Music and Perceived Time

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(Dated: July 25, 2024)

There is a common expression that states "Time flies when you're having fun". The truth in this statement may yet need to be discovered as the attempted validation of this phrase using synthesized moods by means of music did not produce convincing results in either direction. Music is known to influence moods, however, a very strong correlation between perceived time and music tempo negates what correlation may have been relating to time and mood. The data suggests that music tempo directly and significantly impacts time perception, with no significant impact from the mood that the music creates.

The purpose of this experiment is to investigate how music impacts a person's perception of time. The hypothesis driving this experiment is that listening to different music genres will create different moods and that these moods will impact how someone perceives time. This experiment puts the age-old adage "time flies when you're having fun" to the test, and will be done using choice sets of music that are intended to impact mood.

As described in the guidelines for this project [1], all measurements will be done by and on the author, Abigail deGroot. The procedure for this involves creating different moods and taking measurements of perceived time.

The time measurement is taken by starting and stopping a stopwatch without reading the time, attempting to stop at fifteen seconds consistently each time. It is hypothesized that the perceived length of time will be longer or shorter depending on the music genre (or mood) at that time. These genres are from pre-made playlists on *Spotify*. Sample song names for the genres are listed, but the playlist names are not because they often change daily or multiple times daily.

The music is heard through headphones to minimize other sounds. Each genre plays for seven minutes (arbitrary) to create a mood, and measurements are taken while the music is still playing. There should be at least five measurements for each music genre with a one-song buffer (one to three minutes) between each measurement to minimize muscle memory for the length of time. There will be at least three minutes of silence or white noise between genres to allow time for the subject to return to neutral.

Any regular activities may be performed during the seven minutes before the measurements while listening to music which may include other assignments, scheduling, etc. Measurements were taken in a study room (neutral location)

This is analyzed using bar graphs to determine if there are any significant differences between genres.

A control measurement with no music is necessary when the subject is not feeling any particular way.

TABLE I. Time Measurements for Each Genre in Seconds

Genre	(Trial) 1	2	3	4	5	Average	Std.Dev.
Control:	14.95	14.83	14.35	15.03	15.37	14.91	0.37
Upbeat:	11.64	12.14	13.37	12.54	11.43	12.22	0.77
Sad:	21.18	23.24	21.39	22.70	21.38	21.98	0.93
Intense:	11.27	8.53	13.45	11.38	9.76	10.88	1.86
Calm:	18.80	16.04	16.34	17.61	15.03	16.76	1.46

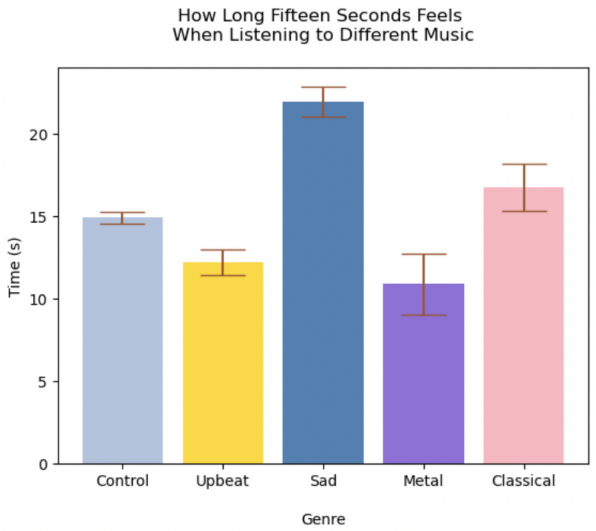

FIG. 1. comparison of how long feels like fifteen seconds feels when listening to different kinds of music with error bars corresponding to standard deviation (from table I)

The theory going into this experiment was that the mood created by the music would be the major influence on the perception of time. What is demonstrated in Figure 1 is that there is a distinct difference in perceived time between the genres.

However, the data in Figures 1 and 2 give a second possible explanation for the differences. While listening

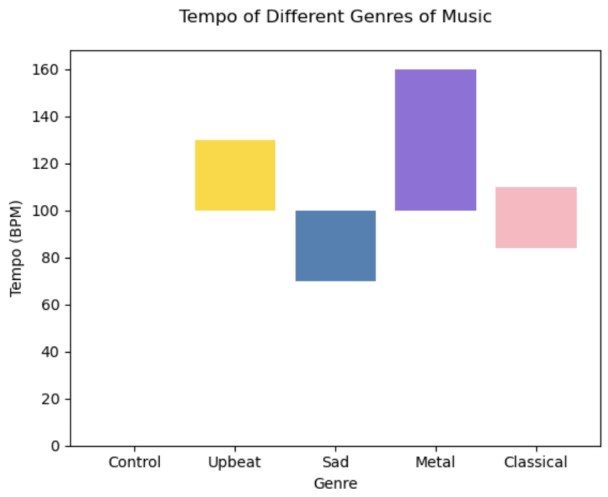

FIG. 2. comparison of tempo ranges for different genres of music (from Table III)

to the different genres, it was noted that each genre has a different tempo range. These ranges can be compared to the variance in time. If the tempo were to cause a change in time perception, we would expect a tempo with a higher rate of beats per minute (bpm) to correspond to a shorter perceived time. This is precisely what Figures 1 and 2 show.

Another interesting element is the correlation between the standard deviation in the perceived time and the range in the standard tempo for the music genre. Upon visual inspection, it is clear that the metal time group has the largest standard deviation, and that the metal group has the largest range of bpm. This makes a very convincing argument that the bpm of the specific song being played directly impacts time perception.

These results indicate that if a relationship between mood and time exists, the mood has a much smaller impact than song tempo. There seems to be a clear and significant correlation between faster tempos and feeling as if time is moving faster. This impact appears not to have effects past the end of a song, as the deviation in bpm and time perception for the metal genre suggests, though more rigorous testing is required to validate that theory.

This experiment raises more questions than answers, as such, there are a few natural next steps building on these results. It would be interesting to have an artist make song mixes featuring a fast tempo and sad themes and slow tempo and very upbeat themes and retake these measurements to see if the results are the same relating to tempo. It also would be a natural progression to test time perception from song to song, to see how quickly the change in perception might occur. Furthermore, removing music and tempo from the equation completely would remove tempo as a variable completely, but would require another way to fabricate emotions. A possible complication in the latter experiment would be the ethics of attempting to produce strong negative emotions in people and the long-term psychological impact that may have on the individual.

The files containing the raw data and code used for the analysis can be found in the dedicated repository on GitHub

This work would not have been possible without the support of Professor J. D. D. Martin and the Department of Physics and Astronomy at the University of Waterloo. An additional thank you to the Flock Stop for fuelling my study sessions with a delicious 1:1 ratio of English toffee cappuccino to medium roast coffee for only $1.85 a cup.

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[1] J. D. D. Martin.
[2] M. Biss, Rhythm tips for identifying music genres by ear.

TABLE II. Qualitative observations for each genre, noted during the experiment.

Genre/mood	**Qualitative Observations**	**Possible External Influence**
Control	Thinking about the egg sandwich I was going to get after I took this measurement	Hungry; Not used to doing the experiment yet
Happy/Upbeat	I was bobbing along with the music almost immediately	Eating a delicious egg sandwich
Sad	I did not cry as promised by the title of the playlist; Some songs gave me chills; fun to sing along to	This is one of my preferred genres for daily life
Angry/intense/metal	I got a headache	Filling my schedule while listening; Metal isn't to my taste
Calm/Classical	Listening to this feels like getting a brain massage; really felt calm	

TABLE III. Sample songs for each genre, accessible on *Spotify*.

Genre	Song and Artist	Average Tempo (BPM)[2]
upbeat/pop:	Everybody Talks, Neon Trees; Tongue Tied, GROUPLOVE; Hey Ya!, Outkast	100-130
moody/soul:	listen before i go, Billie Eilish; Train Wreck, James Arthur; Supermarket Flowers, Ed Sheeran	70-100
metal:	Brackish, Kittie; Break Stuff, Limp Bizkit, Wait and Bleed, Slipknot	100-160
Classical:	Adieux, Ludovico Einaudi; Fracture, Stephan Moccio; Suite Bergamasque, L.75:III. Clair de lune, Claude Debussy, Alice Sara Ott	112-120