ACOUSTIC PARAMETERS AS CUES TO JUDGMENTS OF HAPPY AND SAD EMOTIONS IN MUSIC

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1. INTRODUCTION

Though music can be appreciated for its technical merit and precision, it is no doubt the emotional content that is the main attraction for listeners (Panksepp, 1995). Clynes (1986) believed that emotions have biologically specified dynamic forms present in a gesture, music, dance, etc. If so, then the dynamic forms of emotion in music must be identifiable from the available acoustic parameters.

Acoustic parameters may be defined in terms of musical properties. Two parameters that have been studied extensively are tempo, or beats per minute (bpm) and mode, or key. Generally, a fast tempo and major mode are associated with 'happy' music, and a slow tempo and minor mode with 'sad' music (Dalla Bella et al., 2001; Hevner, 1935, 1937; Peretz, Gagnon, & Bouchard, 1998). However, other parameters, such as vibrato (frequency modulation) and articulation (related to tone onset rise time) (Gabrielsson & Juslin, 1996), have also been found to affect judgments of happy and sad emotion in music.

Our strategy was to select short musical segments, half composed with fast tempo and in the major mode, and half with slow tempo and in the minor mode. On the basis of past research, it was expected that the former would elicit judgments of happy and the latter judgments of sad. Differences in tempo and mode were then selectively removed so that tempo and/or mode could not be used as cues to discriminate emotional content. Reduced discrimination between the two types of segments would therefore implicate the role of tempo and mode. As well, the segments were later analysed for other potential correlates to judgments of emotion.

2. METHOD

2.1 Participants

The first of two groups included 20 (17 women, 3 men) third-year university undergraduates with a mean age of 23.0 yrs (range 21-30 yrs). The second group consisted of 42 (23 girls, 19 boys) high school students with a mean age of 16.7 yrs (range 15-18 yrs). Participants in both groups represented a wide range of music training--from zero to 12 years.

2.2 Stimuli

Twenty pieces of Western classical music in MIDI format were chosen so that 10 of the pieces had a relatively fast tempo (mean = 151 bpm) and were in the major mode and the other 10 had a relatively slow tempo (mean = 60 bpm) and were in the minor mode. Segments of three durations--0.5 s, 1 s, and 2 s--were taken from each piece, each beginning at a common point within the piece. Segments were presented under each of four cue conditions: (1) original tempo and mode; (2) equalized tempo (90 bpm) but original mode; (3) all in major mode but original tempo; (4) equalized tempo with all in major mode. Condition 2, 3, and 4 were constructed with sound editing software. Playback of stimuli was restricted in timbre and intensity. All segments were realized by a Yamaha S 100 XG piano timbre and key velocity was held to a narrow range.

2.3 Design and Procedure

There were 240 trials--20 randomly ordered segments within each of 12 blocks. Each block represented one of the factorial combinations of three segment durations and four cue conditions. Participants rated each segment on a 10-point scale, where '1 = very sad', '5 = slightly sad', '6 = slightly happy' and '10 = very happy'. Participants were tested in groups.

3. RESULTS

For both the original and edited segments, segments from compositions with fast tempo in the major mode were rated as significantly more 'happy' than segments from compositions with slow tempo in the minor mode. The difference decreased as the original tempo and mode cues were removed, as exemplified in Figure 1 for the 2 s segments. Differences were highly significant ($p < .001$) even at the shortest (0.5 s) duration, and increased as segment duration increased. Thus, the data implicate tempo, mode, and duration as influencing judgments of happy and sad emotions in music.

However, the finding that ratings for the two types of segments differed significantly when both tempo and mode cues were removed suggests the presence of other cues influencing judgment. Mean ratings for each segment were entered into a regression analysis with predictors note

density (number of notes per s) and average pitch height along with tempo and mode. Results are shown in Table 1. All four predictors contributed significantly to the regression. From the beta weights, note density and mode were determined to be the most important cues in predicting emotion ratings.

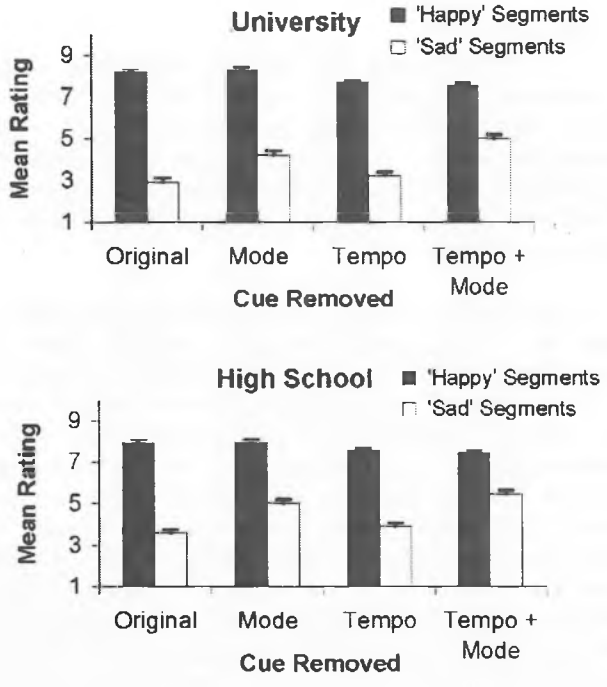

Figure 1. Mean emotion ratings for 2.0 s 'happy' and 'sad' segments in the four conditions for University (top) and High School students (bottom). The orientation of the rating scale is from sad '1' to happy '10'.

4. DISCUSSION

Both groups were easily able to use ratings of happiness/sadness to distinguish properties of musical segments with as little as 0.5 s exposure. When tempo and mode cues were removed, judgments became less distinct. Replicating earlier studies, the present study found that tempo and mode are clearly implicated in judgments of musical emotion.

The regression further clarified the involvement of tempo and mode but also showed that note density is as important as mode, and average pitch height of a segment may be more important than tempo in judgments of emotion. More notes per second and a higher average pitch height both lead to higher happiness ratings. Similarity of the two groups in ratings and in the regression equations suggests that, by the age of 15 years, people respond in an adult way.

In summary, tempo and mode were verified as important cues to judgments of happy and sad emotion in music. The addition of note density and average pitch height as perhaps equally important cues to judgments of emotion has implications for further research on emotions in music. Interpretation of data, taking into account only tempo and mode, may be problematic because identification of emotion can take place through other, uncontrolled cues available in music (Lantz, Kilgour, Nicholson, & Cuddy, in press).

Table 1. Results of multiple regression of acoustic cues on emotion ratings for both university and high school students.

	University			High School		
Cue	beta	*t*	*p*	beta	*t*	*p*
Note Density	.459	12.31	<.001**	.399	11.13	<.001**
Mode	.352	9.80	<.001**	.415	11.99	<.001**
Pitch Height	.215	6.28	<.001**	.228	6.94	<.001**
Tempo	.179	2.64	<.001**	.186	5.53	<.001**
Variance Accounted For		76%**			78%**	

**$p < .01$

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