

AFFECTIVE EXPERIENCE OF MUSIC EMOTIONAL AND COLOR PERCEPTION OF FOLK AND OTHER MUSICAL GENRES

GREGOR STRLE, MATEVŽ PESEK, AND MATIJA MAROLT

The article presents an experimental study of the emotional and color perception of music, focusing on folk music in comparison with other musical genres. The analysis showed that some musical emotions are conveyed differently between different genres. Overall, Folk genre had the most balanced distribution of the emotions used in the ratings, along with Pop and Rock. On the other hand, Punk and Metal had over 40% of their ratings represented by only two emotions, liveliness and anger. This is further reflected in the emotion-color associations. The presented findings point to the genre specificity of musical emotions.

Keywords: *emotions, colors, music, music genre, music perception*

Prispevek predstavlja eksperimentalno raziskavo čustvenega in barvnega zaznavanja glasbe, s poudarkom na primerjavi med ljudsko glasbo in drugimi glasbenimi zvrstmi (žanri). Analiza rezultatov je pokazala, da so ob poslušanju glasbe različnih glasbenih zvrsti čustvene zaznave pogosto različne. Najbolj uravnotežena in raznovrstna je porazdelitev čustev pri popu, rocku in ljudski glasbi, najmanj pa pri panku in metalu, pri katerih več kakor 40 % glasbenih primerov prevzemata le dve čustvi, to sta živahnost in jeza. Ugotovitve se izražajo tudi v čustveno-barvnih asociacijah. Rezultati kažejo na žanrsko specifičnost »glasbenih« čustev.

Ključne besede: *čustva, barve, glasba, glasbena zvrst, zaznavanje glasbe*

INTRODUCTION

The past two decades have seen a growing amount of research in music cognition and related interdisciplinary efforts, such as music information retrieval (MIR) and music emotion recognition (MER). The aim of these efforts is to better understand and model an individual's perception and use of music. These are influenced by many factors, most notably by the individual's mood, personality, music styles and preferences (Juslin and Sloboda 2001; Juslin 2013; Eerola 2013), as well as cognitive, social and cultural influences (Pearce and Rohrmeier 2012; Stalinski and Schellenberg 2012; Stevens 2012). Moreover, as engagement with music is, for most people, a highly emotional experience, considerable research efforts are being aimed towards the understanding of the individual's affective processing of music. The rapid development of these researches is spawned by technological advances and publicly available digital music collections, which enabled systematic and large-scale investigations of music and its users. However, in the field of ethnomusicology, these types of researches are still significantly under-represented and often ignored.

This article¹ aims to contribute to the field by presenting an experimental study on emotional and color perception of folk music, comparing it with other musical genres.

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It builds upon the authors' existing work (Pesek et al. 2017) and is further motivated by the rapidly growing interdisciplinary work on music perception and cognition (for an extensive overview, see Tirovolas and Levitin 2011; Pearce and Rohrmeier 2012; Stevens 2012; Eerola and Vuoskoski 2013), as well as research on the role of human affect and cognition in cultural heritage studies (Smith 2006; Fairchild Ruggles and Silverman 2009; Zunshine 2010; Logan, Craith, and Kockel 2015).

The following chapters first present related work on the emotional and color perception of music and the experimental study of the emotion–color–music associations. Next, discussion of the results is presented, focusing on differences in emotional and color perception of music excerpts from different genres. The article concludes with a short summary.

EMOTION IN MUSIC

There is a wide range of interdisciplinary researches investigating the emotional perception of music (e.g., Juslin and Sloboda 2001; Gabrielsson 2002; Juslin and Västfjäll 2008; Zentner, Grandjean, and Scherer 2008; Koelsch 2010; Zwaag, Westerink, and Broek 2011; Vuoskoski and Eerola 2011; Stevens 2012; Schubert 2013; Palmer et al. 2013; Pesek et al. 2017). For example, Vuoskoski and Eerola (2001) investigated personality factors involved in the emotional processing of music and found mood and trait-congruent biases in the perception of musical emotions. Several researches (Gabrielsson 2002; Zentner, Grandjean, and Scherer 2008; Schubert 2013) investigated emotions induced by music and found variation in emotional responses to various musical genres and types of emotion (felt vs. perceived). Zentner, Grandjean and Scherer report that “the relationships between felt and perceived emotions varied substantially across listeners with different music preferences” (Zentner, Grandjean, and Scherer 2008: 500). Other studies investigated correlations between individual musical features and valence and arousal dimensions (e.g., Eerola and Vuoskoski 2010; Zwaag, Westerink, and Broek 2011; Schubert 2013). Research on musical features found rhythm, tempo, and mode to be the three most prominent musical features affecting emotional processing, with rhythm having significant correlation along both valence and arousal dimensions, tempo typically correlated with the arousal dimension, and mode (major, minor) correlated with the valence dimension (e.g., Zwaag, Westerink, and Broek 2011; Eerola 2011; Palmer, Langlois, and Schloss 2016). Furthermore, research also showed that various acoustic cues, particularly overall sound intensity, can predict music-induced subjective arousal (Gingras, Marin, and Fitch 2014).

EMOTIONAL MEDIATION OF COLOR AND MUSIC

Particularly relevant to the presented study is the research investigating the link between emotions, colors and music, and the effects of emotional mediation of color and music (Palmer et al. 2011; Palmer et al. 2013; Lindborg and Friberg 2015; Palmer, Langlois, and Schloss 2016; Isbilen and Krumhansl 2016).

Palmer et al. (2013) conducted a study investigating associations between colors, music and emotions. The participants (48 US and 49 Mexican) were tasked with rating 18 excerpts of classical orchestral music (from Bach, Mozart, and Brahms) that varied in tempo (slow/medium/fast) and mode (major/minor) with the five most consistent colors and the five least consistent colors for each excerpt. The set of 37 colors was distributed systematically on the three dimensions of the HSV color space: hue, saturation, and lightness. The authors found that more saturated, lighter, and yellower colors were associated with a major mode and faster tempo, whereas less saturated, darker, and bluer colors were associated with a minor mode and slower music. Moreover, strong correlations ($0.89 < r < 0.99$) were found between the emotion–music associations and the color–music associations, supporting the authors’ hypothesis that the music–color associations are mediated by common emotional associations. The authors conclude that these mappings “associate specific dimensions of color (saturation, lightness, and yellowness–blueness) with specific high-level musical dimensions (tempo and mode) [...] show clear evidence of mediation by emotional dimensions” (Palmer et al. 2013: 8836).

These results were replicated in the subsequent study (Palmer, Langlois, and Schloss 2016) on music–color associations for single piano melodies. The color–music associations were examined along four emotional dimensions: *happy/sad*, *agitated/calm*, *angry/not-angry*, and *strong/weak*. Faster music in the major mode was associated with lighter, more saturated, warmer colors, and slower music and minor mode were associated with darker colors. In general, lightness was the best predictor for the *happy/sad* and the *angry/not-angry* dimensions, while saturation was the best predictor for the *agitated/calm* and the *strong/weak* dimensions. For individual emotions, *happiness* was associated with saturated yellower colors, *angry* with darker and redder colors, and *agitated* with more saturated reds and yellows.

The study conducted by Isbilen and Krumhansl (2016) on excerpts of classical music confirmed the findings presented in Palmer et al. (2013), Palmer, Langlois, and Schloss (2016). The study was comprised of three experiments to examine whether one can predict music–color associations (Experiment 1) by color–emotion associations (Experiment 2) and music–emotion associations in Experiment 3 (Isbilen and Krumhansl 2016). In Experiment 1, a total of 36 15-seconds-long music excerpts from Bach’s Preludes and 8 saturated color patches (from Palmer et al. 2013) were annotated by 128 participants. The results show that the color choices grouped the excerpts according to tempo, mode, pitch height, and attack rate. In Experiment 2, 26 participants rated the colors on a scale (0–10) for the following

emotions: *lively, happy, positive, weak, calm, sad, negative, strong, and angry*. Experiment 3 rated the music excerpts on the set of emotions from Experiment 2. The authors report that the music–color data of Experiment 1 could be predicted by the color–emotion and music–emotion ratings from Experiments 2 and 3.

Similar effects of the emotional mediation of color and music were reported in the study conducted by Lindborg and Friberg (2015). For the purpose of the study, Lindborg and Friberg developed a tablet interface with the CIE Lab colour space for the annotation of 27 film music excerpts. 22 participants were tasked with manipulating the color and size of an on-screen color patch to match the emotion perceived in the given music excerpt. The authors report that *happy* music was associated with yellow, *angry* music with large red colour patches, and *sad* music with smaller patches towards dark blue.

Further evidence of emotional mediation of color and music can be found in the authors' previous work (Pesek et al. 2017), where the perception of emotions and colors was investigated in both non-music and music contexts. A general comparison of the emotion–color associations in both contexts is reproduced in Fig. 1, for reader's convenience. In the non-music context, the dark blue–violet–grey hues and black color were associated with more negative emotions, such as *fear* and *sadness*, whereas the saturated yellow–green–red hues were associated with positive emotions, such as *joy, happiness, energetic, and liveliness*. High-activity emotions, such as *anger, energetic and liveliness*, had prevailing saturated red hues, regardless of their emotional valence (positive or negative), whereas the more passive positive emotions had prevalent desaturated green hues. This is in line with previous research on emotions and colors (Adams and Osgood 1973; Ou et al. 2004).

In the music context, the red–purple hues prevailed over the dark blue–violet–grey hues for the perceived negative emotions (*anger and fear*), whereas the green hues prevailed over the yellow hues for the perceived positive emotions (*joy and happiness*), and especially for the more passive emotions (such as *relaxation*). *Sadness* differentiated itself from the rest of the musical emotions with the prevalent blueness. As in the non-music context, the color saturation was correlated with the arousal dimension: the color of active emotions was saturated, whereas the color of passive emotions was desaturated. These results are in line with the study done by Palmer et al. (2011), where faster music was associated with lighter, more saturated colors, and slower music was associated with darker, desaturated colors. However, compared to the emotions rated in the non-music context, the ratings for musical emotions exhibited significantly higher variance on the valence dimension (Pesek et al. 2017). These results show that musical emotions are being perceived differently and can at times occupy semantically opposite positions of the valence–arousal space, especially along the valence dimension (Zentner, Grandjean, and Scherer 2008; Eerola 2011). This is often the case for sad music, which is sometimes perceived as pleasant (Vuoskoski et al. 2012).

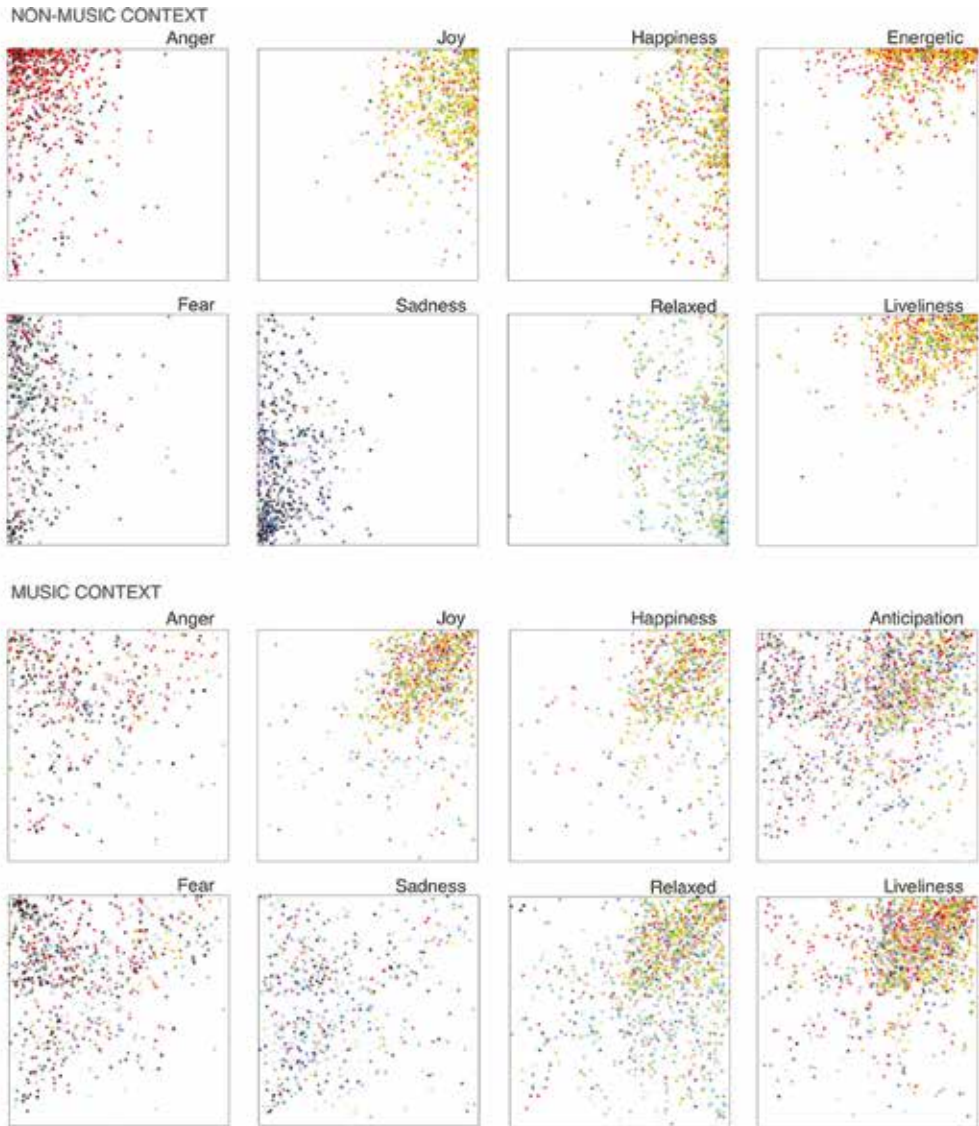


Figure 1. Above (left to right): emotion–color associations in non-music context. Emotions: *anger*, *joy*, *happiness*, *energetic*, *fear*, *sadness*, *relaxed*, and *liveliness*. Below: emotion–color associations in music context. Emotions: same as above, except for *anticipation* replacing *energetic*. The x-axis represents the valence dimension (left to right: unpleasant–pleasant), the y-axis represents the arousal dimension (bottom to top: passive–active). Reproduced from Pesek et al. 2017.

MUSICAL EMOTIONS AND GENRES

Research investigating the link between emotions and genres is limited. One of the few relevant and systematic studies on emotions and music genres is Eerola's audio-based study on the perception of emotions across various genres (Eerola 2011). The set of musical samples contained approximately 400 of the most typical examples for each of the 15 musical genres: Alternative, Folk, Iskelmä, Pop, World, Blues, Gospel, Jazz, Rock, Classical, Heavy Metal, Soul, Electronic, Hip-Hop, and Soundtrack. Musical features were extracted from the audio to investigate whether a particular music genre can convey emotions in a particular way. The 39-feature set was extracted from 15 second excerpts and further reduced by applying Principal Component Analysis (PCA). PCA yielded a 9-feature set that explained 81% of the variance for the original matrix, and was roughly divisible into four groups: the dynamic, the rhythmic, the timbral, and the tonal. The results showed moderately low generalizability across and moderately good generalizability within genres for the valence dimension, and relatively good generalizability of arousal for both within and between genres. These findings suggest genre-specificity of emotions on the valence dimension, but not for arousal (Eerola 2011).

Most existing studies relate to the topic of genre-specificity of musical emotions indirectly, focusing mostly on the interaction between music preferences and personality. For example, Rentfrow and Gosling (2003) and Rentfrow, Goldberg, and Levitin (2011) examined the underlying individual differences in music preferences. The analysis of the music preferences of over 3,500 individuals across 14 music genres (including folk music) revealed 4 general music preference dimensions: Reflective and Complex, Intense and Rebellious, Upbeat and Conventional, and Energetic and Rhythmic. These dimensions were used to develop Short Test of Music Preferences (STOMP). The results of factor analysis map the four dimensions across the genres as follows: a) Reflective and Complex (blues, jazz, classical, folk); b) Intense and Rebellious (Rock, Alternative, Heavy metal); c) Upbeat and Conventional (Country, Soundtracks, Religious, Pop); and d) Energetic and Rhythmic (Rap/Hip-hop, Soul/Funk, Electronic, Dance). Preferences for these music dimensions were also mapped onto the Big Five Inventory (BFI) personality dimensions of *openness*, *conscientiousness*, *extraversion*, *agreeableness*, and *neuroticism* (John and Srivastava 1999). The results showed that openness and extraversion were the two main predictors of individual's music preferences (Rentfrow and Gosling 2003).

Several researchers also examined the semantic association between the emotions, colors and genre labels. For purpose of audio mood classification, a study by Hu and Downie (2007) conducted an association test on mood and music genre labels over 3903 unique albums and 22 genres, yielding 7134 genre–mood pairs. While the distribution across the items was uneven (half of the genre collection was skewed towards Rock), some meaningful associations were nevertheless gathered from the test. For example, Folk was associated with mood terms *earnest* and *wistful*, Gospel with *joyous* and *spiritual*, Latin with *spicy* and

rousing, Rap with *witty*, New Age with *soothing*, Alternative with *cold* and *volatile*, RnB with *sensual*, Electronica with *fun*, and Rock with *snide* and *hungry*.

An investigation of associations between the colors and music genre labels was conducted by Holm, Aaltonen, and Siirtola (2009). A total of 104 participants, 80% male and 20% female, participated in the study. The participants were shown 12 colors one at a time, and asked to associate the given color with a genre from a list of 18 genres. The favorite genres among the participants were Rock (19%), Metal (12.5%), Alternative Indie (9%), Classical (9%), Pop (8%), Electronica Dance (8%), with Folk preferred by 3% of the participants. The results showed the following color–genre associations: red: Rock, Metal, Electronica Dance, Hip-hop/Rap, Pop, Latin; green: Country, Reggae, Folk; yellow: Reggae, Latin, Electronica Dance; blue: Blues, Jazz, Classical, New Age; black: Metal, Rock, Alternative Indie; white: Gospel, Classical, New Age; pink: Pop, Electronica Dance, Soul; cyan: Electronica Dance, New Age; grey: Unclassified songs; orange: Reggae, Soul, RnB Funk; brown: Country, Folk; purple: Electronica Dance, New Age, Soul, RnB, Funk. However, the results of this study should be treated with caution due to the poor choice of color scale that provided no variety in saturation and lightness levels for the 12 colors. As shown by the aforementioned studies, saturation and lightness play a crucial role in emotion–color associations.

EXPERIMENTAL STUDY

MATERIALS AND METHODS

An interactive web interface with a hybrid emotion model and a discrete color wheel was developed for the purpose of the study, and later used in the online experiment. The hybrid emotion model integrates the discrete emotion model with the dimensional, circumplex model of affect.² The color wheel comprises of 49 colors, distributed systematically on the three dimensions of the HSV color space: hue, saturation, and value (lightness). In the experiment, the participant is asked to select the individual emotion labels from the interface’s list and rate them by dragging them onto the valence–arousal space, as presented in Fig. 2.

Additionally, two separate sets of emotion labels were prepared for the study, one for describing participants’ perceived emotions (non-music context) and the other for the annotation of musical emotions (music context). The decision to use two separate emotion sets was based on the findings of several studies which showed that certain emotions are more relevant in the music context than others (e.g. Juslin and Sloboda 2001; Juslin and Västfjäll 2008; Juslin 2013; Eerola 2012; Schubert 2013).

² For a detailed presentation of the interface and the emotion models used in the experimental study, refer to Pesek et al. 2017.

A set of 17 emotion labels was chosen for the annotation of emotions in the non-music context: *active, angry, calm, cheerful, disappointed, discontented, drowsy, happy, inactive, joyous, miserable, relaxed, sad, satisfied, sleepy, tired, wide-awake*.

A separate set of 15 musical emotion labels was gathered across several experimental studies and scientific literature (e.g. Juslin and Sloboda 2001; Juslin and Laukka 2004; Eerola 2012). It comprises the following musical emotions: *anger, anticipation, calmness, dreaminess, fear, gloominess, happiness, inspiring, joy, liveliness, longing, relaxation, sadness, surprise, and tension*.

A set of 200 music excerpts was selected for the annotation task. Each excerpt was 15 seconds long and tagged with a genre label gathered from the respective music collection. It includes 80 excerpts from the free online music service Jamendo (with variety of music genres), 80 excerpts from the film music dataset (Eerola and Vuoskoski 2010), 20 excerpts from a contemporary collection of electronic music, and 20 excerpts of folk music from the collection of Slovenian folk songs. In total, 21 music genres were included: Classical, Opera, Country, Folk, Latin, Dance/Disco, Electronic, RB/Soul, Hip-hop/Rap, Reggae, Pop, Rock, Alternative, Metal, Blues, Jazz, Vocal, Easy Listening, New Age, Film (soundtrack music), and Punk.

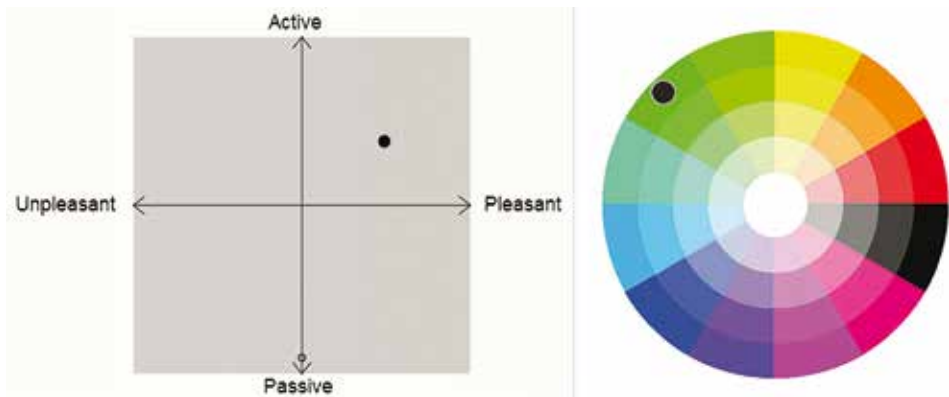


Figure 2. The emotion–color annotation interface. Left: the two-dimensional *valence–arousal* space. The valence dimension is represented on x-axis (left to right: unpleasant–pleasant), whereas the arousal dimension is represented on y-axis (bottom to top: passive–active). The blue dot indicates the position of the emotion label (here, *sadness*) when dragged onto the valence–arousal space. Right: the *discrete color wheel* with a set of 49 colors (the black dot indicates the selected color). Reproduced from Pesek et al. (2017).

EXPERIMENT

The experiment on emotional, color, and music associations was conducted online, in the Slovenian language. It was divided into three parts: demographic questionnaire; a survey of emotion–color associations; and a survey of emotion–color–music associations.

The participants were first asked to sign the consent form and complete the demographic questionnaire, reporting details on their age, gender, native language, area of residence (city/rural area), music education, musical experience, and genre preferences.

Next, the participants were tasked with the annotation of emotions and colors in a non-music context. For each of the 17 emotion labels, the participants were first asked to select the associated color (from the discrete color wheel), and then place the individual emotion label onto a two-dimensional valence–arousal space (Fig. 2).

The final, third part of the survey gathered participants' emotional and color responses to music. Each participant was presented with a total of 10 music excerpts, one at a time and in random order. For each music excerpt, the participant was tasked with selecting a color best associated with the excerpt and then rating the excerpt with one or more musical emotions by dragging them onto the valence–arousal space of the interface.

PARTICIPANTS

The entire experiment was completed by 741 participants. In total, 6999 annotations were gathered, resulting in what is currently one of the largest publicly available datasets on emotional and color responses to music. The average age of the participants was 26.5 years, the youngest was 15 years old and the oldest 64 years old. 66% were from an urban area, 67% of the participants were women. 50% of the participants, among them 60% men and 40% women, had no music education. Of the participants with music education, 12% of women and 6% of men had finished primary music education, a standardized 6-year music curriculum in Slovenia. 47% of the participants did not play an instrument or sing. The amount of music listening per day was evenly spread from less than 1 hour to over 4 hours per day. Participants were also asked to rate their three most favorite genres. The overall favorite music genre among the participants was Rock (chosen by 31% of the participants), followed by Pop (chosen by 17% of the participants), whereas Alternative and Classical were chosen by 5% of the participants. Other genres received less than 5% of the votes. As their second favorite genre, 20% of the participants chose Rock, whereas Pop received 14% of the votes. Classical music was chosen by the participants as the third favorite genre (13%), followed by Rock (12%) and Pop (10%).

RESULTS AND DISCUSSION

Music genres are often represented by different sets of musical emotions. Additionally, the musical emotions are often conveyed differently from one genre to another, also depending

on the musical style conveyed by a particular genre. Differences in emotion–color associations can thus be detected across music genres. The following sections shortly investigate this link.

GENRE SPECIFICITY OF MUSICAL EMOTIONS

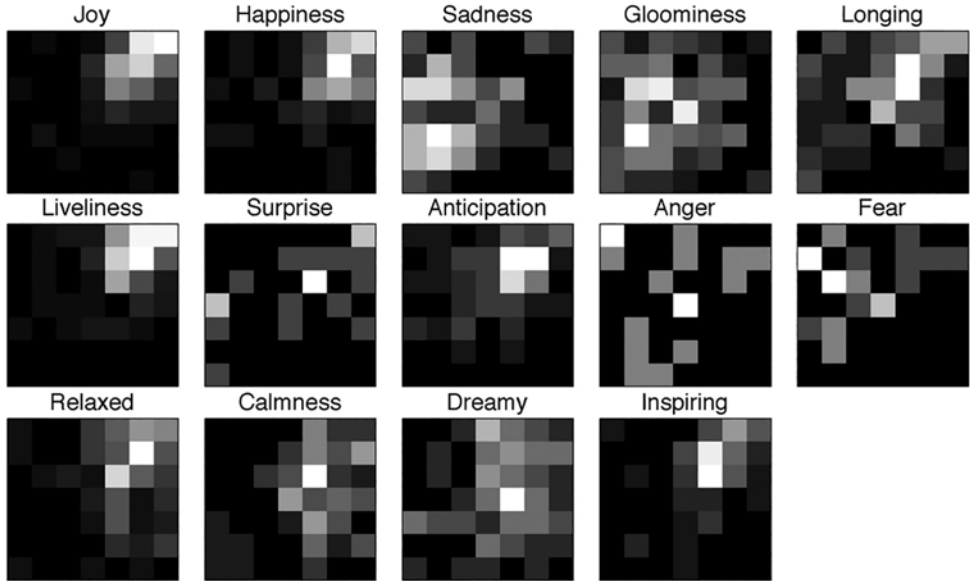
Table 1 shows the proportions of the emotions used to describe the music excerpts for the selected 10 genres: Folk, Pop, Rock, RB/Soul, and New Age, Classical, Electronic, Punk, Hip-hop/Rap, and Metal. The genre categorization of the music excerpts is based on their categorization in the music collections used in the study. The most fully represented emotions are *anticipation*, *liveliness*, *dreaminess*, *longing*, *relaxed*, and *gloominess*. *Anticipation* is present in all the genres, and particularly in Electronic, whereas *liveliness* is the prevalent emotion across all the genres except RB/Soul. *Dreamy*, *longing*, and *relaxed* are characteristic of the genres with typically slower tempo, such as New Age and RB/Soul, and also in Pop. RB/Soul has *longing* as the prevalent emotion. *Inspiring* is mostly associated with New Age and Metal, *gloominess* with Folk, Pop and Rock. *Anger* is mostly associated with Punk, Hip-hop/Rap and Metal, which, along with Classical, are also the most lively genres. *Joy* and *happiness* are mostly associated with Folk and Classical genres.

| Emot/Genre | Folk | Pop | Rock | R&B/Soul | New Age | Classical | Electronic | Punk | HipH/Rap | Metal |
|--------------|------|-----|------|----------|---------|-----------|------------|------|----------|-------|
| Anger | 1 | 2 | 4 | 3 | 1 | 2 | 7 | 12 | 17 | 21 |
| Anticipation | 6 | 7 | 9 | 11 | 10 | 14 | 20 | 9 | 10 | 8 |
| Calmness | 6 | 5 | 4 | 7 | 10 | 0 | 4 | 0 | 2 | 2 |
| Dreamy | 5 | 11 | 7 | 16 | 13 | 2 | 6 | 0 | 6 | 2 |
| Fear | 2 | 1 | 1 | 1 | 2 | 0 | 17 | 3 | 8 | 4 |
| Gloominess | 12 | 10 | 13 | 12 | 6 | 0 | 6 | 0 | 3 | 3 |
| Happiness | 9 | 5 | 5 | 3 | 4 | 13 | 1 | 3 | 5 | 3 |
| Inspiring | 6 | 8 | 8 | 3 | 11 | 7 | 8 | 0 | 5 | 11 |
| Joy | 14 | 7 | 6 | 4 | 5 | 15 | 2 | 13 | 7 | 3 |
| Liveliness | 15 | 12 | 16 | 1 | 9 | 29 | 9 | 40 | 18 | 23 |
| Longing | 8 | 15 | 13 | 19 | 10 | 3 | 4 | 7 | 5 | 11 |
| Relaxed | 9 | 9 | 7 | 11 | 15 | 7 | 3 | 6 | 7 | 4 |
| Sadness | 6 | 5 | 6 | 8 | 3 | 2 | 3 | 0 | 1 | 2 |
| Surprise | 2 | 3 | 1 | 1 | 3 | 7 | 10 | 3 | 6 | 2 |

Table 1. The emotion–genre frequency table, showing the proportion (%) of the emotions per genre for the selected genres.

As shown in Table 1, genres can be differentiated by different sets of musical emotions. The emotions are more evenly distributed in the genres Folk, Pop, Rock, RB/Soul, and New Age. On the other hand, Punk stands out with *liveliness* representing 40% of the overall ratings for this genre. Similarly, 44% of Metal is represented by *liveliness* and *anger*. In general, *anger*, *fear*, *happiness*, *sadness*, and *surprise* are the least used emotions across the presented genres. *Sadness* is mostly found in RB/Soul, Rock, Pop, and Folk. Interestingly, *fear* and *surprise* are the prevalent emotions in Electronic music, along with *anticipation*.

FOLK



ELECTRONIC

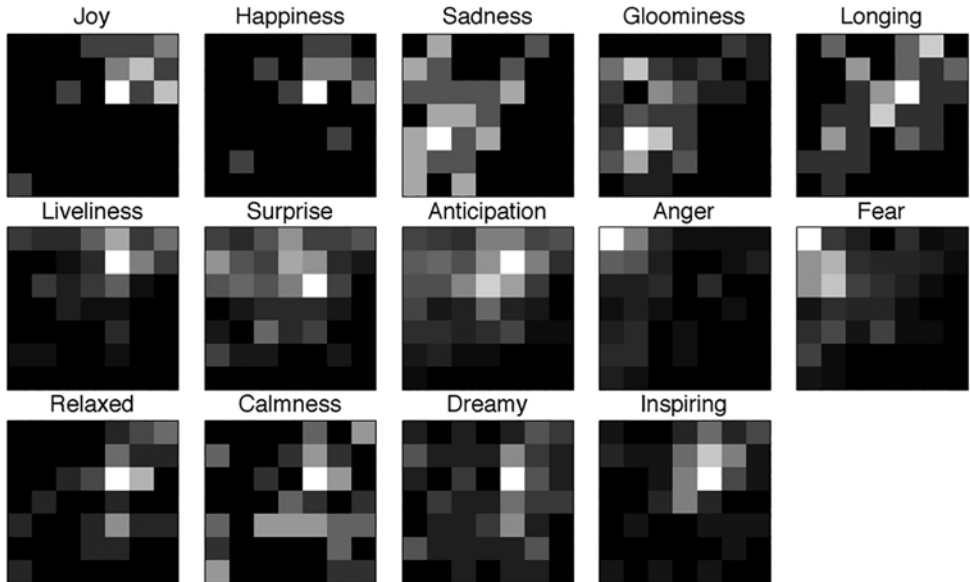


Figure 3. Comparison of Folk and Electronic genres: distribution of emotion ratings in the valence–arousal space. The frequency of the ratings is represented by the grayscale range, from black (min.) to white (max.).

One would expect *fear* to be more characteristic of genres such as Metal, but in our study, it is only represented in Hip-Hop Rap, and there only moderately.

Statistical analysis of the results showed some of the emotions are conveyed differently across the selected genres. The Kruskal–Wallis test showed some statistically significant differences in the perception of musical emotions across the selected genres. For example, *sadness* in Rock is perceived as significantly more negative than in Pop ($p = 0.02$), *anticipation* is perceived as more neutral in Electronic genre than in New Age ($p = 0.01$) or Pop ($p = 0.01$), and *calmness* is perceived as less positive in Pop than in New Age ($p = 0.02$) or Easy Listening ($p < 0.001$).

A comparison of the Folk genre with other music genres showed further statistically significant differences in the perception of musical emotions, both on the valence and the arousal dimensions. For example, *liveliness* is perceived as more pleasant in Folk than in Rock ($p=0.002$), Hip-hop/Rap ($p=0.038$), Metal ($p=0.003$), or Electronic ($p=0.001$). *Gloominess* is perceived as less unpleasant than in Rock ($p=0.035$) and *longing* is perceived as less pleasant than in New Age ($p=0.011$). *Relaxed* is perceived as more pleasant than in RB/Soul ($p=0.013$) and as much more active than in Pop ($p=0.012$) and New Age ($p=0.014$). However, *dreamy* is perceived as more pleasant in New Age ($p=0.001$) than in Folk. *Inspiring* is perceived as significantly more active in Classical music ($p=0.01$) and as significantly more pleasant in RB/Soul ($p=0.009$) and New Age ($p=0.005$). There are also differences in the perception of *anticipation*, which is perceived as moderately pleasant in Folk music and as slightly unpleasant in Electronic ($p=0.037$).

Some of the differences between the Folk and Electronic genres are further presented in Fig. 3. The same set of 14 musical emotions is used as in Table 1. Fig. 3 shows a two-dimensional histogram for the frequency and position of the emotion ratings in the valence–arousal space. Observe the valence–arousal distribution of the ratings between both genres, particularly for *gloominess*, *surprise*, *anticipation*, *anger*, *relaxed*, and *calmness*.

COLOR ASSOCIATIONS ACROSS GENRES

The rationale for incorporating the visual (color) modality lies in the link between emotions, colors, and music. However, color can also give us insight into the qualitative differences among the emotions sharing the regions of the two-dimensional affective space. One obvious limitation of such space is the reduction of emotions on the two dimensions of valence and arousal. In consequence, perceptually different emotions (e.g. *sadness* and *fear*) often overlap. In such cases, the additional dimension of color can help us differentiate between the emotions perceived as different but sharing the same region of the valence–arousal space.

Fig. 4 shows the proportions of the colors used in the ratings of the music excerpts for each of the selected genres. We can observe that the color proportions to an extent reflect the distribution of emotions across each genre, as presented in Table 1. Saturated colors, especially yellow, orange, and green hues, correlate with the positive valence and arousal quadrant and represent positive emotions such as *happiness*, *joy*, and *liveliness*. Genres with

predominantly passive emotions, occupying the quadrant of positive valence and negative arousal, are represented by the desaturated green and blue hues for the positive and neutral emotions (*calmness, relaxed, dreamy*, and partly *longing*). On the other hand, the blue, violet, and purple hues represent moderately negative emotions (e.g., *sadness, gloominess*) in the two quadrants of the negative valence space, and are further differentiated with saturated hues for the positive arousal and desaturated hues for the negative arousal. Highly negative emotions, such as *anger* and *fear* (and partly anticipation), are represented by black color and grey hues, as well as saturated reds, predominantly in the quadrant of high arousal and negative valence. In general, highly active emotions, both positive and negative, such as *liveliness* and *anticipation*, are represented by saturated reds. The perception of other emotions is less uniform. For example, *anticipation* can be perceived as both positive or negative in valence and consequently adopts the respective hues: saturated blue, violet and grey hues, as well as black, dominate the quadrant of the negative valence space, with saturated reds and greens dominating the quadrant of positive valence and arousal. Passive and neutral emotions, such as *dreamy*, contain light blue–cyan and violet–magenta hues, which are often associated with slow, contemplative music occupying the quadrants of the negative arousal space (with both negative and positive valence).

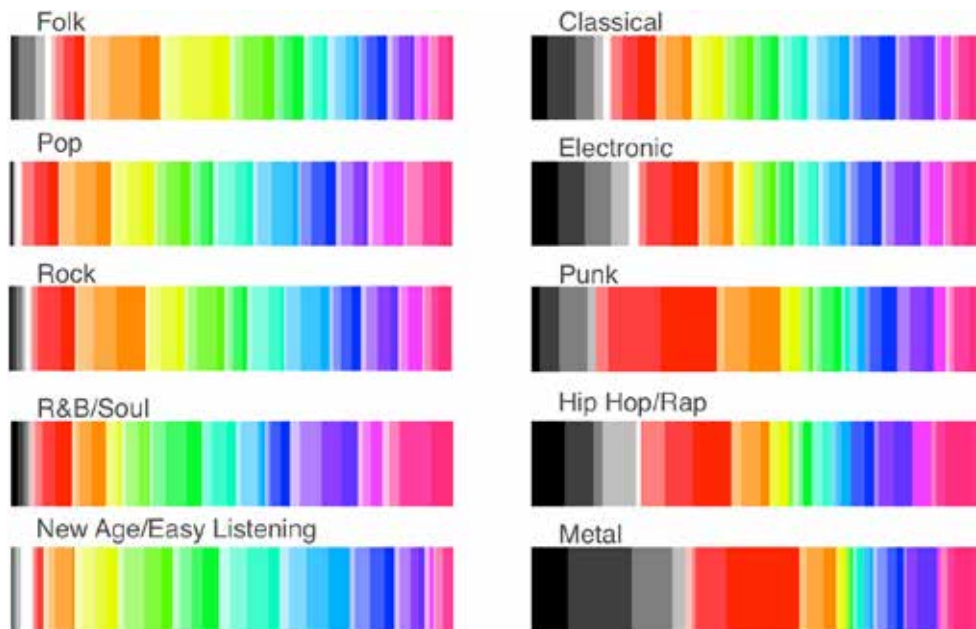


Figure 4. Color ratings for the selected genres.

As shown in Fig. 4, Classical, Electronic, Punk, Hip-hop/Rap and Metal are the genres with a large proportion of highly active and negative emotions (*anger, fear, and anticipation*, where the latter is perceived as negative) and differentiate themselves from the other genres with a larger proportion of black color and saturated red and grey hues. Apart from Classical and Electronic, these genres have the lowest proportion of desaturated yellow–green–blue–cyan hues which are characteristic of slow music. Overall, the Folk genre has the most balanced color distribution. It is very similar to Pop and Rock, but with less blue and violet hues that reflect the larger proportion of passive and at times moderately negative emotions (such as *longing* and *anticipation*) in Pop and Rock (see Table 1). RB and Soul have the largest number of violet–magenta hues representing passive and at times moderately negative emotions (e.g., *dreamy* and *longing*, as well as *sadness*), whereas New Age and Easy Listening have the largest proportion of desaturated, light yellow–green–blue–cyan hues representing passive but positive emotions (e.g., *inspiring, relaxed, and longing*).

These results partly corroborate the findings of Palmer, Langlois, and Schloss (2016), who reported that faster music in the major mode was associated with lighter, more saturated, warmer colors, and slower music and minor mode were associated with darker colors. As Fig. 4 shows, slower music is not necessarily perceived with darker colors, as is the case for the light blue–cyan hues in genres New Age and Easy Listening. However, further systematic analysis of underlying musical features (e.g., mode, tempo, rhythm) is required to corroborate these findings.

In general, the results presented point to the genre specificity of musical emotions. However, it is important to note that the definition of musical genre is fundamentally vague. Genre is not something innate to music, i.e., it is not a physical feature and does not contribute to the psychoacoustics of a sound. Rather, genre is a cognitive and cultural construct, transient representation of a certain musical style, with no clear boundaries or natural taxonomy (Aucouturier and Pachet 2003). Cultural and social context play a significant role in genre preferences, as well as personality, age, gender, and education, among others. Moreover, genre preferences are inherently biased. For example, an individual might have rich categorical representation of a certain genre, but recognize other genres only as stereotypes (Gjerdingen and Perrott 2008). The analysis presented here should be extended to the investigation of music preferences and user context, as well as to the investigation of the underlying musical features.

CONCLUSIONS

The article has presented an experimental study on the emotional and color perception of music, focusing on folk music in comparison with other musical genres. In general, the results of the study point to the genre specificity of musical emotions. Statistical analysis of the results showed that some of the emotions were conveyed differently across the selected

genres. For the Folk genre, *liveliness* was perceived as more pleasant than in Rock, Hip-hop/Rap, Metal, or Electronic, whereas *relaxed* was perceived as more pleasant in Folk than in RB/Soul, and as much more active than in Pop.

Overall, along with Pop and Rock, the Folk genre had the most balanced distribution of the emotions used in the ratings, whereas Punk and Metal had over 40% of their ratings represented by only two emotions, by *liveliness* for the former, and *liveliness* and *anger* for the latter. Similar results were obtained for the emotion–color associations. Color distributions for Folk, Pop and Rock were very similar, but with more blue and violet hues for Pop and Rock, which reflected the larger proportion of the passive and at times moderately negative musical emotions in these two genres. Punk and Metal had the largest proportion of black color and saturated reds and grey hues.

Future work will extend the analyses with further investigations of user context, such as demographic information, music education and use, music preferences, and influences of underlying musical features, such as mode, tempo, rhythm). For this purpose, it will be necessary to gather additional user and music data.³

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³ The dataset of emotional and color perception of music, together with various visualization tools, is publicly available at moodo.musiclab.si

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ČUSTVENO IN BARVNO ZAZNAVANJE LJUDSKE GLASBE IN DRUGIH GLASBENIH ZVRSTI

Prispevek predstavlja eksperimentalno raziskavo čustvenega in barvnega zaznavanja glasbe. Temelji na že objavljenem delu avtorjev (Pesek idr. 2017) in govori o aktualnih interdisciplinarnih raziskavah kognicije glasbe.

Poslušanje glasbe je za večino ljudi čustvena izkušnja, na katero med drugim vplivajo tako poslušalčeve/poslušalkine glasbene preference, osebnost, razpoloženje, spol in starost kakor tudi družbeni in kulturni vidiki. Pomembno vlogo pri preučevanju čustvenega zaznavanja

glasbe ima tudi barva. Kakor so pokazale dosedanje eksperimentalne raziskave, lahko učinke čustvene razsežnosti preučujemo prek barvnih in glasbenih asociacij. To potrjujejo tudi v tem članku predstavljeni rezultati.

Avtorji v nizu analiz preučujejo vpliv čustev na zaznavanje barv in glasbe. Glasba je odvisna od širšega konteksta, splošni vzorci in razlike v zaznavanju pa so vidni tudi v primerjalni analizi glasbenih zvrsti (žanrov), pri čemer se v več primerih izraža žanrska specifičnost glasbenih čustev. Statistična analiza je v nekaterih primerih pokazala na očitne razločke v čustvenem zaznavanju glasbe posamičnih zvrsti. Če govorimo o ljudski glasbi, živahnost v njej zaznavamo prijetneje kakor v rocku, hip-hopu/rapu, metalu ali v elektronski glasbi, medtem ko sproščenost v ljudski glasbi zaznavamo precej aktivneje kakor v popu in prijetneje kakor v ritmu in blues/soulu. Na splošno je čustvena porazdelitev najbolj uravnotežena in hkrati najraznovrstnejša v ljudski glasbi, popu in rocku, medtem ko je več kot 40 % primerov označb panku in metala predstavljeno le z dvema čustvoma, živahnostjo in jezo. Slednje je vidno tudi v analizi čustveno-barvnih asociacij, ki so povezane z glasbenimi zvrstmi. Barvna porazdelitev za ljudsko glasbo, pop in rock je primerljiva, s temnejšimi odtenki za pop in rock, kar v teh dveh zvrsteh kaže na večji delež pasivnih in občasno zmerno negativnih glasbenih čustev. Po drugi strani pa v panku in metalu prevladuje delež črne barve in nasičenih rdečih in sivih odtenkov, ki predstavljajo zlasti aktivna negativna čustva. Izsledki raziskave kažejo na žanrsko specifičnost glasbenih čustev.

Pri interpretaciji predstavljenih rezultatov je treba opozoriti, da glasbeni žanr kot kognitivni in kulturni konstrukt, za katerega sta značilna nenehno prehajanje in prepletanje različnih glasbenih stilov, nima jasne razmejitev.

Za boljše razumevanje čustvene mediacije glasbe bo treba predstavljene raziskave v bodoče razširiti s preučevanjem glasbenih preferenc, uporabniškega konteksta in splošnih glasbenih značilnosti tipičnih primerov glasbenih zvrsti.

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