

BACKGROUND

Music listeners often select music with a specific emotional content for invoking a desired mood in a personal or social situation (Sloboda 2004). Relations between musical structures and emotions have been subject to extensive investigation (Juslin & Vestfjäll 2008). Interaction between rhythmic and tonal features and their associated emotions is an important field for future research on realistic music stimuli, which consists of composite combinations of musical elements (cf. Webster & Weir 2005). Different tonal modes, such as major and minor, are associated with different emotions. We suggest that the mode of a melody can however be affected by the rhythmic framework in which it is interpreted.

Here we ask the questions: Do the rhythmic and tonal patterns of melodies interact while they evoke emotions to the listener? Further, is there an explicit theoretical explanation, which can be applied to predict temporal-tonal-emotional interactive effects?

AIM

We test whether the theories of dynamic attention (Jones 1989), tonal rhythm (Schachter 1976) and key-finding rules (Lerdahl 2001) can be applied to predict listeners' evaluation of moods associated with tonal keys of monophonic melodies.

METHOD

21 singers of average age 38 years from amateur choirs in Aarhus, Denmark, heard 10 melodies, where metric and rhythmic emphases were either placed on important pitch classes in C-major or A-minor, and rated these for 'happiness' or 'sadness' on a Likert scale. 4 musicians tapped the downbeat positions to test our expected locations of emphases. Further, an artificial neural network model was trained to simulate the theoretical predictions.

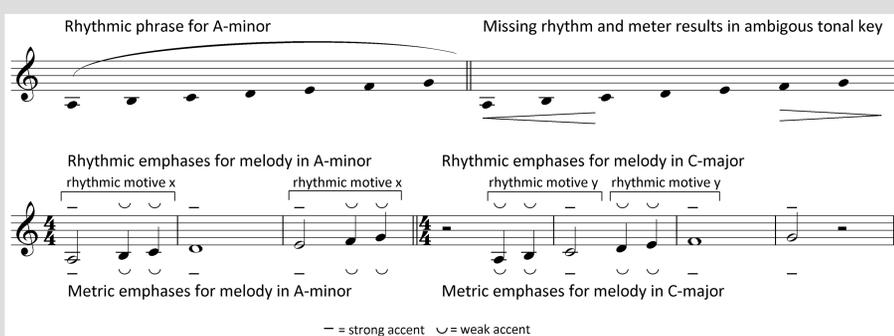


Figure 1. Examples on the theoretical predictions of the rhythmic-tonal interactions.

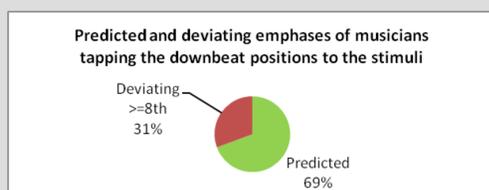


Figure 2. Results of the tapping task. 69% downbeat responses are as we predicted, whereas 31% deviates with more than or equal to 1/8th note.

References:

- Bigand, Emmanuel (1993): The influence of implicit harmony, rhythm and musical training on the abstraction of "tension-relaxation schemas" in tonal musical phrases. *Contemporary Music Review*, Vol. 9, Parts 1 & 2.
- Jones & Boltz (1989): Dynamic Attending and Responses to Time. *Psychological Review*, Vol. 96, No. 3.
- Juslin, Patrick N. & Västfjäll, Daniel (2008): Emotional responses to music - the need to consider underlying mechanisms. *Behavioral and Brain Sciences* 31.
- Krumhansl & Shepard (1979): Quantification of the hierarchy of tonal functions within a diatonic context. *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 5, No. 4.

RESULTS

Listeners evaluate the melody excerpts pointing to major scale as happier (+0.23) than the minor scale excerpts (-0.24) (UNIANOVA: N=210, F=4.368, df=1, p<0.05). There is a significant effect of the rhythmically emphasized pitches' degree of match to the tonal profile (UNIANOVA, F=3.659, df=3, p<0.05, though no significant difference between the two less clear stimuli, t-test, p=0.32).

69% of the rhythmic emphases are identified as we expected.

A regression analysis shows that the artificial neural networks' output values predicts the human subjects' emotional responses (adjusted R square=0.105, df=1, F=25.495, p<0.001).

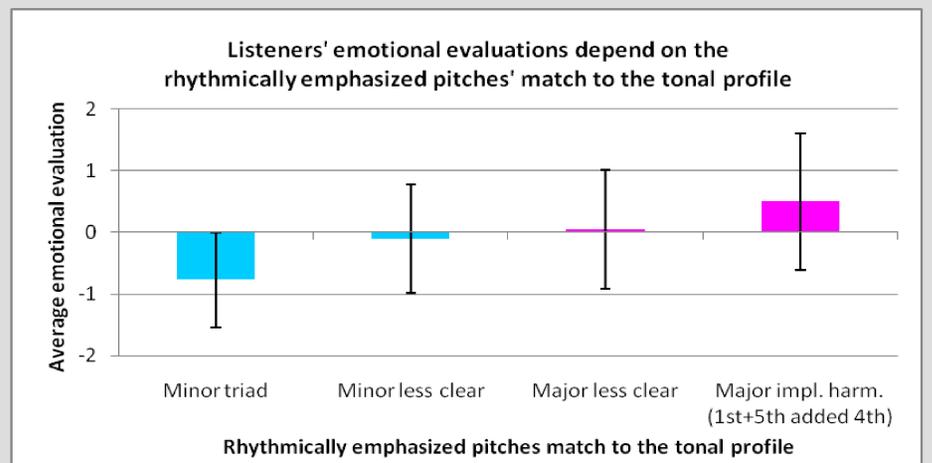


Figure 3. Listeners' emotional evaluations depend on the rhythmically emphasized pitches' match to the tonal profile. The category minor triad (Minor 4) has emphases on pitch-classes A-E-C and major implicit harmony (Major 2 and 3) has emphases on pitch-classes C-G-F. The categories minor less clear (Minor 1,2,3,5) and major less clear (Major 1,4,5) further includes 1 or 2 emphases on less relevant pitch-classes. The vertical lines indicate standard deviations.

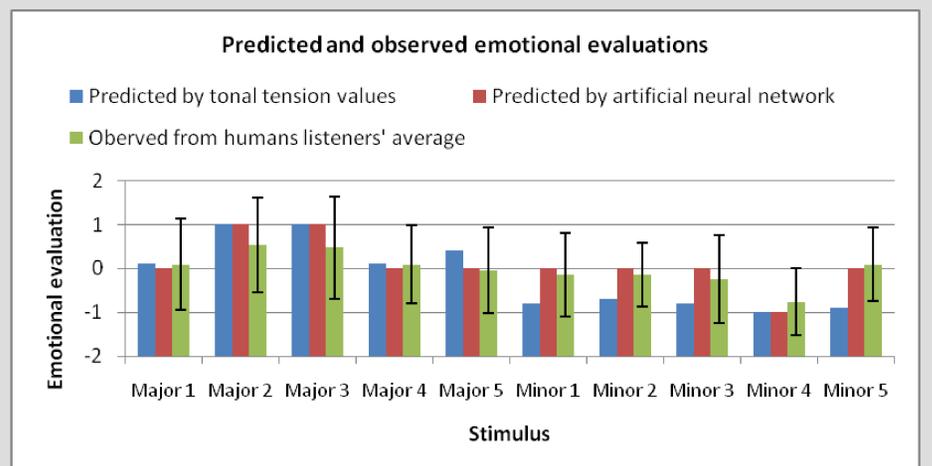


Figure 4. Predicted and observed emotional evaluations. Predictions by tonal tension values are calculated with an adaptation of Lerdahl's (2001) key-finding rule. The ANN is trained on 63 examples covering all possible combinations of 1, 2 or 3 emphasized diatonic pitch classes, when the number of emphases are evenly distributed on each pitch class. The vertical lines indicate standard deviations.

CONCLUSIONS

Our results confirm that interaction between temporal and tonal patterns determines listeners' emotional evaluation of monophonic melodies. The emotional evaluations seem to be highly sensitive to the degree of match between the emphasized pitches and a tonal profile (cf. Krumhansl's and Shepard's 1979) or an implicit harmonic progression in a specific key (cf. Bigand 1993). An artificial neural network trained according to the applied theories successfully predicts the listeners' emotional evaluations.

- Lerdahl, Fred (2001): *Tonal Pitch Space*. Oxford University Press. Oxford. New York.
- Schachter, Carl (1976/1999): *A Preliminary Study i Unfoldings: Essays in Schenkerian Theory and Analysis*. Oxford University Press. New York.
- Sloboda, J. A. (2004): *Exploring the Musical Mind*. Oxford: Oxford University Press.
- Webster & Weir (2005): Emotional Responses to Music - Interactive Effects of Mode, Texture, and Tempo. *Motivation and Emotion*, Vol. 29, No. 1.