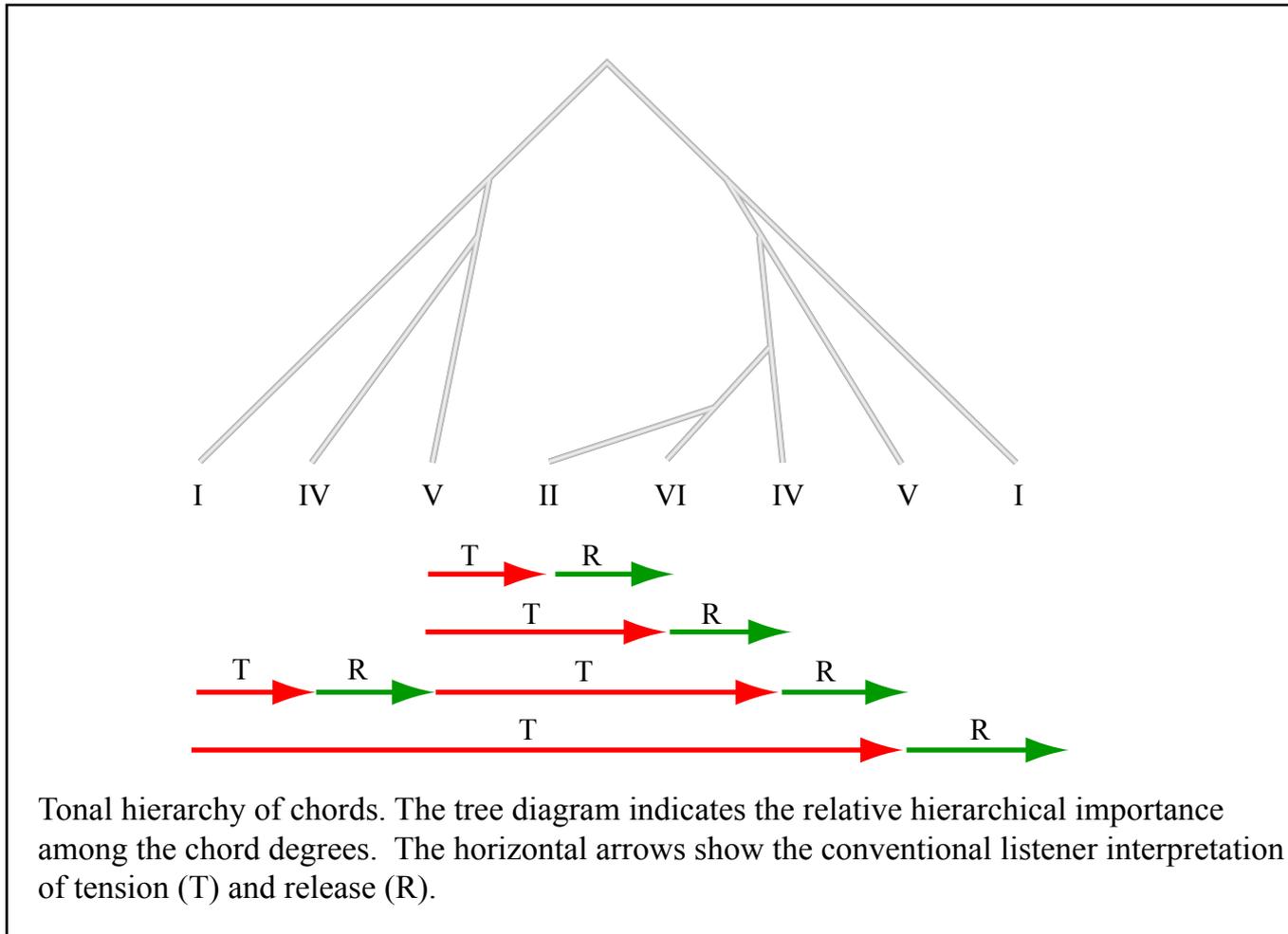


Figure by MIT OpenCourseWare.

Hierarchies of organization

Qualities - similarity relations

- Tonal hierarchies
 - Proximity to tonic (key, scale-relations)
- Chord hierarchies
 - Proximity to major or minor triad

Events grouped in time

- Melodic hierarchies (time)
 - Phrases, themes
- Rhythmic hierarchies
- Harmonic movements -

Tonal system

see also

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

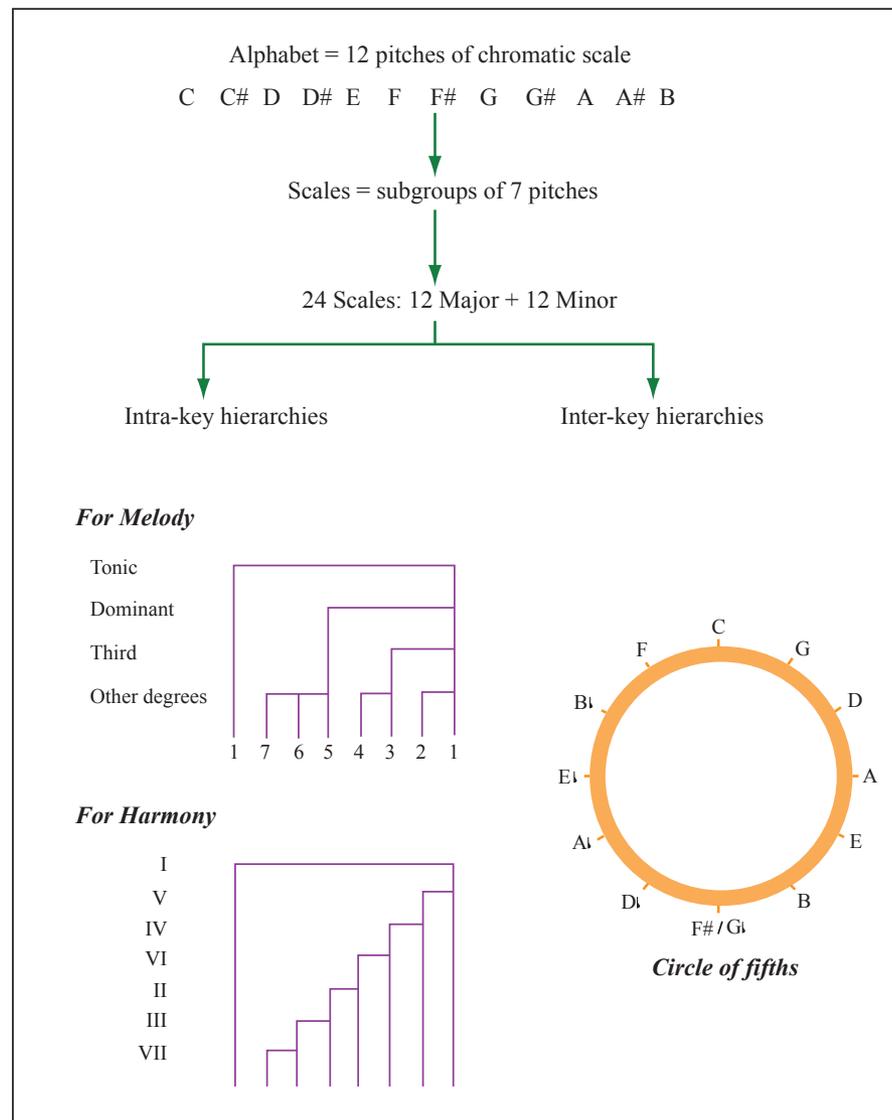
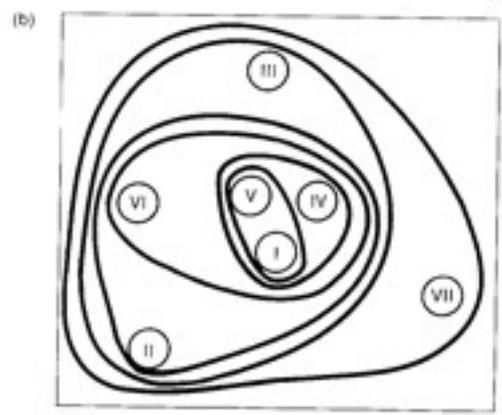
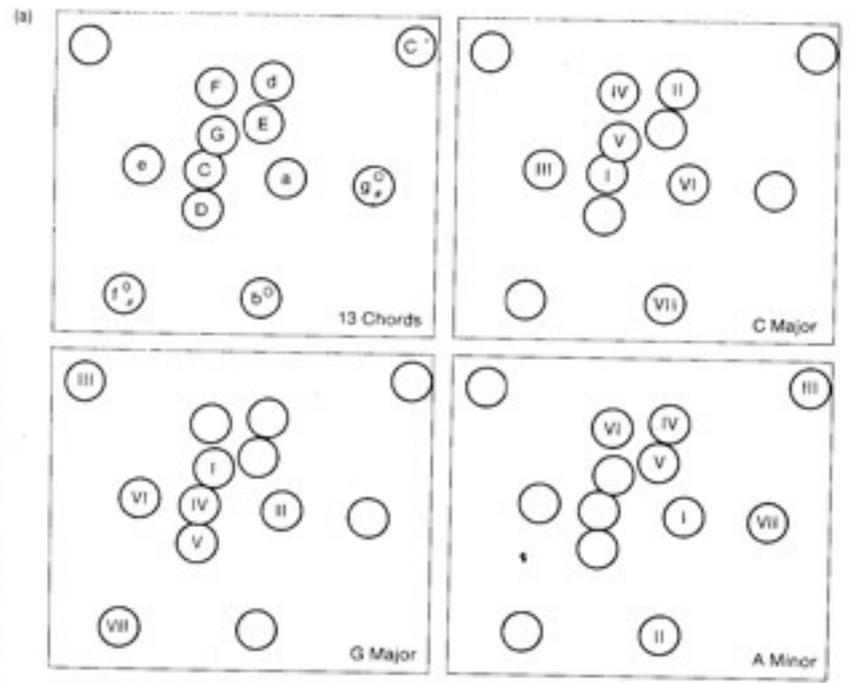
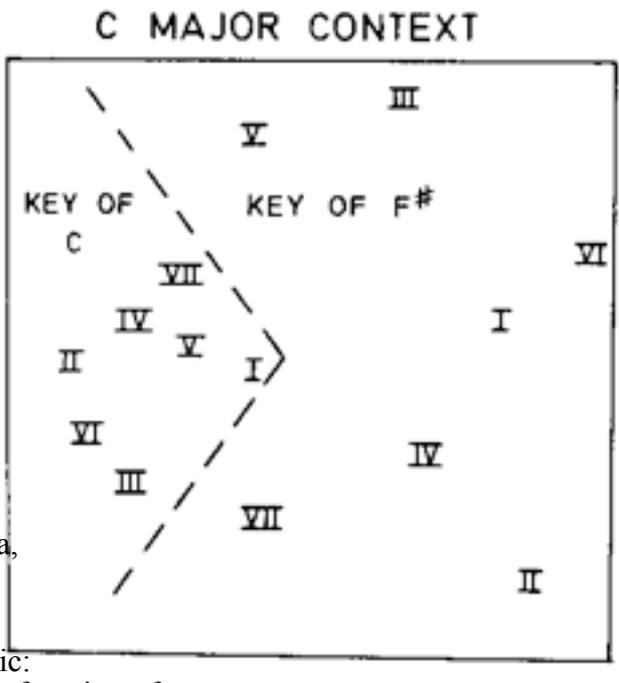


Figure by MIT OpenCourseWare.

Chord Hierarchies

Distance relations

**Greater distance from tonic
creates greater tension
Smaller distance resolves
tension**



Source: Krumhansl, C., J. J. Bharucha, and E. J. Kessler. "Perceived Harmonic Structure of Chords in Three Related Musical Keys." *J Exp Psychol Hum Percept Perform* 8, no. 1 (Feb 1982): pp. 24-36. Courtesy of American Psychological Association.

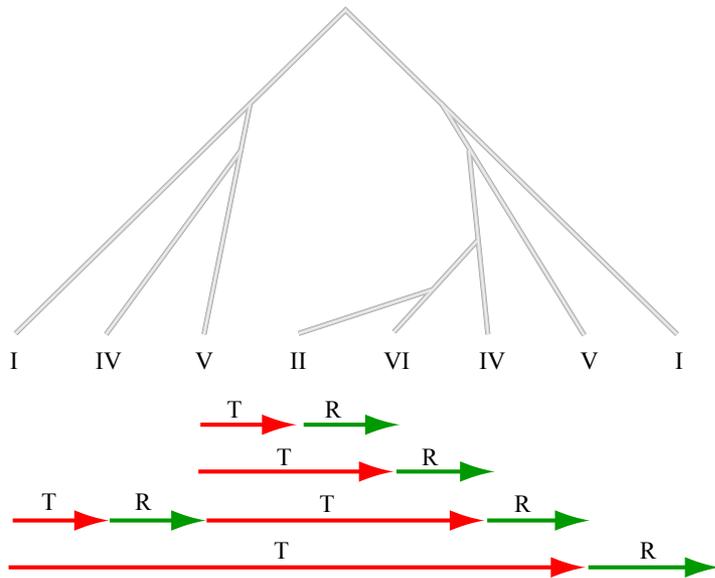
Source: Fig. 1 in Bharucha, J. and C. L. Krumhansl.

"The representation of harmonic structure in music: Hierarchies of stability as a function of context." *Cognition* 13, no. 1 (January 1983): pp. 63-102. Courtesy Elsevier, Inc., <http://www.sciencedirect.com>.

Used with permission.

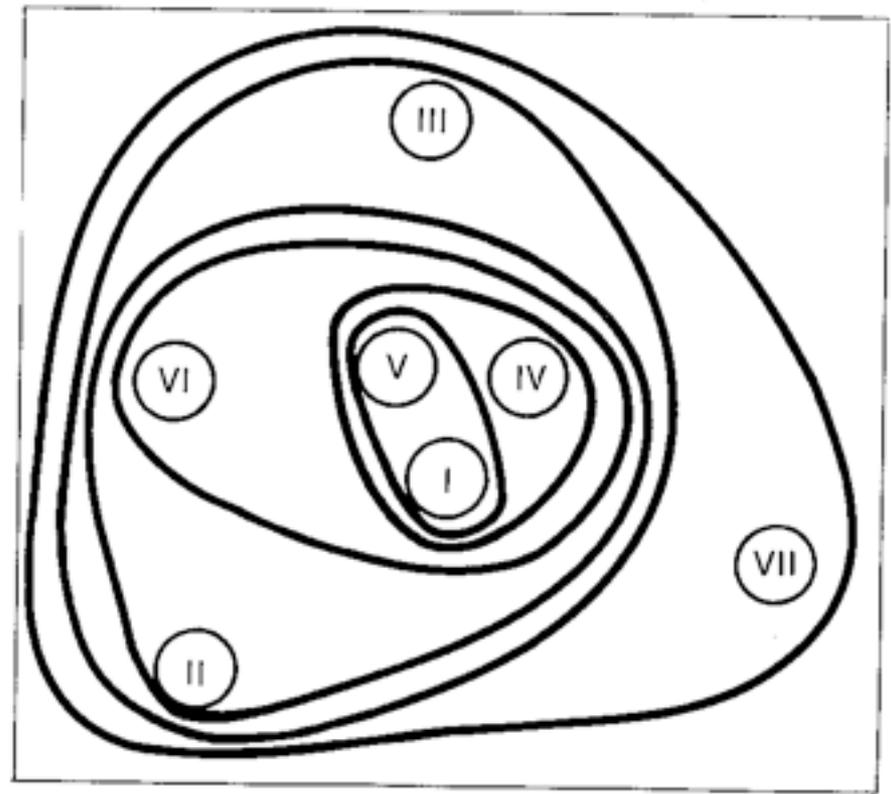
Tonal hierarchies: trees, nestings, and neighborhoods

Emmanuel Bigand 239



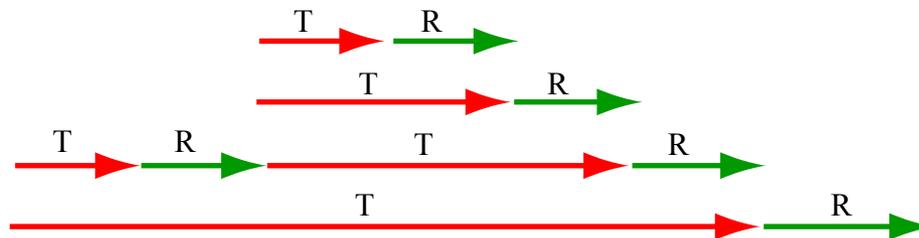
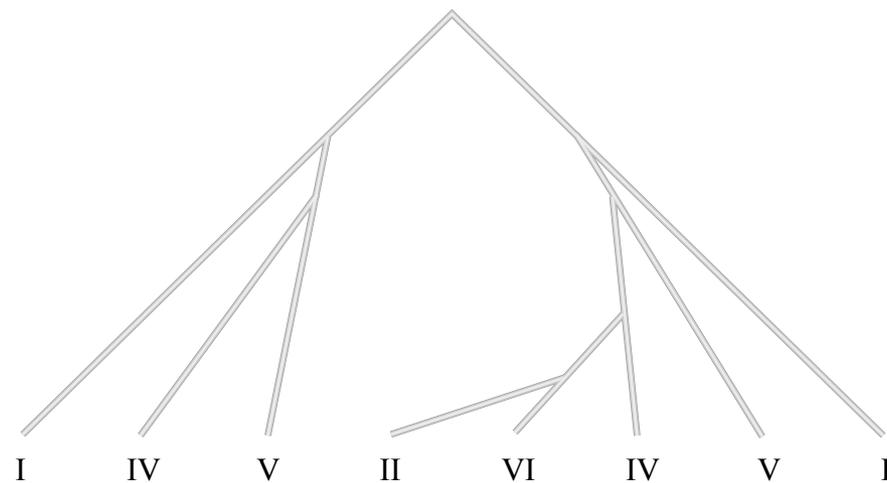
Tonal hierarchy of chords. The tree diagram indicates the relative hierarchical importance among the chord degrees. The horizontal arrows show the conventional listener interpretation of tension (T) and release (R).

Figure by MIT OpenCourseWare.



Source: Krumhansl, C., J. J. Bharucha, and E. J. Kessler.
"Perceived Harmonic Structure of Chords in Three Related Musical
Keys." *J Exp Psychol Hum Percept Perform* 8, no. 1 (Feb 1982):
pp. 24-36. Courtesy of American Psychological Association.

Tonal hierarchies



Tonal hierarchy of chords. The tree diagram indicates the relative hierarchical importance among the chord degrees. The horizontal arrows show the conventional listener interpretation of tension (T) and release (R).

Figure by MIT OpenCourseWare.

Katz (in Musical Networks)

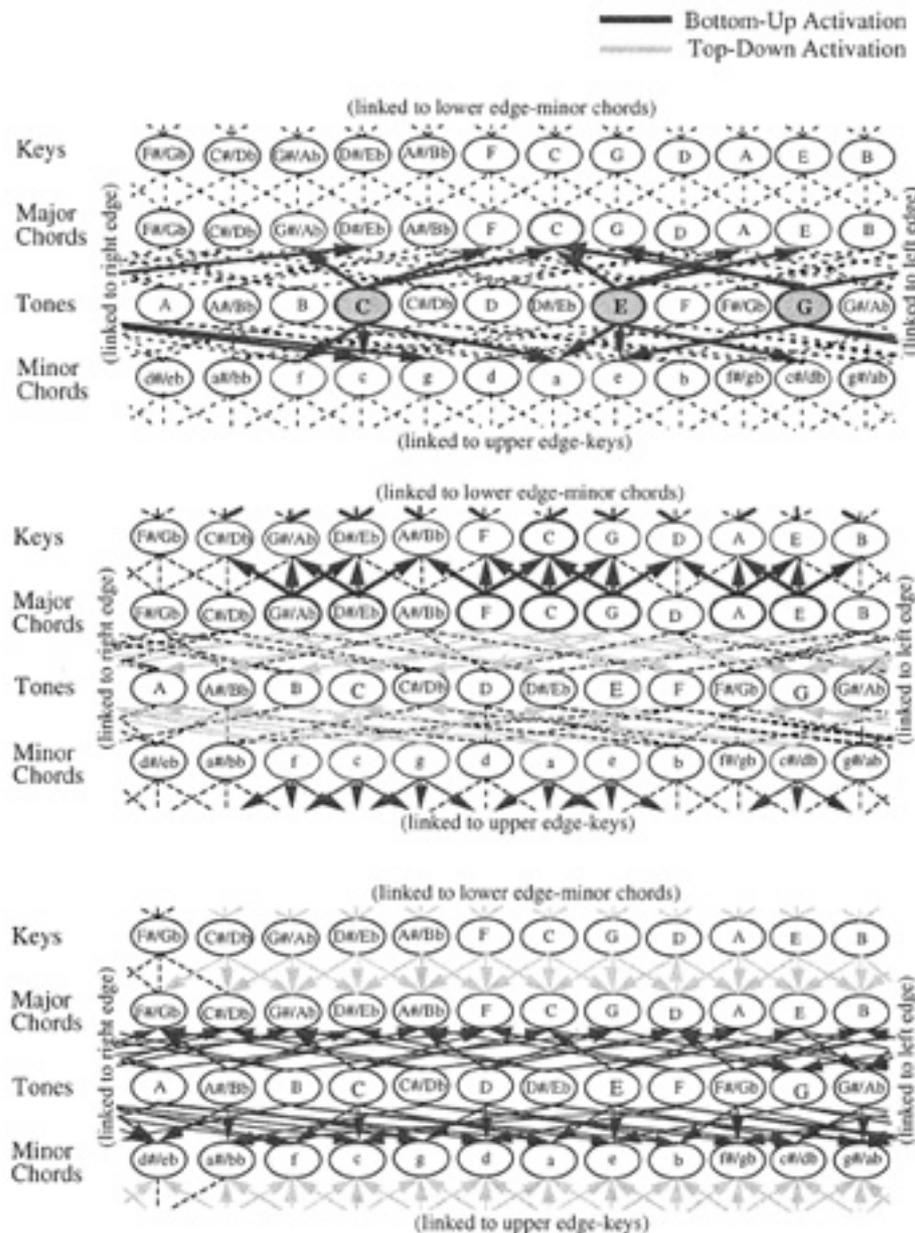
**Attempt to develop
computer models
that behave in a manner
like human listeners in
their evaluation of
melodies**

Two graphs removed due to copyright restrictions.
See Fig. 15 in Katz, Bruce F. "An Ear for Melody."
In *Musical Networks*. Edited by N. Griffith and P. M. Todd.
MIT Press, 1999. (Reprinted from *Connection Science* 6:299
(1994).)

Tillman, Bharucha & Bigand

Key relations through bottom-up and top-down associations

Connectionist nets



Courtesy of the Cognitive Science Society.

Used with permission. Source: Bharucha, J. J. "MUSACT:

A Connectionist Model of Musical Harmony."

In *Program of the Ninth Annual Conference of the Cognitive Science Society*, pp. 508-517.

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HST.725 Music Perception and Cognition
Spring 2009

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