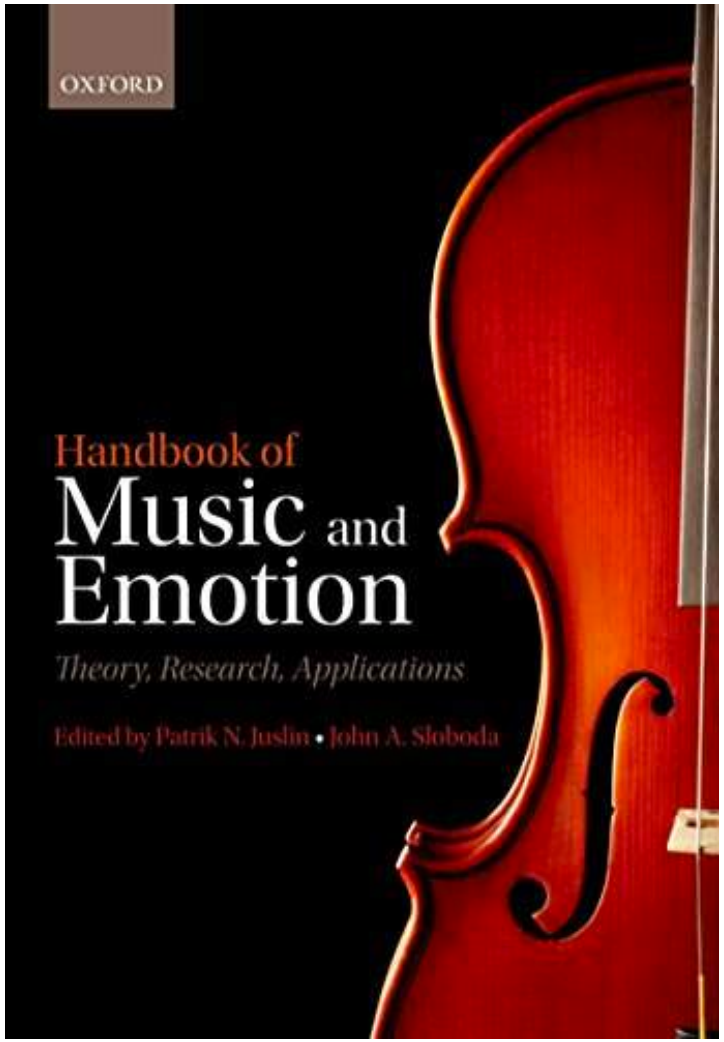
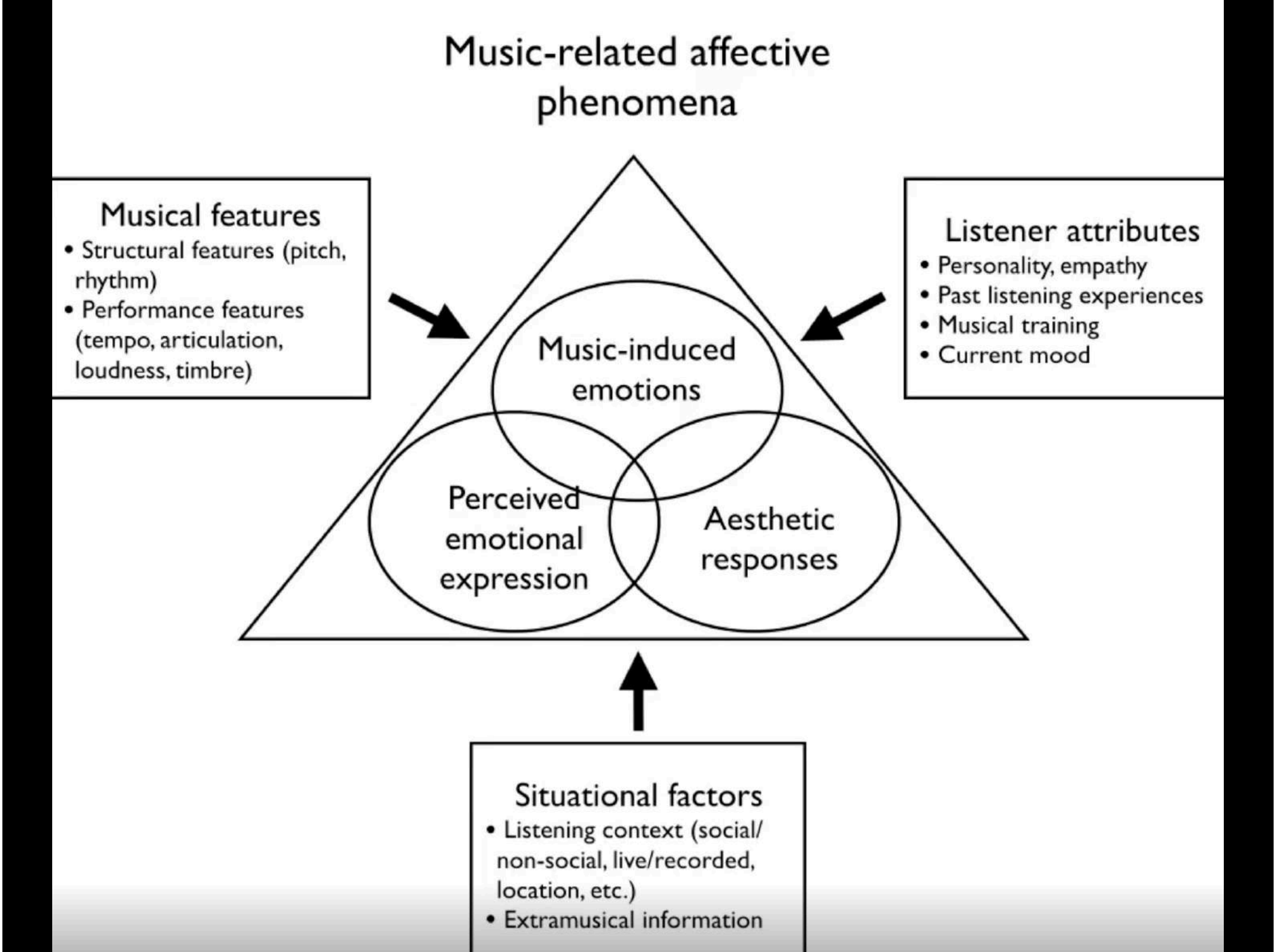
Assignment 1


OXFORD
Handbook of
Music and
Emotion
Theory, Research, Applications
Edited by Patrik N. Juslin • John A. Sloboda


Music-related affective phenomena
Musical features
• Structural features (pitch, rhythm)
• Performance features (tempo, articulation, loudness, timbre)
Listener attributes
• Personality, empathy
• Past listening experiences
• Musical training
• Current mood
Music-induced emotions
Perceived emotional expression
Aesthetic responses
Situational factors
• Listening context (social/ non-social, live/recorded, location, etc.)
• Extramusical information

What emotions can music express?

Table 3. Frequencies with which various emotion labels were selected in response to the question "What emotions can music express?" ($N = 141$).

Emotion	Freq.	Emotion	Freq.	Emotion	Freq.
Joy	99% (98%)	Pride	71% (69%)	Curiosity	46% (63%)
Sadness	91% (91%)	Pain	70% (86%)	Boredom	45% (47%)
Love	90% (89%)	Desire	69% (74%)	Disappointment	43% (49%)
Calm	87% (89%)	Hope	67% (70%)	Guilt	42% (43%)
Anger	82% (83%)	Nostalgia	67% (76%)	Satisfaction	42% (57%)
Tenderness	82% (86%)	Fear	63% (79%)	Admiration	37% (37%)
Longing	77% (71%)	Contempt	55% (53%)	Jealousy	35% (42%)
Solemnity	76% (73%)	Tiredness	55% (52%)	Sympathy	34% (39%)
Anxiety	75% (90%)	Regret	53% (56%)	Shame	31% (39%)
Hate	74% (69%)	Expectancy	51% (66%)	Trust	30% (33%)
Humour	74% (87%)	Confusion	49% (65%)	Interest	29% (44%)
Loneliness	73% (79%)	Disgust	47% (51%)	Humiliation	28% (31%)
Tension	72% (89%)	Surprise	47% (68%)	Other	10% (16%)

(Juslin & Laukka, 2004)

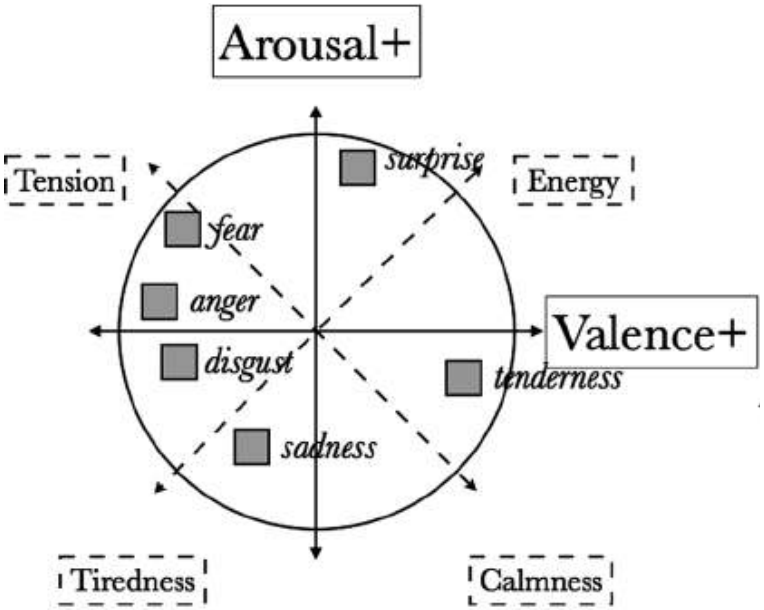
What emotions can music induce?

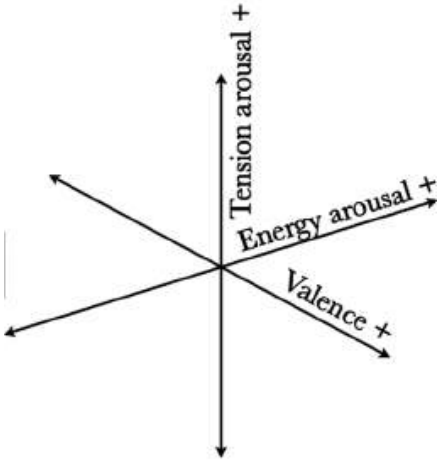
Table 4. Preliminary evidence on the relative frequency of felt emotions in response to music, as estimated by the present listeners. *Note:* the emotions are listed from the most commonly experienced to the least commonly experienced ($N = 141$).

1. Happy*	23. Empathic
2. Relaxed*	24. Proud
3. Calm*	25. Spiritual
4. Moved	26. Curious
5. Nostalgic	27. Relieved
6. Pleasurable*	28. Bored
7. Loving*	29. Indifferent
8. Sad*	30. Frustrated*
9. Longing*	31. Tense*
10. Tender	32. Disappointed*
11. Amused	33. Surprised*
12. Hopeful	34. Honored*
13. Enchanted	35. Regretful
14. Expectant*	36. Contemptuous
15. Solemn*	37. Confused*
16. Interested	38. Anxious*
17. Admiring	39. Afraid*
18. Angry*	40. Jealous
19. Ecstatic*	41. Disgusted
20. Lonely	42. Guilty
21. Content*	43. Shameful*
22. Desiring	44. Humiliated

*These emotions were mentioned in free descriptions of strong experiences of music (SEM), as reported by Gabrielsson (2001, Table 19.2).

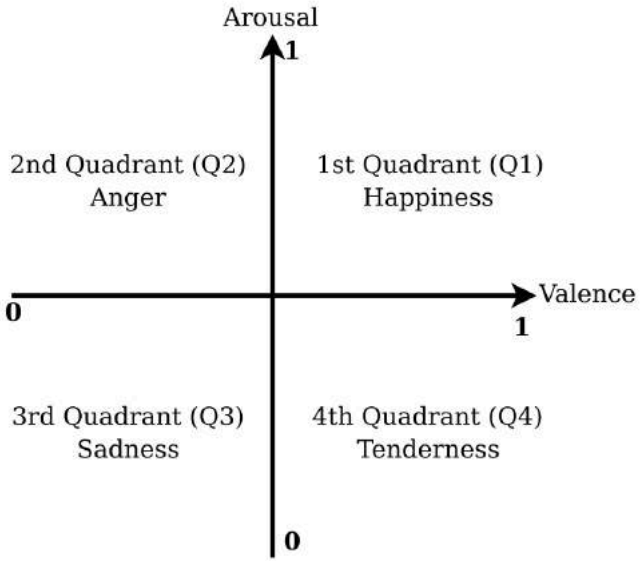
Emotions?
Emotional Space?

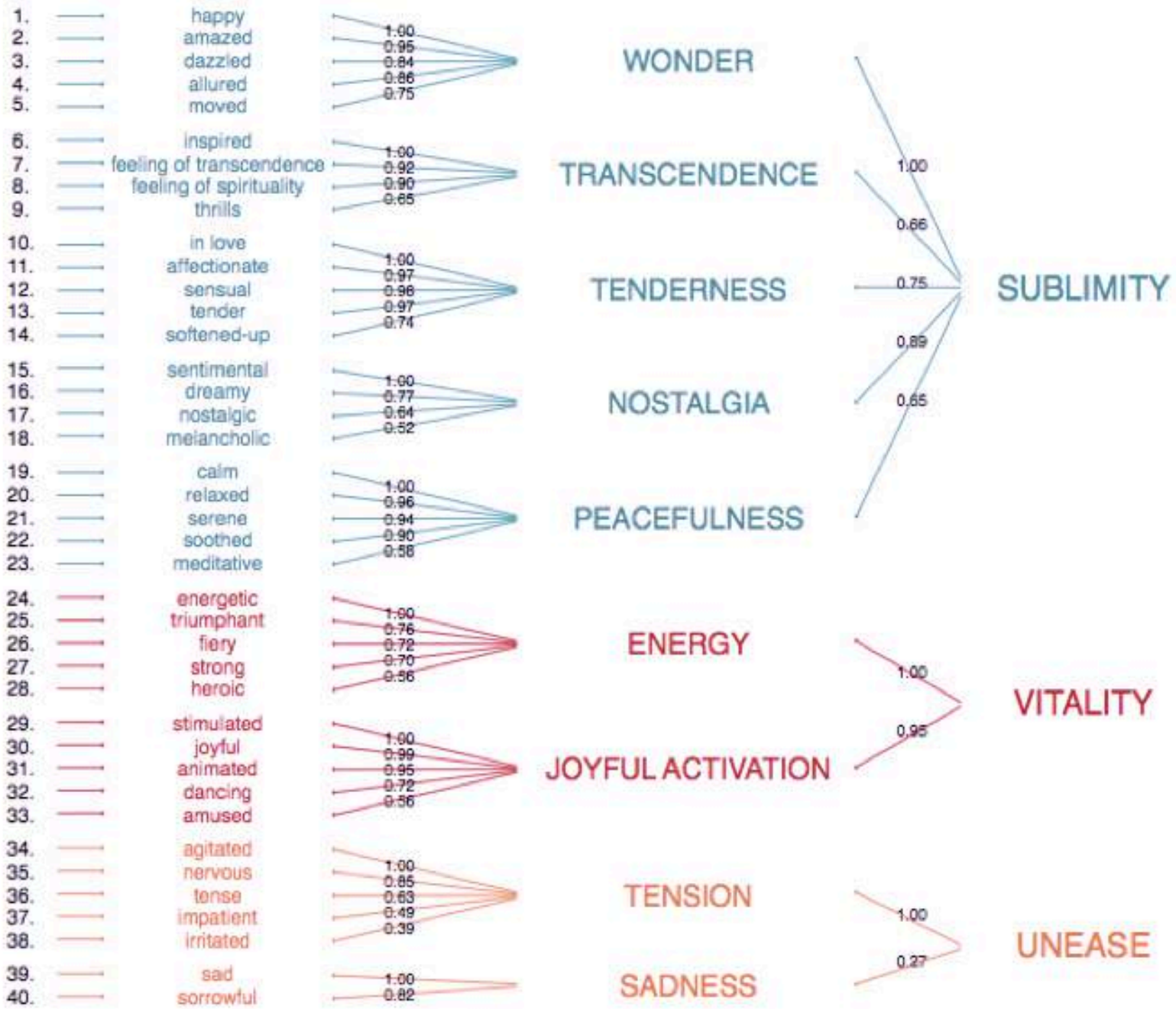




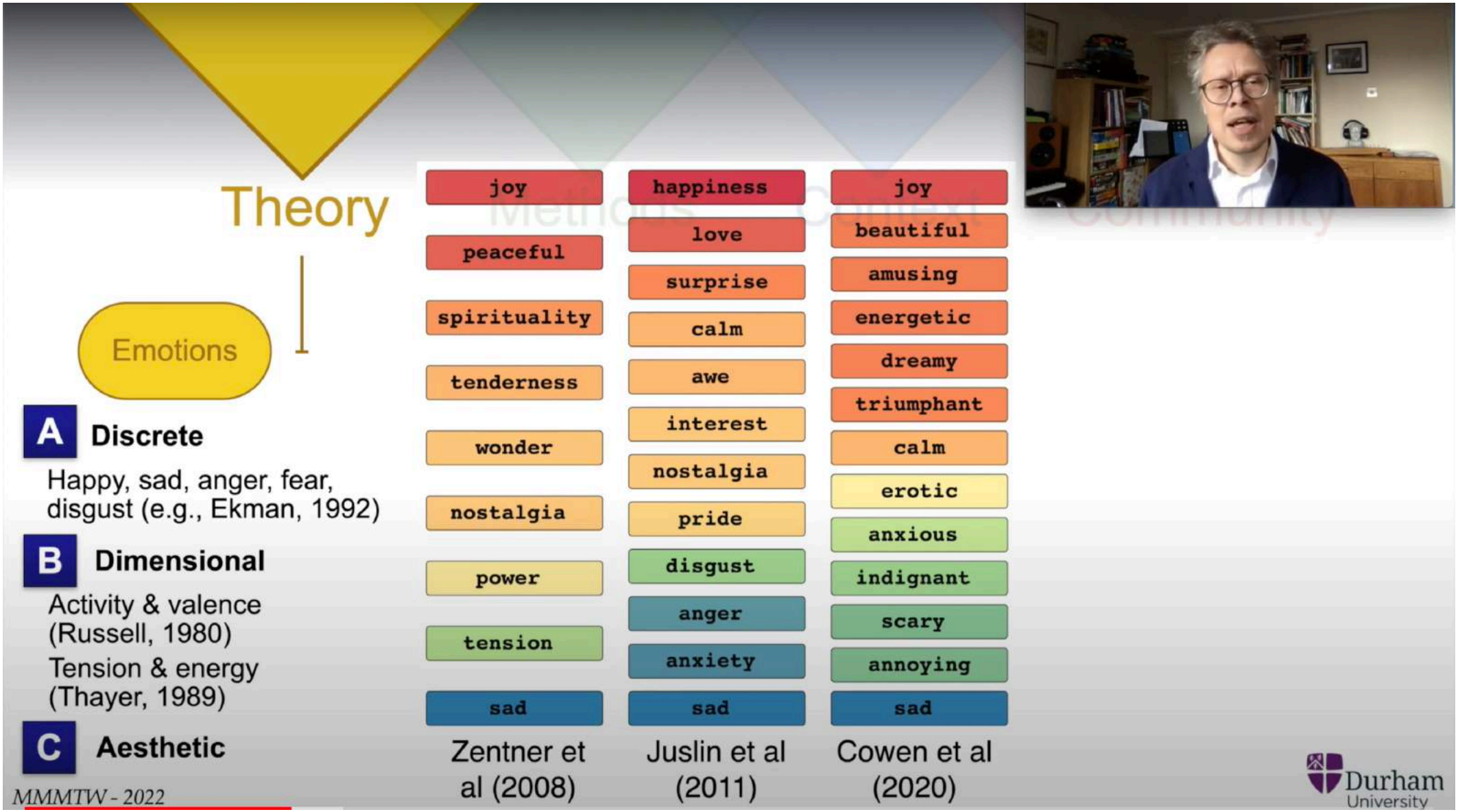
Schimmack & Grob model

Russell's circumplex model
Thayer's model
Basic emotion terms





The Geneva Emotional Music Scales (GEMS)



basic/survival vs aesthetic emotions

Measuring emotions?

Measuring emotions?

Self-report (Subjective)

- *Verbal*: interviews, questionnaires, adjective checklists, etc
- *Non-verbal*: e.g. moving a cursor or slider

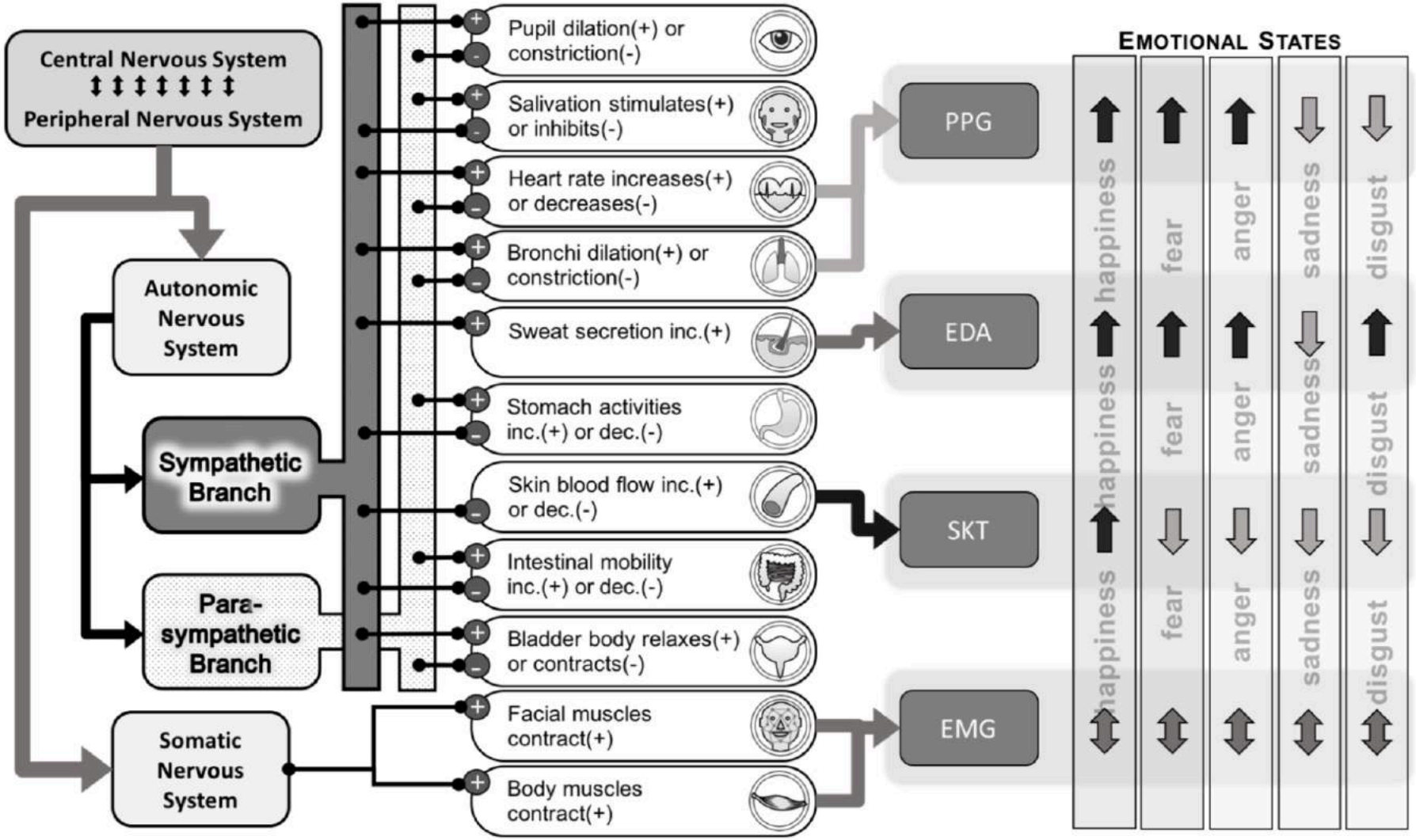
- Limitations
  - accuracy of introspection (both retrospective and real-time) and awareness of one's emotions
  - difficulties and individual differences in the conceptualisation and verbalisation of music-induced emotions
  - demand characteristics

Measuring emotions?

Physiological measurements (Objective)

- Emotions are associated with certain ANS (autonomic nervous system) response patterns, and these can be measured
  - ex: Heart rate, blood pressure, skin conductance, respiration, skin temperature, muscular tension, startle reflex, chills...
- *Limitations*:
  - differentiating between emotions is difficult, and valence of emotional responses is difficult to measure

Measuring emotions?

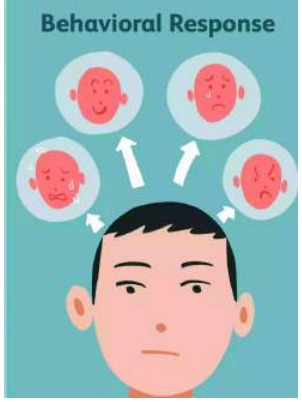


Measuring emotions?

Brain imaging (Subjective + Objective)

- Used to measure neural activity in the brain in response to music
  - Functional magnetic resonance imaging (**fMRI**) most widely used
- *Limitations*:
  - Multiple possible interpretations for neural activity in particular areas
  - How to distinguish between activation related to perceived vs. felt emotion, auditory processing, etc.
  - Self-report data often required to validate measurements

Measuring emotions?



Action and expression (Indirect measures)

- Based on the premise that affective states like emotions and moods are accompanied by changes in information processing and behaviour (and that music-induced emotional states extend beyond the duration of the musical piece listened to)

- Associative Network Theory of Affect (Bower, 1981): emotional states alter the processing of emotional information, causing affect-congruent biases

- Tasks:

    - Picture judgment, word recall, distance perception, reaction time (when responding to emotional stimuli), behaviour, counting speed, etc.

- Limitations: effects can be sensitive and unreliable, and interpretation of results complicated

Choice Depend on **Focus**

Theory Methods Context Community

Emotions

Framework

Level of explanation

Types of measures

Aesthetic

"WONDER"
"NOSTALGIA" "MOVED"

Experience

Narratives, metaphors

Appraisal

Basic

"Sadness"

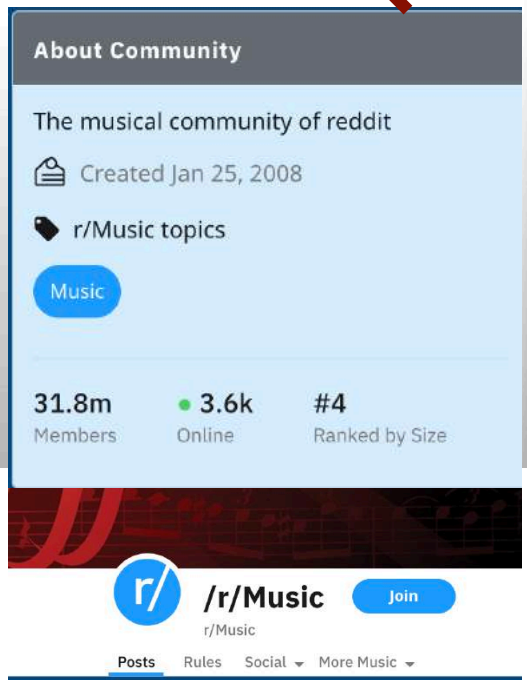
Recognition

(Eerola, 2018)

Dimensional

Arousal Valence

Core Affect



How is music able to **communicate** emotional meaning?

How can music **induce** emotions?

How is music able to **communicate** emotional meaning?

…. in the absence of lyrics?

Cues used to express (and infer) emotions in other human domains

- **Speech and vocal expression of emotion** (Juslin & Laukka, 2003)
  - Music communicates emotional meaning to listeners by exploiting the acoustic code for vocal expression of emotions
  - Many similarities between musical and vocal expression of emotion in terms of acoustic features, recognition accuracy

Cues used to express (and infer) emotions in other human domains

potential problems: cultural differences, mild/subtle cues, contextual & personal factors

Musical features

- Distinct structural and performance features contribute to the expression of different emotions
  - **Sadness**: ?
  - **Happiness**: ?
  - **Anger**: ?
  - **Tenderness**: ?

Musical features

- Distinct structural and performance features contribute to the expression of different emotions
  - **Sadness**: minor mode, low tempo, low pitch, narrow melodic range, low sound level, little sound level variability, soft timbre, and legato articulation
  - **Happiness**: major mode, regular rhythm, fast tempo, high pitch, wide melodic range, consonant harmonies, and staccato articulation
  - **Anger**: fast tempo, high sound level & sound level variability, low key clarity/ atonality, fast tone attacks, and microstructural irregularity
  - **Tenderness**: major mode, slow tempo, low sound level, little sound level variability, low pitch level, little pitch variability, smooth rhythm, and slow tone attacks

(Gabrielsson, 2009; Juslin & Laukka, 2003)

Musical features

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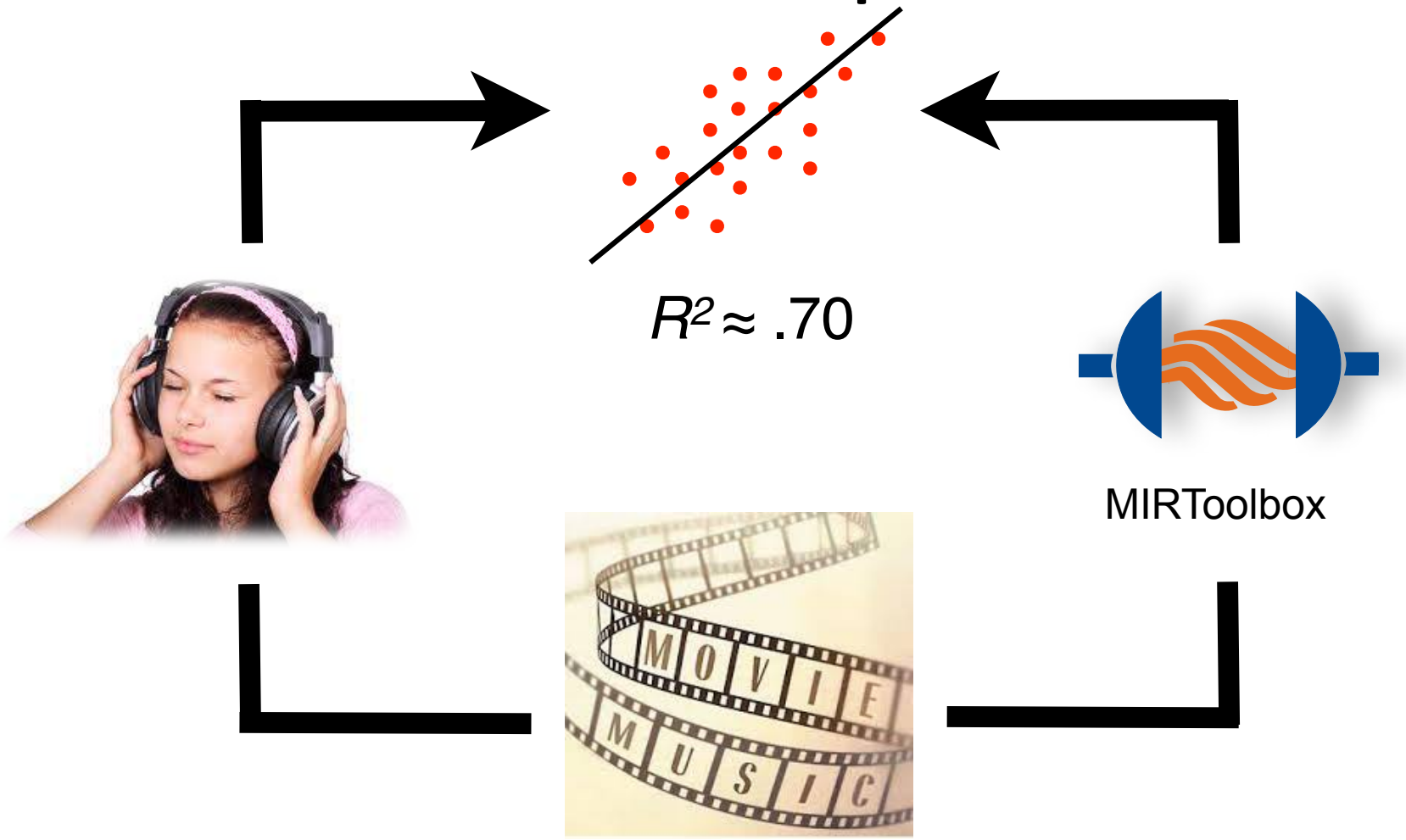
(Gabrielsson, 2009; Juslin & Laukka, 2003)


KIRJASTO
Musiikki
Elokuvat
TV-ohjelmat
Podcastit 9
iTunes U
Kirjat
Ohjelmat 11
Radio
STORE
Toistettava
Nimi
1 I'll Work Fo
2 Speak Dark
3 Repressed
4 Mita kaikat
5 Bach (JS): G
6 San Francis
7 Declare Ind
8 Dancing Qu
RG
BRUCE SPRINGSTEEN
MAGIC
8 kappale

MIR & emotion prediction



Eerola, T., Lartillot, O., & Toiviainen, P. (2009) **Prediction Of Multidimensional Emotional Ratings In Music From Audio Using Multivariate Regression Models.** In proc. of 10th International Society for Music Information Retrieval Conference (ISMIR).

basic emotion concepts and dimensional ratings, on Likert scales

Valence

1 2 3 4 5

Low High

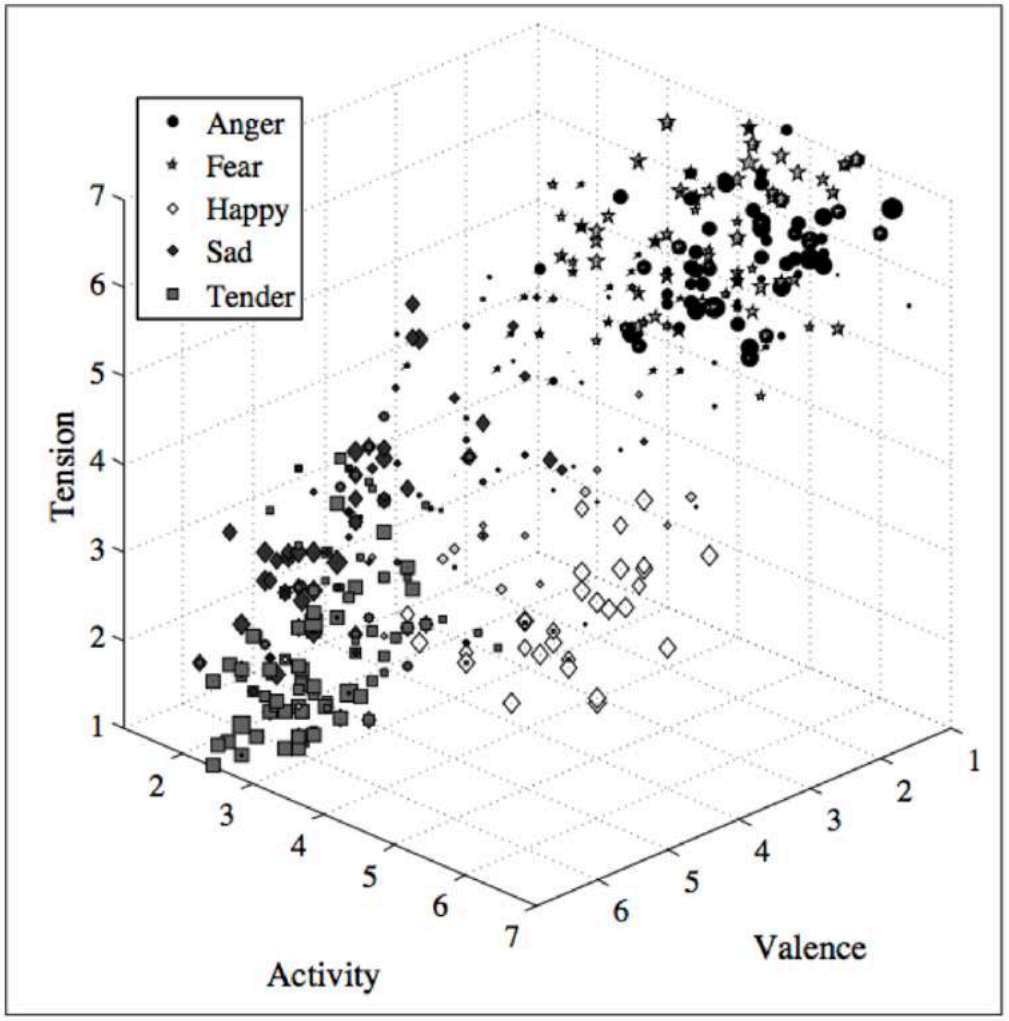


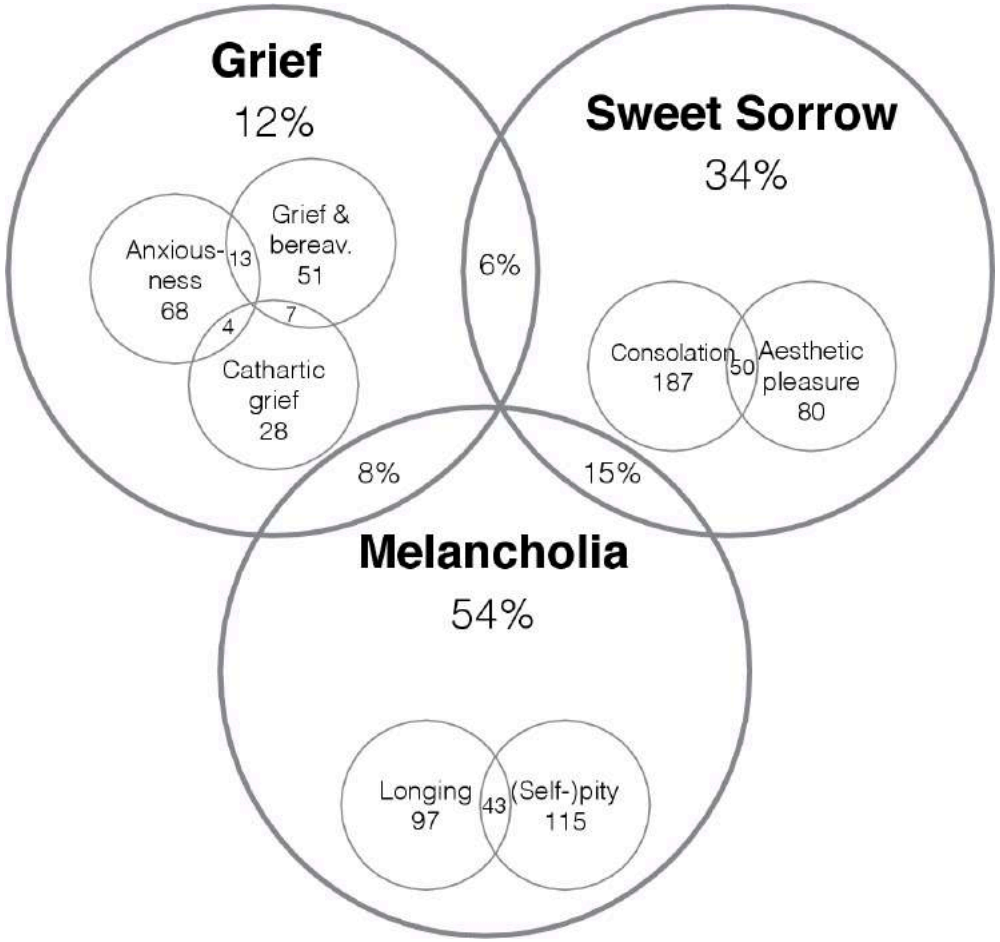
Figure 1. Average ratings of the three dimensions and basic emotions for the 360 soundtrack excerpts.

	Prediction rate (R^2)		
Model	Valence	Activity	Tension
MLR	.64	.75	.67
PCA	.42	.74	.51
PLS	.70	.77	.71
MLR_λ	.66	.74	.69
PCA_λ	.51	.73	.63
PLS_λ	.72	.85	.79

	Prediction rate (R^2)				
Model	Angry	Scary	Happy	Sad	Tender
MLR	.46	.55	.46	.38	.38
PCA	.66	.67	.60	.59	.54
PLS	.66	.62	.61	.61	.50
MLR_λ	.56	.55	.63	.54	.45
PCA_λ	.56	.47	.53	.52	.45
PLS_λ	.70	.74	.68	.69	.58

Anger		**Tenderness**	
Feature	β	Feature	β
Fluctuation peaks	-.14	RMS variance	-.44
Key clarity	-.07	Key clarity	.08
Roughness	.05	Majorness	-.08
Sp. centroid variance	-.04	Sp. centroid	-.05
Tonal novelty	.004	Tonal novelty	-.01

Distinction within “Emotion families”?



Peltola, H., & Eerola, T. (2016). Fifty shades of blue: Classification of music-evoked sadness. *Musicae Scientiae, 20*, 102 - 84.

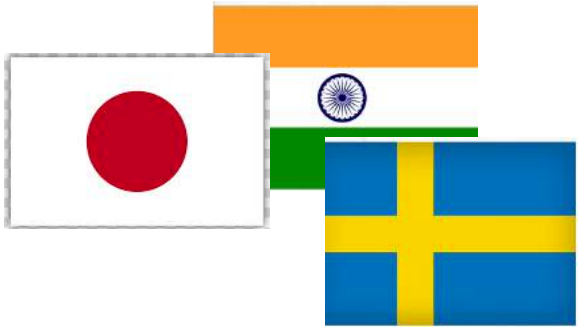
Cues used to express (and infer) emotions in other human domains

- **Human movement & gesture**
  - All sounds from traditional acoustics instruments are produced by human movement -> we can "hear" this movement in music
  - Music emulates the speed, posture, and smoothness/jerkiness of human movement and gestures when experiencing/expressing emotions (Jackendoff & Lerdahl, 2006)

Other cues

- **Culturally learned cues**
  - Mode (minor/major)
  - Pitch (high/low)
  - Contextual associations (e.g., wedding and funeral music)
  - Frequent pairing with narrative content (song lyrics, films, TV, opera)

Other cues



- **Culturally learned cues**
  - better identification of basic emotions (anger, fear, happiness, and sadness) than non-basic ones (e.g., solemnity, humor, and longing)
  - better able to identify the intended emotions in music from their own culture

Laukka, P., Eerola, T., Thingujam, N. S., Yamasaki, T., and Beller, G. (2013). Universal and culture-specific factors in the recognition and performance of musical affect expressions. *Emotion* 13, 434–449. doi: 10.1037/a0031388

Other cues

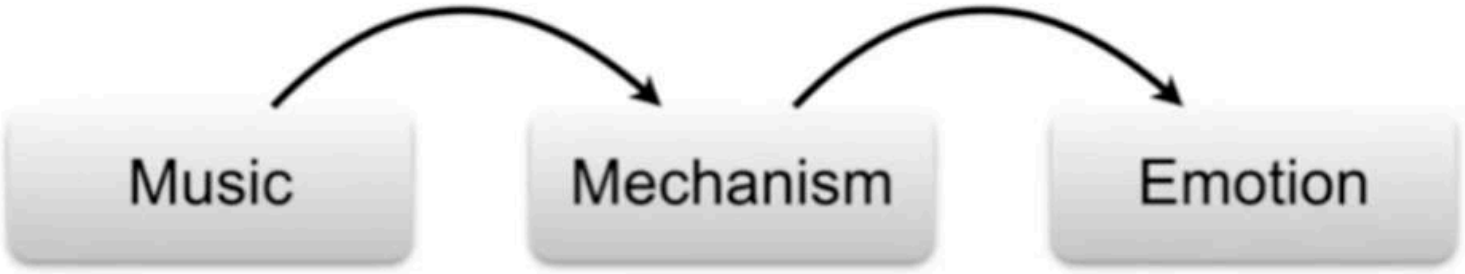
- **Human characteristics/virtual person**
  - Music is assigned attributions that normally would be assigned to a person -> music creates a "virtual person"? (Watt & Ash, 1998)

"……a piece of music can be assigned an attribution that has the value female
rather than male. This need not imply that the music is female, just that the attribution that is made has more of the quality of female rather than of the quality of male. These attributions are made to the music, not to the composer or the performer. Loosely speaking, music creates a virtual person. "

How is music able to **communicate** emotional meaning?

How can music **induce** emotions?

How does music induce emotions?



Juslin & Västfjäll (2008); Juslin (2013)

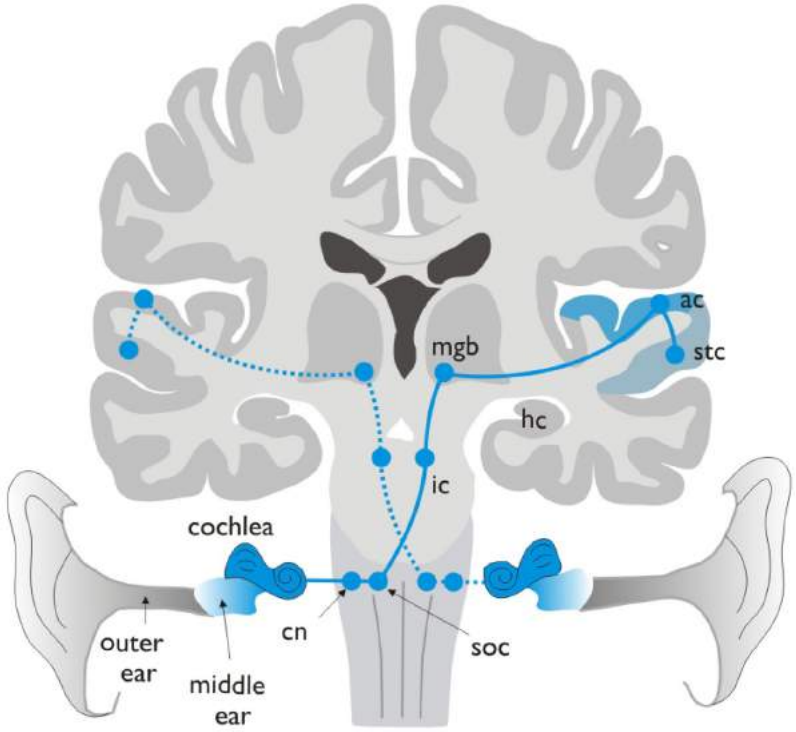
Mechanisms:

- **B**rain stem reflexes
- **R**hythmic entrainment
- **E**valuative conditioning
- Emotional **C**ontagion
- **V**isual imagery
- **E**pisodic memory
- **M**usical expectancy
- **A**esthetic Judgement

Different mechanisms may be at function simultaneously, and lead to differing emotional responses (i.e., mixed emotions)

Brain stem reflexes

- One or more fundamental acoustic characteristics of the music are taken by the brain stem to signal a potentially important and urgent event that needs attention



Brain stem reflexes

- E.g., sounds that are sudden, loud, or dissonant, or that feature accelerating patterns

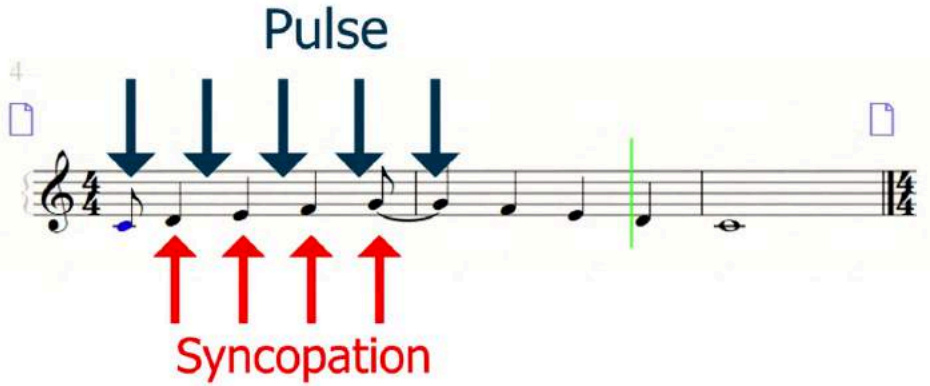
- quick, automatic, and unlearned

- may increase arousal and evoke feelings of **surprise**

Rhythmic entrainment

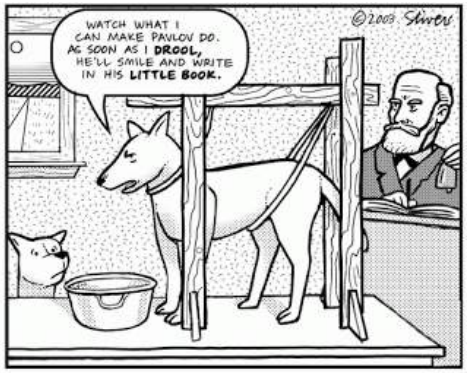
- The rhythm in the music influences some internal bodily rhythm of the listener (e.g., breathing), so that it 'locks in' to a common periodicity with the music
    - evident in techno music, march music, and certain types of film music
- Can increase arousal, but may also arouse feelings of **communion** and '**emotional bonding**'
    - Studies utilizing tapping tasks have shown that when tapping in synchrony with another, the tapping partner evokes more compassion and altruistic behaviour than when tapping asynchronously (Valdesolo & DeSteno, 2011).

Rhythmic entrainment



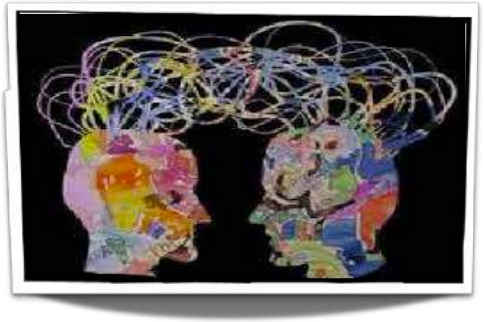
- Optimally syncopated music (i.e., groove) induces a **pleasurable emotional response** and a strong desire to move to the music - to physically enact the musical structure and directly participate in the rhythms of groove, due to the perceptual tension and 'open spaces' afforded (Witek, 2013)

Evaluative conditioning



- An emotion is induced because a piece of music has often been paired with other emotional stimuli
- Through repeated pairing, the music alone will eventually evoke the associated emotion
    - ex: music in marketing and advertising, Wagner's *Leitmotiv* technique

Emotional contagion



- The listener perceives the emotional expression of the music, and then ‘mimics’ this expression internally

- The listener will respond to music as they would to the perceived emotional state of a another human, resonating with those auditory and gestural features that resemble vocal and motor expression of emotion

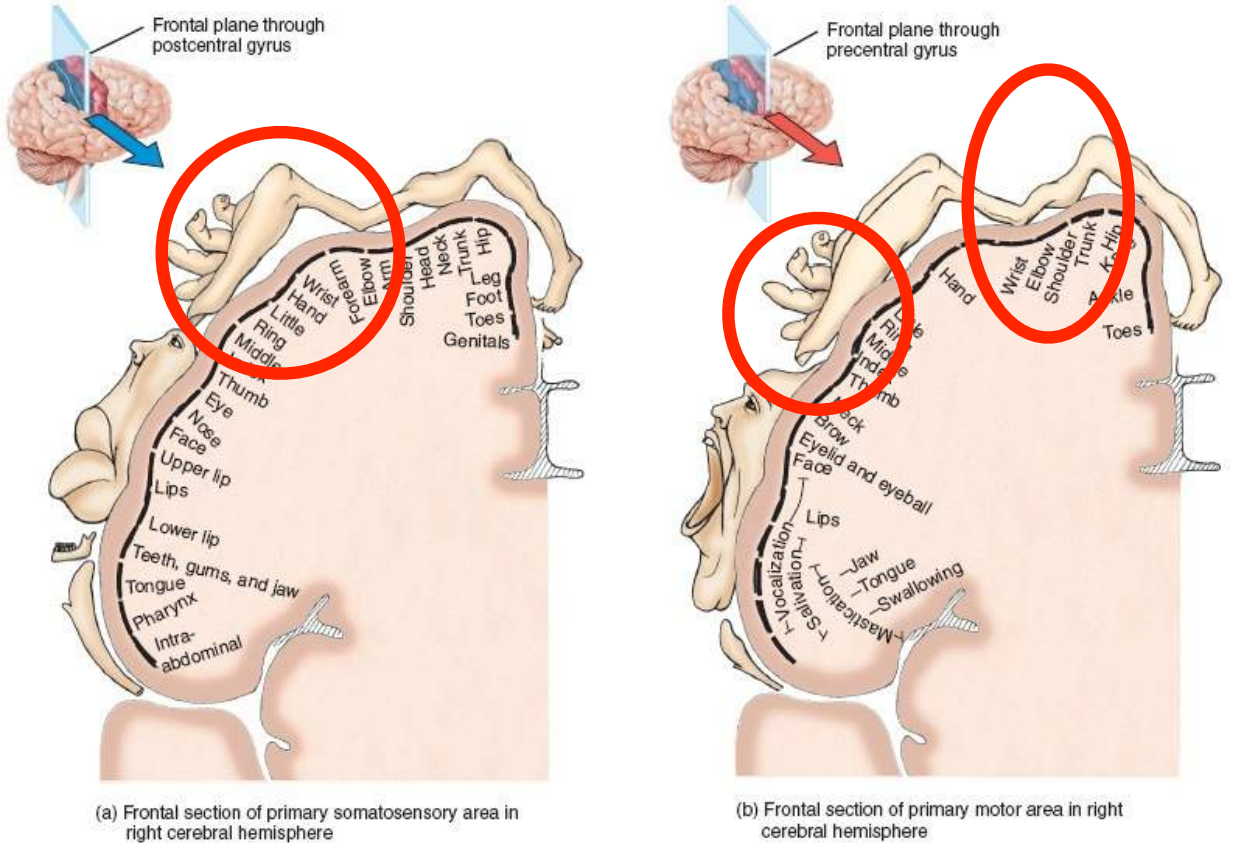
- A ‘pre-conscious’ form of empathy - may utilise mirror-neuron pathways, engaging our motor systems at a pre-conscious, perceptual level - ‘feel’ what another agent is intending or experiencing (McGuiness & Overy, 2011)

Emotional contagion (2)

- Mirror neurons
- ex: same face muscles activated (as shown by electromyography) (Dimberg et al. 2000)
- listening to expressive music activated brain regions associated with pre-motor representations for vocal sound production

Emotional contagion (3)

- Musical sound is perceived not only in terms of the auditory signal, but also in terms of the intentional sequences of expressive motor acts behind the signal (Molnar-Szakacs et al., 2012)



(a) Frontal section of primary somatosensory area in right cerebral hemisphere

(b) Frontal section of primary motor area in right cerebral hemisphere

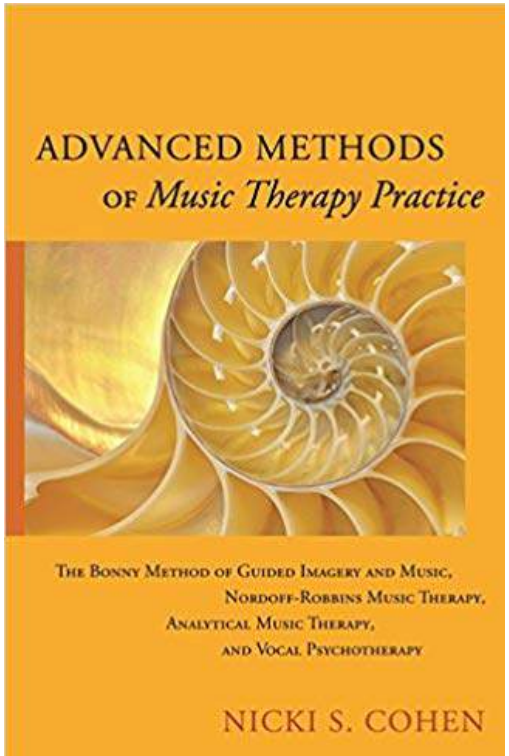
Visual imagery

does this evoke any visuals? if yes, what kind?

Visual imagery

- process whereby a listener conjures up – either intentionally or unintentionally – visual images while listening to music and emotions experienced are the result of a close interaction between the music and the image

- visual imagery is more strongly influenced or shaped by the unfolding structure of the music



Visual imagery

Episodic memory

- The music evokes a personal memory of a specific event in the listener's life
- also called the 'Darling, they are playing our tune' phenomenon
- Episodic memories linked to music often arouse emotions such as **nostalgia**
- Familiar, self-selected music often evokes autobiographical memories and more intense emotions (Vuoskoski & Eerola, 2012)

Episodic memory

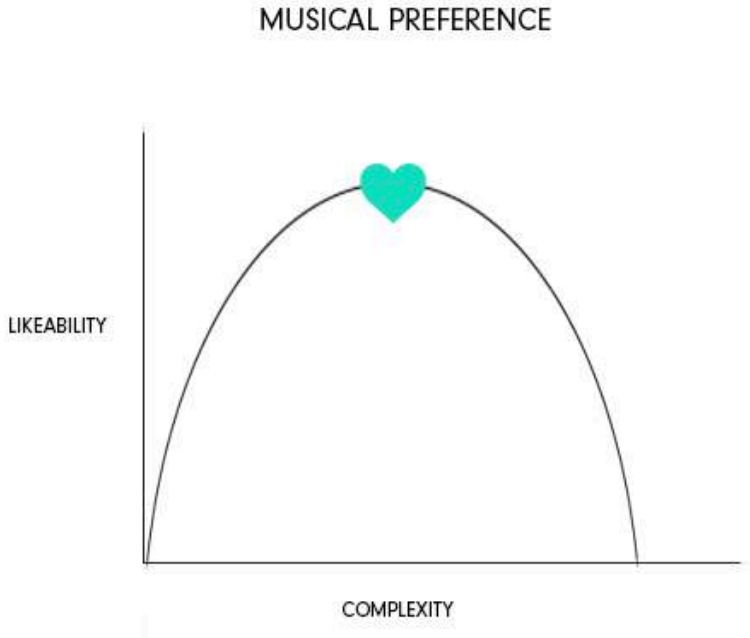
Musical expectancy

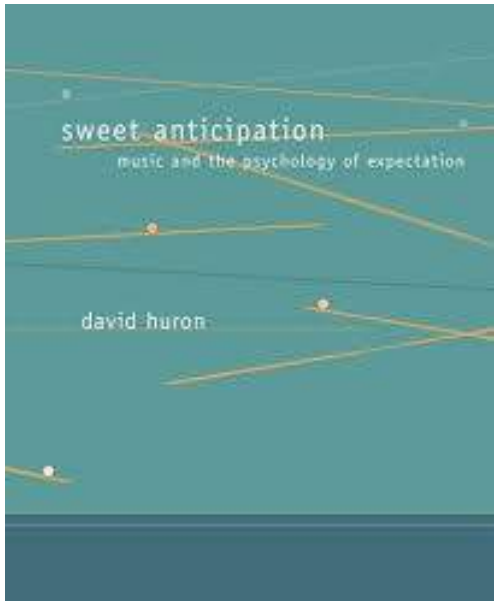
Musical expectancy

- An emotion is induced in a listener because a specific feature of the music violates, delays, or confirms the listener's expectations about the continuation of the music (e.g., Meyer, 1956)
    - based on listener's previous experience of the same musical style and correlate with statistical regularities

Musical expectancy

- Musical emotions induced by expectancy violations might include **tension**, **surprise**, and **thrills**



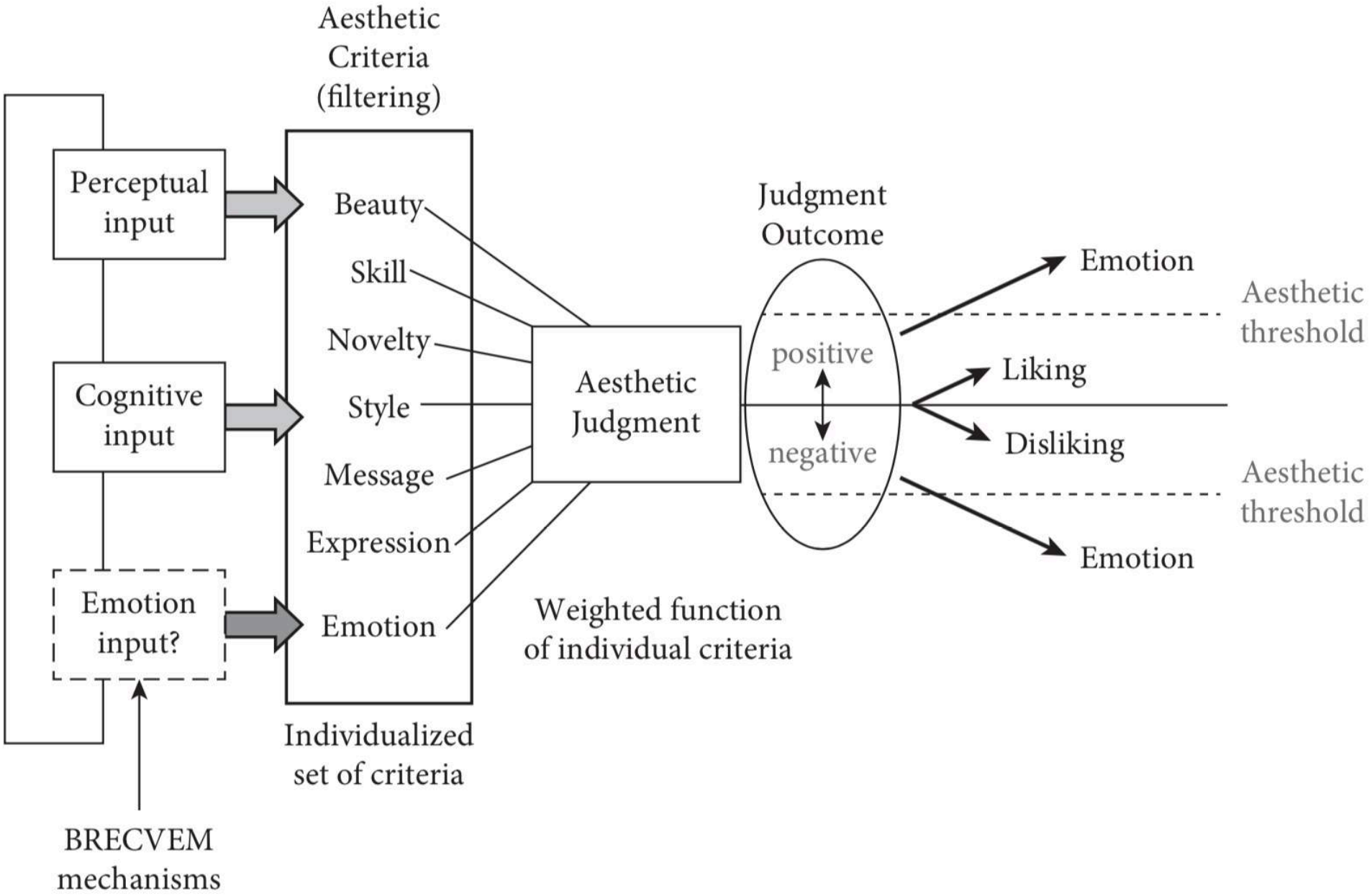


Aesthetic Judgement

- because of his or her evaluation of the music's aesthetic value by adopting an "aesthetic attitude" (e.g., beauty, novelty)
- emotion evoked if the result is that the music is judged as extraordinarily good (or bad) over-all ("aesthetic threshold")
    - ex: **awe**

The 'BRECVEM' mechanisms of music-induced emotion (Juslin & Västfjäll, 2008; Juslin, 2013)

Mechanism	Induced affect
Brain stem reflex	General arousal, surprise
Rhythmic entrainment	General arousal, feelings of communion
Evaluative conditioning	Basic emotions
Contagion	Basic emotions
Visual imagery	All possible emotions
Episodic memory	All possible emotions, but especially nostalgia
Musical expectancy	Interest, anxiety, surprise, chills, hope, disappointment


Aesthetic
Criteria
(filtering)
Perceptual
input
Cognitive
input
Emotion
input?
Beauty
Skill
Novelty
Style
Message
Expression
Emotion
Individualized
set of criteria
BRECVEM
mechanisms
Aesthetic
Judgment
Weighted function
of individual criteria
Judgment
Outcome
positive
negative
Emotion
Liking
Disliking
Emotion
Aesthetic
threshold
Aesthetic
threshold