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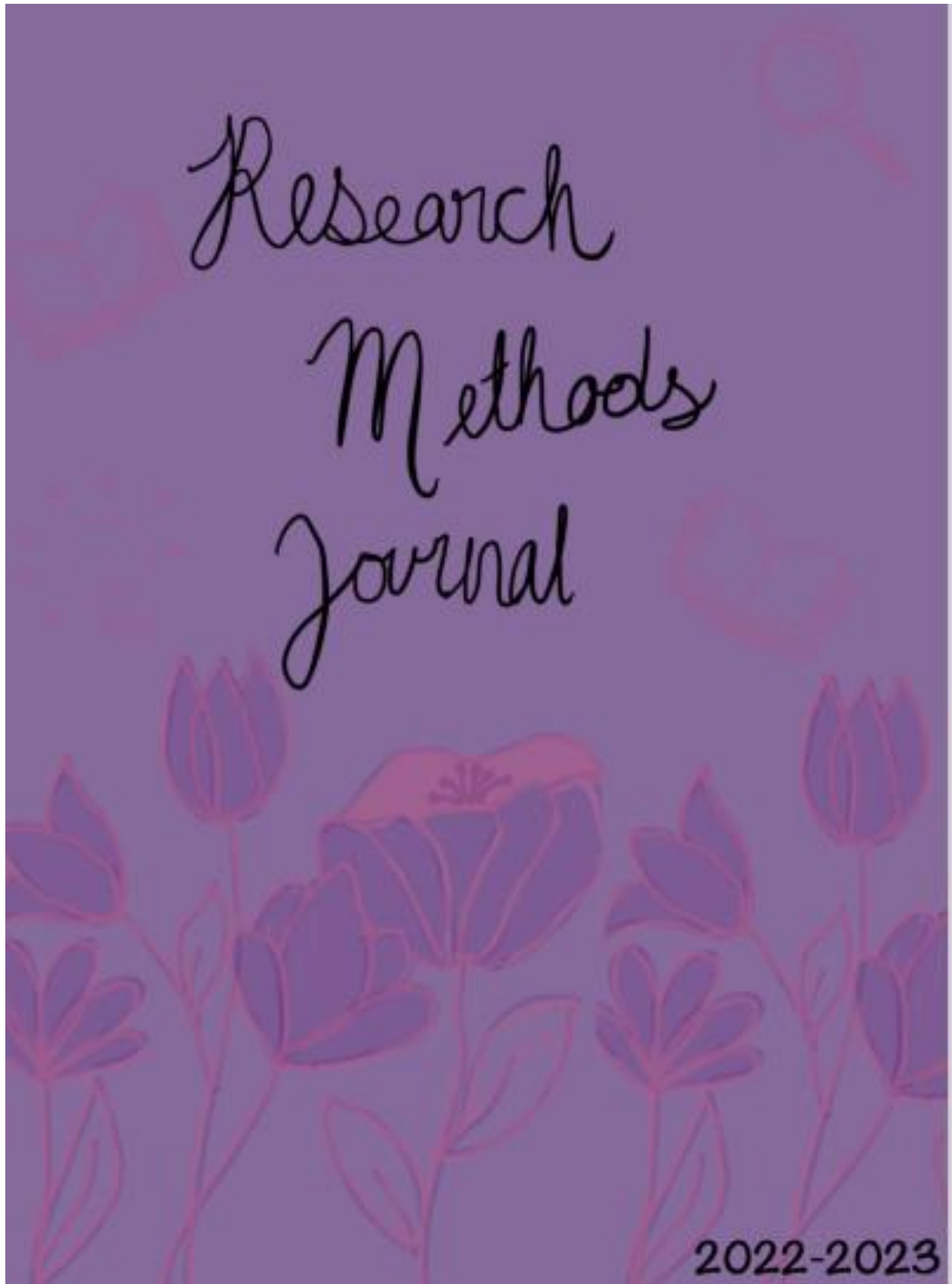
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Prologue*Dr. Michiko Nohara-LeClair*

This issue of the Research Methods Journal contains only two research papers written by two students who worked on their original research projects over two semesters. The journal cover was designed by one of those students, Sydney Beins. Many thanks to Justice Jones, who took on the role of editor for this issue.

Although we no longer offer Advanced Research Methods class due to low enrollment, I hope that our students continue to seek opportunities to conduct independent research. I also hope that this journal continues to serve as an outlet for students' scholarly work moving forward.

Michiko Nohara-LeClair, PhD

Faculty Sponsor

The Effectiveness of Visual vs. Auditory Presentation of Information on Memory

Hannah L. Edwards¹

Purpose: This research project aimed to determine whether it was easier for individuals to memorize and recall words when being presented with a visual presentation than with an auditory presentation. **Method:** To gather data, an online survey was designed and conducted to test participants more sufficiently. This study consisted of individuals that were 18 years or older and who have good visual and auditory abilities. This study was conducted using two lists of 10 words that contained six letters, three syllables, and were nouns. Half of my participants were presented with 10 words visually whereas the other half of the participants were shown the 10 words auditorily. Specifically, half of the participants received List A either visually or auditorily while the other half received List B either visually or auditorily. Each participant only received one list of words during the trial, presented in different ways. After collecting the data, the difference between the two groups of subjects and the number of words correctly recalled were compared using an independent samples *t*-test. **Results:** The analysis then revealed which presentation, visual or auditory, was easier to memorize and recall. **Discussion:** Thus, I hypothesized that it would be more challenging to memorize and recall a list of words when presented auditorily than visually.

Keywords: easier, memorize, recall, presented, visually, auditorily, challenging

The purpose of this study is to better understand whether visual or auditory presentation of information has an effect on an individual's memory. Is it more challenging for an individual to memorize and verbally recall words that are spoken to them or shown visually to them? Various empirical studies have been conducted to identify whether visual or auditory presentation is more challenging to memorize and verbally recall. Heikkilä et al. (2015) investigated the relationship between audiovisual encoding and recognition memory performance. They asked participants to memorize auditory or visual stimuli such as spoken and written words while trying to ignore stimuli presented in the other modality. Kroll et al. (1970)

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on the other hand presented 10 undergraduate students with a single letter of the alphabet to remember while hearing letters being repeated in the background. The participants were asked to first memorize the letter in a 1-s interval when presented both visually and auditorily. This was then proceeded by being asked to memorize the letter in a 25-s interval when presented both visually and auditorily. Both studies have found that it was easier for individuals to verbally recall visual presentations when compared to auditory presentations (Heikkilä et al., 2015 & Kroll et al., 1970).

In another study, Gloede et al. (2017) investigated to see if recognition memory for sounds is indeed inferior to memory for pictures. They proceeded to a total of three experiments to evaluate the role of experience in visual and auditory memory. Participants were first asked to study both pictures and sounds and then take a recognition memory test. Participants were then asked to complete auditory training with each of the sounds that were presented to them and then take a second memory recall test. Gloede et al. (2017) found that even though the participants went through auditory training in each experiment visual memory was superior to auditory memory each time. Overall, this study found that auditory memory and visual memory are different memory systems and that the differences between auditory and visual recognition memory could be due to the different amounts of experience with auditory and visual information (Gloede et al., 2017).

Marian et al. (2021) investigated if environmental sounds vs. spoken words have anything to do with how well humans encode and later recall concurrently presented visual objects. Participants in this study were asked to view a series of drawings while listening to a word or sound that was congruent to that drawing in stages congruent, incongruent, and neutral.

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For example, Marian et al. (2021) presented participants with a drawing of a cat and then proceeded to play a recording that was congruent to that drawing. That is, while being presented with the drawing of a cat, the participants were presented with either a recording of the word “cat” or a recording of a cat meowing. This study found that it was easier for individuals to recall the visual objects when presented with the congruent environmental sound than spoken words. Overall, Marian et al. (2021) showed how cross-modal interaction between visual and auditory input impacts memory retrieval.

Contradictory findings were reported in an empirical study conducted to identify the modality on memory span for words (Drewnowski & Murdock 1980). The study provided evidence which showed that auditory presentation led not only to greater recall of words, but also greater recall of word order given. Drewnowski and Murdock (1980) discovered this evidence by conducting two experiments with 64 college students using both visual and auditory stimuli. They first tested the students using the up-and-down method where half of the participants either started with a larger number of words and slowly descend to a smaller number of words to memorize and recall, while the other half of the participants start with smaller number of words and slowly ascend to a larger number of words to memorize and recall. Drewnowski and Murdock (1980) then proceeded to test the students using constant stimuli where they present the lists in blocks of 30 or 40 at each list length. Drewnowski and Murdock (1980) showed that it was easier for the participants to memorize and recall words using the auditory presentation compared to the visual presentations.

Finally, Kurdi et al. (2017) investigated memory accuracy of word lists using both visual and auditory stimuli presented to their participants. Participants were asked to memorize either 1

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list of words or 10 lists of words either using a visual and auditory presentation or both auditory presentations. The visual and auditory presentation had participants read and listen to the assigned word lists at the same time. For both auditory presentations the participants were asked to listen to assigned lists of words both being played aloud and read to them. Based on those presentations Kurdi et al. (2017) revealed that regardless of the presentation method it was overall easier to recall more words with the 1-list condition with more accuracy than with the 10-list condition.

Many of these studies have found that visual and auditory presentation have an effect on memory, but in different ways. My study is similar as I chose to investigate what effects visual versus auditory presentation of information have on memory. I hypothesized that it is more challenging to memorize and verbally recall words that are spoken than it would be to memorize and verbally recall words that are shown visually. To determine which presentation is more challenging I chose to present each participant with two lists of 10 words once presented visually, and once presented auditorily.

Method

Participants

Research participants for this study consisted of individuals that were 18 years or older and who had good hearing and visual abilities. A total of 53 participants took my study; however, 7 of the participants did not fully complete the survey and 6 of the participants had either a visual or auditory impairment leaving 40 viable participants. Out of the 40 viable participants 31 were women and 9 were men with ages ranging from 18-64. Based off the 40 participants there were 8 freshmen, 3 sophomores, 3 juniors, 8 seniors, 17 not in school, and 1 other. For this study, I

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chose to recruit participants through the Lindenwood Participant Pool (LPP) and through two different social media platforms Snapchat and Facebook. The LPP provides an opportunity for students' social science courses to earn extra credit points and it also allows student researchers to recruit participants for their research studies. For this study, students were able to receive two credit points for their participation. This study was conducted as an online study using an online survey that was created using Qualtrics. This research study did meet ethical standards evaluated by the Lindenwood Institutional Review Board and the Psychology Program Scientific Review Committee.

Materials

For this research study, I originally was going to ask participants to memorize two lists of 10 words, List A and List B, (see Appendix) presented either visually or auditorily. Therefore, I prepared two-word lists that were presented visually and auditorily. The two lists both consisted of words that contained six letters, three syllables, and were nouns. I chose these control variables so that both lists are of equal difficulty. I chose to include words that did not have any relation to each other because if the words were to relate to each other it would be easier for the participants to remember when being asked to recite the words back. For the visual presentation the words were presented to the participants at a rate of 1 word per second for 10 s and for the auditory presentation, I proceeded to an audio recording of myself reading the list of words at a rate of 1 word per second for 10 s.

Procedure

For this research study, I recruited participants through the LPP and through two social media platforms Snapchat and Facebook. However, what I originally planned to have Qualtrics

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randomly give out either of the two lists of words either visually or auditorily. By doing so, I would have counterbalanced the order of the word lists as well as the modality of word presentation. Unfortunately, Qualtrics did not work how I originally set it up to and therefore, every participant only received either List A or List B words delivered either virtually or auditorily resulting in an independent-groups design. Therefore, in the end, I asked the participants to either visually or auditorily memorize one of the lists of words that would be randomly presented to them. Half of the participants received List A words and the other half received List B words. Half of those who received List A words received them visual whereas the other half received them auditorily to memorize. The other half that received List B words received them visual whereas the other half received them auditorily to memorize as well. After the participants memorized the list of words presented to them either visually or auditorily, they were asked to recall the words in the recall question. After the participants recalled as many of the words that they could, they were asked to answer three short demographic questions that pertained to their gender, age, year of school. I, overall, used Qualtrics to deliver the experiment as well as a small questionnaire to the participants.

In the trial participants were asked to memorize 10 words that were either shown visually for 10 s at a rate of one word per second or auditorily at a rate of 1 word per second for 10 s and then they were asked to recall as many of the words they heard by typing them out. Half of my participants were presented with 10 words visually whereas the other half of the participants were shown the 10 words auditorily. Specifically, half of the participants received List A either visually or auditorily while the other half received List B either visually or auditorily. Each participant only received one list of words during the trial, presented in different ways.

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I counted the total number of words participants recalled and compared the means between the two groups of subjects. After the data were obtained from the research study, I analyzed the data using IBM SPSS Statistics (Version 28) to conduct a one-tailed independent samples *t*-test.

Results

For this study, I hypothesized that it would be more challenging for participants to memorize and recall words that are auditorily presented than it would be when being visually presented. I conducted a one-tailed independent samples *t*-test to analyze the data. After conducting the study on 40 participants, the results showed that those given the visual stimuli did not recall more words ($M = 6.86, SD = 2.61$) than those who were given the auditory stimuli ($M = 8.21, SD = 2.37$), $t(40) = -1.709, p = .048, d = .602$. The results show that there is a statistically significant difference between the two groups of subjects and the number of words correctly recalled, but in the wrong direction. That is, the results revealed that it was more challenging for participants to memorize and recall words that were presented visually than auditorily. Thus, my hypothesis was not supported.

Discussion

This study revealed that auditory presentation of information was not more challenging to memorize and recall. Thus, resulting in my hypothesis not being supported. This study does not correlate with many of the past studies findings, such as Heikkilä et al., 2015 & Kroll et al., 1970, because my study did not reveal that it was more challenging to memorize and recall a list of words auditorily than visually, which could have been due to the study being changed to an independent measures design. Since I had to change the design of the study it could have resulted

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in a better recall when presented auditorily than visually. Whereas a repeated measures design would have given each participant both stimuli.

My study was also different from other past studies because all previous studies conducted their studies as an in-person study. I changed the study into an online study from an in-person study because I wanted to have a greater number of participants. Changing my study from an in-person study to an online study could have affected the results because I cannot be sure that the participants are completing the study or simply just completing it correctly. The results could have also been affected because having a survey completed online can come with its complications, for example, Qualtrics not working correctly for the participants.

While conducting this study there were some limitations that arose. The biggest limitation that occurred was that Qualtrics did not display the study correctly to the participants. To overcome the limitation in the future, I recommend having a pilot test or a practice trial to ensure that the study operates correctly. To ensure that the survey works correctly, I would have individuals that I know take part in the survey and report back if there were any issues that may have arisen while taking it. My study may have been too easy for the participants to memorize considering 10 of the auditory participants recalled all 10 words perfectly while 5 of the visual participants recalled all 10 words perfectly. I would also recommend making the list of words longer and using longer words to ensure that the lists are not as easy to memorize no matter how it is presented to the participants. For future research, I recommend conducting this study as a repeated measures design instead of an independent measures design to ensure each participant receives both forms of modality instead of having one half of the participants receiving one modality and the other half of participants receiving the other modality.

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Hearing Productivity: Music and Productivity Study

Sydney Beins²

Purpose: The current study explored the research question which music genre increases one's productivity the most? **Methods:** Data was collected from 45 participants from social media (Reddit, Instagram, Twitter) and the Lindenwood Participant Pool. An online Qualtrics survey was created to test participants productivity through typing tasks and a few demographic questions were asked at the end. Participants were asked to type as many nonsense words as they could in a minute while having one of the four music genres: R&B, classical, Latin, and rap playing in the background. The task was completed four times so all participants were exposed to all music genres and lists of nonsense words. This was followed by two demographic questions that asked about participants' gender and race/ethnicity and participants were also asked if they used a normal keyboard or a touchscreen keyboard. **Results:** The findings revealed there was no statistically significant effect of genre on the variable of correctly typed nonsense words $F(3,28) = 1.913, p = .150$. **Discussion:** The implications of these findings greatly contrast previous research, and more research will need to be conducted to confirm these differences.

Keywords: music, productivity, task performance, music genres, typing, timed

Music has been around for thousands of years. It has been used as a form of communication, self-expression, healing, and productivity. Since music has been around there has been numerous research studies that observed the relationship between music and various human behaviors (Küssner et al., 2019). One focus of many research studies is on the impact of music genres and one's task performance.

A study conducted by Young and Nolan (2015) explored an individual's attention level on various tasks as they listen to music. The participants were placed into one of three groups: no music (control group), classical music (no lyrics), and popular music (lyrics). Young and Nolan (2015) found an increase of reaction times for the participants completing their multi-part tasks

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for those who listened to classical music compared to the no music group (control). This shows a relationship between music and its impact on one's task performance. Although there is a possible connection, the study did fail to account for the potential impact of using popular songs that were well known at the time on participant's task performance.

Kiss and Linnell (2021) examined the effect background music can have on people's attentional state and their task performance. For this study, participants were asked to create a 30-min playlist of preferred songs to replicate the participant in their normal environment. They were asked to complete two sets of tasks; one set was completed while they listened to their playlists and the other set was completed in silence. Kiss and Linnell (2021) concluded people tended to have a higher attention level on a task when background music was playing compared to when a task was completed in silence. They also did not find an association between task-focus or mind-wandering and lyrics. This would mean any songs participants listened to with lyrics did not affect their performance or attentional levels while completing tasks.

Mohan and Thomas (2020) also conducted a similar study to Kiss and Linnell (2021). They wanted to analyze the effect of background music more specifically, cultural preference of music and task performance. All participants were Indian adolescents and were asked to listen to Indian classical music and Western classical music. First, participants completed a reading comprehension task with no music this was followed by completing the same task while listening to the Indian classical music and Western classical music. This was done over the course of four weeks, each week a new condition was given. Mohan and Thomas (2020) found that participants had a significant increase in task performance when background music was playing than when

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no music was playing. They also found that participants had the highest task performance when listening to Indian classical music (Shanmukhapriya) compared to Western classical music (Mozartian).

Geethanjali et al. (2016) decided to look more into the link between music and cognitive performance. They investigated not only task performance but the possible change in one's mood. Participants listened to classical Indian instrumental music or Indian jazz music. Participants were asked to complete three different tasks under three different conditions. In the first condition participants were asked to listen to their chosen music so a baseline pulse rate could be taken. Participants were then asked to listen to the chosen music and complete a short task. For the last task, participants were asked to complete it in silence. Participants were also given a short rest in between every task in an attempt to accurately measure their pulse rates. Geethanjali et al. (2016) identified a decrease in task performance when participants completed the task in silence. They found an improvement in task performance for both music genres compared to the task completed in silence. But Geethanjali et al. (2016) also found the reaction time was greatly decreased when participants were listening to both music genres compared to having no music playing.

Arboleda et al. (2022) investigated the effect of music on an individual when completing a stressful task. They tasked participants with creating a vacation plan for a made-up client and placed participants in one of the three groups (fast-tempo, slow-tempo, no music). Arboleda et al. (2022) made the task stressful by creating random glitches within the website participants were using to create the vacation plan. They found that regardless of the tempo of music this condition

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did decrease task performance in participants. Arboleda et al. (2022) also found the performance of neither of the temp groups differed from the no music group.

Wientjes et al. (2021) conducted a study to explore the perceptions of listening to music while working on homework. They used a questionnaire to ask around 84 participants various formed questions about the use of music when completing school-related assignments. Wientjes et al. (2021) found during reading assignments participants are less likely to listen to music compared to during writing assignments.

Oldham et al. (1995) conducted a study to see if there was a connection between headset use and employee mood and performance. Contrary to the other studies, Oldham et al. (1995) found no significant main effect in music type and performance with the employees in the workplace. Their results even suggested that the duration of the music would not influence the worker's performance either.

Most of these studies reported there to be a significant impact of music on task performance in participants. But many of the studies did not focus on different music genres, they tended to focus on background music or similar music genres. My study explored how different music genres will impact participants productivity. I hypothesized there will be a difference in productivity between music genres.

Method

Participants

There was a total of 45 participants that completed my survey. Of those 45 participants, 37 were women and 8 were a man. There were 38 who identified as White and 1 who identified as Black and 6 who identified as Other. All participants marked they did not have any hearing issues. But out of the 45 participants, only 32 participants had complete sets of data from completing all the typing tasks causing the sample size to be become small.

I recruited participants from social media (Instagram, Reddit, Twitter) and Lindenwood Participant Pool (LPP). The LPP is a participant pool at Lindenwood University. The LPP offers extra credit opportunities to participate in behavioral research for those in qualifying Lindenwood courses. LPP uses Sona Systems to upload studies for their participants. My study met the requirements of Lindenwood Institutional Review Board. Those recruited using the LPP received two extra credit points while those recruited on social media did not receive compensation.

Materials

There were four music genres being used for this experiment (R&B, Classical, Latin, Rap). The songs used for each genre were “A Song for You” (R&B; Hathaway, 1971), “Juba Dance” (Classical; Price, 1932), “Indigo” (Latin; Camilo & Evaluna, 2021), and “No Role Modelz” (Rap; Cole, 2014). An instrumental version of the original songs was used to decrease the chances of participants being distracted by lyrics. The songs were downloaded from YouTube by using the website Addoncrop. This made the YouTube videos into audio files that could be

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uploaded into Qualtrics (see Appendix A). All songs were carefully selected to exclude current popular songs and instrumental versions of the songs were used. Using songs without lyrics was done to avoid distractions that lyrics might have caused.

For the task, four lists of nonsense words were created. Nonsense words were created to account for familiarity with everyday words. This would allow participants to have an accurate measure of productivity since they have no familiarity with these made-up words. The nonsense words were created using Soybomb.com, a nonsense word generator. All the lists of words contained five short nonsense words (5-7 letters long), seven medium-length nonsense words (8-10 letters long), and three long nonsense words (11-15 letters long) which equals 15 nonsense words per list (See Appendix B). Creating the lists in this way ensured all lists have a similar level of difficulty. For the task, one song appeared at the top of the screen followed by a list of nonsense words that participants typed as quickly as they could within a minute. Participants played the music and began the typing task. Lastly, a question asking participants if the audios played properly, and a set of demographics completed the survey. The demographic questions asked participants their race/ethnicity and gender and if they use a keyboard or a touchscreen keyboard to complete the tasks.

Procedure

I used Qualtrics to create an online survey. The survey was comprised of an informed consent statement that had been edited from a template provided by the Lindenwood Institutional Review Board. The informed consent gave a summary of the tasks in the survey, compensation

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in the form of extra credit points for those recruited through the LPP, privacy of participant's data, and the researcher's contact information.

After giving consent, participants were asked to complete a short task while music played in the background. This task was repeated for four different music genres (R&B, classical, Latin, rap) and four lists of nonsense words (List A, B, C, D).

Every music genre was paired with all lists of nonsense words and randomized. So, participants received a random pairing of all songs and lists once without any repeats. This accounted for if any of the lists were not created to a similar difficulty as the other lists. When displayed to participants all lists followed the same order, so participants received all levels of difficulty (short, medium, long) at least once before the time was over. The order followed: short, medium, short, medium, long. This order was repeated three times to create the full list of 15 nonsense words. This task was followed by demographic questions. The questions ask participants their gender, race/ethnicity, and if they completed the survey using a keyboard or touchscreen keyboard.

Lastly, the experiment included a debriefing statement that thanked the participant, stated the study aim, restated all information will be kept confidential, and the researcher's contact information. A version of my online experiment can be found in Appendix B. The link to my survey was uploaded to Instagram, Reddit, Twitter, and Sona Systems. Once the data collection process was completed, I used Excel to score the data by reviewing all the nonsense words participants typed to see if they were correctly typed compared to the nonsense word. I then used IBM SPSS (Version 28) to analyze the data. I ran a one-way repeated measures analysis of

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variance (ANOVA) and descriptive statistics were run to find the mean and standard deviation of the correct number of words typed for each music genre.

Results

To test my hypothesis, a one-way repeated measures ANOVA comparing the dependent variable of correctly typed nonsense words by music genre revealed there was no statistically significant effect of genre $F(3,28) = 1.913, p = .150$. As for the descriptive statistics for the music genres, the average number of words typed correctly for R&B was 10.65 ($SD = 4.103$). For classical, the average number of words typed correctly was 10.45 ($SD = 4.073$). For Latin, the average number of words typed correctly was 11.48 ($SD = 3.586$). For rap, the average number of words typed correctly was 11.90 ($SD = 3.004$).

Discussion

My results found there was no connection between music genre and productivity. There was no statistical difference between music genre on productivity. The results differed from those of past studies. When reviewing Mohan and Thomas (2020)'s study they found there to be an increase of task performance while background music played which was not supported in the current study.

There were quite a few limitations for the current study. The first limitation was due to the many participants seemed to be confused by the task instructions. Since the task included nonsense words, participants thought the task involved unscrambling the words instead of typing them as they were presented. This occurred for a handful of participants, and I think this also

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caused many participants to drop out of the survey because they thought the task was hard when it was not the correct task.

Another limitation came from the study being conducted online. This online format made it difficult to know if participants were in fact listening to the audios when completing the tasks. While there was a question to verify if participants played the audios and there was no way for me to verify this.

The last limitation I observed was with the type of keyboard participants used to complete the task. I asked participants what type of keyboard participants used (touchscreen or a keyboard) and noticed the participants who used a touchscreen keyboard had more issues with autocorrected words compared to those who used a regular keyboard. Since the study used nonsense words the autocorrection feature on some devices could have interfered with the data collected.

For future research, I would suggest conducting the study in-person; this would resolve a few of the limitations above. It would ensure participants are indeed listening to the audio files and allow participants to ask questions about the instructions they are still confused about before attempting the tasks. Also, if this study was conducted in-person it could account for the issue with the keyboards. The researcher would be able to use the same device and device settings for all participants. This will hopefully allow for all participants to have the most similar conditions to receive the most accurate results.

The next suggestion I have is to include a practice task for participants. This will give participants a chance to familiarize themselves with the task before attempting the real one. It

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would also give the participants a chance to ask the researcher for further clarity if they still are unsure about the task or how to complete it.

My last suggestion would be to use different music genres to test productivity, especially ones that have not been tested in various experiments such as pop, electric dance music, K-pop, and so on. I would even advise selecting music genres that have become popular over the last five years. This would be most beneficial because it would show how productive or nonproductive popular music genres might be. It might also help to change the task participants are being asked to better measure productivity. Instead of having one task, participants could be timed to see how many different tasks they can complete correctly. The task could be simple like matching an image and name. I hope line of this research helps individuals in finding a music genre that increases their productivity the most especially for studying and in work environments.

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Appendix A

Audio files

[A Song For You by Donny Hathaway](#) (R&B)

[Juba Dance by Florence Price](#) (Classical)

[Indigo by Camilo and Evaluna](#) (Latin)

[No Role Modelz by J. Cole](#) (Rap)

Appendix B

List of Nonsense words

List A:

- extiturnicized
- happlargetal
- specarrouse
- smastrial
- marldles
- foulent
- printees
- nitablazy
- slotect
- boasuran
- donavy
- bismite
- butiverse
- binoon

List B:

- novaneymoric
- bespoority
- extialitions
- drauduzes
- caciates
- complid
- begicalin
- pounons
- diseize
- wanesses
- coalka
- eltiman
- begroileightly
- snownuard

List C:

- hobbinted
- fondingened
- autorty
- faneip
- snaprogagilly
- pulaug
- utalle
- sinonon
- whitomets
- nonoposer
- bootecks
- satcheally
- rattinton
- centin

List D:

- vestalambly
- hapleathine
- claste
- glarfillinter
- concint
- surito
- slotozena
- pinceds
- cleisma
- denterler
- dogtonal
- primpuzzie
- jottarite
- clairfoire