

What makes ragas sad?

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Purpose

Sadness is a near universal response to music from a great variety of cultures. Less well understood is what characteristics of music evoke sadness. Here we examine the extent to which judgments of sadness are based on basic acoustic features such as pitch and timbre. We wished to test whether features that have been shown in other studies to correlate with sadness (average pitch height, spectral centroid etc.) would generalize to Indian music in both novice and experienced listener populations.

Methods

An Internet-based survey was conducted that collected sadness judgments in response to a diverse set of ragas drawn from North Indian classical music (NICM). For each of ten raags (Bageshri, Bhimpalasi, Darbari, Desh, Gujari Todi, Khamaj, Malkauns, Marwa, Shree, Yaman) a 60s excerpt was presented randomly from a set of 3-4 recordings. Excerpts were drawn from the alap, a section in which the raag's essential qualities are thought to be most clearly expressed.

Using music information retrieval techniques, each excerpt was pitch tracked and analyzed spectrally to derive a set of simple pitch and timbre related features including average pitch height, standard deviation of pitch, spectral centroid, and pitch-class distribution (duration weighted count of pitches). These features were correlated with sadness judgments.

From previous work, we hypothesized that average pitch level, spectral centroid, and pitch standard deviation would be negatively correlated, while "minor" note usage (e.g. -2, -3, -6 scale degrees) would correlate positively with sadness judgments.

Results

A total of 1770 sadness judgments were collected from 362 different subjects ranging from those with no exposure to NICM to those who described themselves as "very" familiar with NICM.

Table 1 shows the Pearson correlation coefficient for several acoustic features and sadness judgments. Note that the Binary Minorness feature is calculated by counting the number of minor scale degrees used in a particular raga. Because pitch estimates were noisy, particularly for instrumental excerpts where more than one string may be vibrating and amplitude decays quickly, it was thought that this feature might provide further insight.

Bold items in tables below are significantly correlated at the 95% confidence level, using Sidak correction of the p-value threshold for multiple tests.

Table 1: Correlation between features and sadness judgments

Feature	Correlation coefficient	p-val
Spectral Centroid	-0.0250	0.2930
Avg. pitch height	-0.0457	0.0548
STD of pitch height	-0.1641	< 0.0001
Minorness (-2, -3, -6)	0.0810	0.0006
Majorness (2, 3, 4, 6)	-0.0677	0.0044
Binary Minorness	0.2353	< 0.0001

Table 2 shows results stratified by exposure to NICM. A few interesting trends are apparent. For listeners in the ‘somewhat’ or ‘very’ categories, judgments of sadness are more strongly positively correlated with minor scale degrees and negatively correlated with major scale degrees.

Table 2: Correlation between features and sadness judgments by NICM familiarity

Feature	NICM Exposure							
	‘not at all’		‘a little’		‘somewhat’		‘very’	
	Corr.	p-val	Corr.	p-val	Corr.	p-val	Corr.	p-val
STD pitch	-0.1664	0.0002	-0.2546	< 0.0001	-0.1643	0.0035	-0.1643	0.7484
Minorness (-2, -3, -6)	0.0708	0.1195	0.0605	0.1159	0.1387	0.0138	0.1439	0.0261
Majorness (2, 3, 4, 6)	-0.0884	0.0516	0.0252	0.5133	-0.1455	0.0097	-0.2252	0.0005
Bin. Min.	0.2076	< 0.0001	0.1959	< 0.0001	0.3377	< 0.0001	0.3509	< 0.0001

Conclusions

The current data show weak but significant correlations between melodic and timbral features and judgments of sadness in NICM. Because ecological stimuli were used, it is difficult to judge the true relative contribution of each parameter. However, it seems clear that the use of minor scale degrees is correlated with sadness and major scale degrees are inversely correlated, and that this is true for both novice and enculturated listeners. Further, the data support the role of pitch range in sadness judgments, but not average pitch height.

Research Implications

The study provides cross-cultural support for previously observed acoustic predictors of sadness judgments. Future research will require the careful construction of controlled prospective experiments to assess the contribution of each feature.