On the Relationships Between Music-induced Emotion and Physiological Signals

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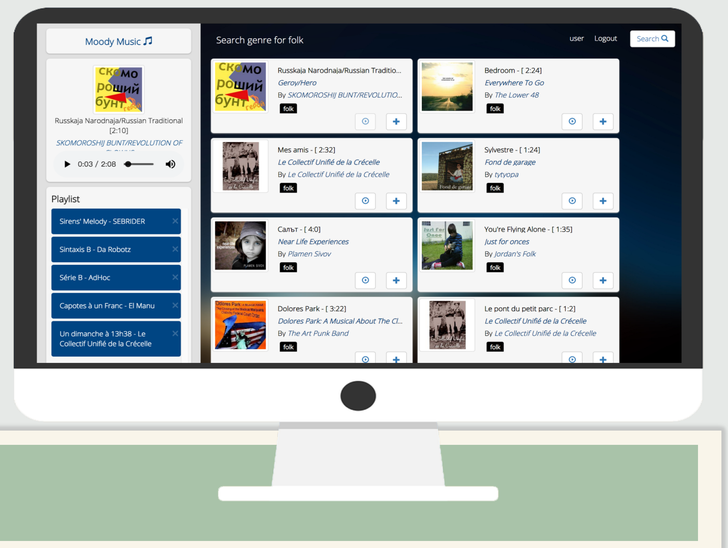
OBJECTIVES

- To explore the possibility of using **physiological signals** to detect users' **emotional responses** to music
- To explore which **physiological features** differ significantly across different emotion responses
- To explore to what extent do prediction performances vary across **individuals** and **user characteristics**



METHODS

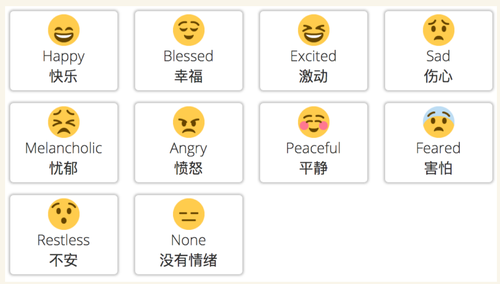
User Experiment | Machine Learning

Pre-exp Survey → **Music search and listening (40mins)** → **Post-exp Survey**

- Demographics
- Music listening behaviors
- **Music preference**
- **Personality**

Q1: Arousal

Q2: Mood



- Electrodermal Activity (EDA)
- Blood Volume Pulse (BVP)
- Inter Beat Interval (IBI)
- Heart Rate (HR)
- Skin Temperature (TEMP)

Data Preprocessing → **Feature Extraction** → **Statistical Tests** → **Classification & Evaluation**

Category	Features
Statistics based	Mean, Standard deviation, Median, Range
Time series based	Means of the absolute values of the 1st / 2nd differences of the raw / normalized signals
Frequency domain	HF, LF, LF/HF
Physiological signal specific	Skin conductance response (SCR), Heart rate variability (HRV)

- one-way **ANOVA:** positive, negative, neutral
- **T-test:** positive, negative

- **Classifiers:** Decision Tree, k-NN, SVM, Naïve Bayes
- 10-fold cross-validation
- **Measure:** ***Kappa*** (0.2~0.4: Fair; 0.4~0.6: moderate; 0.6~0.8: substantial)

RESULTS

- ANOVA and T-tests

Feature	Arousal		Mood	
	ANOVA	t-test	ANOVA	t-test
BVP_median	0.034	0.012	0.004	-
BVP_HF	0.049	0.007	-	-
HR_stdev	0.022	0.002	-	0.005
HR_range	0.010	< 0.001	0.039	0.003
HR_LF	0.022	< 0.001	-	0.004
HR_HF	0.028	0.001	-	0.006
EDA_MFDN	0.020	0.003	-	-
EDA_MSDN	0.017	0.003	0.050	0.008
EDA_LF/HF	0.036	-	-	-
IBI_median	-	-	0.006	-
IBI_mean	-	-	0.006	-

(Bonferroni correction applied)

- Classification on participants

Personality	No. of users	Arousal	Mood
Extrovert	12	0.248	0.300
Introvert	11	0.351	0.273
Agreeable	3	0.581	0.682
Disagreeable	20	0.250	0.233
Open	7	0.290	0.332
Close	16	0.259	0.494
Stable	9	0.281	0.388
Unstable	14	0.248	0.248
Conscientious	6	0.395	0.378
Unconscientious	17	0.213	0.221
Music Preferences			
Pop only	7	0.285	0.426
Classical, Folk, Pop	10	0.303	0.281
Electronica, Rock, Pop	6	0.380	0.535

User	Arousal	Mood
User 1	0.400	0.294
User 2	0.577	0.262
User 3	0.571	0.800
User 4	0.537	0.700
User 5	0.788	0.604
User 6	0.490	0.516
User 7	0.435	0.516
User 8	0.767	0.767
User 9	0.694	0.765
User 10	0.670	0.747
User 11	-0.063	0.000
User 12	0.722	0.843
User 13	0.614	0.405
User 14	0.580	0.750
User 15	0.427	0.440
User 16	0.259	0.423
User 17	0.595	0.475
User 18	0.784	0.784
User 19	0.507	0.750
User 20	0.380	0.586
User 21	0.673	0.818

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