Semantics, Pragmatics, Key Link

Patel Chapter 6.3-6.6

Krumhansl 2002

DiPaola MusicFace

Linguistic Meaning in Relation to Music

- Is it categorically true that music lacks a semantic component?
- Might music at times engage semantic processing, using cognitive and neural operations that overlap with those used in language?
- Here, we will focus on semantic reference, rather than predication.
- Perhaps instrumental music lacks semantic *content*, but it can at times suggest semantic *concepts*.
- And it can do this with some consistency in terms of the concepts activated in the minds of listeners within a culture.

The semantics of leitmotifs

- Richard Wagner (1813-1883)
- Leitmotifs in Wagner's Ring Cycle. Götterdämmerung (The Twilight of the Gods): Video from PBS Great Performances 1995.
- Hacohen & Wagner 1997 tested Israeli students' perception of meaning in Wagner's leitmotifs.
  - Wagner is banned in Israel.
  - 174 listeners rated each leitmotif according to seven semantic scales, plus how it made the listener feel "liking" or "disliking".

Box 6.2 Wagnerian Leitmotifs Studied by Hacohen and Wagner (1997)

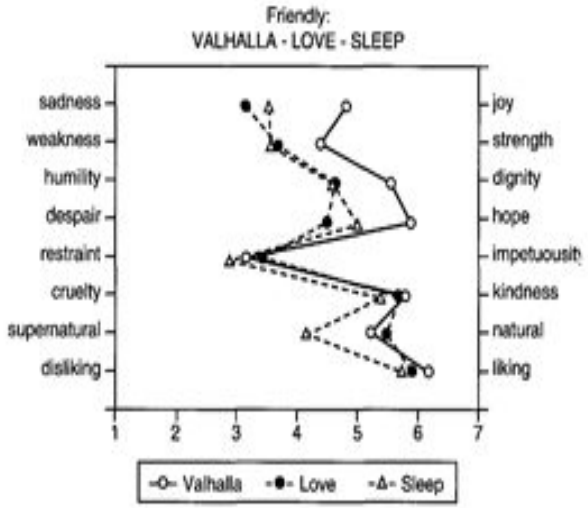
Curse	Valhalla	Fire
Death	Hunding (a character)	Love
Frustration	Sleep	Fate

Box 6.3 Semantic Scales Used by Hacohen and Wagner (1997)

Joy-sadness	Strength-weakness	Dignity-humility
Hope-despair	Impetuosity-restraint	Kindness-cruelty
Natural-supernatural		

The semantics of leitmotifs

- Most leitmotifs fell into three clusters:
  - A “friendly” cluster.
  - A “violent” cluster.
  - A “dreary” cluster.
- Each cluster featured a pair of “synonyms”.
- In a second study, 102 listeners gave a title to an imaginary film featuring a leitmotif as the musical theme.
  - A remarkable degree of consistency was found.
  - Film naming disambiguate the synonyms found earlier
    - Love (emphasized interpersonal aspects) vs. Sleep (emphasized scenery).



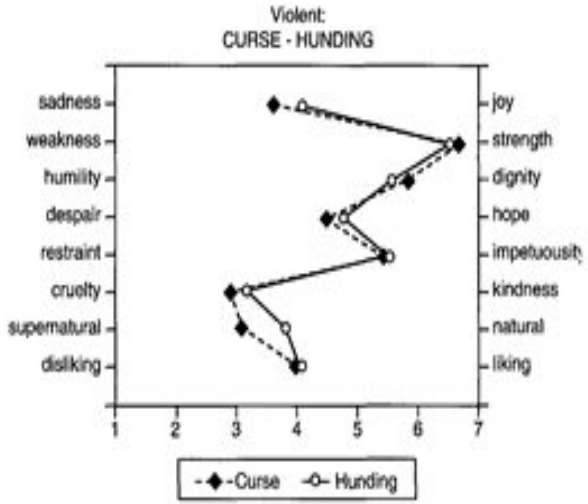


Figure 6.3 Semantic profiles of Wagnerian Leitmotifs, from Hacohen & Wagner, 1997. The numbers along the x-axes represent how much a given leitmotif expresses one of two opposite semantic concepts, in which 1 represents strong expression of the concept on the left of the scale (e.g., sadness), 7 represents strong expression of the concept on the right of the scale (e.g., joy), and 4 is neutral.

continued

Figure 6.3, *continued*

A Short Map of the Fire Motif

Action or Event		Agent			Place	Affect
Animated Movement	Celebration	Legendary, Magical, Animals, Many	Legendary, Magical, Single (s)	Creatures of Nature	Country-side/ Magic	Pleasant Affect
The dance		of the fairies			in the forest	
The race		of the angels				
		of the horses				
The dance		of the muses				
The dance		of the stars				
The dance		of the witches				
The dance		of the devils				
		of the dolls				
	The wedding		of the marionette			
The adventures			of Peter Pan			
The dance		of the Hobbits				
		In the Guzmeks'			forest	
The escape		of the dwarfs				
The war against		the cockroaches				
The flight		of the fireflies				
The dizziness				of Nature		
The dance			of the lovers			before the tragedy
						A moment of happiness

Figure 6.4 Some titles associated with the "fire" motif in the study of Hacohen & Wagner, 1997.

Neural evidence that music can evoke semantic concepts

- The N400 is an ERP produced by the brain in response to semantically anomalous or difficult to integrate words.
  - The pizza was too hot to cry/eat.
  - The girl put the sweet in her pocket/mouth after the lesson.

Neural evidence that music can evoke semantic concepts

- Koelsch et al. 2004
  - Listeners rated the semantic relatedness of musical excerpts and words.
    - "wideness" for large pitch intervals and consonant harmonies.
    - "sigh" for melody iconically imitating a sigh.
    - "caravan" for an exotic, Middle Eastern sounding excerpt.
  - Other listeners heard musical excerpts followed by related vs. unrelated words.
    - They exhibited an N400 to words that were semantically mismatched vs. matched to the musical excerpts.
    - Quantitatively similar to when these same words followed semantically matched or mismatched sentences.
    - Neural generators for both language and music were in the posterior portion of the middle temporal gyrus bilaterally.

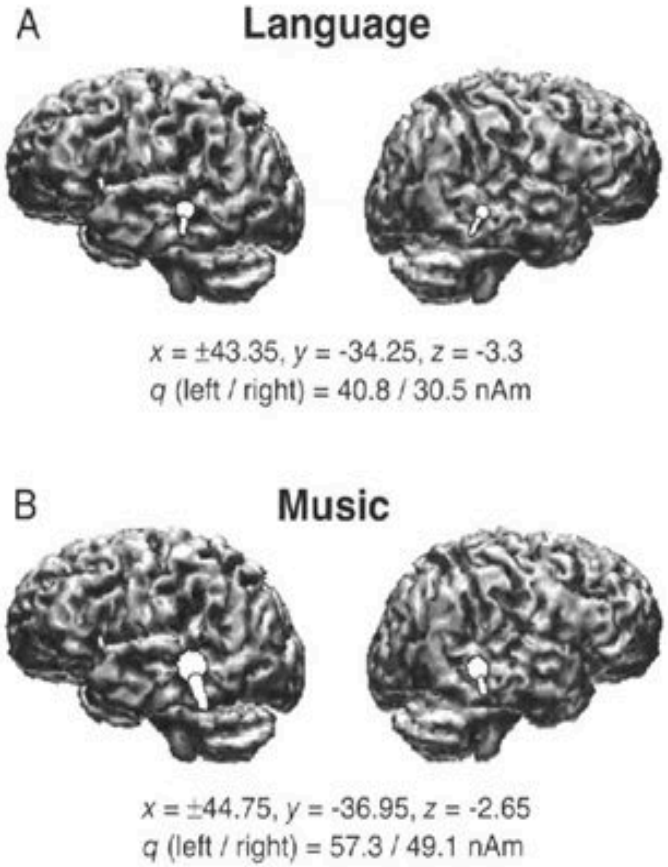


Figure 6.5 Neural generators of the N400 effect elicited by target words that were semantically unrelated to preceding sentences (A), or to preceding instrumental musical excerpts (B). The estimated neural generators (shown as white dipole sources in the temporal lobes) did not differ between the language and the music conditions (x-, y-, and z-coordinates refer to standard stereotaxic space, dipole moments [q] in nanoamperes). Adapted from Koelsch et al., 2004.

Music and Pragmatics

- Discourse coherence:
  1. The father saw his son pick up his toy chainsaw. Seashells are often shiny on the inside. John likes peas.
  2. The father saw his son pick up his toy chainsaw. The boy pretended to cut down a tree, but didn't touch the delicate flowers growing in the garden. Mom was pleased.
- Kehler 2004
  - "Just as hearers attempt to recover the implicit syntactic structure of a string of words to compute sentence meaning, they attempt to recover the implicit coherence structure of a series of utterances to compute discourse meaning."

Music and Pragmatics

- Kehler 2002
  - Following David Hume 1748 *Enquiry Concerning Human Understanding*.
  - Three broad types of connections between utterances:
    - Resemblance
      - Based on the ability to reason analogically, categorizing events and seeing correspondences between them.
    - Cause-effect
      - Drawing a path of implication between events.
    - Contiguity
      - Understanding that events happen in a certain order.
- If there are general cognitive processes underlying the perception of coherence in discourse, might these same processes apply to the perception of coherence in music?

Cognitive aspects of discourse coherence

- Wolf & Gibson 2005 came up with an annotation system for texts that utilizes coherence relations from Kehler 2002, which Patel suggests are also relevant to music.
  - Parallelism
    - [There is an oboe leaning on the black music stand.] [There is another oboe leaning on the gray music stand.]
  - Contrast
    - [John liked salsa music,] [but Susan liked reggae.]
  - Elaboration
    - [A new concert series was launched this week.] [The "Stravinsky Retrospective" is scheduled to last until December.]
  - Result
    - [There was bad weather at the airport,] [so our flight got delayed.]
  - Violated expectation
    - [The weather was nice,] [but our flight got delayed.]
  - Temporal sequence
    - [Roger took a bath.] [He went to bed.]

1. Susan wanted to buy some tomatoes
2. and she also tried to find some basil
3. because her recipe asked for these ingredients.
4. The basil would probably be quite expensive at at this time of year

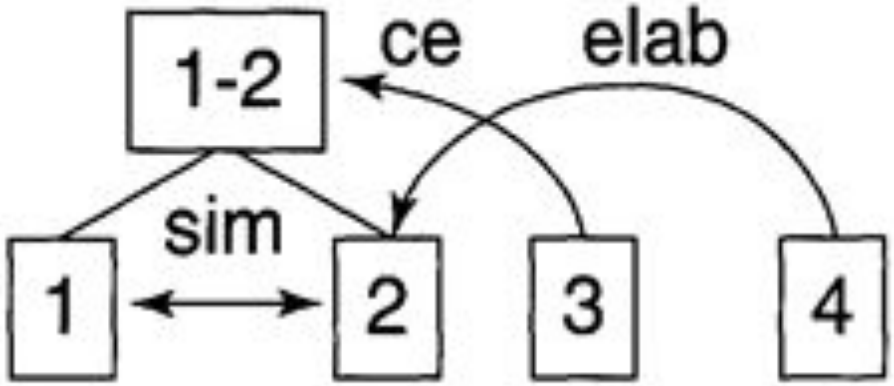


Figure 6.6 Coherence relations between segments of a short discourse (example 6.9 in the text). In this diagram, "sim" = "similar," "ce" = "cause-effect," and "elab" = elaboration. From Wolf & Gibson, 2005.

Cognitive aspects of discourse coherence

- Wolf & Gibson 2005 trained two annotators, and found good agreement.
- Lines often crossed in the graphs, thus distinguishing discourse structure from syntactic structure.
- Patel: This technique could be fruitfully applied to music.

Neural aspects of discourse coherence

- Brain regions critical to the inferencing processes involved in linguistic discourse comprehension.
  - Right cerebral hemisphere areas homologous to left hemisphere language areas.
- Brownell et al. 1986
    - *Barbara became too bored to finish the history book. She had already spent five years writing it.*
    - Correct inference question*: Barbara became bored writing a history book.*
    - Incorrect inference question: *Reading the history book bored Barbara.*
    - Incorrect factual question: *Barbara grew tired of watching movies*.
    - Correct factual question: Sh*e had been writing it for five years.*
  - Right-hemisphere damaged patients had more difficulty than controls on inference questions.

Neural aspects of discourse coherence

- Functional neuroimaging work with normal subjects is inconclusive.
  - Strong right-hemisphere laterality
    - Mason & Just 2004
  - Bilateral involvement
    - Kuperberg et al. 2006
- Patel's suggestion:
  - Use scrambled music and elicit musical coherence ratings.
  - Would patients with linguistic inferencing problems also have trouble with musical coherence?

Interlude: Linguistic and Musical Meaning in Song

- Composers have used “word painting” to represent the meaning of lyrics in the music.
  - “Swing low, sweet chariot, coming for to carry me home”.
  - Bach chorale of a psalm, the only question in the psalm is the emotional climax, and is set to the dominant (V), which conveys a sense of incompleteness.

Interlude: Linguistic and Musical Meaning in Song

- Listeners find lyrics more meaningful when embedded in their original musical context.
  - Galizio & Hendrick 1972, inter alia.
- Thomas & Russo 2004
  - Used unfamiliar songs from the 1970s.
  - The lyrics of familiar songs were judged more meaningful when accompanied by music, but the lyrics of unfamiliar songs were not.
  - Repeated background exposure to songs led to higher meaningfulness ratings of the lyrics.
  - Music is semiotically protean, and repeated association with a text comes to enhance the text's meaning.

The Expression and Appraisal of Emotion as a Key Link

- Unyk et al. 1992
  - Lullabies, including African, Native American, Samoan and Ukrainian.
  - Western adults had to identify a melody as a lullaby.
  - Accuracy was predicted by the percentage of descending intervals.
- Cohen 1971
  - In Palestrina's music (Renaissance), rules of counterpoint in vocal music act to suppress sudden changes in volume, pitch or rhythm.
  - Matches Council of Trent's instructions that music should be tranquil.

Acoustic cues to emotion in speech and music

- Juslin & Laukka 2003 reviewed 104 studies of vocal expression and 41 studies of music performance, 50% vocal vs. instrumental.
- In both domains, listeners were accurate in judging speaker/performer intended emotion.
  - Happiness, sadness, anger, fear, tenderness.
- Substantial overlap in acoustic cues used to convey emotions in speech and music.
- Musical instruments are used as "superexpressive voices".
- Studies tended to be unnatural, asking performers to play with a certain emotion.
  - Perhaps elicits imitation of emotional speech patterns.

Table 6.2 Shared Acoustic Cues for Emotions in Speech and Music

Summary of Cross-Modal Patterns of Acoustic Cues for Discrete Emotions	
Emotion	Acoustic Cues (Vocal Expression/Music Performance)
Anger	Fast speech rate/tempo, high voice intensity/sound level, much voice intensity/sound level variability, much high-frequency energy, high F0/pitch level, much F0/pitch variability, rising F0/pitch contour, fast voice onsets/tone attacks, and microstructural irregularity
Fear	Fast speech rate/tempo, low voice intensity/sound level (except in panic fear), much voice intensity/sound level variability, little high-frequency energy, high F0/pitch level, little F0/pitch variability, rising F0/pitch contour, and a lot of microstructural irregularity
Happiness	Fast speech rate/tempo, medium-high voice intensity/sound level, medium high-frequency energy, high F0/pitch level, much F0/pitch variability, rising F0/pitch contour, fast voice onsets/tone attacks, and very little microstructural regularity
Sadness	Slow speech rate/tempo, low voice intensity/sound level, little voice intensity/sound level variability, little high-frequency energy, low F0/pitch level, little F0/pitch variability, falling F0/pitch contour, slow voice onsets/tone attacks, and microstructural irregularity
Tenderness	Slow speech rate/tempo, low voice intensity/sound level, little voice intensity/sound level variability, little high-frequency energy, low F0/pitch level, little F0/pitch variability, falling F0/pitch contour, slow voice onsets/tone attacks, and microstructural regularity

Note: F0 = Fundamental frequency.

Source: From Juslin & Laukka, 2003.

Neural aspects of auditory affect perception

- Right hemisphere has been implicated in perception of emotional speech prosody.
  - Right inferior frontal regions.
  - George et al. 1995, inter alia.
- Affective music processing studies are more variable, perhaps due to different methodologies.
  - Blood et al. 1999 found right hemisphere active in perceiving consonance/dissonance as pleasant/unpleasant.
  - Schmidt & Trainor 2001 found left frontal activity for positive emotions and right for negative emotions.
  - Brain damage resulting in difficulty judging the affective quality of speech involves both hemispheres but especially the right.

Cross-domain influences

- Thompson 2004
  - Does musical training improve ability to discriminate emotion in speech?
  - English speaking adults judging emotion in English or Tagalog speech.
    - Musical training helped identify sadness and fear in both languages.
  - 6-year-old children were given music lessons, drama lessons or no lessons:
    - Music and drama lesson children were better at detecting fear vs. anger in speech.
    - Happy/sad showed a ceiling effect.

Emotion in speech and music: future directions

- More emotional dimensions should be tested.
  - Most studies have used two dimensions (positive/negative valence, low/high activity)
  - Cross-domain similarities have been investigated, but what about differences?
    - Ilie & Thompson 2006
    - Positive valence: lower-pitched music, higher-pitched speech.
  - Studies have focused on tempo, intensity and pitch contours, but what about timbre?
    - E.g. to distinguish anger from happiness.
    - fMRI has implicated overlapping but distinct areas of the Superior Temporal Sulcus in vocal vs. musical timbre analysis (Belin et al. 2000, inter alia).
    - Selective impairment has been found (Sacks 2007), suggesting separate initial processing mapping to a common interpretation.

Krumhansl 2002

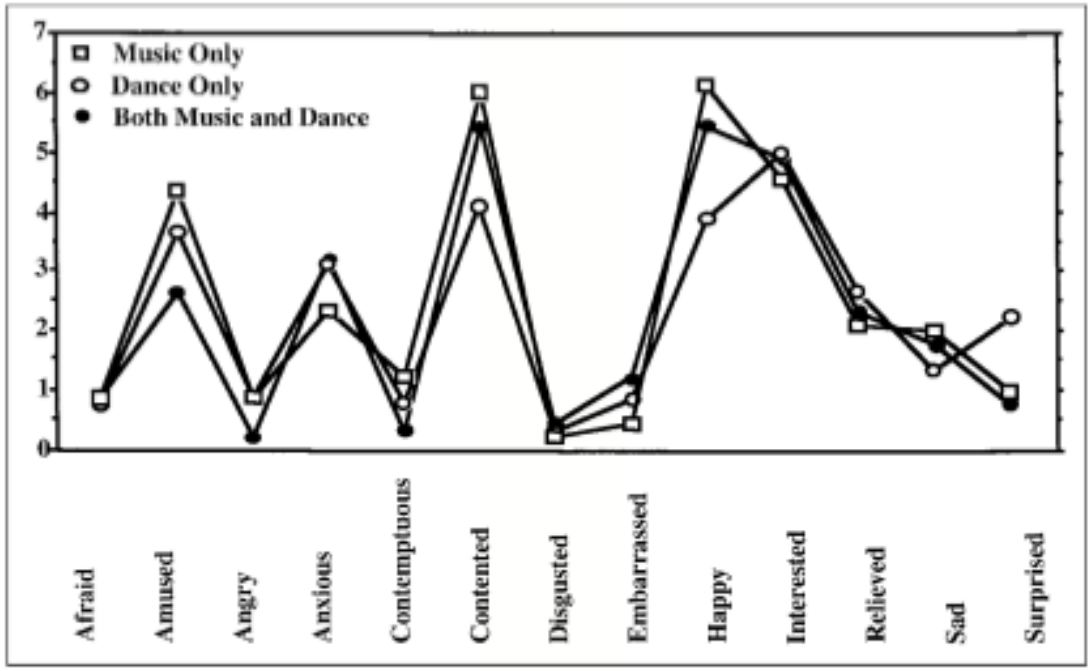


Fig. 3. The emotion-quality judgments made for the three conditions: music only, dance only, and both music and dance. From "Can Dance Reflect the Structural and Expressive Qualities of Music? A Perceptual Experiment on Balanchine's Choreography of Mozart's *Divertimento* No. 15," by C.L. Krumhansl and D.L. Schenck, 1997, *Musicae Scientiae, 1*, p. 75. Copyright 1997 by the European Society for the Cognitive Sciences of Music. Reprinted with permission.

Krumhansl 2002

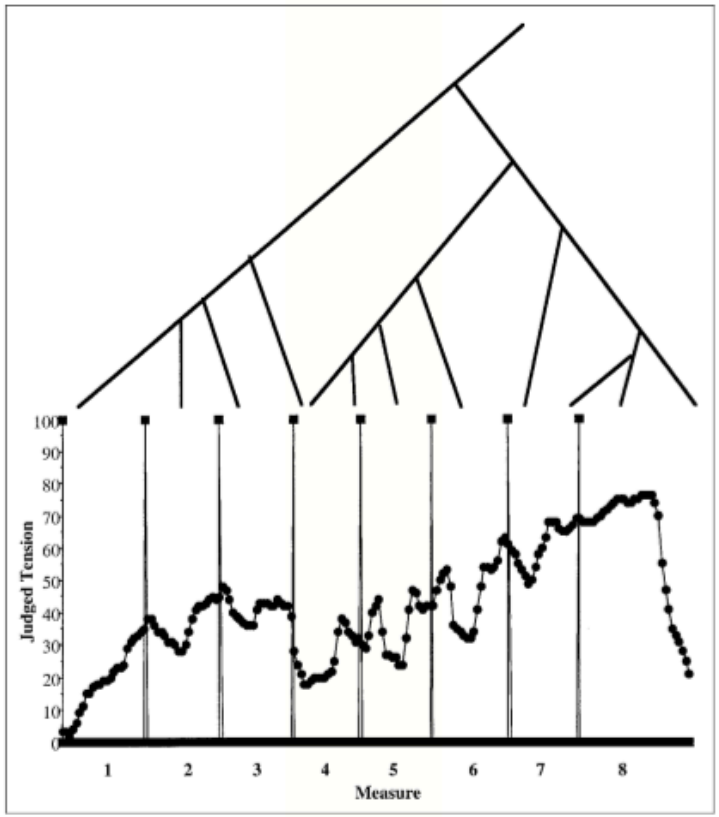


Fig 1. The main branches of Lerdahl's (2001) tree model for the first eight measures of Mozart's Piano Sonata in E-flat major, K. 282 (top panel) and the tension ratings made by listeners (Krumhansl, 1996; bottom panel). From "Music and Affect: Empirical and Theoretical Contributions From Experimental Psychology," by C.L. Krumhansl, 2000. In D. Greer (Ed.), *Musicology and Sister Disciplines: Past, Present, and Future*, p. 91. Copyright 2000 by Oxford University Press. Reprinted with permission of Oxford University Press.

Steve DiPaola's MusicFace

- MusicFace (c. 2003)

- About
  Can you extract the emotional aspects of a piece of music to animate a face. Music-driven Emotionally Expressive Face (MusicFace) is a early stage project that creates "facial choreography" driven by musical input. In addition to its artistic uses, MusicFace can be used for creating visual effects in movies and animations, and also realistic characters in computer games and virtual worlds.

  MusicFace starts by receiving the input music in MIDI format. Structure and expressive cues such as tempo, loudness, and timing are combined with emotion color cues from extracting harmonic tension and rhythm, which then can be translated into emotional states. A rule-based fuzzy system is responsible for "re-mapping" the aesthetic communication stream to facial emotions and actions (e.g. blinking).

Wagner's Leitmotifs again

- Could it be that Wagner's system of leitmotifs in his operas begins to create a system of meaning in music directly analogous to the sense that language has meaning?
- With leitmotifs, a given musical pattern (i.e. word) actually serves to create a link between a sound and something in the world (i.e. reference).
- Reference is the basis of linguistic propositional (truth-conditional), compositional meaning, which is what music in general seems to lack.
- Another video on leitmotifs.