Age, Sex and Music Genre Effects on Music Embodiment

Yigit Ozkan

Sabanci University

Supervisor: Olesya Blazhenkova

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"Most of the people believes that brain shapes all our decisions and body acts according to those decisions", as Jason Silva explains in his NatGeo show named "Mind/Body Connection" and he makes the simile with the words, "the brain is like the pilot seat, whereas the body is the airplane, simply answering the commands of the pilot".

Research provided evidence that different emotions are perceived in different parts of the body. In particular, Nummenmaa, Glerean, Hari, and Hietanen (2014) found that emotions can

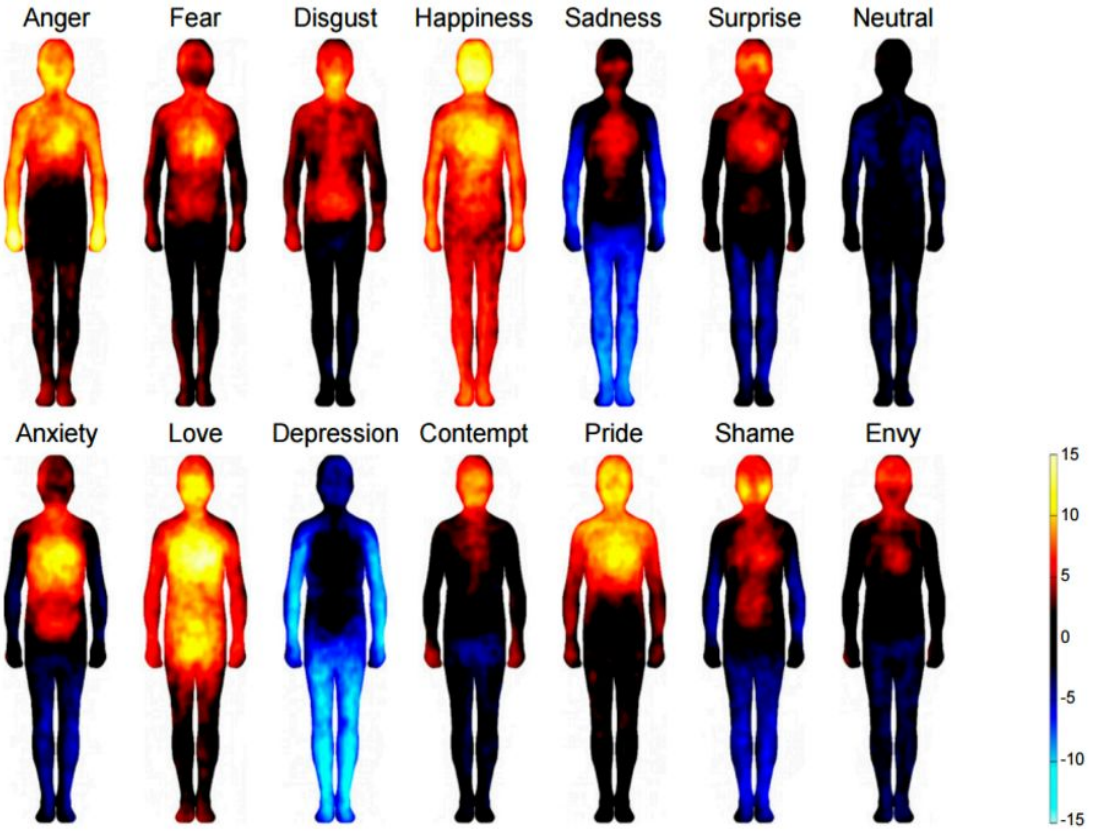


Figure 1. Bodily topography of basic (Upper) and nonbasic (Lower) emotions associated with words. The body maps show regions whose activation increased (warm colors) or decreased (cool colors) when feeling each emotion.

be perceived in the body. The participants were shown a different types of emotional stimuli (words, stories, movies, and faces) and were asked to color the body maps according to in which region of their body they feel the emotions evoked. They had to indicate the bodily sensations, that they experience, in terms of activations or deactivations. The classification of Ekman (1992) after the examination of the bodily responses are 7 basic emotions (anger, fear, disgust, happiness, sadness, surprise, and neutral) as well as 7 non-basic emotions (anxiety, love, depression, contempt, pride, shame, and envy). Researchers found that, across conditions, different emotions were consistently associated with sensations in different bodily parts (see Figure 1).

For example, happiness activated almost in the entire body and especially head and heart areas, anger activated upper part of the body and especially lower parts of the hands, whereas depression mostly deactivated the body, and especially limbs. Zentner et. al (2008) has conducted a research to show that music evokes emotions. In the study of Zentner and his colleagues they compiled a list of music-relevant emotion terms and they examine the frequency of both felt and perceived emotions across 5 groups of listeners with varying music preferences. Upon musical genre and type of responses, they concluded that emotional responses varied greatly.

Research evidences suggest that music, especially dynamic and rhythmic music (like dance) may encourage people to move. Bacon et al. (2012) discovered that cyclists who synchronize their movements with the music at the background consume 7 percent less oxygen to do same task, with the ones who do not synchronize. In the end of the study, the researchers, concluded that the cyclists who feel and adapt themselves to the rhythm of the music, by

synchronizing their movements can do a same job easier compared to the ones that do not synchronize. In other words, feeling the music can evoke one's physical movement.

Based upon these studies, the goal of this current research is to examine how music is perceived by the body and in which regions it is embodied. For not getting limited one type, different samples of music types is used. According to the hypothetically created intensity-positiveness graph 4 different music types are picked. Shamanic type is assumed to be perceived as intense and negative, whereas, dance to be intense and positive, meditation to be non-intense and positive, and classic as non-intense and negative. The conclusions about this graph will be discussed in the discussion part of this paper.

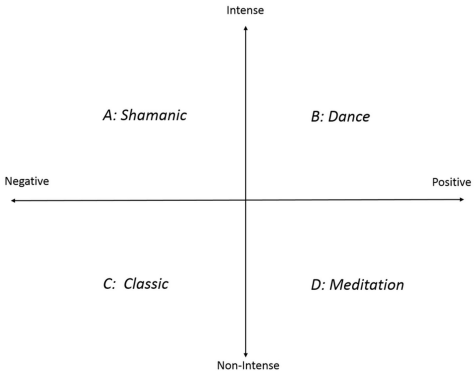


Figure 2. Hypothetical graph for different music types

Current research focused on the examination of music perception inside the body. For this goal, we adapted the bodily map methodology from the study of Nummenmaa et al. (2014) to study how music is felt in different body parts. In particular, we examined and how do different regions of the body activated and deactivated during the perception of different types of music (shamanic, classic, dance, and meditation). We included four different music types , supposedly evoking different emotions. To control for this, we included questions about music likeness as well as emotional intensity and sign for each music piece. In addition, we investigated the individual differences variables (age, gender, as well as musical and

bodily-kinesthetic ability and experience). To examine effects of age on music embodiment, we studied a wide range of ages (9-88 years old).

Method

Participants

A total of 163 participants (42 males, 121 females, 9-88 years old) took part in the study. The majority of the participants were Sabanci University students, who were compensated with extra points towards their psychology classes. Non-student participants were found through personal connections and social media (e.g., Facebook); they either participated voluntarily or were compensated with a gift (e.g., candies). All participants agreed with the consent form, approved by the Sabanci University Research Ethics Committee. Children provided verbal consent, and a formal signed consent was obtained from their parents. Adult participants indicated their agreement to participate in the study by clicking NEXT in the online survey after reading the consent agreement.

Materials and Procedure

Participants were tested via survey that was administered online (Qualtrics software Qualtrics, Provo, USA). Since most of the participants were Turkish, the survey was available in 2 languages (Turkish and English), from which they can choose. There was no time limit for completion, and it took approximately 30 minutes to complete.

Background Information. Participants were asked their age and gender. In addition, they were asked about their musical training experience and ability, as well as bodily kinesthetic training experience and ability.

Age

Gender

- Male
- Female

Questions about Music

Which of the following best describes your musical ability?

- 1. My musical ability is extremely poor.
- 2. I have little or no musical ability.
- 3. I have some musical ability.
- 4. I have talent for music.
- 5. I have marked talent for music.

What is your formal training experience in music (i.e., taking music classes beyond high school)?

- 1. None
- 2. Little
- 3. Some
- 4. Amateur/hobby level
- 5. Professional level

Questions about Body

Which of the following best describes your bodily-kinesthetic ability (i.e., use the body effectively, strong sense of body awareness and coordination, enjoy movement and physical activity)?

- 1. My bodily-kinesthetic ability is extremely poor.
- 2. I have little or no bodily-kinesthetic ability.
- 3. I have some bodily-kinesthetic ability.
- 4. I have bodily-kinesthetic talent.
- 5. I have marked bodily-kinesthetic talent.

What is your formal training experience in bodily-kinesthetic activities (i.e., taking classes in dance, sports, yoga etc.) beyond high school?

- 1. None
- 2. Little
- 3. Some
- 4. Amateur/hobby level
- 5. Professional level

Music embodiment task. This task measured the amount of activations and deactivations inside the body during the perception of music. The bodily map of sensations method was based on the idea from Nummenmaa et al. (2014).

The task was to attend to an music and at the same time attend to the feelings inside own body (e.g., participants might feel that activity in some parts of their body becomes stronger or faster, whereas in some other parts activity might get slower or weaker). In particular, participants had to indicate the regions of activation and deactivation on a body map using a specific coloring system, in which activations should be colored with green and deactivations with red. See the Body Map in Figure 3.

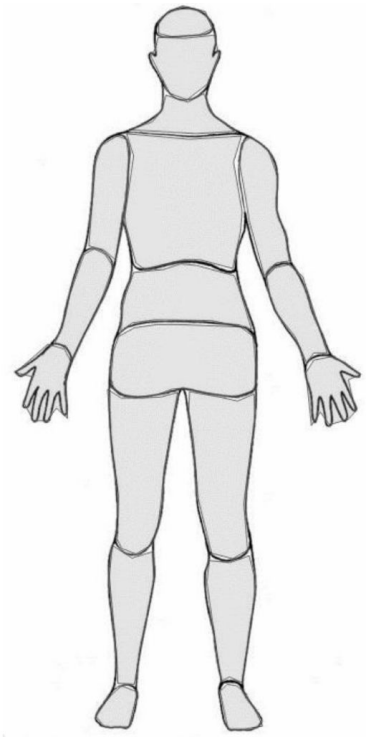


Figure 3. Body map

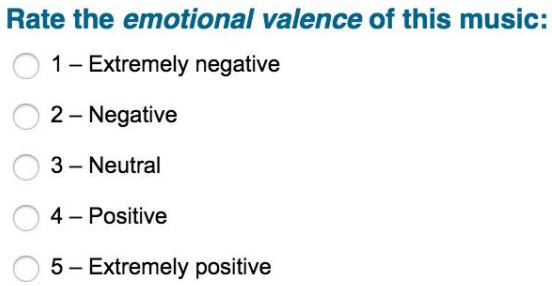
Each stimulus was followed by 3 questions, assessing how much participant liked it, how emotionally intense was it and what was emotional valence.

Rate *how much did you like* this music, you just listened to:

- 1 – I hated it
- 2 – I disliked it
- 3 – Neutral
- 4 – I liked it
- 5 – I loved it

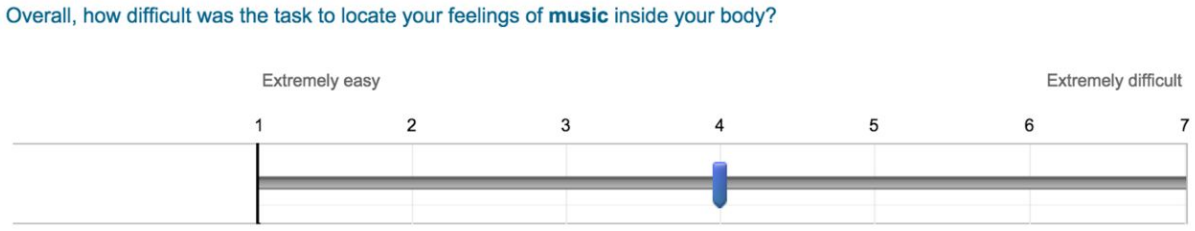
Rate the *emotional intensity* of this music:

- 1 – Not at all intense
- 2 – Not intense
- 3 – Neutral
- 4 – Intense
- 5 – Extremely intense



Music embodiment. Participants listened to 16 music samples (each 20-second-long), that were fragments from four different music styles: 'shamanic', 'dance', 'classic' and 'meditative'. None of the music samples had lyrics. None of them were popular and well-known. Participants were allowed to listen more than one time.

In the end, participants were requested to rate the difficultness of music and visual art rating, of the study from range of 1-7, where "1-Extremely easy" and "7-Extremely difficult".



Analysis

For the convenience of the analysis, based on the number of activations and the number of deactivations in a particular body part, the new *Activation-Deactivation* scores were computed as the number of activations minus the number of deactivations (e.g., positive score reflects that activations exceeded deactivations in a particular body area). These *Activation-Deactivation* values were averaged inside each of the 18 body areas for each of the four different music styles: 'shamanic', 'dance', 'classic' and 'meditative'.

Furthermore, for the subsequent analysis, the *Activation-Deactivation* scores were combined as follows: 'head & neck' (1, 2, and 3), 'upper body' (4, 5, 6, 7, 8, 15, and 16), 'middle body' (9 & 10), 'lower body' (11, 12, 13, 14, 17, & 18). In addition, total activations-deactivation scores for different music types were computed.

Music Embodiment Analysis:

The data from all participants was analyzed using Repeated Measures ANOVA (Pillai's Trace) with *Activation-Deactivation* scores the 18 body areas evoked by Shamanic Music from the Music Embodiment task as within-subject variables.

The results revealed a significant effects of *Activation-Deactivation* in different body parts evoked by '*Shamanic' Music*, F (17, 146) = 2.597, $p < .001$, '*Dance' Music*, F (17, 146) = 6.536, $p < .001$, '*Classic' Music*, F (17, 146) = 4.397, $p < .001$ and '*Meditation' Music*, F (17, 146) = 3.727, $p < .001$. Subsequent Post hoc multiple comparisons revealed a number of the significant differences in activations between different body parts (not reported here). Figure 4

presents the mean *Activation-Deactivation* scores for different body parts evoked by different types of music.

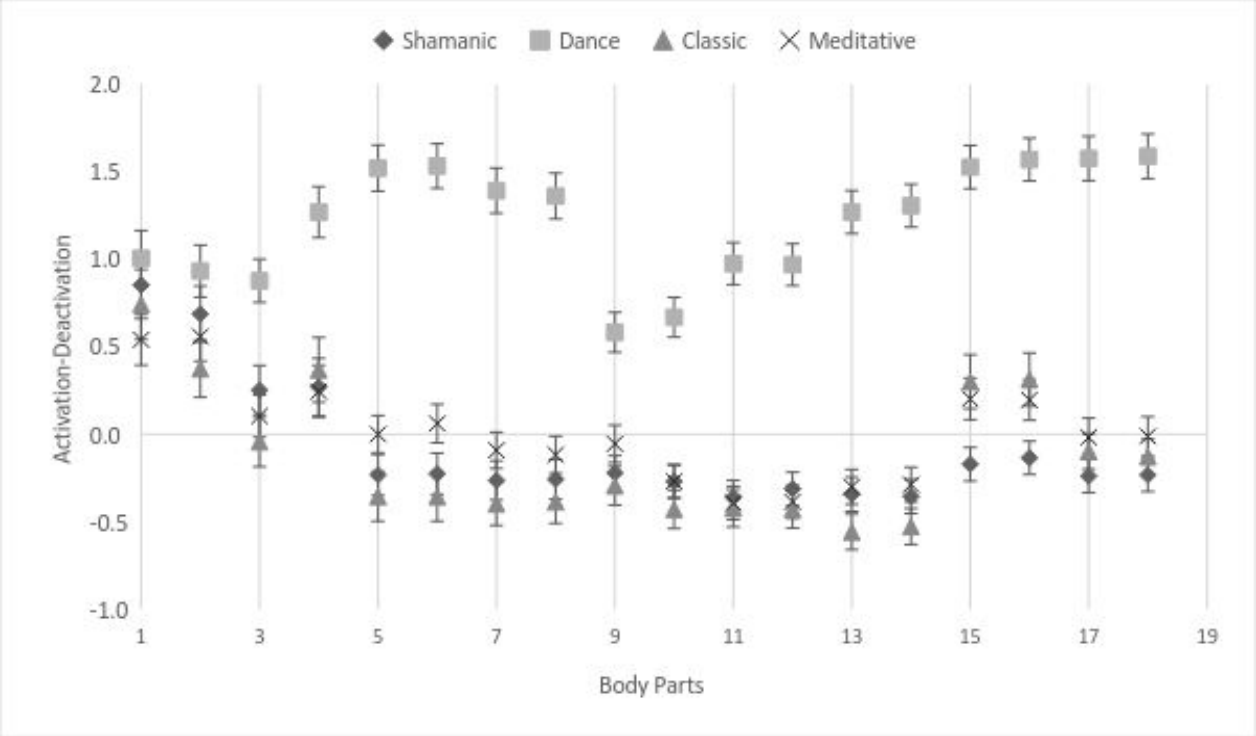


Figure 4. Activation-Deactivation scores for different body parts evoked by different types of music. 1: upper head, 2: face, 3: neck, 4: chest, 5 & 6: left and right arms, 7 & 8: left and right forearms, 9: abdomen, 10: groin, 11 & 12: left and right thighs, 13 & 14: left and right legs, 15 & 16: left and right palms, 17 & 18: left and right feet.

Gender:

Gender was added as a between-subject variable to the Repeated Measures ANOVA (Pillai's Trace) with Activation-Deactivation scores the 18 body areas (see results in Figure 5).

The analysis for 'shamanic' music revealed a significant effect of Activation-Deactivation ($p < .001$), *no significant effect of Gender* ($p = .340$), and significant Activation-Deactivation *Gender interaction ($p = .009$).

The analysis for ‘dance’ music revealed only a significant effect of Activation-Deactivation ($p < .001$), *no significant effect of Gender* ($p = .535$), and not significant Activation-Deactivation *Gender interaction ($p = .070$).

The analysis for ‘classic’ music revealed only a significant effect of Activation-Deactivation ($p < .001$), *no significant effect of Gender* ($p = .741$), and no Activation-Deactivation *Gender interaction ($p = .287$).

The analysis for ‘meditative’ music revealed only a significant effect of Activation-Deactivation ($p < .001$), *no significant effect of Gender* ($p = .328$), and no Activation-Deactivation *Gender interaction ($p = .209$).

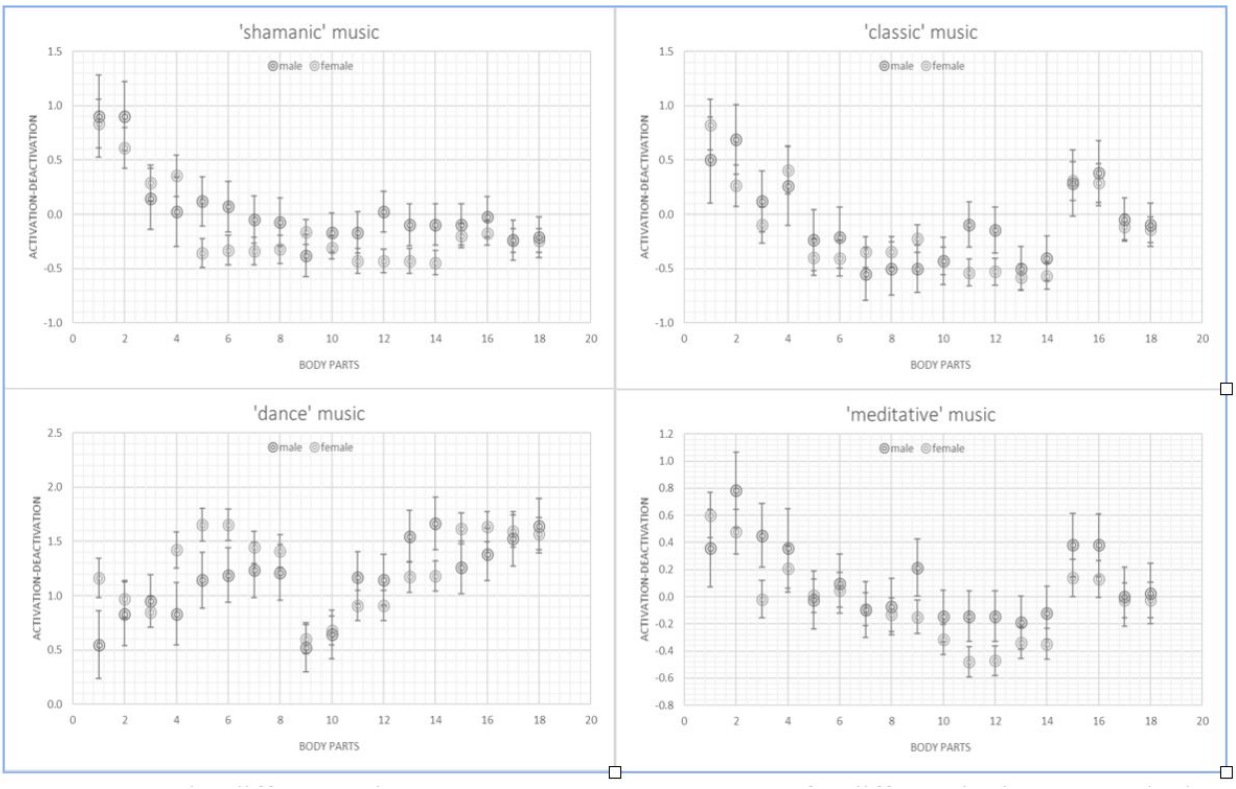


Figure 5. Gender differences in *Activation-Deactivation* scores for different body parts evoked by different types of music.

Age:

Pearson Correlation analysis between Age and combined activations-deactivation scores 'head & neck', 'upper body', 'middle body', and 'lower body') as well as total activations-deactivation scores for different music types did not reveal any significant associations.

Analyses of Likeness, Intensity and Valence for different types of music:

Repeated Measures ANOVA (Pillai's Trace) with *Likeness* ratings for the 4 types of music as within-subject variables results revealed significant differences, F (3, 160) = 239.893, p < .001. Pairwise comparisons demonstrated that all the differences were significant (p < .001), expect for the 'Dance' and 'Mediation' music (p = .219).

Repeated Measures ANOVA (Pillai's Trace) with *Intensity* ratings for the 4 types of music as within-subject variables results revealed significant differences, F (3, 160) = 44.897, p < .001. Pairwise comparisons demonstrated that all the differences were significant (p < .001), expect for the 'Dance' and 'Mediation' music (p = .195).

Repeated Measures ANOVA (Pillai's Trace) with *Valence* ratings for the 4 types of music as within-subject variables results revealed significant differences, F (3, 160) = 232.326, p < .001. Pairwise comparisons demonstrated that all the differences were significant (p < .05), expect for the 'Classic' and 'Meditative' music (p = .563).

Overall, different ratings (*Likeness, Intensity,* and *Valence)* were positively correlated in the moderate to high range (r's ranged from .303 to .526), that is, more intense and positive

music also tended to be more liked. Among other music types, 'Shamanic' music was estimated as less liked, less intense and less positive (Figure 6).

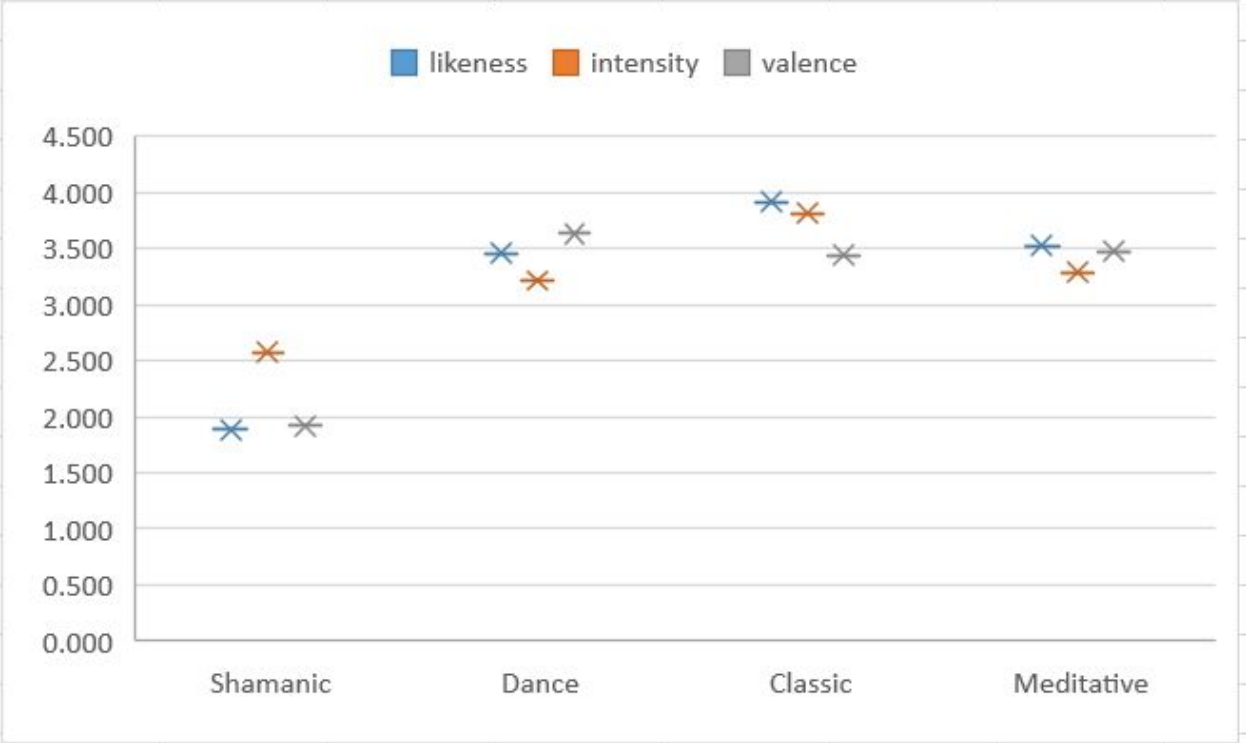


Figure 6. Likeness, intensity, valence of difference music types

Analyses of Likeness, Intensity and Valence ratings and Bodily Activations-Deactivations:

Bodily Activations-Deactivations in different body parts evoked by 'shamanic' music positively correlated *intensity* of 'shamanic' music ratings (r =.217, p=.005 for 'head & neck' and r =.177, p=.024 for 'upper body'), but any other ratings.

Bodily Activations-Deactivations in different body parts evoked by 'dance' music positively correlated *likeness* of 'dance' music ratings (r =.379, p <.001 for 'upper body' and r =.277, p <.001 for 'middle body', and r =.240, p =.001 for 'lower body'), *valence* of 'dance' music ratings (r =.241, p=.002 for 'upper body'), but not for intensity ratings.

Bodily Activations-Deactivations in different body parts evoked by 'classic' music positively correlated *likeness* of 'classic' music ratings (r =.230, p =.003 for 'head & neck' and r =.162, p =.039 for 'upper body'), *valence* of 'classic' music ratings (r =.170, p=.03 for 'head & neck'), but not for intensity ratings.

Bodily Activations-Deactivations in different body parts evoked by 'meditation' music positively correlated *intensity* of 'meditation' music ratings (r =.253, p=.001 for 'head & neck'), *likeness* of 'meditation' music ratings (r =.184, p =.019 for 'head & neck'), as well as *valence* of 'meditation' music ratings (r =.240, p=.002 for 'head & neck').

Analyses of Ability and Expertise ratings and Bodily Activations-Deactivations.

Pearson Correlation analysis between Ability and Expertise ratings and combined activations-deactivation scores ('head & neck', 'upper body', 'middle body', and 'lower body') as well as total activations-deactivation scores for different music types was conducted.

This analysis did not reveal any significant associations with *Music Ability* or *Bodily-Kinesthetic* ratings.

Interestingly, the analysis revealed significant negative correlations between *Music Experience* ratings and Bodily Activations-Deactivations evoked by 'classical' music (r =-.173, p=.027 for total, and r =-.195, p=.012 for 'upper body' area). Thus, musical experience was associated with deactivation of bodily sensations during the perception of 'classical' music. There were no other significant associations with *Music Experience* ratings.

Furthermore, the analysis revealed significant negative correlations between *Bodily-Kinesthetic Experience* ratings and Bodily Activations-Deactivations evoked by

'shamanic' music (r =-.157, p=.046 for 'middle body') and by 'dance' music (r =-.182, p=.02 for 'head and neck' area).

Discussion

Activations-Deactivations evoked by different music styles

The distribution of activations-deactivations inside the body was quite similar for all music types except for 'dance' music. Dance music, overall, evoked more activations (in all the areas activations were higher than deactivations). In particular, the highest activations were higher in the chest and limps (both, upper and lower) as compared to head and lower body. Interestedly, this mostly resembled 'happiness' emotion bodily mapping (Nummenmaa et al., 2014), though, with less activation in the head area.

As for 'shamanic' music, activations exceeded deactivations for head and chest area, whereas, most of other body areas were deactivated. This pattern resembled 'sadness' and 'surprise' (also, 'anxiety' and 'shame') emotions' bodily mapping revealed by Nummenmaa et al. (2014).

The overall pattern of activations-deactivations evoked by 'classic' and 'meditative' music was similar to the pattern evoked by 'shamanic' music, however, for 'classic' and 'meditative' music, activations exceeded deactivations in the palms. This pattern did not closely resemble any of emotions' bodily mapping revealed by Nummenmaa et al. (2014).

The analyses revealed a number of positive but inconsistent associations between activations in body and likeness, intensity and valence ratings. In other words, the analysis of correlations among Ability and Expertise ratings and Bodily Activations-Deactivations suggest that experience (but not the ability) may be suppressing bodily feelings of music. There is a need

for future studies to examine these relationships.

Although during the study around 40 males has participated, they only formed the one-fourth of the total participants, which leads to a disbalance among the female and male participants. Another limitation of the research was among the unequal distribution of the participants in terms of age groups. Especially for the kids and older adults age groups the number of participants are quite a little compared to other age groups. These limitations should be overcome by more equal male to female ratio and more stable distribution of the age groups.

There was neither any gender differences nor age differences. Thus, results are quite consistent across ages and genders. For the future studies the embodiment of music study can be expanded into cross-cultural dimensions. This current study has been done to Turkish people in a high majority, hence it is impossible to draw conclusions in global manner. The next expansion can be in this way, by using participants from different countries and cultures.

Another expansion area can be by changing the embodiment type. Obviously musical embodiment is not the only way that the body perceives from its surroundings. Via eyes body gets all visual information it can gets, hence instead of studying musical embodiment, similar research can be done to examine the visual embodiment and the relationship of visual images with emotions.

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