

# Music and Emotion-Recognition: The Music Experience Factor

Joseph Kayne

Indian Hill High School

## ABSTRACT

Music is a powerful influencer. The ways in which people interpret music are determinative of how the music makes an individual feel and thus, how it influences them. The interpretation of emotion in music has been well-studied in musicology. This study seeks to investigate a specific under-researched factor of emotion recognition in music: the music experience of an individual. Utilizing the study design and musical clips laid out in Erola and Vuoskoski, 10 clips of music were played for individuals with varying types and amounts of music experience. Participants ranked happiness, sadness, tenderness, fear, and anger, on a scale of 1-9. The data collected from the musicians' rankings in this study was compared with the nonmusicians in the Erola and Vuoskoski study. It was found that there was a statistical difference in how musicians versus nonmusicians ranked emotions in the same music clips. Further, the emotion of sadness was the most similarly ranked between the two groups. Differences between the types and amounts of music experience of participants were also analyzed but generally remained at the same degree of difference between musicians and nonmusicians.

## Introduction

Music plays an important role in human experience. Music can not only facilitate expression (Wilson 3), unite people (Bakagiannis, et al. 6), and positively impact key aspects of physical and mental health (MacDonald 4), but can also have a powerful unconscious influence on its listeners from its physiological, psychological, and neural effects, most significantly through the emotion it portrays (Kayne and Kullar 11). Accordingly, understanding the ways in which an individual perceives emotion in music is essential to a full understanding of music's ability to influence. Because of this, the individuality of music emotion perception has been studied well in the field of music research (e.g. Eerola, et al.; Juslin, et al.; Mohn, et al.; Quinto, et al.; Yang, et al.). However, one of the factors of individual perception, music experience, has been significantly under investigated by current research. This study explores whether having music experience affects the recognition of emotion in music compared to those without music experience.

## Literature Review

### Background on Emotion Recognition

Previous emotion recognition research has heavily focused on music's emotional cues and individual characteristics in a person that can affect the recognition of those cues. Many elements in music can be a cue for emotion recognition including melody, harmony, rhythm, dynamics, tone color, expressivity, texture, and form (Panda, et al. 3). These factors can be combined to capture elements of musical expressivity, including emotion. Further, Coutinho, et al. demonstrates with a study that collected continuous data from a participant's brain while listening to film music and natural speech (10) that a significant part of the listeners' second-by-second reported emotions to music and speech prosody can be predicted from a set of seven psychoacoustic features: loudness, tempo/speech rate, melody/prosody

contour, spectral centroid, spectral flux, sharpness, and roughness (7). This agrees with Panda, et al. findings but concludes even further that it is the temporal structure of acoustic features that communicates emotional information (10). Quinto, et al. tested these factors of emotion and found the aspects can be used in both the compositional and performance elements of a musical selection (519). They also found that straight compositions resulted in the most successful recognition of happiness and fear whereas the straight performance of a musical selection resulted in the most successful recognition of happiness and sadness, demonstrating that different cues from different types of listening can result in different emotions recognized more readily (Quinto, et al. 519).

Compositional factors of emotion recognition can also be found in features of speech (Bachorowski 54). These factors can be recognized differently depending on how the vocal expression is delivered (Kadiri, et al. 8), as well as the familiarity of the individual delivering it (Bachorowski 56). Juslin suggests that interpreting emotional expression in music performance is built off of evolutionary factors for interpreting emotion in vocal expression (6) and requires many of the same brain regions (7).

Similar to speech, music can be recognized differently depending on how it is produced or who is producing it (Mohn, et al., Yang, et al., Eerola, et al.). In fact, music emotion recognition is highly variable based on individual characteristics of the listener such as personality, sex, and cultural background (Yang, et al. 8). For example, Yang, et al. attempts to resolve the role of individuality in music emotion recognition by performing a regression analysis where individuals are grouped by factors of sex, academic background, music experience, and personality (3). However, doing this did little to improve the prediction accuracy of the recognition of emotional content of music, suggesting the subtlety of individuality and the need to explore other methods to isolate and describe individual differences in music perception (8). Thus, a more specific method is needed to delineate the independent traits of listeners when predicting (or attempting to predict) how they will recognize emotion in music.

## Background on Music Experience Factor

One important emotion-recognition trait that is of particular interest to me is the music experience of an individual listener. The positive effects of music education on students have been well-researched. Practicing composing music in a classroom has been shown to increase students' academic skills (Hogenes, et al. 13) and accurately predict a student's empathy skills (Cho 10; Hietolahti-Ansten and Kalliopuska 1), among numerous other benefits of music education. The most relevant effect of music education/experience in relation to emotion recognition is what Reimer defines as "musical taste: a combination and interaction of (a) attitudes toward music, (b) musical preferences, and (c) musical discrimination" (149). Reimer found that the longer a person has participated in music, and the more kinds of experiences they have had, the higher their "musical taste" tends to be (149). Further, he found that high school vocal students had better taste and discrimination of music than high school instrumental students (Reimer 154) meaning the type of music experience was highly important. Hogenes, et al. reaffirms this by explaining that music production practice leads to more desire for music production and music experiences (Hogenes 13). This increased familiarity and taste for music could be an important individual characteristic in the perception of music.

However, when it comes to emotion recognition in music, it is not clear whether this characteristic would have an effect. On one hand, researchers have shown a certain universality of emotion. A cross-cultural meta-analysis suggests that certain core components of emotions are universal and likely biological (Elfenbein, et al. 228). On the other hand, researchers have shown that because music experience promotes empathy (Cho 10; Hietolahti-Ansten and Kalliopuska 1) and increases musical taste (Hogenes 13; Reimer 154), musicians might be better able to feel, understand and identify the music's emotion. This discourse is the basis for my research.

## Identifying Research Gap

Given the hypothetical ambiguity between the effects of music experience and emotion recognition, it is important to note that previous research has not adequately analyzed this variable (e.g. Mohn, et al.; Yang, et al.). Emotion recognition research either fails to include or isolate this factor or fails to expand upon it with enough depth to differentiate between different types of musical experiences (e.g. composition, instrument playing, singing, etc.). A leading study on emotion music recognition conducted by Eerola and Vuoskoski has explained the limitation and need to investigate the influence of individual factors more thoroughly, such as musical expertise, on the processing of music emotions (41). This study's large data set of emotion-ranked music from film soundtracks has pathed the way for future music emotion research and is cited in many more recent studies (e.g. Juslin; Quinto, et al.; Resnicow, et al.; Taruffi et al.; Vuoskoski and Eerola). Yet, in all of these studies, the individual trait of musical experience in this data set is not identified, nor researched. This study aims to fill that gap by researching if having both a certain type and amount of music experience affects the recognition of emotion in music compared with the public.

## Method

To address the question whether music experience affects the recognition of emotion in music, I conducted a study utilizing a mixed-method approach. A survey was used to collect background data about the independent variable in my study, an individual's music experience. Survey participants then ranked five emotions (happiness, sadness, anger, fear, tenderness) on a Likert scale for ten short clips of music, the dependent variable. Refer to Appendix A and B for the two parts of this study.

### Survey of Music Experience

The first part of my study was a survey to identify an individual's music background. Since the study population was limited to individuals with music experience, I chose to commission study participants from music classes at my high school. I obtained permission to conduct my study with the students and teachers of 9 different music classes at my high school including choir, orchestra, band, and music theory. Each student and teacher first signed a consent form detailing their willingness to participate in the study and for any data collected to be anonymously published. Refer to Appendix C for the full consent form. A total of 112 students and teachers completed the consent form. These participants filled out the survey where they indicated what they were currently participants in musically (e.g. playing a string instrument, composing, singing) and then indicated how long they have been participating in that musical experience (e.g. 2 years, 10 years). Refer to Appendix A for the survey questions in full. Rather than limit the data simply to years of experience, I chose to allow participants to include their type of music experience as well because of possible differences in type of music experience and emotion perceived. For example, one could hypothesize that a composer would have a better understanding of emotion than a percussionist. This detailed data about each participant's music experience allows me to fill the gap in previous emotion recognition research by analyzing how different types and lengths of music experience could affect the recognition of music differently.

### Study of Emotion Recognition

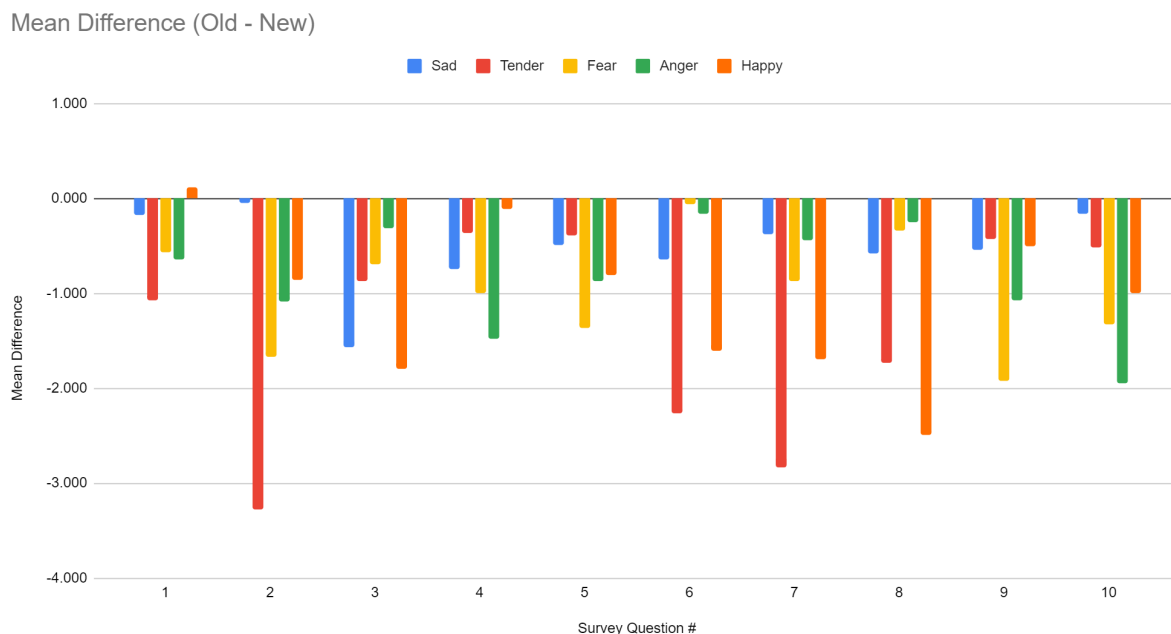
The second part of my study was the emotion recognition of musical clips. To gather emotion recognition data, 10 musical clips about 15 seconds in length were played for each group of participants. I played each clip twice. After each clip was played, the participants ranked the happiness, sadness, anger, fear, and tenderness on a Likert scale of 1-9. Once all ten clips were ranked, the survey was submitted, and the study was complete. Refer to Appendix B for the emotion-ranking Likert scale for one of the ten clips. This part of my study mimics the procedure of the research

conducted by Eerola and Vuoskoski. In their study, Eerola and Vuoskoski gathered hundreds of musical selections from film clips and asked the general public to rank 10 emotions in these clips on a scale of 1-9 (26). My study used 10 of the Eerola and Vuoskoski music clips and asked participants to rank 5 emotions from 1-9. The specific 10 clips of music that my study uses in order are: clip 23, clip 33, clip 41, clip 11, clip 92, clip 55, clip 50, clip 29, clip 66, and clip 04. The first five clips I use ranked high in the Eerola and Vuoskoski study in one of the five emotions. The second five clips I use are more complex, having received lower rankings in each emotion. Because my emotion-music recognition study is a condensed version of Eerola and Vuoskoski, it eliminates possible confounding variables created from new clips of music. If my own music clips were utilized, the emotion-ranking within it would be biased because I would have had to act as the general public to determine what emotion was portrayed within the clips. It would also not be a fair comparison of emotion-recognition in music, since the clips compared would be different. While Eerola and Vuoskoski use the general public (nonmusicians) (26), my study involves only musicians with music experience. My study will therefore fill the research gap by ascertaining whether there is a statistical difference between the two groups' emotion recognition of the same music clips.

## Data Analysis

### Overall Difference

To determine whether there was a statistical difference between how musicians and nonmusicians recognize emotion in music, I needed to first establish how people were ranking each clip of music. To do this, I collected the mean ranking of each emotion in each clip of music in the old study (Eerola and Vuoskoski) and the mean rankings for my study participants with music experience. For the differences in how emotion was ranked, refer to Figure 1 (graph below) highlighting the mean difference of each emotion of each clip.



**Figure 1.** All music experience mean differences

This graph highlights the original mean of the emotions for each clip in the old study minus the mean of the emotions in the current study. The graph demonstrates that there is a large difference in several ranked emotions between my study of people with music experience and the Eerola and Vuoskoski study of people in the public. The greatest difference can be seen in the Tenderness Survey Question (survey question 2), with a mean difference of -3.2. Interestingly, almost all differences were negative, indicating that people with music experience ranked strong emotions lower on the scale than people without this music experience. The idea about why the ranking from people with music experience might be divergent will be explored in the discussion section. What's most important about this graph is seeing that in general, emotion seems to be ranked very differently by the general public and by those with music experience. To see if these differences were statistically significant, I conducted a two-tailed t-test. My test included a degree of freedom of 111, and I set an alpha level of 0.05.

T-Value / Statistical Significance						
Survey Questio	Happy	Sad	Tender	Fear	Anger	
1	0.893	-2.072	-4.254	-3.646	-4.466	← T-value
	0.374	0.041	0.000	0.000	0.000	← P-value (highlighted= significant)
2	-5.739	-0.206	-12.984	-6.591	-5.681	
	0.000	0.837	0.000	0.000	0.000	
3	-7.425	-6.240	-4.300	-3.919	-2.883	
	0.000	0.000	0.000	0.000	0.005	
4	-1.616	-3.358	-2.353	-6.807	-4.680	
	0.109	0.001	0.020	0.000	0.000	
5	-4.961	-2.670	-3.224	-4.870	-3.594	
	0.000	0.009	0.002	0.000	0.000	
6	-9.549	-4.043	-7.931	-0.411	-0.922	
	0.000	0.000	0.000	0.682	0.358	
7	-7.458	-1.526	-11.237	-3.642	-3.197	
	0.000	0.130	0.000	0.000	0.002	
8	-11.397	-2.437	-8.209	-2.506	-1.846	
	0.000	0.016	0.000	0.014	0.068	
9	-3.610	-2.530	-3.213	-9.941	-3.455	
	0.000	0.013	0.002	0.000	0.001	
10	-4.488	-0.757	-2.836	-4.581	-7.443	
	0.000	0.451	0.005	0.000	0.000	

Figure 2. All music experience statistical difference

This chart displays the t-value and statistical significance of each test. The t-value is located on top of each p-value for every emotion of each survey question (clip of music). Each value was based on the respective means of emotion in the old and new study. It's important to note that because of the limited information I had about the past study (Eerola and Vuoskoski), I was unable to obtain standard deviations from their data. As such, I conducted this test using only the standard deviations from my data. This should not have any effect on the test because I predicted that the variation of ranking would remain relatively constant. In this chart, I highlighted the boxes with statistical significance less than my alpha level (0.05), indicating that there was a significant difference in the ranking of that emotion. Out of the 50 emotions in all the clips, 42 of them were ranked significantly differently. The majority of every clip of emotion was statistically different. There also doesn't seem to be a difference between the first five and second five clips of music. Recall that the first five clips ranked strongly in each category whereas the second five were more complex (meaning that the general public ranked each clip less extreme and more equal with regards to each emotion). In the high-ranking emotions, there were 3 not statistically different. In the complex emotions, there were 5 not statistically different. An explanation for this difference could be the same explanation for why the graph in figure 1

displays only negative differences in the means: the people with music experience ranked all the emotions as complex, thus agreeing with the general public more when they also ranked them complex. To further probe whether music experience affects recognition of emotion in music, the data also was tested to ascertain whether there were statistical differences among amount and types of music experience.

### Amount of Music Experience

To ascertain whether the amount of music experience created a statistical difference when recognizing emotions, the data was grouped into survey participants with less than 10 years of experience and with 10 or more years of experience for at least one instrument. The less than 10 years test had a degree of freedom of 71 (Figure 3) and the 10+ years t-test had a degree of freedom of 23 (Figure 4). I maintained an alpha level of 0.05 for both.

T-Value / Statistical Significance						
Survey Questio	Happy	Sad	Tender	Fear	Anger	
1	1.057	-2.250	-3.835	-2.776	-3.730	
	0.294	0.028	0.000	0.007	0.000	
2	-4.964	0.044	-10.580	-5.190	-4.906	
	0.000	0.965	0.000	0.000	0.000	
3	-5.666	-4.786	-3.706	-3.302	-2.553	
	0.000	0.000	0.000	0.002	0.013	
4	-1.496	-2.961	-2.499	-4.844	-3.569	
	0.139	0.004	0.015	0.000	0.001	
5	-4.523	-2.264	-3.246	-4.327	-2.004	
	0.000	0.027	0.002	0.000	0.049	
6	-8.126	-3.727	-6.402	-0.630	-1.085	
	0.000	0.000	0.000	0.531	0.282	
7	-6.615	-1.683	-9.335	-2.773	-2.873	
	0.000	0.097	0.000	0.007	0.005	
8	-9.244	-2.514	-6.110	-2.331	-1.724	
	0.000	0.014	0.000	0.023	0.089	
9	-3.166	-2.465	-3.089	-7.769	-2.357	
	0.002	0.016	0.003	0.000	0.021	
10	-4.260	-0.455	-2.885	-3.578	-5.006	
	0.000	0.650	0.005	0.001	0.000	

Figure 3. Less than 10 years of experience statistical difference



T-Value / Statistical Significance							
Survey Questio	Happy	Sad	Tender	Fear	Anger		
1	1.345	-0.330	-2.620	-3.337	-2.828		
	0.192	0.744	0.015	0.003	0.010		
2	-3.116	-0.190	-10.772	-4.283	-3.488		
	0.005	0.851	0.000	0.000	0.002		
3	-5.128	-4.624	-4.327	-2.423	-2.135		
	0.000	0.000	0.000	0.024	0.044		
4	-0.899	-2.429	-1.322	-8.902	-2.860		
	0.378	0.023	0.199	0.000	0.009		
5	-2.636	-1.814	-1.546	-2.160	-3.834		
	0.015	0.083	0.136	0.041	0.001		
6	-5.661	-1.666	-4.653	-0.245	0.240		
	0.000	0.109	0.000	0.808	0.812		
7	-3.710	-1.423	-7.445	-2.196	-2.156		
	0.001	0.168	0.000	0.038	0.042		
8	-10.370	-0.355	-6.277	-1.280	-1.318		
	0.000	0.726	0.000	0.213	0.200		
9	-2.054	-1.630	-2.320	-7.536	-2.534		
	0.052	0.117	0.030	0.000	0.019		
10	-2.425	-0.554	-1.916	-3.735	-6.887		
	0.024	0.585	0.068	0.001	0.000		

**Figure 4.** 10+ years of experience statistical difference

Figures 3 and 4 show that there is a slight difference in the amount of emotion perceived differently between musicians with less than 10 years of experience and those with 10+ years of experience, as seen by the fact that there are less highlighted boxes for statistical difference. Interestingly, the amount of emotion ranked differently decreased as the years of experience increased, although there is not much that can be drawn from this finding given that there were so few (i.e. a statistically insignificant number of) survey participants with 10 or more years of music experience.

Compared with figure 2 (everyone in the study), figure 3 (<10 years of experience) is almost exactly alike. This is likely because individuals with <10 years made up a majority of my study. Also, it's important to note that there is still a large majority of difference in the amount of emotions that were ranked statistically differently in both figures. For 10+ years, 33/50 emotions were ranked differently. So, it's safe to conclude that the emotion is still recognized differently when compared with the general public. Interestingly, sadness, in general, seems to be ranked more similarly (because of the least highlighted boxes) between those with 10+ years of experience and those without music experience. A reason for this emotion being ranked similarly could be because of its recognizability and understanding between both groups of people.

### Types of Music Experience

I also tested the statistical difference between the various music experience types. The degrees of freedom for each figure is 39 for orchestral players (Figure 5), 61 for singers (Figure 6), 27 for brass players (Figure 7), and 18 for trained dancers (Figure 8).

T-Value / Statistical Significance						
Survey Questio	Happy	Sad	Tender	Fear	Anger	
1	-0.260	-1.799	-2.376	-3.146	-3.907	
	0.796	0.080	0.022	0.003	0.000	
2	-4.333	0.781	-9.580	-3.772	-3.634	
	0.000	0.439	0.000	0.001	0.001	
3	-4.019	-4.685	-2.526	-2.389	-2.171	
	0.000	0.000	0.016	0.022	0.036	
4	-1.580	-0.672	-2.125	-4.276	-2.311	
	0.122	0.505	0.040	0.000	0.026	
5	-4.419	-0.613	-2.734	-2.456	-1.734	
	0.000	0.543	0.009	0.019	0.091	
6	-5.945	-3.067	-4.182	0.157	0.897	
	0.000	0.004	0.000	0.876	0.375	
7	-5.715	0.562	-8.983	-2.653	-1.656	
	0.000	0.577	0.000	0.011	0.106	
8	-7.232	-1.528	-4.817	-1.573	-1.343	
	0.000	0.135	0.000	0.124	0.187	
9	-2.946	-0.720	-2.967	-5.871	-1.698	
	0.005	0.476	0.005	0.000	0.097	
10	-4.048	1.318	-2.535	-4.100	-3.089	
	0.000	0.195	0.015	0.000	0.004	

Figure 5. Orchestral experience statistical difference

T-Value / Statistical Significance						
Survey Questio	Happy	Sad	Tender	Fear	Anger	
1	0.708	-1.260	-2.857	-2.891	-4.013	
	0.482	0.213	0.006	0.005	0.000	
2	-4.151	-1.813	-10.075	-5.888	-5.147	
	0.000	0.075	0.000	0.000	0.000	
3	-7.473	-5.041	-4.220	-3.939	-2.257	
	0.000	0.000	0.000	0.000	0.028	
4	-0.736	-2.814	-1.798	-11.086	-3.886	
	0.464	0.007	0.077	0.000	0.000	
5	-3.295	-2.408	-2.490	-6.087	-5.089	
	0.002	0.019	0.016	0.000	0.000	
6	-8.261	-2.760	-6.899	-0.334	-1.237	
	0.000	0.008	0.000	0.740	0.221	
7	-5.727	-2.134	-9.254	-3.347	-2.677	
	0.000	0.037	0.000	0.001	0.010	
8	-10.088	-1.883	-7.419	-2.047	-1.406	
	0.000	0.064	0.000	0.045	0.165	
9	-3.119	-1.568	-2.378	-10.097	-2.897	
	0.003	0.122	0.021	0.000	0.005	
10	-2.839	-0.669	-2.017	-5.068	-10.278	
	0.006	0.506	0.048	0.000	0.000	

Figure 6. Singing experience statistical difference



T-Value / Statistical Significance						
Survey Questio	Happy	Sad	Tender	Fear	Anger	
1	0.981	-2.156	-3.328	-1.693	-3.111	
	0.335	0.040	0.003	0.102	0.004	
2	-4.955	0.656	-10.607	-4.617	-3.330	
	0.000	0.518	0.000	0.000	0.003	
3	-4.717	-4.244	-0.974	-2.738	-2.117	
	0.000	0.000	0.339	0.011	0.044	
4	-2.045	-3.165	-1.121	-1.849	-4.157	
	0.051	0.004	0.272	0.075	0.000	
5	-3.028	-2.728	-1.678	-3.212	-2.268	
	0.005	0.011	0.105	0.003	0.032	
6	-9.296	-3.459	-4.961	-0.396	-1.358	
	0.000	0.002	0.000	0.695	0.186	
7	-5.284	-0.790	-8.956	-2.306	-3.091	
	0.000	0.436	0.000	0.029	0.005	
8	-9.278	-2.149	-8.401	-2.081	-1.230	
	0.000	0.041	0.000	0.047	0.229	
9	-2.834	-2.488	-2.291	-4.191	-3.553	
	0.009	0.019	0.030	0.000	0.001	
10	-2.740	-1.726	-1.437	-2.429	-6.055	
	0.011	0.096	0.162	0.022	0.000	

Figure 7. Brass/Band experience statistical difference

T-Value / Statistical Significance						
Survey Questio	Happy	Sad	Tender	Fear	Anger	
1	0.850	0.835	-1.467	-2.001	-2.780	
	0.407	0.415	0.160	0.061	0.012	
2	-3.346	-1.164	-6.809	-3.345	-3.507	
	0.004	0.259	0.000	0.004	0.003	
3	-4.827	-3.103	-2.776	-2.431	-1.515	
	0.000	0.006	0.012	0.026	0.147	
4	-0.196	-2.469	-1.062	-6.826	-3.301	
	0.847	0.024	0.302	0.000	0.004	
5	-2.401	-1.641	-1.894	-4.122	-5.013	
	0.027	0.118	0.074	0.001	0.000	
6	-3.622	-2.449	-3.585	-0.455	-1.228	
	0.002	0.025	0.002	0.655	0.235	
7	-4.981	-0.868	-14.835	-2.751	-1.687	
	0.000	0.397	0.000	0.013	0.109	
8	-5.771	-1.744	-3.542	-1.046	-1.444	
	0.000	0.098	0.002	0.310	0.166	
9	-2.513	-1.162	-1.489	-7.131	-3.249	
	0.022	0.260	0.154	0.000	0.004	
10	-2.382	-0.251	-1.542	-3.713	-6.733	
	0.028	0.805	0.140	0.002	0.000	

Figure 8. Trained dance experience statistical difference

Each graph shows the statistical differences for each type of musical experience of my study participants, compared with nonmusicians (the general public) in the Eerola and Vuoskoski study. For example, figure 8 shows how people with trained dance experience recognize certain emotions differently than those with no music experience. Once again, the highlighted boxes in the charts show where there was a p-value of less than 0.05, and thus where this is a statistically significant difference. Most of the boxes in these charts vary somewhat from one another, representing the slight differences in what each group recognized. Interestingly, however orchestral and singing are exactly the same in terms of which emotions they differed on (See figure 5 and 6). This could be due to a significant overlap in the participants who are singers and orchestral players, which can be seen in the data. In general, each type of music experience still resulted in a majority of difference in emotion recognition. The smallest majority of emotions that were ranked statistically different was from those with trained dance experience, where only 29/50 emotions were ranked differently. The greatest majority of emotions ranked differently was from those with brass/band experience, where 36/50 emotions were ranked differently. This could simply be due to variable differences in study location, but it is interesting to note the differences when comparing music production methods.

## Conclusions

The data analysis detailed above enabled me to see which emotions were ranked statistically different between people with and without music experience. Compiled together, people with music experience ranked a majority of emotions statistically significantly differently than the general public. Therefore, it can be concluded that having music experience does affect the recognition of emotion in music compared with the non-musicians. There are several explanations for this phenomenon. One hypothesis I have is that musicians, because of their background listening to and performing varying musical selections, would choose to rank emotions for music in a more complex way. For example, if there is a clip of music that the general public ranked very strongly in anger, an experienced musician might hear anger, but also some fear, tenderness, and sadness. So, the musician would rank that emotion as less strong because of the presence of the other perceived emotions. This explanation is supported by my data because the difference in emotion between the two groups was almost always negative (figure 1). Additionally, this explanation is supported by researcher Reminer, who found that the longer a person has participated in music, the more kinds of experiences they have had, and thus the higher their "musical taste" tends to be (Reminer 54). In this case, musical taste can be equated to the complexity of the music. This previous research validates my theory about why people with music experience rank emotion differently.

To further confirm my initial research question, I analyzed how the type and amount of music experiences influenced the differences in emotion recognition observed in my data. From groups of amount (less than 10 and 10 or more years) and of type (orchestral, brass/band, singer, dance), I found that in sum, the difference between musicians and nonmusicians remained the same. In other words, for each group, a majority of emotions were ranked statistically differently than the general public. But looking at each set of data independently, some interesting conclusions can be drawn.

First, in terms of the amount of music experience, it seems that the amount of emotion ranked differently decreased as the years of experience increased. This could be a byproduct of becoming more familiar with music emotions and thus knowing when to rank a clip of music strong rather than complex. However, this might also simply be due to a lack of participants (only 24) who had greater than 10 years' experience, a limitation of my resources. Regardless, there is still a majority difference when compared with non-musicians as a whole.

Second, in terms of type of music experience, there were some differences between the individual data, but in general, each data set was consistent with the broader conclusion of this paper, since a majority of emotions differed from the general public. Across all the groups studied, it is interesting to note that the ranking of sadness differed the least between musicians and nonmusicians. This could be due to its recognizability and understanding between both groups of people. This is consistent with the research of Quinto, et al., who found that the most successful recognition of emotion in performed musical selections was of happiness and sadness (Quinto, et al. 519). So it follows that the

difference in those two emotions between musicians and nonmusicians would be less as well. Of the groups of data, the type of music experience that resulted in the most amount of difference was brass/band, and the one with the least amount of differences was dance. This is likely due to the fact that a dancer only experiences music in relationship to listening, not performing, something that nonmusicians can experience the same way. Brass/band likely only includes most differences due to circumstance, since it was very close to orchestra and singing as well. With all the data compiled, it can be concluded that there is a difference between how people with and without music experience recognize emotion, taking into consideration both the type and amount of music experience.

## Limitations

There were several limitations to my research, the most prominent of them being my study population. Unfortunately, due to the resources I had available, I was only able to promote and conduct my study with people within my school. So the population of my study included the music educators and musicians within my high school. While this did still result in a variety of amount and type of music experience, there could potentially be a bias in how people rank emotion. Another limitation I had was the data I had access to from the previous research in Eerola and Vuoskoski. From the data collected from their ranking of emotions, I only had access to the averages from the general public- I had no standard deviations. So, in my data analysis I used my standard deviation to account for both sets in the t-test. There is unlikely to be much variability in the results due to this, but my analysis could still be more accurate if I had access to this previous data. Finally, I was also limited in the clips of music I presented within my study. In Eerola and Vuoskoski's research, they utilized over 110 clips of music, but this was not practical for the smaller study I conducted within my school. So, I only chose 10 clips with varying emotional ratings to represent the whole. There is a possibility that if I had chosen different clips, the results of my analysis could be different, although this is unlikely.

## Future Research

These limitations present some important possible future research regarding this topic. To validate my conclusions, research should be conducted to include a much wider population of musicians. This range should include all ages and all types of music experience, particularly including music composition since there were not enough survey participants in my study with music composition experience to be studied individually. Additionally, future research should use more clips of music to compare between populations to get more accurate data comparison. In addition to emotion, it would be interesting in future research to investigate how music experience can affect other recognition aspects in music, such as the ability to determine a composer's motifs and themes within a piece of music. There are many ways in which music experience can affect recognition, and in each case it's worth investigating.

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