# The Effects of Different Genres of Music on Tics in Tourette's Syndrome Subjects

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Studies on music and music therapy have shown a variety of effects on humans, both mentally and physically. There have been a multitude of studies evaluating how music can influence a variety of mental and physical disorders. Tourette's Syndrome (TS) is a mental disorder that has been shown to be strongly affected by music. The primary symptoms of TS are tics, which are involuntary physical or verbal movements. This study examines how different genres of music can have an effect on tics in Tourette's Syndrome subjects. There were a total of 7 participants in this study, each listening to 4 different genres of music, with and without earphones. A series of variables were analyzed including music genres, musical preferences, emotions, use of earphones, and tics. The results demonstrate that a subject's personal preference and opinion of the music has a larger effect rather than specific music genres themselves. They also show the correlation that emotions can have to tics as well as the change in intensity with the use of music. This study was an online study performed and created after the COVID-19 pandemic, helping to continue Tourette's Syndrome research, even in an online or remote setting.

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## Introduction

Tourette Syndrome (TS) is a neuropsychiatric disorder with the predominant symptom of tics. Tics are sudden, involuntary movements that are difficult or impossible to control. The two types of tics in the human body are motor (physical body movements) and vocal tics (American Psychiatric Association, 2013). TS is common in children between ages 2-15 and symptoms for it usually begin to appear around the age of 6. It is stated to be a lifelong disorder, although most patients' symptoms tend to reduce by adulthood (Cavanna, 2010).

There are several medical conditions associated with tics, depending on the types of tics present and the duration of them. People with Chronic Motor or Chronic Vocal Tic Disorder have either motor *or* vocal tics and have symptoms for at least a year; people with Provisional Tic Disorder *may* have a mixture of motor and vocal tics, but only for less than a year. Tourette Syndrome is characterized as having multiple motor and vocal tics for longer than one year (American Psychiatric Association, 2013). Approximately 90% of people with TS also have comorbid psychiatric disorders, meaning that most patients with TS frequently have multiple other mental disorders, such as ADHD, OCD, and anxiety (Quast, 2019).

From the Yale Global Tic Severity Scale (YGTSS), tics can be measured in several ways, such as the number of them, their frequency, intensity, complexity, or their interference in daily life. The YGTSS uses a 6-point scale from 0-5 (Leckman, 1989). Past studies have shown that various emotions can change the intensity or frequency of tics (Bhikram, 2020). For example, a person with TS might report a greater frequency in tics while feeling angry, upset, or anxious. It's also been revealed that music is able to induce and alter people's emotions (Cook, 2019). A previous study regarding music therapy and its effect on mood showed that there were significant improvements in emotions and other mental disorders when testing them with several music-based

interventions (Devlin, 2019). When looking at the effect of music on tics directly, research has shown controversial results mostly due to differences in various factors, such as the testing environment or method of music administration. The best outcome resulted when the subject wore headphones in order to listen to the music, as this environment decreased both the intensity and frequency of tics. This was shown to be most effective because the headphones isolate the subject from their surroundings, so they may be able to focus on the music more than usual (Scataglini, 2017). Another study has shown that several types of musical activities, such as listening to music, playing an instrument, or singing, can reduce the frequency of tics as well. Through that study, several factors that play into tics while listening to music were discovered such as soft, calming, or familiar music as well as how the listener feels at the time (Bodeck, 2015). Despite the growing amount of research on music and its effect on tics, there is a gap in knowledge regarding how diverse genres of music may affect the frequency of tics.

**Purpose and Hypothesis**

Knowing the correlation between music and emotions as well as emotions and tics, it can be assumed that the correlation between music and tics will have a relation to emotions too. The purpose of this study is to understand the effect of various genres of music on tics. It is hypothesized that music that correlates with more heightened and negative emotions will increase tics whereas music that correlates with more reduced and positive emotions will reduce tics.

## Methodology

### *Music*

Four different types of music were chosen to represent four general types of emotions: classical, pop, rap/hip-hop, and heavy metal. Each genre was aligned to represent a specific emotion: calmness, joy, energy, and anger, respectively. The emotions were chosen from each range that was meant to be tested, including heightened, reduced, positive, and negative emotions. Preferences for certain types of music have also been shown to be correlated based on age. The causation of this could be because your preferences are usually related to the music you grow up with and listen to (Cook, 2019). For example, adults may have more of a preference towards 90's rock whereas teenagers would be more interested in rap and pop because it is what each age group grew up listening to. For this reason, this study focused on adolescents in the United States. One song per genre was chosen for this experiment prior to the start of the experiment by researching the most popular songs within each genre category at the time of November 2021. The criteria for the songs will be a 4/4 time signature to increase consistency and reduce the possibility of extraneous factors to consider.

### *Subjects*

Volunteers were collected through Tourette Syndrome organizations, social media, and public information. Before the experiment began, informed consent forms were sent to the subject and signed. Ethical approval was also obtained. Subjects were asked to fill out a Google Form with demographic information, history about their Tourette' Syndrome, and questions regarding their music preferences. General TS questions were asked as well as questions from the Yale Global Tic

Severity scale (Leckman, 1989). Each subject was asked to rate each genre of music on a scale of 1-7, 1 being dislike strongly and 7 being like strongly.

*Equipment*

The experiment was conducted online through a Zoom meeting. The videotape protocol consisted of 10 tests for about 2.5 minutes each (Goetz, 1999). The subjects were asked to be in a room with reduced distractions and asked to sit in front of the camera so their body was visible from the waist up. During each test, the experimenter turned off their camera and muted their microphone during the baselines to decrease distractions.

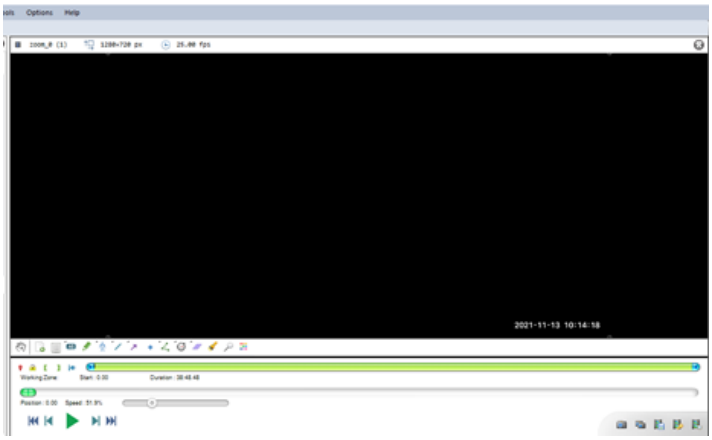
*Procedures*

For the first five tests, the subjects were asked to use earphones and were tested in the order of no music, classical, pop, rap/hip-hop, and heavy metal. The classical song chosen was “Spring in E Major” by Antonio Vivaldi, the pop song was “Stay” by Justin Bieber, the rap/hip-hop song was “Industry Baby” by Lil Nas X, and the heavy metal song was “Seek and Destroy” by Metallica. After each test, each subject filled out a survey on how they believed their tics were affected during the test with the question “did your tics increase, decrease, or stay the same?” Questions regarding their current state of emotions and feelings were also included. Questions were taken from the Self-Evaluation Questionnaire STAI-CH and asked “On a scale of 1-4, which phrases accurately describe how you currently feel” for the following emotions: happy, excited, calm, upset, nervous, and scared (Spielberger, 1977). Afterward, all five tests were repeated without earphones and without the excess survey in between; the no music test was conducted at the end.

*Analysis*

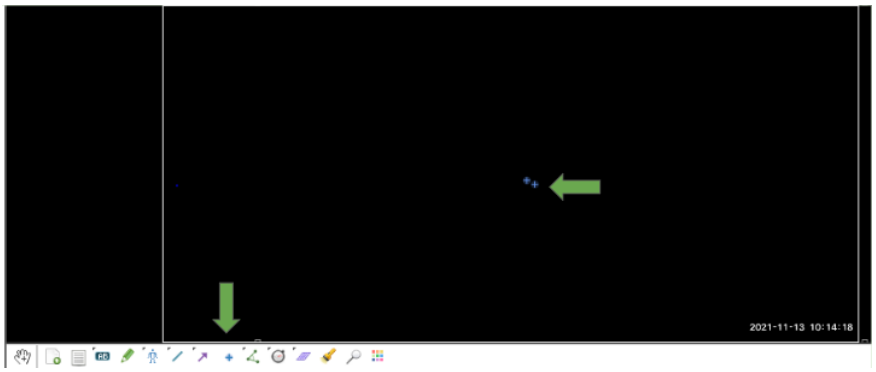
All of the Zoom meetings were videotaped in order to analyze after the experiment. Each test was cut into 2.5 minute videos and were analyzed individually. The Zoom videos were analyzed using Kinovea Software (Figure 1) in order to calculate the number and intensity of tics and for each video test.

**Figure 1**. Kinovea Software



The software allows you to insert marker points on a video and is inserted as the video progresses (Figure 2). We played the video several times, looking for indications of motor tics in the videos. Every time a motor tic was visually detected, a marker was added and the markers were exported out to be analyzed. Each marker was assigned a number for its presumed severity on a scale of 1-5 (Leckman, 1989).

**Figure 2.** Use of Kinovea Markers



Text can be added to markers and points in the video as well to detect the intensity of each tic. Additionally, the speed of the video can be accelerated or decelerated to

make the process easier. Each of the videos was individually analyzed and the data was compiled into Google Sheets. The number of tics for each video was taken and each specific number of intensity of tics was recorded as well. Once all of the data was taken and analyzed, we compared subjects' musical preferences to how each of their own tics were affected and also looked at the percent change of each intensity of tics. We looked to see if there was a difference with and without earphones and how each music genre compared to the baseline as well.

**Results**

There were a total of 7 subjects in this study, including 4 females, 1 male, 1 trans-man, and 1 non-binary subject. Their ages had an average of about 16.286 years (SD = 1.799). From the demographic information that was collected, it was revealed that 6 of the participants were white and 1 was hispanic/latino(a). Three subjects were from the northeast and the other four from different parts of the US, including Southeast, West, Midwest, and Southwest.

Through the analyses, the data compiled consisted of the number of motor tics, as well as the number of each intensity of tics, on a scale of 1-5 . First, the number of tics were analyzed for all 10 tests (Table 1) and compared against the no music test (Table 2).

**Table 1.** Total Motor Tics Data Chart

| | **Subject 1** | **Subject 2** | **Subject 3** | **Subject 4** | **Subject 5** | **Subject 6** | **Subject 7** | **Average** |
|---|---|---|---|---|---|---|---|---|
| **No Music (before)** | 68 | 61 | 45 | 41 | 31 | 43 | 57 | 49.43 |
| **Classical (e)** | 44 | 54 | 40 | 37 | 29 | 37 | 51 | 41.71 |
| **Pop (e)** | 47 | 38 | 41 | 35 | 24 | 31 | 43 | 37.00 |
| **Rap (e)** | 40 | 50 | 43 | 34 | 27 | 25 | 49 | 38.29 |
| **Heavy Metal (e)** | 48 | 46 | 51 | 29 | 33 | 35 | 55 | 42.43 |
| **Classical** | 49 | 57 | 36 | 39 | 35 | 36 | 54 | 43.71 |
| **Pop** | 40 | 42 | 32 | 33 | 28 | 30 | 46 | 35.86 |
| **Rap** | 50 | 54 | 34 | 36 | 28 | 27 | 44 | 39.00 |
| **Heavy Metal** | 43 | 51 | 42 | 32 | 32 | 37 | 57 | 42.00 |
| **No Music (after)** | 47 | 58 | 39 | 36 | 29 | 40 | 48 | 42.43 |

**Table 2.** Percentage of Motor Tics Data Chart

| | **Subject 1** | **Subject 2** | **Subject 3** | **Subject 4** | **Subject 5** | **Subject 6** | **Subject 7** | **Average** |
|---|---|---|---|---|---|---|---|---|
| **No Music (before)** | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| **Classical (e)** | 64.71% | 88.52% | 88.89% | 90.24% | 93.55% | 86.05% | 89.47% | 85.92% |
| **Pop (e)** | 69.12% | 62.30% | 91.11% | 85.37% | 77.42% | 72.09% | 92.98% | 78.63% |
| **Rap (e)** | 58.82% | 81.97% | 95.56% | 82.93% | 87.10% | 58.14% | 85.96% | 78.64% |
| **Heavy Metal (e)** | 70.59% | 75.41% | 113.33% | 70.73% | 106.45% | 81.40% | 96.49% | 87.77% |
| **Classical** | 72.06% | 93.44% | 80.00% | 95.12% | 112.90% | 83.72% | 94.74% | 90.28% |
| **Pop** | 58.82% | 68.85% | 71.11% | 80.49% | 90.32% | 69.77% | 80.70% | 74.30% |
| **Rap** | 73.53% | 88.52% | 75.56% | 87.80% | 90.32% | 62.79% | 77.19% | 79.39% |
| **Heavy Metal** | 63.24% | 83.61% | 93.33% | 78.05% | 103.23% | 86.05% | 100.00% | 86.79% |
| **No Music (after)** | 69.12% | 95.08% | 86.67% | 87.80% | 93.55% | 93.02% | 84.21% | 87.06% |

After the first no music test, all of the tics had a drastic decrease in the number of tics. The average decrease of tics was 12.94% (range: 4.92-30.88%) between the two no music tests. The most significant decrease from the first no music test occurred during pop music, with and without earphones. An average of a 21.37% decrease with earphones and 25.7% decrease without earphones was observed.

Then, the data was analyzed to see if there was a significant effect with and without earphones. Each music genre was within a 9.72-25.7% decrease for the tests with and without earphones. There was no statistical significance found with the use or lack of earphones. Classical and rap music had a larger decrease with the use of earphones, while pop and heavy metal had a larger decrease without earphones.

We looked at how each specific music genre as well as subjects' musical preferences affected the total number of tics. The data was organized into graphs to compare the trendlines of how the overall genres can affect tics. When the data was organized by music genres, the trendlines show that there are no significant patterns or trends within the data (Figure 3). However, when the data is changed to be organized based on each subject's musical preference, there is a significant positive correlation between the two variables (Figure 4).

**Figure 3.** Music Genres; Number of Tics Line Graph

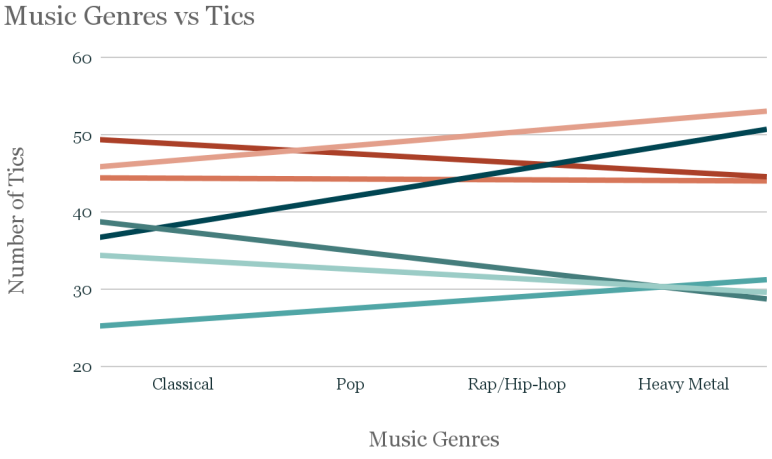
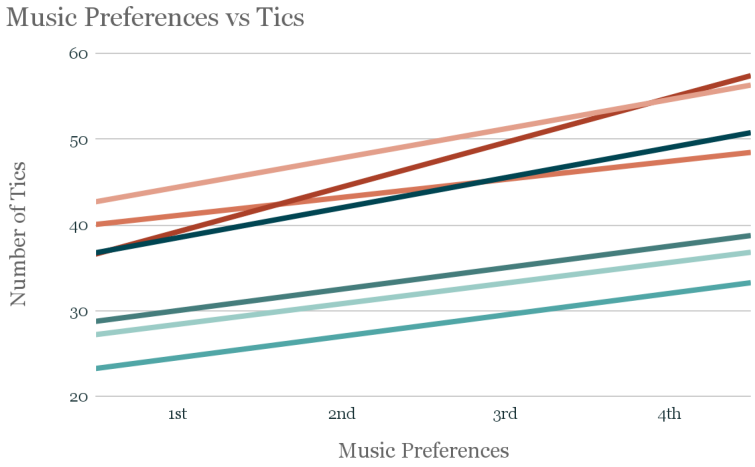


**Figure 4.** Music Preferences; Number of Tics Line Graph




Each tic detected was given an intensity number on a 1-5 scale. The percent change of each intensity of tics during each test was analyzed. (Table 3).

**Table 3.** Average Tic Intensities Data Chart

| ***Genres*** | **No Music (before)** | **Classical (e)** | **Pop (e)** | **Rap (e)** | **Heavy Metal (e)** |
|---|---|---|---|---|---|
| **# of 1** | 36.69% | 38.84% | 33.85% | 33.21% | 33.30% |
| **# of 2** | 23.86% | 25.43% | 24.69% | 24.28% | 28.08% |
| **# of 3** | 20.62% | 19.53% | 25.24% | 27.89% | 29.22% |
| **# of 4** | 14.86% | 12.29% | 15.09% | 14.62% | 9.48% |
| **# of 5** | 5.61% | 3.49% | 0.00% | 0.00% | 0.33% |
| | | | | | |
| ***Genres*** | **Classical** | **Pop** | **Rap** | **Heavy Metal** | **No Music (after)** |
| **# of 1** | 32.81% | 35.91% | 33.39% | 35.51% | 35.54% |
| **# of 2** | 27.18% | 27.83% | 26.78% | 30.47% | 25.77% |
| **# of 3** | 25.53% | 22.27% | 29.93% | 26.94% | 27.66% |
| **# of 4** | 13.92% | 11.22% | 8.33% | 6.07% | 9.69% |
| **# of 5** | 0.56% | 1.15% | 0.43% | 0.51% | 1.04% |

The fluctuation in the percentage of tics is displayed in Figure 5 and Figure 6. The intensity of 5 tics has a major decrease with music and the second no music test.

**Figure 5.** Music Genres; Percentages of Tic Intensities Bar Graph (earphones)

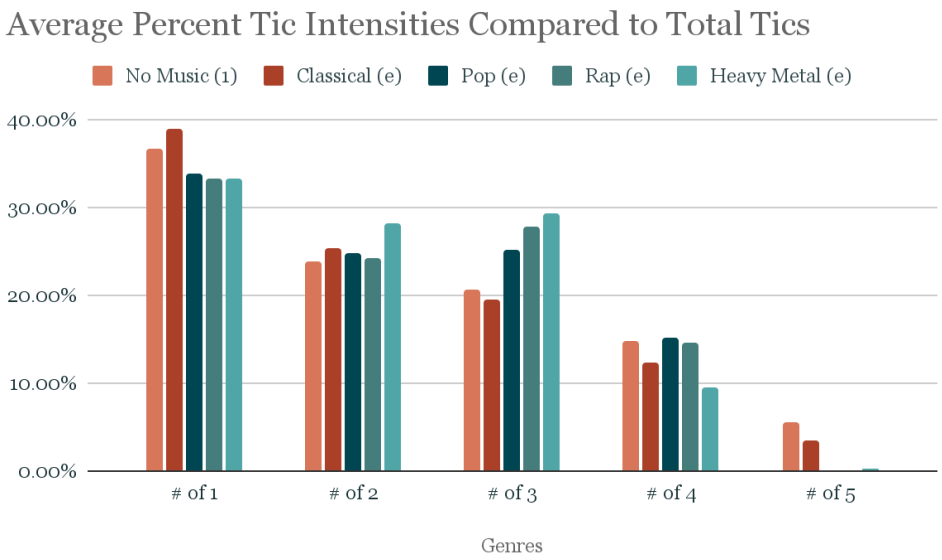
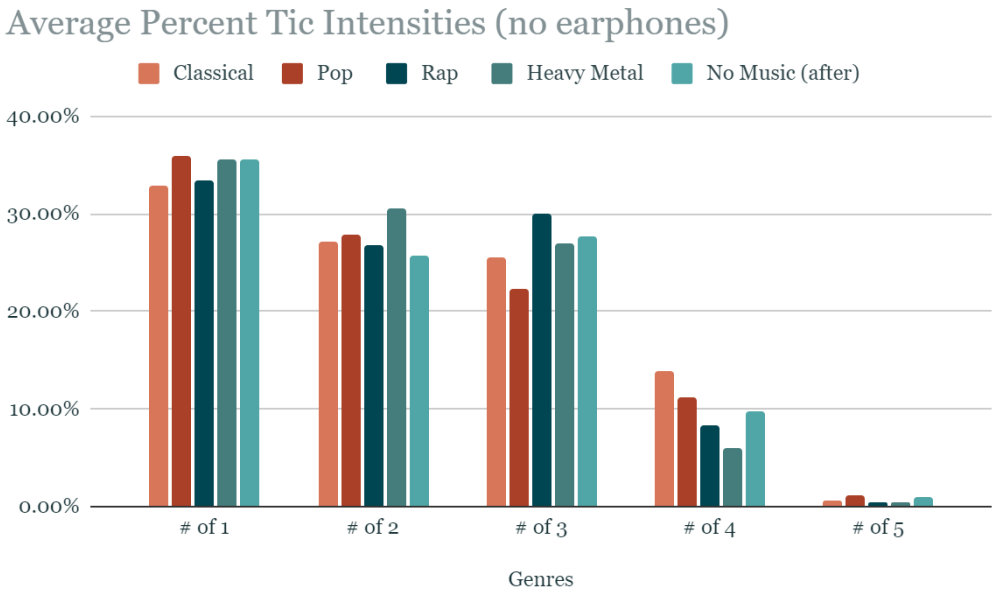



**Figure 6.** Music Genres; Percentages of Tic Intensities Bar Graph (no earphones)



Intensity 3 and 4 tics vary based on the music genre, and intensity 1 and 2 tics stay fairly constant throughout each test. The graphs show the difference in intensity 5 tics, with spikes during the no music tests and the classical music with earphones.

**Discussion**

Music has shown to have a prominent decrease in the number of tics. There was no trend found between specific genres of music, meaning that no one genre will definitely reduce tics the most. This could be due to other musical factors, such as pitch, where pop music is known to have higher and sharper pitches compared to the other music genres. However, the significant difference between the two no music tests represents a short-term effect of music on tics.

There was no statistically significant difference between the earphones and no earphones tests. The repetition of the same song in a short manner of time may also affect whether the music will have the same impact as it did during the original listening, leading to the changes in the subject's reactions during each test.

Personal music preference seems to also have an impact on the tic variation. The most significant decrease of tics occurred during pop music, which correlates as 57% of the subjects' most preferred music preference was pop. Pop music, the more positively emotional music genre, didn't show any significant trend lines when looked at.

Throughout the entirety of the experiment, a significant difference was found within the number of intensity 4 and 5 tics. Lower intensity tics decreased as well, but continued to occur more steadily than high intensity tics. Intensity 1, 2, and 3 tics were around the same percentages throughout the experiment, being at least one-fifth of the tics in almost every test. This reveals positive results in the continuous decrease of tics. This decrease corroborates with the idea that music helps relieve high intensity tics and suppresses the general intensity itself.

The hypothesis of this experiment was that music genres correlated with more heightened and negative emotions will increase tics and music genres correlated with more reduced and positive emotions will reduce tics. The results of the study show that the hypothesis was partially supported. The different music genres have a significant effect on tics, however the extent of their effect is based on the subject's preference rather than the music genres themselves. The data shows that the effect on tics is not genre specific.

The small experimental group can affect the accuracy of the data. Limitations to this study include the inaccuracy of tic detection. The intensity is labeled based on personal perception, which can vary from person to person. This can be redeemed with multiple people analyzing the videos, including experts in the field, and comparing the data from each experimenter. There are also limitations associated with an online test. There are several uncontrollable variables in an online experiment, including the output of music to the subjects as well as the devices used for the tests.

**Conclusion**

The inconsistencies in the data may be caused by the several other factors related to music as well as emotions that are still to be studied and further explored. Identifying which causations are music related and which are emotion related will be vital to understanding more about this area of study.

Future research would be to continue this experiment with a larger sample size and broader population and see the significance as well as focus on various musical factors, such as tempo, pitch, rhythm, etc. Future studies can also test how different musical activities, such as dancing, playing an instrument, and listening to music, can affect mood and emotions.

This case study was able to confirm the ability to test and research TS in a digital health aspect. Due to the COVID-19 pandemic, it was difficult to continue many research studies during the time. This experiment helps solidify another possibility of continuing research on TS for future occurrences.

Music has a very prominent effect on several factors, including mood, emotions, and mental disorders. Medically, it can help reduce generic symptoms as well as create a more positive or encouraging environment. Tourette's Syndrome continues to be a well-known disorder that is continually researched. Its symptoms have been shown to be severely reduced as a result of music and music therapy. Studying more into how various factors of music as well as types of musical activities would contribute to the research of Tourette's Syndrome as well as help patients in daily life.

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