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The Role of Enculturation in Music-Induced Emotions: A Study on Psychophysiological Responses during Music Listening

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ABSTRACT

Previous cross-cultural studies in music and emotion have mostly focused on emotion recognition and whether basic perceived emotions are recognised across cultures. As a result, the impact of enculturation on music-induced emotions remains largely unexplored. In addition, such studies have relied mainly on subjective self-reports, ignoring other components of emotion such as physiology. Cross-cultural studies have suggested that cultural learning has a differential effect on certain emotional components (subjective feeling, physiology, and facial expression), yet this has not been tested in a music setting. To test this hypothesis, three groups of Finnish, Chinese, and Greek non-musicians listened to 20 excerpts of Western, Chinese, and Greek music that were selected from previous studies in which the emotional character of the music had been rated. Self-reports were used to collect continuous ratings of valence and arousal, along with measures of physiological activity (heart rate, skin conductance, and respiratory rate). Ratings of intensity, familiarity with the excerpt and familiarity with the music style were also collected after each stimulus. Results showed similar levels of familiarity with Western music across nationalities. However, the subjective measurements revealed group differences in the subjective feeling, even when familiarity was controlled for. Arousal was the only subjective rating that did not have a differentiating pattern, in line with previous research that has suggested arousal has a more universal quality. Physiological activity also showed less variation across nationalities, indicating that autonomic nervous system responses to music listening are less mediated by enculturation.

INTRODUCTION

In the context of music, existing cross-cultural studies have focused primarily on emotion recognition, using variations of discrete classification models. Several studies have argued that a few basic emotions (typically joy, sadness, and anger) are universally recognized across cultures (Adachi, Trehub, & Abe, 2004; Balkwill & Thompson, 1999; Balkwill, Thompson, & Matsunaga, 2004; Fritz et al., 2009). On the other hand, secondary emotions that share common properties (e.g. sadness and peacefulness that share low valence) are often misidentified and have not produced consistent results (Argstatter, 2015; Balkwill & Thompson, 1999; Laukka, Eerola, Thingujam, & Yamasaki 2013). This might be due to linguistic or taxonomic differences of discrete emotion labels (Mesquita & Frijda, 1992), translation inaccuracies or variations in meaning (Thompson & Balkwill, 2010), or to the existence of emotions that are unique to only certain cultures (Averill, 1982). Using models of emotion with fewer core principles instead of multiple word tags such as the dimensional model (Russell, 1980) could reduce the amount of linguistic errors, although few attempts have been made so far.

Another common challenge in music and emotion research in general is prior exposure to the stimuli (Eerola & Vuoskoski, 2013), which can be especially hard to balance in a cross-cultural setting. Familiarity is known to enhance emotional responses (Schellenberg, Peretz, & Vieillard, 2008) and as it has not been fully controlled in many existing studies, it is hard to conclude whether any observed differences across groups were due to cultural or familiarity factors.

Beyond emotion recognition, induced emotions have largely been ignored, making it unclear how cultural factors affect them. Egermann, Fernando, Chuen and McAdams (2015) investigated felt emotions using the dimensional model and physiological measurements on two groups of Canadian and Congolese Pygmies. Results suggested that physiology and arousal scores have more universal responses to low level acoustic features of music, whereas valence is affected more by cultural learning (Egermann et al., 2015). When it comes to the effect of enculturation in different components of emotion, Soto, Levenson, and Ebling (2005) found that cultures with distinct tendencies towards emotional expression also had distinct subjective emotional responses to aversive acoustic startle stimuli, while their behavioral and physiological responses were less differentiated. However, it is unclear whether these differences between the subjective feeling and physiology can be generalized in a more complex auditory context, such as music listening. It is also remains to be seen whether cultural predispositions towards emotional expression will have an effect on self-reports of music-induced emotions, making some ethnic groups to report stronger emotional responses than others.

To this extend, the current study poses the following research question:

What is the role of enculturation in subjective and physiological responses to music-induced emotions?

To address this question, a cross-cultural study was devised, using three groups of Finnish, Greek, and Chinese participants listening to Western, Greek and Chinese music. The three groups and music styles were selected based on previous experimental and ethnographic research. Subjective self-reports of the emotional experience and physiological measurements were collected. Familiarity was controlled with two sets of ratings, identifying both familiarity with the music excerpt and familiarity with the music style. The hypotheses were as follows:

Hypothesis 1: All groups would have a similar level of exposure to Western music, but a different degree of familiarity for Greek and Chinese music.

Hypothesis 2: The groups will have differentiated subjective ratings, but similar levels of physiological activity.

Hypothesis 3: When familiarity is controlled, some nationalities will consistently report stronger subjective emotional responses than others.

METHODS

PARTICIPANTS

A total of 65 participants (mean age 27.4, *SD* = 6.98, 35 females) were recruited in three groups based on nationality (Finns = 22, Greeks = 22, Chinese = 21). Criteria for selection were that all participants should be nationals, should have grown up and spent most of their life in the target country.

STIMULI

Twenty instrumental recordings (8 Western, 6 Greek, 6 Chinese) were used as stimuli, with durations ranging from 50 to 67 seconds (*M* = 55.3 seconds, *SD* = 4.76). They were edited in Protools (Avid, Version 11.03) to add a two-second fade-out effect at the end of each track and they were equalized in volume (a peak normalization filter was applied). The Chinese and Western stimuli were selected from databases of previous studies that rated the emotional character of the music (Chinese traditional music database: Hu & Lee, 2016; film music database: Vuoskoski & Eerola, 2011) and excerpts were chosen to represent all quadrants of the valence-arousal dimensional model (Russell, 1980). In the case of Greek music, Zacharopoulou & Kyriakidou (2009) provided a database that mainly consisted of songs of Greek traditional music. As there have not been enough existing instrumental excerpts, 12 tracks were pre-selected on premises of similarity with Zacharopoulou & Kyriakidou's database in terms of music style, rhythm and orchestration. These tracks were then tested in a pilot study with Greek listeners (*N* = 15), in order to identify the six final stimuli that better represented the four quadrants of the dimensional model.

MEASURES

The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) 20-items inventory was used to measure participants' positive and negative affect before the experiment on a 5-point Likert scale ranging from 1 (*Very slightly or not at all*) to 5 (*Extremely*), while a questionnaire with demographic information was completed after the experiment.

Participants were instructed to rate the felt component of emotions ('the emotions awakened to them by the music') through a computer-based interface made in PsychoPy2 1.85.2 (Peirce, 2009). During stimulus presentation, continuous ratings of valence and arousal were collected on bipolar scales. At the onset of each stimulus, a marker appeared in the center of each scale and participants were instructed to adjust the ratings as their emotions evolved. Valence was described as the positive or negative character of the felt emotion (unpleasant – pleasant), and arousal as the energy of the felt emotion (low – high, sleep – awake).

After the end of each stimulus, a further set of intensity and familiarity scores were collected. Intensity was a unipolar scale described as the strength of the experienced emotion, ranging from 1 (*No emotion experienced*) to 7 (*Very strong emotion experienced*). Familiarity consisted of two distinct ratings. The first assessed familiarity with the excerpt on three levels from 1 (*Unfamiliar*) to 3 (*Very familiar*), and the second the familiarity with the music style from 1 (*Very unfamiliar*) to 7 (*Very familiar*).

Physiology was recorded using a MindMedia NeXus-10 MKII biofeedback system and visualized with BioTrace (MindMedia, Version 2017A). Electrocardiography (ECG) was measured with a 3-lead system where the electrodes were placed on the upper and lower chest. A respiration belt was used to record the respiration activity and was placed around the abdominal region. Electrodermal activity (EDA) was measured with two Velcro strap electrodes placed on the distal phalanges of the index and middle finger of the non-dominant hand. The sample rate was 256 Hz for ECG and 30 Hz for EDA and respiration.

PROCEDURE

The experiment was conducted in a sound-proof room, using a Samsung SyncMaster SA450 monitor for stimulus presentation and Audiotechnica ATH-M50x headphones. Participants signed a consent form containing general information about the experiment at the beginning of the session. The cross-cultural aspect was not mentioned, participants were informed that the study was about how music affects listener's emotions. The PANAS questionnaire was completed and the physiology equipment was attached. Then, a two-minute relaxation state recording was completed to obtain the baseline activity and ensure that all the electrodes were properly attached.

After the relaxation period a training session with further information began. The difference between perceived and felt emotions was explained and participants were instructed to rate how the music made them feel, not to rate the emotional character of the music. It was also mentioned that music might not evoke any emotion, which they could report via the intensity rating. Participants were then presented with a training music example to acclimatize them to the experimental setting. During this training trial, the volume was set by the participants to a comfortable level and it remained at the same level for the whole experiment. The order of the stimuli was randomised and a one-minute relaxation period occurred before the onset of each stimulus to eliminate carryover effects across trials. The duration of the music listening was approximately 40 minutes and participants could have a break half-way if they wished.

DATA ANALYSIS

Both the behavioral and physiological data were exported and preprocessed in Matlab (TheMathworks Inc., Version R2016b). The continuous valence and arousal ratings were averaged across excerpt and participant. As felt emotions are known to occur with a certain latency, the time onset for computing the mean valence and arousal score was identified as the first change that the participant inflicted in each score. If the participant had not registered a response in the first 15 seconds, a default time onset was placed in that instant.

The tonic component of EDA was extracted using a continuous decomposition analysis (Benedek & Kaernbach, 2010) in the Matlab-based Ledalab toolbox (V3.4.9). Respiration rate and heart rate scores were also computed from the respiration and ECG scores respectively, using the Biotrace Software. The baseline activity of the one-minute relaxation periods were averaged and subtracted from the raw signal of

each succeeding stimulus, in order to correct for inter-subject differences in baseline physiology. Average scores were then computed for each excerpt and they were z-scored for each participants. For both physiological and behavioral data, composite scores were created from the responses of each stimulus, with music style being the grouping variable. This resulted in three scores for each measure, corresponding to the three music styles (Western, Greek, and Chinese).

RESULTS

The composite PANAS scores for positive and negative affect were calculated for each participant. Three participants with negative scores of more than two standard deviations from the grand mean were excluded from the analysis. A further participant was excluded due to equipment failure in the physiological measurements, reducing the total number of participants to 61 (20 Finns, 21 Greeks, and 20 Chinese). The Kolmogorov-Smirnoff test for normality in the behavioral and physiological variables within the groups was not significant, suggesting that assumptions of normality were not violated. Excerpt familiarity scores revealed that in 92%, of the cases participants had not listened to the excerpts before.

Familiarity with the music style was tested with a 3 × 3 (Nationality × Music style) analysis of variance (ANOVA), with music style serving as a repeating measure. Mauchly's test revealed that the assumption of sphericity was violated, therefore degrees of freedom were corrected with Huynh–Feldt estimates of sphericity (ε = .92). The main effect of music styles on the familiarity scores was not significant $F(1.84, 106.46) = 1.12$, $p = .33$, suggesting that the overall familiarity level with each music style was similar across participants. There was a significant interaction effect of music style and nationality $F(3.67, 102.82) = 50.98$, $p < .001$, $\eta^2 = .64$. To further investigate these results, one-way ANOVAs were carried out to test the familiarity of each music style across the nationalities (Figure 1). There was a significant effect on familiarity scores for Greek music, $F(2, 58) = 46.55$, $p < .001$, $\eta^2 = .62$; and for Chinese music, $F(2, 58) = 23.64$, $p < .001$, $\eta^2 = .45$. There was no significant effect on familiarity scores for Western music, $F(2, 58) = 2.53$, $p = .09$.

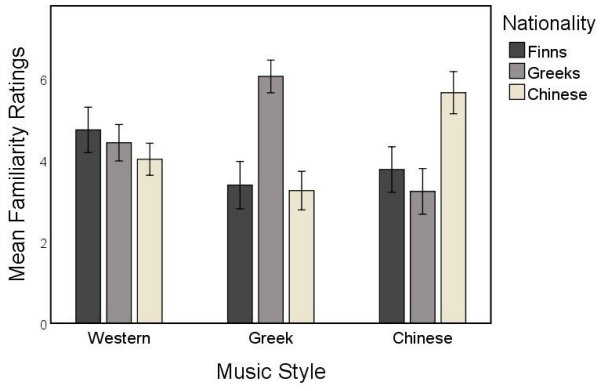

Figure 1. Mean Familiarity ratings per nationality and music style. The error bars denote confidence intervals at $p = .05$.

As only the Western music familiarity scores remained similar across the groups, only responses to Western music were considered in subsequent analyses. In order to investigate the effect of enculturation on the subjective feeling under Hypothesis 2, the valence, arousal and intensity scores were tested in a multivariate analysis of variance (MANOVA). There was a significant main effect of nationality $F(6, 114) = 5.78$, $p < .001$, $\eta^2 = .24$. To elaborate on these findings, separate univariate ANOVAs were carried out. There was a significant effect of nationality on valence and intensity, but not on the arousal scores: Valence, $F(2, 58) = 7.94$, $p = .001$, $\eta^2 = .22$; Intensity, $F(2, 58) = 6.25$, $p = .004$, $\eta^2 = .18$; Arousal, $F(2, 58) = 2.76$, $p = .072$. Pairwise comparisons with Bonferroni corrections were conducted to further investigate the group differences. The Finnish group reported significantly higher valence ratings than the two other groups at $p < .05$, the Chinese participants had the strongest intensity responses, and the Greeks showed significantly lower intensity responses to both other groups ($p < .05$).

Table 1. Means and Standard Deviations for subjective ratings in each group

	Finns		Greeks		Chinese	
Ratings	M	SD	M	SD	M	SD
Valence	6.36	.83	5.57	1.39	5.06	.75
Arousal	5.37	.74	4.91	.97	5.5	.87
Intensity	4.93	.68	4.24	1.04	5.09	.65

A MANOVA was also conducted for the physiology measurements for the Western excerpts. There was not a significant effect of the groups on the physiological responses $F(6, 98) = 1.61$, $p = .15$. One-way ANOVAs were tested for each measure, but only the heart rate scores revealed a significant effect $F(2, 57) = 4.37$, $p = .02$, $\eta^2 = .13$. Pairwise comparisons with Bonferroni corrections revealed that there was a significantly higher heart rate response in the Finnish group when compared to the Greek group ($p = .02$).

DISCUSSION

The aim of this study was to investigate the effect of enculturation on the emotional components of subjecting feeling and physiological responses. In order to control for differences in exposure to the music excerpts and the music style, two sets of familiarity scores were used to assess familiarity with the excerpt and familiarity with the music style. The music excerpt familiarity scores revealed that in 92% of cases participants reported that they either had not listened to the excerpt before or they were not certain. While it is possible that participants had been exposed to some of the excerpts and a recollection bias existed, it can be argued that emotional responses influenced by evoked episodic memories (Juslin & Västfjäll, 2008) remained relatively low. With regards to familiarity with the music styles, there were differences in the Greek and Chinese music, with the respective nationality groups exhibiting considerably higher familiarity scores than the rest (Greeks being more familiar with Greek music and Chinese more familiar with Chinese music). Hypothesis 1 was confirmed, as familiarity with Western music scores was similar and had no significant differences across the groups. This result concurs with Huron's (2008) notion that many non-Western cultures have a level of implicit knowledge of Western music, as a result of globalization. It also supports the idea that Western music can be a suitable candidate for baseline stimuli in cross-cultural research, in order to minimize discrepancies in the prior exposure to the stimuli and music style.

The results of the subjective ratings revealed that only arousal was undifferentiated across the groups. This is in agreement with Egermann et al. (2015), suggesting that arousal shows less variation across different cultures and has more universal tendencies. On the other hand, even when the level of familiarity was relatively similar (Western music), there were significant variations across the groups in valence and intensity scores. As for the autonomic nervous system activity, physiology scores revealed that when the familiarity factor was controlled in Western music, all groups showed similar patterns of activity, with the only difference observed in the heart rate scores between the Finnish and Greek participants. These results seem to concur with previous cross-cultural studies (Levenson, Ekman, Heider, & Freisen, 1992; Soto et al., 2005), suggesting that physiology is less subject to individual differences and societal norms of behavior and expression, whereas subjective feeling is shaped more by cultural learning and can vary greatly across cultures.

Hypothesis 3 held that cultural groups with different tendencies to emotional expression would also consistently report distinct levels of subjective feeling when familiarity factors were controlled. However, the pairwise comparisons revealed that this was not the case, as there were not consistent differences across the groups in all subjective measures. Although the Finnish group had significantly higher responses in terms of valence, this was not the case with intensity and arousal. In a similar vein, while the Chinese group reported lower levels of valence than the other two, it outperformed both in terms of arousal and intensity, with the intensity scores being significant only when compared to the Greek group. Possible explanations for these inconsistencies might be traced to the relatively small sample size and confounding variables that are present in experimental designs of naturalistic listening, having a negative effect on validity. Equally important is that although familiarity levels remained relatively similar across the groups, they were not identical, with the Finnish group reporting the highest level of familiarity with Western music. However, eliminating fully the background exposure discrepancies between participants is unlikely in a music setting, and thus will always introduce some bias in self-report comparisons. Therefore, Hypothesis 3 cannot be confirmed and further research is needed to identify exactly how the subjective feeling of groups of different cultural backgrounds is affected during music listening.

CONCLUSION

The current study investigated how enculturation affects different components of emotional responses during music listening in a cross-cultural setting. Results suggested that Western music can be used as a baseline across certain groups for cross-cultural comparisons. It was shown that the component of subjective feeling was more susceptible to cultural factors and had more variation across the groups compared to physiology. This has implications in future music studies dealing with emotions in cross-cultural settings, as it emphasizes the need to consider mixed methods for accurately measuring emotional activity. In addition, this study highlights the need to control familiarity factors more strictly in future studies and can have methodological implications for the use of dimensional over discrete models, in order to reduce linguistic errors in cross-cultural research.

REFERENCES

Adachi, M., Trehub, S. E., & Abe, J.-I. (2004). Perceiving emotion in children's songs across age and culture. *Japanese Psychological Research, 46*, 322–336. https://doi.org/10.1111/j.1468-5584.2004.00264.x

Argstatter, H. (2015). Perception of basic emotions in music: Culture-specific or multicultural?. *Psychology of Music, 44*(4) 674 –690. https://doi.org/10.1177/0305735615589214

Averill, J. R. (1982). *Anger and aggression: An essay on emotion*. New York, NY: Springer-Verlag.

Balkwill, L. L., & Thompson, W. F. (1999). A cross-cultural investigation of the perception of emotion in music: Psychophysical and cultural cues. *Music Perception*, *17*(1), 43–64. https://doi.org/10.2307/40285811

Balkwill, L. L., Thompson, W. F., & Matsunaga, R. I. E. (2004). Recognition of emotion in Japanese, Western, and Hindustani music by Japanese listeners. *Japanese Psychological Research, 46*(4), 337-349. https://doi.org/10.1111/j.1468-5584.2004.00265.x

Benedek, M. & Kaernbach, C. (2010). A continuous measure of phasic electrodermal activity. *Journal of Neuroscience Methods, 190*, 80-91. https://doi.org/10.1016/j.jneumeth.2010.04.028

Eerola, T., & Vuoskoski, J. K. (2013). A review of music and emotion studies: Approaches, emotion models, and stimuli. *Music Perception, 30*(3), 307–340. https://doi.org/10.1525/MP.2012.30.3.307

Egermann, H., Fernando, N., Chuen, L., & McAdams, S. (2015). Music induces universal emotion-related psychophysiological responses: comparing Canadian listeners to Congolese Pygmies. *Frontiers in Psychology, 5,* 1341. https://doi.org/10.3389/fpsyg.2014 .01341

Fritz, T., Jentschke, S., Gosselin, N., Sammler, D., Peretz, I., Turner, R., & Koelsch, S. (2009). Universal recognition of three basic emotions in music. *Current biology*, *19*(7), 573-576. https://doi.org/10.1016/ j.cub.2009.02.058

Hu, X., & Lee, J. H. (2016). Towards global music digital libraries: A cross-cultural comparison on the mood of Chinese music. *Journal of Documentation*, *72*(5), 858-877. https://doi.org/10.1108/JD-01-2016-0005

Huron, D. (2008). Science & music: Lost in music. *Nature*, *453*(7194), 456-457. https://doi.org/10.1038/453456a

Juslin, P. N., & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and brain sciences*, *31*(5), 559-575. https://doi.org/10.1017/S0140525X08005293

Laukka, P., Eerola, T., Thingujam, N. S., Yamasaki, T., & Beller, G. (2013). Universal and culture-specific factors in the recognition and performance of musical affect expressions. *Emotion, 13*(3), 434–449. https://doi.org/10.1037/a0031388

Levenson, R. W., Ekman, P., Heider, K., & Friesen, W. V. (1992). Emotion and autonomic nervous system activity in the Minangkabau of West Sumatra. *Journal of personality and social psychology*, *62*(6), 972.

Mesquita, B., & Frijda, N. H. (1992). Cultural variations in emotions: A review. *Psychological Bulletin, 112*, 179–204.

Peirce, J. W. (2009). Generating stimuli for neuroscience using PsychoPy. *Frontiers in neuroinformatics*, *2*, 10. https://doi.org/10.3389/neuro.11.010.2008

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *59*, 1161-1178.

Schellenberg, E. G., Peretz, I., & Vieillard, S. (2008). Liking for happy-and sad-sounding music: Effects of exposure. *Cognition & Emotion*, *22*(2), 218-237. https://doi.org/10.1080/02699930701350753

Soto, J. A., Levenson, R. W., & Ebling, R. (2005). Cultures of moderation and expression: emotional experience, behavior, and physiology in Chinese Americans and Mexican Americans.

Emotion, *5*(2),154-165. https://doi.org/10.1037/1528-3542.5.2.154

Thompson, W. F., & Balkwill, L-L. (2010). Cross-cultural similarities and differences. In P. N. Juslin & J. A. Sloboda (Eds.), *Handbook of music and emotion. Theory, research, and applications* (pp. 755–788). New York, NY: Oxford University Press.

Vuoskoski, J. K., & Eerola, T. (2011). Measuring music-induced emotion: A comparison of emotion models, personality biases, and intensity of experiences. *Musicae Scientiae*, *15*(2), 159-173. https://doi.org/10.1177/1029864911403367

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology, 54*(6), 1063-1070.

Zacharopoulou, K., & Kyriakidou, A. (2009). A cross-cultural comparative study of the role of musical structural features in the perception of emotion in Greek traditional music. *Journal of Interdisciplinary Music Studies*, *3*(1), 1-15.