The Effects of Music Genre on Memory Recall

Name

Florida Institute of Technology Spring 2015

Abstract

Background music has been determined to have constructive, detrimental, or no effect at all on human behavior and cognitive processes. This report is an analysis of previous research on the topic of the effects of music on cognitive processes, especially working memory. Our research was conducted on the effects of 5 different music genres, to include a baseline group, on working memory recall. In our analysis, we identified that there is a scarcity of research published on this particular topic. We were able to identify related research such as: A comparison of studies in which reading performance was measured with and without music; a study in which participants listened to classical music, relaxation nature sounds, or silence while being measured on spatial reasoning ability; and a study in which participant performed 11 different memory tasks to try to establish links between working memory, short term memory and general fluid intelligence. We hope that our unique approach to the topic of working memory recall and music genre will identify significant differences between the main effects of the different music genres on controlled attention. The researchers argue that music that is more dense with vocals will have the most detrimental effect on working memory recall, in the case of mathematic computation.

Keywords: music, memory recall, working memory, genre, controlled attention

The Effects of Music Genre on Memory Recall and Controlled Attention

Background music has been determined to have constructive, detrimental, or no effect at all on human behavior and cognitive processes. A topic studied much longer than the United States of America has been a country, the effects of music on cognitive processes, especially working memory. The ease of access to technology has affected the way that students study and do homework, people ride on elevators, the lens through which we as a species experience the world as we know it. In many parts of the world, including third world countries, the daily activities of human beings are accompanied by a symphony of lyrical tempos; each movement stimulating in a different way, pleasing to our individual palates on a unique level which is difficult to replicate in a controlled laboratory environment. It's changing the way we learn, the ways in which we transition from adolescence into young adulthood. Are young adults in 2015 a different breed when it comes to their approaches to problem solving and their ability to concentrate? Perhaps music changes and stretches plasticity in the brain, to withstand the ever-increasing demands to multitask and pay attention that is relevant to students in our present day. Everyone is always doing everything; multitasking, emailing, texting, posting to social media, reading, learning from all types technological stimuli, listening to music. Most American teenagers in 2015 do not remember ever having a landline home phone, may remember when phones did not have the internal storage capacity to store music, but likely do not remember having a phone that did not have a camera. Music is readily available to the student with a stroke of a key on a smartphone, the press of a button on an ipod, or perhaps a swipe on an Android. Our world is inundated with music, but what effect might it have on working memory? The study of the effects of music on cognition is a legacy topic in experimental psychology studies.

Working Memory is largely affected on an individual level by one's capacity for working memory for a particular area of processes, also referred to as fluid intelligence. Engle, Tuholski, Laughlin, and Conway conducted a study which showed compelling evidence that working memory, specifically the central executive or controlled-attention component of, drives a particularly strong relationship with fluid intelligence (Engle et al., 2009, 328). It would then be logical to think that working memory using recall, that is, using memory recall of common knowledge to critically solve problems, is also related to fluid intelligence. Aside from fluid intelligence, working memory task is a high-order functioning component that is essential to controlled attention (Engle et. al, 1999). Controlled attention can be thought of as one's capacity to divide, sustain or switch attention between different tasks involved in controlled attention, these tasks can be considered reading span and operation span. Reading span can be thought of as a processing operation, reading sentences, or solving an arithmetic computation, where the operation span can be thought of as a storage process, such as memorizing word or numbers (Engle et al., 1999). A study done by Conway and Engle attempted to look at the processing demands of the span task, by reasoning that if the working memory measure and reading comprehension is a result of a trade-off between storage and processing components (Engle et. al., 1999). The results of that particular study showed that when presented with more difficult high-span processing tasks, the subjects performed better and were able to block out interference of visual interference better than those performing low-span tasks (Engle et al., 1999). Furthermore, they concluded that interference and attention-switching tasks were most detrimentally affected by simultaneous working memory-load (Engle et al., 1999). For the purposes of these researchers, we will be looking at implementing background music as an

interference, with a simultaneous divided attention requirement in the form of an arithmetic computation measure. Based on the supporting research and logical connections, the researchers hypothesize that the genre of music that is most dense with lyrics, will have the most detrimental effect on performance of the arithmetic computation measure. Furthermore, we hypothesize that classical music and white noise, respectively, will have the highest rates of completion and accuracy. It is also the opinion of the researcher that hip-hop, because it is typically a lyrically dense genre, will have the most detrimental effects on performance of the arithmetic computation measure.

Background

Working memory is a central element to complex thought, such as reasoning, problem solving, and language comprehension (Just, 1992). Modern concepts of working memory replace previous notions of short-term memory as merely storage, to offer a more complete understanding of the processes that are involved in understanding contextual implications for reasoning and problem solving a particular task. One example of this is computation, operations such as comparison, retrieval, logical and numerical operations (Just, 1992). For the purposes of this study, the arithmetic computation measure that we will implement will measure speed and accuracy, and is based on a fourth-grade level standards in the United States. Universally, music is characterized by eight perceptual attributes, or dimensions, each of which can be varied independently: pitch, rhythm, timbre, tempo, meter, contour, loudness, and spatial location (Levitin 1999; Pierce 1983). We hope to replicate manipulations of these attributes by choosing different genres of music, characterized by the use of the different dimension of music.

Method

Participants

Florida Institute of Technology instructors and teaching assistants from the Psychology department approved the study, and informed consent was obtained from each participant. Ninety-six undergraduate students from all five colleges on the main campus, including the college of aeronautics, business, engineering, psychology & liberal arts, and the college of science, were represented in this convenience sample. This convenience sample was comprised of 67.7% males and 32.3% females, ages ranging between 17 and 38 years (mean = 21.06, SD = 0.88). The year levels for the undergraduate students represented in this sample include 43.8% Sophomores, 28.1% Juniors, 22.9% Seniors, and 5.2% Freshmen. The sample representation was 17.7% from the college of aeronautics, 16.7% from the college of business, 32.3% from the college of engineering, 20.8% from the college of psychology & liberal arts, and 12.5% from the college of science. Although a convenience sample, the participants were all volunteers, and no compensation was provided.

Measures

There was one condition used in this study, background, of which there were six levels. Those levels were rock music, country music, hip hop music, classical music, white noise, and absence of music. The participants were presented with a math worksheet (See Appendix A), which they completed during a 1 minute duration, in which they experienced one of the 6 levels of the background condition. The participants were asked to complete as many computations as possible, with the highest level of accuracy possible. Demographic questions were on a second sheet of paper, and asked participants for their age, gender, major, year in school, and whether or not they listen to the music that was played during the experiment.

Procedure

Materials used in the conduct of the research experiment include 5 songs, each lasting 1 minute: Rock, “Smells Like Teen Spirit” by Nirvana; Country, “Cruise” by Florida Georgia Line; Hip-Hop, “Thrift Shop” by Macklemore; Classical, “Flight of the Bumblebee” by Nikolai Rimsky-Korsakov; White noise, sound clip. The songs were cut using online audio cutter, and the most recognizable portion of the songs were used to prevent undue distraction. The demographics form, which included inquiry for age, gender, school year, major, and if they listened to the music being played. The consent form, which outlined anonymity in the experiment, possible risks and benefits, and that the experiment was voluntary. A 4th grade level math worksheet including 42 arithmetic computations, consisting of an equal number of addition, subtraction, division, and multiplication. The problems on the math sheet were not numbered, to allow participants to complete whichever problems they most prefer. Experimenters dressed in professional attire and coordinated with Humanities professors to utilize 6 of their classes as convenience samples. The experiment was conducted during the first 10 minutes of the respective class start time. There were six different conditions during the experiment: Rock, Country, Hip Hop, Classical, White Noise, and a control group in which there was an absence of music. Each class was tested under a different condition to prevent exposure effects. The procedure for the experiment was as follows:

1) Queued music file onto classroom computer system.
2) Passed out consent form and verbally explained what was written on the form.
3) After consent form was signed, we passed out the math sheet upside down, with demographics sheet underneath.

4) Explained to subjects they will have 1 minute to complete as many math problems as they can in any order they want. Explained that they are to start when the music begins and stop and flip the sheet over when the music stops. For the control group, the experimenter simply instructed the group to start and stop after one minute had elapsed.
5) Observed participants for compliance with experimental procedures and checked for cheating.
6) Once time was up, we asked subjects to fill out the demographics form, and collected all experimental materials.
7) Once all forms were completed we collected all papers and thanked the subjects and instructor.

All participants in the experiment were voluntary, and were well-informed that they could discontinue participation in the experiment at any time. All participants were informed that results were completely confidential. After the data collection, the experimenters studied the worksheets and calculated the raw data. The information, including the demographics information, was entered the data into SPSS. A test of homogeneity of variance was run, along with a one-way ANOVA between-groups analysis of variance test to determine the impact of the music genre on working memory, and also a comparison of speed of computations and accuracy of the answers.

Prior to running the experiment in these classes, the researchers conducted a pilot study to test the measure and procedures. A pilot study was conducted in a psychology department class, using the same methodology previously discussed. It was found from this group that the

math problems were too complex and there were too many on a page making it hard to read. From this we altered the math sheet to facilitate higher variability.

Results

A one-way between subjects ANOVA was conducted to compare the effect of music genre on working memory tasks by assessing performance on a 4th grade level arithmetic measure, with both the number of problems answered and the number of problems correct. Participants were divided into 6 groups because 6 different classes were sampled (Group 1: Classical music, Group 2: Country music, Group 3: Hip Hop music, Group 4: Rock Music, Group 5: White Noise, and Group 6: no music). There was a significant effect for music genre on the number of problems answered at the $p<.05$ level for the background condition [$F(5, 94)=2.61$, $p = 0.03$]. Post-hoc analysis reveals that there was a significant effect for the music genre of hip-hop, which affected the number of problems answered in a detrimental way ($M=5.94$, $SD=4.54$), compared to country ($M=10.07$, $SD=3.44$), classical ($M=9.71$, $SD=3.65$), rock ($M=8.60$, $SD=4.05$), the control ($M=8.60$, $SD=4.30$), and white noise ($M=8.54$, $SD=3.48$). A one-way between subjects ANOVA was conducted to compare the effect of music genre on working memory tasks by assessing performance on a 4th grade level arithmetic measure, with both the number of problems answered and the number of problems correct. There was not a significant effect for music genre on the number of problems correctly answered at the $p<.05$ level for the three conditions [$F(5, 94)=2.01$, $p = 0.06$]. In post hoc analysis, there was a significant difference between the music genre of hip-hop and its effect on the number of questions answered correctly ($M=5.88$, $SD=4.10$), compared to country ($M=9.59$, $SD=3.73$). The genres of classical ($M=9.71$,

SD=3.65), rock (M=8.60, SD=4.05), the control (M=8.60, SD=4.30), and white noise (M=8.54, SD=3.48).

Discussion

After analyzing the data, there was a significant effect on the number of problems that participants were able to complete based on the background condition. When analyzing the mean number of problems completed, the group that experienced the Hip Hop condition was much lower (M=5.94, SD=4.54) compared to the Country condition (M=10.07, SD=3.44). This is related to the previously discussed research, specifically the detrimental effects of working memory task performance with a higher level of distractors, which in this case was a more lyrically dense genre of music. However, there was findings in our research that were contradictory to previous research, and it was surprising that participants exposed to the Classical music condition (M=9.71, SD=3.65) and the White Noise condition (M=8.54, SD=3.48) did not yield the highest rates of response. It should be noted that our study encompassed more varieties of background conditions than the studies conducted in previous research.

The limitations in this study may have impacted the findings in this study. Had there been no limitations, perhaps we would have found more statistically significant results for rate of response, and perhaps would have found statistically significance between the background music conditions and the accuracy of response. The size of the sample, 96 participants divided into 6 groups, which averages to only 16 participants per condition. It should be noted that the group sizes, because they were convenience samples, were not even; with the lowest number of participants per group seen in the control group, which only had 10 participants. If the number of

participants had been even and higher, it could have affected the means, and altered the results of the study overall, and possibly made it more generalizable.

The validity of the study had was limited in the respect that this was solely convenience sampling, which is definitely inferior to random sampling techniques. Aside from the sampling methodology used, the experiment has acceptable validity both internally and externally. That being said, whether condition effects would be similar outside of a classroom environment would require further research. Also, the participants in the study were college students, which limits the study's generalizability to the populous.

There were a small number of participants who gave feedback that it was difficult for them to discern between the addition and division symbols used on the math worksheet. Florida Institute of Technology has a high number of international students, which could have presented complications in respect to this issue. Symbols for division are not standardized internationally, and this could have altered the results.

The researcher's team experienced loss of one of the three researchers during the development of the experiment procedures, which caused a strain on the two remaining experimenters. Because of conflicting class scheduling for the convenience samples, the remaining two researchers were not able to conduct any of the experiment sessions in tandem. This could have had an effect on the data because it is possible that the researchers could have had subtle differences in the way that they conducted the delivery of the background music conditions.

For future studies the researchers would consider repeated measures methodology for this experiment, and possibly administering a survey to measure stress levels during the experiment

as well. If the researchers were to do this type of study again, they would consider developing a digital measure for this experiment, which would be delivered and completed electronically. This may eliminate social pressures and would randomize the genre of music presented to the participants to offer more validity.

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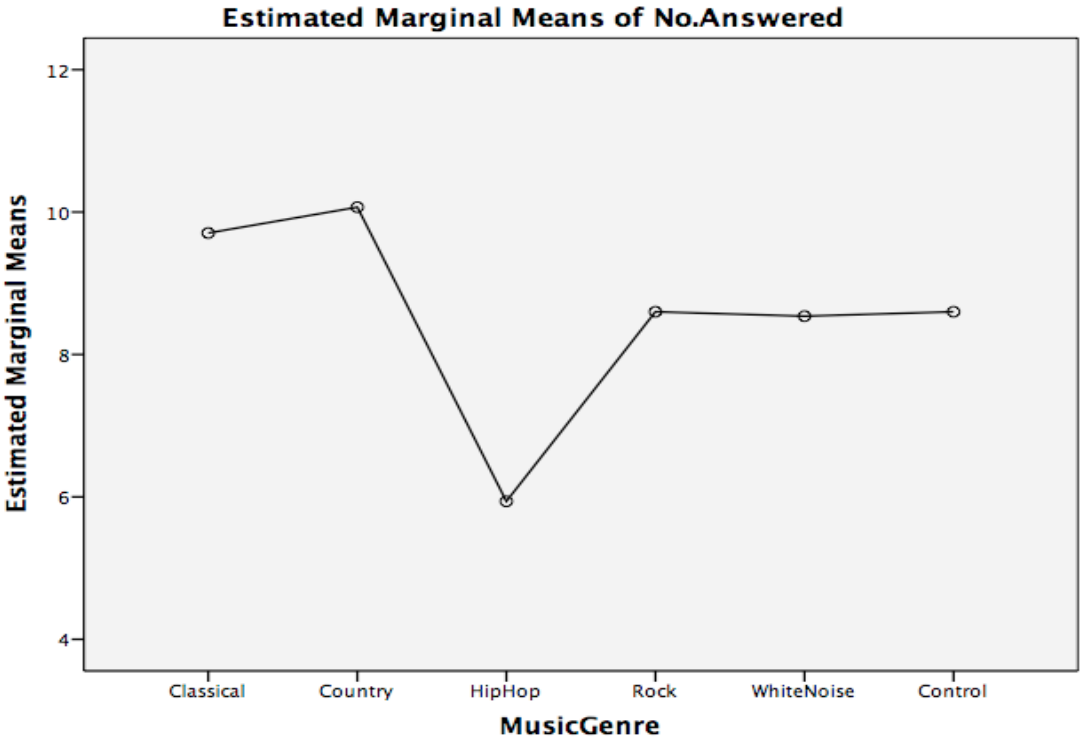
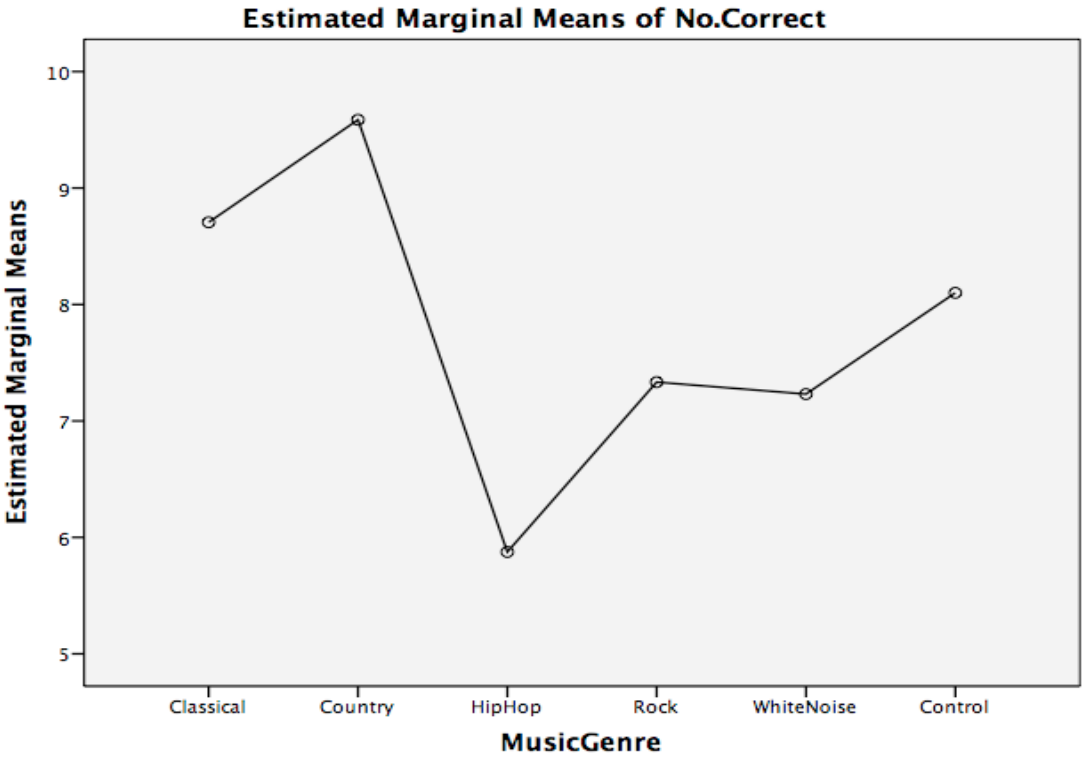
Appendix A

Report			
Music Genre	No.Answered	No.Correct	
Classical	Mean	9.71	8.71
	N	17	17
	Std. Deviation	3.653	4.469
Country	Mean	10.07	9.59
	N	29	29
	Std. Deviation	3.443	3.727
HipHop	Mean	5.94	5.88
	N	16	16
	Std. Deviation	4.538	4.097
Rock	Mean	8.60	7.33
	N	15	15
	Std. Deviation	4.050	3.848
WhiteNoise	Mean	8.54	7.23
	N	13	13
	Std. Deviation	3.479	3.086
Control	Mean	8.60	8.10
	N	10	10
	Std. Deviation	4.300	4.067
Total	Mean	8.78	8.05
	N	100	100
	Std. Deviation	4.007	4.019

Appendix B


Estimated Marginal Means of No.Answered
Estimated Marginal Means
12
10
8
6
4
Classical
Country
HipHop
Rock
WhiteNoise
Control
MusicGenre

Appendix C


Estimated Marginal Means of No.Correct
Estimated Marginal Means
10
9
8
7
6
5
Classical
Country
HipHop
Rock
WhiteNoise
Control
MusicGenre