IEEE SPMB – Lecture Session No.3

Psychophysiological Correlates of Emotion During Music Perception

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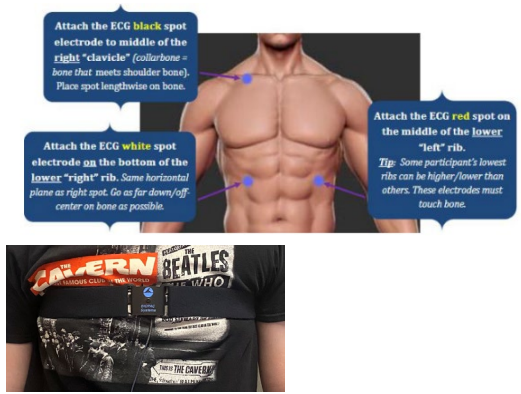
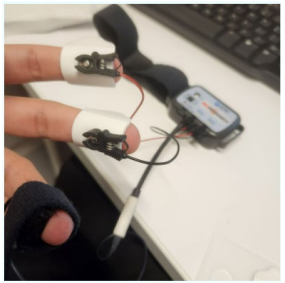
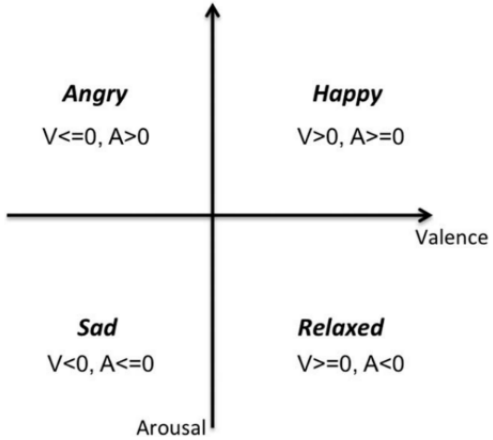
Link to the Paper →

Primary Goal of the Study

Investigate whether a systematic relationship exists between certain physiological measurements (i.e., heart function, skin-conductance, and respiration) and behavioral reports of music-induced emotion (i.e. valence and arousal) in previously unexperienced music



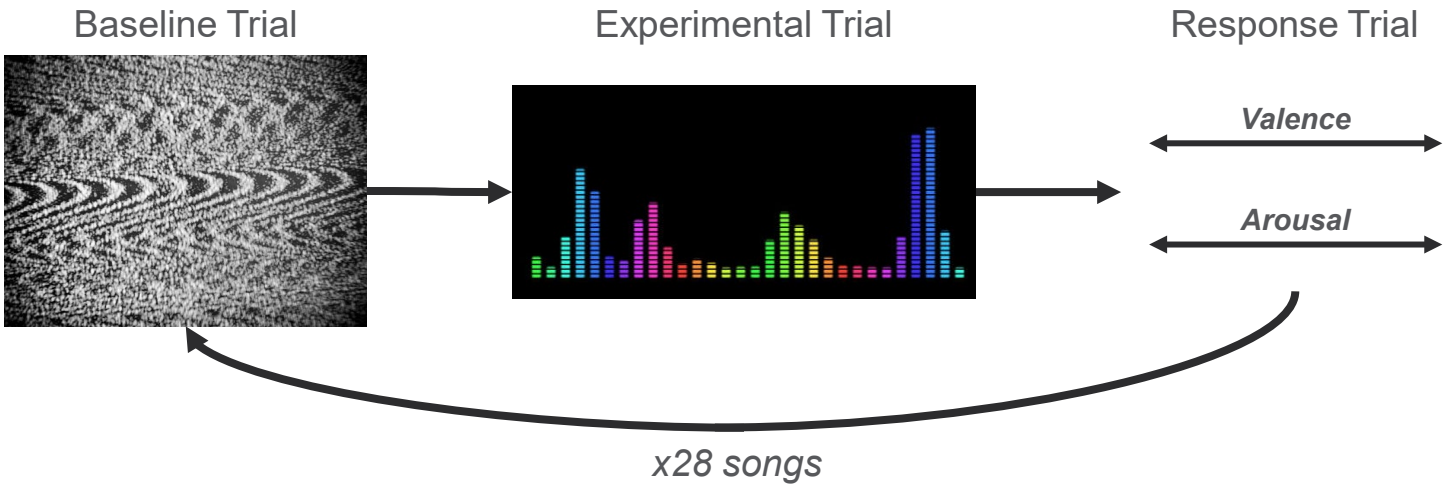




Song et al., 2016

Study Design

The experiment consisted of three repeating stages.



Baseline Validity Results

Table 1. Pairwise t-test results comparing the initial and subsequent baseline trials across participants. Values in **bold** are significant under Bonferroni corrections, where $\alpha = 0.005$, and underlined values would be significant if Bonferroni corrections were not used, where $\alpha = 0.05$.

Measurement	t-value	p-value
BPM	-1.160	0.256
RMSSD HRV	2.277	0.031
HF HRV	2.073	0.048
EDA Tonic	2.378	0.024
EDA Phasic	1.017	0.318
EDA Phasic AUC	1.417	0.167
EDA Phasic Range	-0.763	0.452
RSP Rate	1.105	0.280
RSP Amplitude	-1.643	0.112
PPG	-1.222	0.232

Baseline Validity Results

Table 1. Pairwise t-test results comparing the initial and sub-

Takeaway: HRV and EDA tonic measurements should be interpreted with caution, yet HR, RSP Rate, EDA Phasic Range, and PPG return to baseline even with short inter-trial intervals.

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RSP Amplitude	-1.643	0.112
PPG	-1.222	0.232

Proposed Model

Latent Variable Model

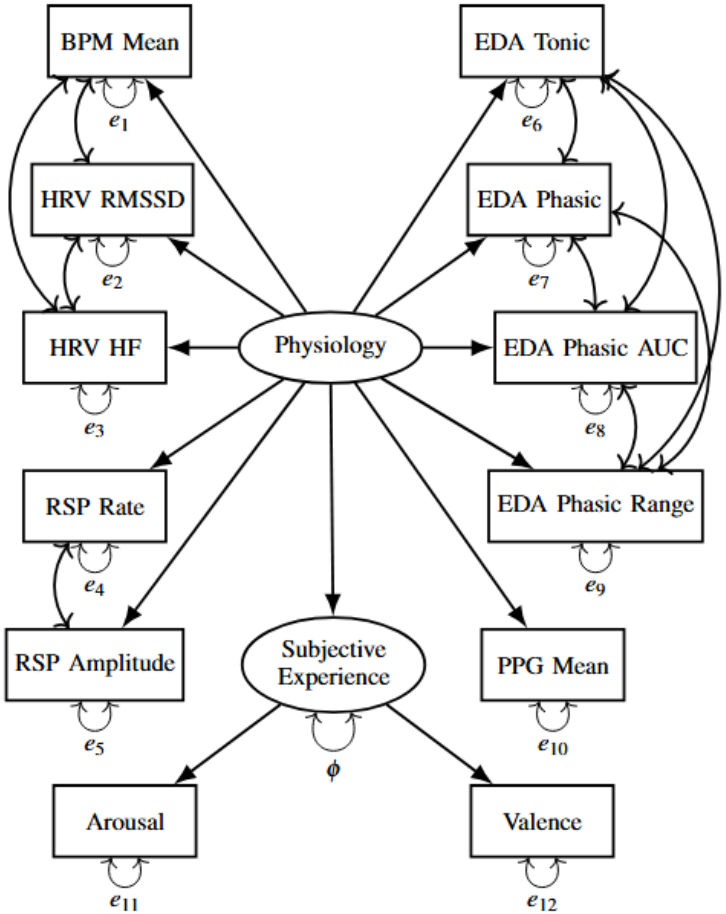
Physiology predicts Subjective Experience

Physiological measurements *load* onto the Physiology latent variable

Subjective ratings of valence and arousal load onto the Subjective Experience latent variable.

Measurements from the same physiological recording covary

Clustered by Participant & Song



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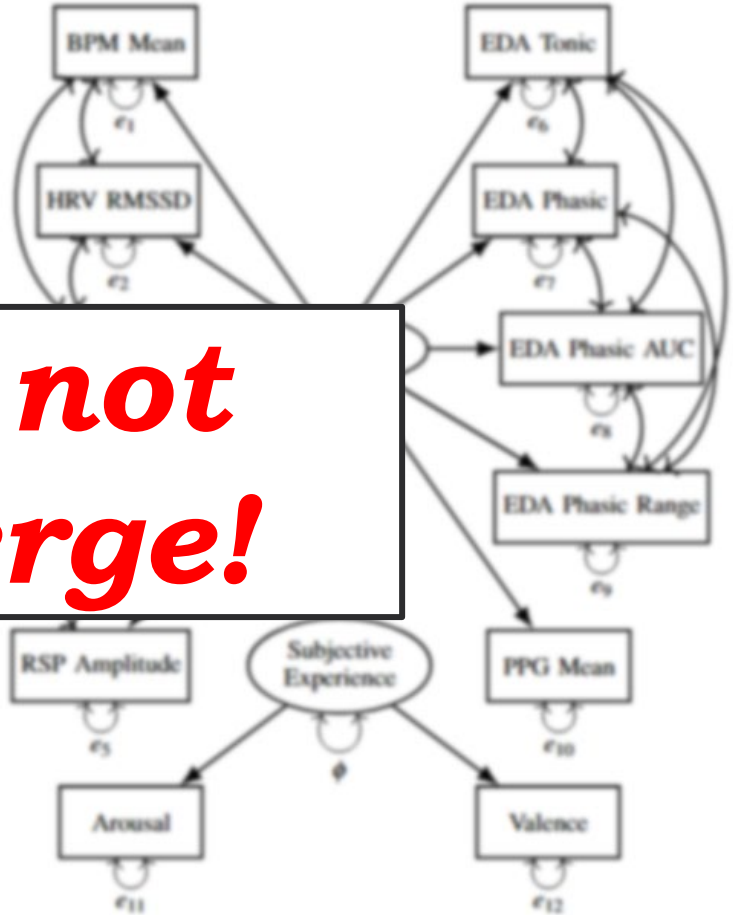
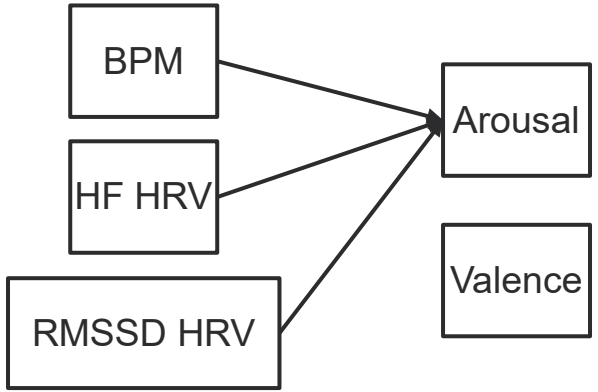


Does not converge!

Exploratory Model

Table 3. Standardized regression coefficients and p-values for all predictors across the four initial physiology models. Values in **bold** are statistically significant ($p < 0.05$) and were later included in the composite model.

Measurement	Arousal	p-value	Valence	p-value
BPM	-0.031	0.470	-0.045	0.300
RMSSD HRV	-0.057	0.199	-0.029	0.514
HF HRV	**0.091**	**0.016**	**0.079**	**0.037**
EDA Tonic	**0.104**	**0.004**	0.040	0.262
EDA Phasic	-0.564	0.293	-0.991	0.062
EDA Phasic AUC	0.623	0.245	0.957	0.072
EDA Phasic Range	-0.033	0.432	**0.165**	**<0.001**
RSP Rate	**0.133**	**<0.001**	0.019	0.621
RSP Amplitude	0.055	0.141	0.039	0.304
PPG	-0.024	0.493	**-0.080**	**0.023**



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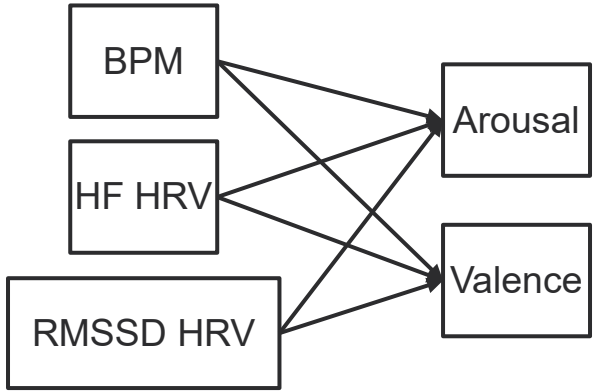

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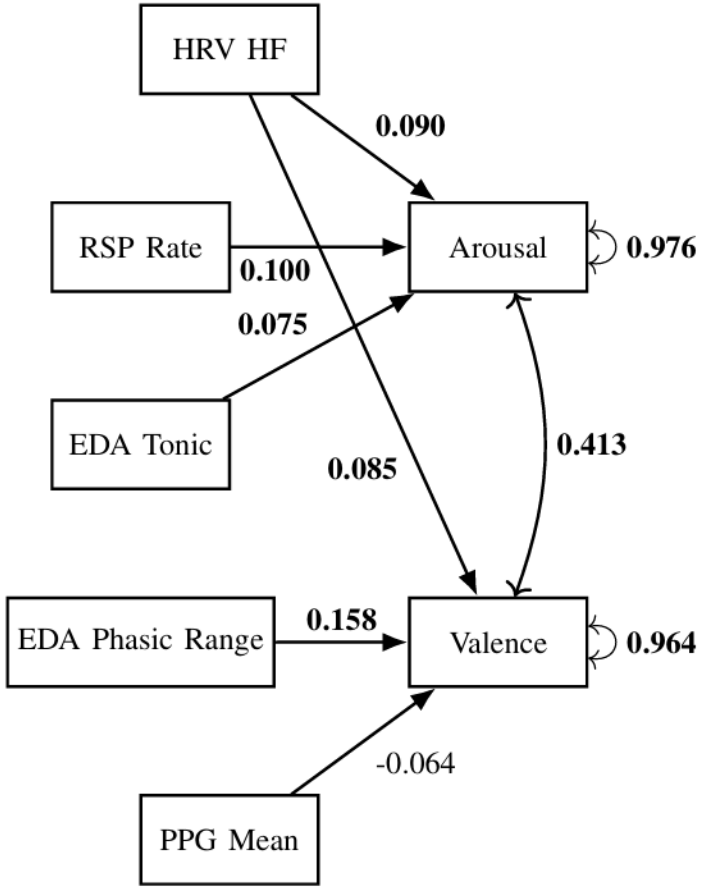

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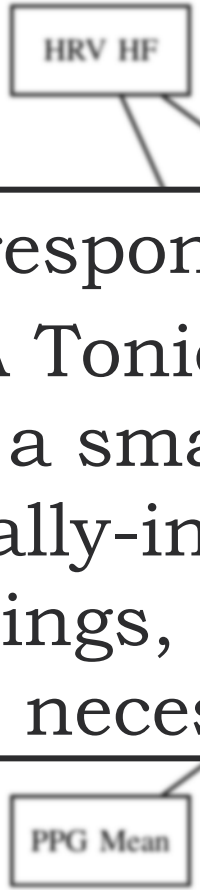

Table 3. Standardized regression coefficients and p-values for

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Takeaway: Physiological responses like HRV HF, RSP Rate, EDA Tonic, and EDA Phasic Range play a small yet significant role in musically-induced valence and arousal ratings, but a confirmatory analysis is necessary.

Intraclass Correlations

Table 4. ICCs for composite model measurements for both the participant level (Level 3) and song level (Level 2) clusters.

Measurement	Level 3 ICC	Level 2 ICC
Arousal	0.027	0.328
Valence	0.074	0.221
HF HRV	0.296	0.024
EDA Tonic	0.858	0.003
EDA Phasic Range	0.332	<0.001
RSP Rate	0.539	0.014
PPG	0.852	0.002

Intraclass Correlations

Table 4. ICCs for composite model measurements for both the

Takeaway: Strong clustering *within participants* for all physiological measurements (e.g., HF HRV, etc.), and strong clustering *within songs* for both subjective reports (e.g., Valence and Arousal).

Internal State Relationship

Internal state – the physiological state of a participant prior to experimentation, as recorded in the initial baseline.

Baseline trials are consistent = we can use them to represent internal state

Table 4. LMM of Prior Baseline Trial and Subsequent Experimental Trial. Values in **bold** are significant.

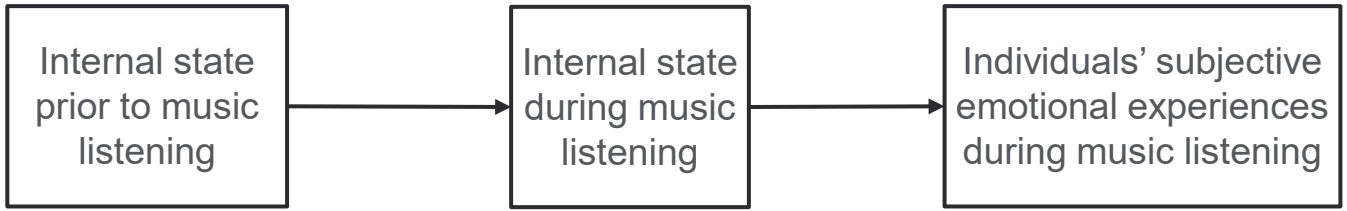
Variable	Fixed Effects	Standard Error	p-value
BPM	**0.656**	0.035	**<0.001**
RMSSD HRV	**0.237**	0.029	**<0.001**
HF HRV	**0.224**	0.039	**<0.001**
EDA Tonic	**0.949**	0.010	**<0.001**
EDA Phasic	**0.485**	0.032	**<0.001**
EDA Phasic AUC	**0.499**	0.032	**<0.001**
EDA Phasic Range	**0.697**	0.021	**<0.001**
RSP Rate	**0.148**	0.039	**<0.001**
RSP Amplitude	**0.561**	0.029	**<0.001**
PPG	**0.344**	0.031	**<0.001**

Internal State

New perspective on the relationship between music-induced emotions and physiology

Example, EDA Phasic Range:

- Strong relationship between baseline measurements and experimental measurements
- Successfully returns to baseline across baseline trials
- Significantly correlated with Valence



Conclusion

- The physiological measurements collected here have the potential to be used as a tool for measuring music-induced emotion
- The present physiological measurements do not fully explain why music induces emotional responses
- Physiological measurements are best predictive of subjective emotional responses when addressed wholistically
- Prior internal state may affect the way humans respond to emotion-inducing music
- More data must be collected to test the proposed clustered latent variable model and validate the present findings

Thank You!

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