4-26-2019

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Abstract

This thesis focused on the effect of both instrumental and vocal music on performance on cognitive tests designed to test memory in order to gain more insight into whether the presence of language in music affects memory. Four hypotheses were tested concerning the effect of music type, question type, the interaction of the two, and personal experience with music/music training on memory assessment performance. The study found no significant effect of background condition on memory assessment performance, a significant effect of question type on memory assessment performance, no significant effect of the interaction between background condition and question type on memory assessment performance, and no significant effect of playing an instrument on memory assessment performance.

Literature Review

Many researchers have investigated the effects of music on memory, but the results have been mixed. Some studies have shown that instrumental music has a positive effect on test performance (de Groot, 2006; Angel, Polzezza, & Elvers, 2010; Ferreri et. al, 2013), while others have found that certain tempos and volumes of music have a detrimental effect on test performance (Thompson, Schellenberg, & Letnic, 2011). However, the literature is incomplete because many of the previous studies have failed to use controlled experimental designs. The goal of this thesis is to explore the effect of language in music on memory, specifically recall and recognition memory.

For the purpose of clarity, instrumental music is not always "classical" music. Instrumental music is simply music that does not contain words. In this case, the instrumental music condition consisted of a non-vocal version of a song from the Disney movie *Moana.*

Classical music, on the other hand, is a category of instrumental music written by European composers during a specific time period (from roughly 1750 to the mid-1800's) and consisting of mostly sonatas, symphonies, and concertos. Classical music is commonly used in studies on the effects of music on cognitive performance, but this thesis utilized only instrumental and vocal music.

Music and Cognition

Previous research on the effects of music on cognitive processes such as attention, memory, comprehension and information processing have produced a wide range of results, which is most likely due to the fact that variables such as type of test used, type of music used, individual experience with music, and other factors can affect the results of different studies (de Groot & Smedinga, 2014). Methods of testing cognitive processes can include reading comprehension tests, spatial processing tests, vocabulary tests, and brain scans such as functional magnetic resonance imaging (fMRI) and functional near-infrared spectroscopy (fNIRS) scans. Music can be instrumental, lyrical, or a combination of both. The effects of music on cognitive test performance have been found to vary depending on the type of music as well as the type of skill being assessed by the cognitive test.

This thesis focused on the effect of both instrumental and vocal music on performance on cognitive tests designed to test memory. Memory and attention are closely interrelated, which is exemplified in the "cocktail party phenomenon," the idea that a subject can only pay attention to one voice in a crowd at any particular moment, but an "unattended" voice can capture that singular attention if the unattended voice is saying things that are personally relevant to the subject (such as the subject's name, Wood & Cowan, 1995).

Conway, Cowan, and Bunting (2001) compared participants with high and low working-memory capacity to test for a correlation between working-memory capacity and the cocktail party phenomenon. Their study measured working memory capacity using an "operation span task" in which a series of mathematical problems were displayed, each accompanied by an unrelated word. The "span" was defined as "the length of the series that could be processed with the subject still able to recall all of the words." Individuals with high working-memory capacity have been found to out-perform individuals with low working-memory capacity on this type of test. Based on the operation span task results, 40 participants were chosen for the study, half with high working-memory capacity and half with low working-memory capacity. The participants were asked to repeat the message presented in their right ear while disregarding the irrelevant message presented in their left ear, which began 30 seconds after the relevant message and contained the participant's name at either the four-minute mark or the five-minute mark. Twenty percent of the participants with high working-memory capacity reported hearing their name in the irrelevant message while 65 percent of the participants with low working-memory capacity reported hearing their name in the irrelevant message. In addition, participants with low working-memory capacity had more difficulty repeating the relevant message correctly and made more mistakes than participants with high working-memory capacity. These results suggested that people with high working-memory capacity are less likely to experience the cocktail party phenomenon than people with low working-memory capacity because they are better able to filter out distracting stimuli. Therefore, participants with a low working memory capacity are more influenced by distractions and might have a more difficult time ignoring background music that is playing while they are studying.

Another interesting aspect of this study is the comparison of the operation span task used as a pre-test, which can be considered a divided attention task, with the dichotic listening task, which can be considered a selective attention task. Participants who scored well on the operation span task also scored well on the dichotic listening task, which suggests that there is a "general cognitive ability," which the authors argue is closely interrelated to working-memory capacity, that allowed participants to perform well on both tasks. These results are relevant to this thesis because one of the premises of the proposed study is that certain conditions could be more distracting than others, but differences in working-memory capacity could be at least partially responsible for some of the differences in memory test performance among the different music conditions.

Instrumental music played during learning has been shown to have a positive effect on performance, especially when the music is classical (de Groot, 2006). In a study of 36 undergraduate participants at the University of Amsterdam, de Groot assigned students to a music condition or a silent condition and had them perform an extensive word-pairing task. The participants were all native Dutch speakers who had received formal foreign language training throughout secondary school and were currently using English textbooks in their college studies (and so were determined to be proficient in English). The participants were presented with 32 Dutch words, each paired with a nonword. In the first round of learning, the participants were shown each pair for 10 seconds. After a brief rest, the participant was again shown each pair for 10 seconds. Half of the participants learned in silence, and the other half learned while listening to part of Bach's fourth *Brandenburg Concerto.* After both rounds of learning, the participants were shown the nonwords one at a time and asked to "translate" them into Dutch. The study found that significantly more nonword words were learned in the music condition than in the

silent condition, which suggests that music improved memory of nonword words in comparison to silence.

In a more recent study, Angel, Polzezza, and Elvers (2010) examined the effect of fast-tempo music on cognitive performance using both a linguistic processing task and a spatial processing task. Spatial processing was assessed using a test requiring the mental rotation of histograms. Linguistic processing was assessed using a test requiring the ability either to identify letters as physically identical or to categorize letters as belonging to the same category of vowel or consonant. In the study, 56 undergraduate psychology students at the University of Dayton were randomly assigned to perform either the linguistic processing task or the spatial processing task. Participants assigned to the spatial task were presented with two histograms, displayed in succession on a monitor. The second histogram was rotated 0, 90, 180, or 270° relative to the first histogram, and the participants were asked to determine whether the two histograms were the same. The linguistic processing task was a letter-matching task in which the participants were presented with pairs of letters on a monitor and asked to classify the pairs as the same or different based on two different criteria. In the physical letter match, the letters had to be physically identical, and in the category match, the letters both had to be consonants or both had to be vowels. The participants performed their assigned task either in silence or listening to an excerpt from one of the ten Mozart sonatas chosen for this study based on their fast tempo. The dependent variables were mean response time and mean proportion of correct responses. The study found that background music increased the speed of spatial processing and the accuracy of linguistic processing. In other words, the presence of fast-tempo background music improved performance on both spatial processing tasks and linguistic processing tasks. However, a limitation of this study was that several participants were removed as outliers because the pre-

training time for the spatial and linguistic processing tasks was insufficient to provide an equal baseline for all participants. In other words, some participants understood how to perform the tasks more easily than others, and the participants who had trouble understanding the tasks performed poorly not because of the background music but because they misunderstood how to perform the task. In the future, in order to assure the statistical legitimacy of the results, a study like this could be conducted with a longer pre-training period. Fortunately, the measurement instrument for this thesis is designed much like an exam, so no pre-training period is necessary.

Other research has supported the hypothesis that background music can have a positive effect on cognitive processes. For example, Ferreri, Aucouturier, Muthalib, Bigand, and Bugaiska (2013) examined the effects of upbeat jazz music on encoding of verbal material. In the study, 22 young adults underwent functional near-infrared spectroscopy (fNIRS) imaging of their brains while encoding words either in silence or in the presence of the upbeat jazz piece "If You See My Mother" by Sidney Bechet. They were presented with different lists of words divided into "blocks," with three blocks of "music encoding" and three blocks of "silence encoding." Each block contained seven words which were displayed in succession. In the "music encoding" blocks, the music began playing 15 seconds before the display of the first word and ended 15 seconds after the display of the last word in the block. Each block was 58 seconds long (15 seconds before and after plus four seconds for each of the seven words) with a 30-second break between each block. Afterwards, the subjects were given two five-minute interference tasks, then tested for memory recognition with 42 words presented previously plus 42 new words. They were asked if they had seen each word and (if yes) in which context they had seen it (music or silence).

The imaging scans showed a significantly higher level of activation in the left hemisphere during encoding, providing support for the hemispheric encoding/retrieval asymmetry (HERA) model of memory lateralization, which claims that the left prefrontal cortex is more involved than the right prefrontal cortex in episodic memory encoding, while the right prefrontal cortex is more involved than the left prefrontal cortex in memory retrieval. The scans also showed a "sustained, bilateral decrease of activity in the dorsolateral prefrontal cortex [the part of the brain associated with higher cognitive functions such as switching attention and working memory] in the music condition compared to silence" (Ferreri et. al, p.1). This study found that decreased dorsolateral prefrontal activation within the music condition compared to the silence condition coincided with improved word recognition. This study provides evidence at the neurological level that music, specifically upbeat jazz music, helps moderate the activation of the dorsolateral prefrontal cortex, which in turn improves retrieval of encoded material. One limitation of this study is the fact that fNIRS data cannot be unconditionally used to assume prefrontal cortex activation. Also, this study was limited to eight fNIRS channels, so other areas of the cortex could have been involved in encoding without being measured in this particular study. However, this study provides strong evidence that retrieval of encoded material (i.e. memories) can be facilitated by certain types of music.

Although Angel, Polzezza, and Elvers (2010) showed that tempo can have a positive influence on cognitive functioning, certain volumes of music may have a detrimental effect. Thompson, Schellenberg, and Letnic (2011) conducted a study in order to determine how loudness and tempo interacted to influence cognitive processes. First, two pilot studies were conducted in order to (a) choose musical selections that were equivalent in tempo and intensity and (b) establish a baseline performance on the reading comprehension tests when taken in

silence. Then, a total of 25 undergraduate students participated in four music conditions: slow/soft, slow/loud, fast/soft, and fast/loud. All four of the music conditions were the same clip of Mozart's *Sonata for Two Pianos in D major*, manipulated to be slow or fast and soft or loud. The participants all read the same four passages, but the order of the passages and the order of the music conditions were randomized. The participants were tested individually with five-minute breaks between passages. They had four minutes to read each passage, then three minutes to complete six multiple choice questions in silence. The study found that background music is most disruptive to reading comprehension when the music is fast and loud. Slow and soft music caused no significant decrease in reading comprehension compared to the control (silence). These results suggest that tempo, speed, and the interaction of tempo and speed are separate variables that affect cognitive processes such as comprehension differently. One limitation of this study is that all of the participants participated in all four categories, which could have caused a fatigue effect.

Research has also examined the effects of music complexity on cognitive performance. Furnham and Allass (1999) compared performance on cognitive tasks in the presence of either simple music, complex music, or silence. Participants were screened based on the Eysenck Personality Questionnaire. Of the 163 participants who completed the questionnaire, 48 were chosen for the study based on either extremely high or extremely low scores. The music used in the study was chosen by a committee of musical experts (Grade 5 Music Theory or above) and rated for "tempo, repetition, rhythmic complexity, melodical complexity, vocal meaningfulness, instrumental layering, and overall complexity." The "simple" songs were "Low" by REM, "You have been loved" by George Michael, and "Only the wind" by Pet Shop Boys. The "complex" songs were "Scream" by Michael Jackson, "Runnin' for the red light" by Meatloaf, and "Poison"

by Alice Cooper. All participants completed three cognitive tasks: a reading comprehension test from a GMAT practice book, a memory test from the British Ability Scales, and a multiple choice test from *Advanced Progressive Matrices: Set 1* that was designed to test observation and clear thinking. The study found no significant overall effect of background music on cognitive test performance. However, each condition was affected differently by personality type, complexity of the music, and the interaction of the two factors. In the reading comprehension test, there was no significant effect of personality type, music complexity, or interaction. In the memory test, there was a significant effect of the interaction between personality type and music complexity: introverts scored highest in the silent condition while extroverts scored highest in the complex music condition. These results suggest that personality can be associated with how participants respond to the presence or absence of simple or complex music. One flaw in this study design was that level of musical training was different among the participants, and musical training was shown to be a statistically significant advantage in the data, but that variable was not discussed in the results. If a researcher were to repeat this study, level of musical training should be discussed as an individual variable.

Some studies have produced mixed results. For example, Proverbio, Nasi, Arcari, de Benedetto, Guardamagna, Gazzola, and Zani (2015) compared the effects of "emotionally touching" instrumental music and other auditory background on memory recall and heart rate. Fifty-four non-musicians listened to joyful or emotionally touching music, rain sounds, or silence while studying hundreds of pictures of different faces. The study was preceded by a training session during which 56 unique pictures of men and women were presented along with auditory background; then the participants were shown eight new faces and eight old faces (randomly mixed together) and asked to identify the pictures they recognized. After the participants were

familiar with the task design, they participated in the experimental session. Three hundred faces were randomly presented on a screen for 800 milliseconds each while assorted auditory clips (60 seconds each; a random mix of all auditory conditions) played in the background. The session lasted 15 minutes. Afterwards, participants were presented with 300 faces (200 old and 100 new) with no auditory background and asked to identify the faces they recognized. The participants wore a heart monitor during the first 15-minute session but not during the recognition test. The study found that listening to "emotionally touching" instrumental music improved memory and significantly increased heart rate, while all other auditory background interfered with memory recall, which suggests that emotionally touching music doesn't interfere with encoding the way that joyful music or rain sounds do. Emotionally touching music increased arousal (measured by an increase in heart rate), but so did joyful music, so an increase in arousal alone cannot explain these results. The researchers hypothesized that emotionally touching music led to emotionally-driven encoding, which strengthened the participants' ability to visualize the faces during later testing, while rain and joyful music produced an interfering effect by overloading the channels for perception and observation.

Another factor, especially in relation to classical music, is the individual's level of experience in relation to musical training. The "Mozart effect," or the theory that performance on cognitive tasks improves after exposure to Mozart's music, has been disproven in relation to musicians but not in relation to non-musicians. This discrepancy can be explained by the fact that musicians process melodic information in both hemispheres, while non-musicians only process melodic information in the right hemisphere (Aheadi, Dixon, & Glover, 2009). In a study of 50 musicians and 50 non-musicians from the Royal Holloway University of London, participants performed a 40-question mental rotation task printed from the Department of Education and

Professional Studies of the University of Limerick website either in silence or while listening to a recording of Mozart's sonata for two pianos in D major (K448). A mental rotation task was used because mental rotation tasks are thought to utilize the right cerebral hemisphere, which is the hemisphere used by non-musicians to process melodic information. Musicians use both hemispheres to process melodic information. The 40 questions were randomly divided in half, and the participants were given eight minutes to answer as many of the first 20 questions as possible. After eight minutes, the participants sat for fifteen minutes either in silence or while listening to K448. The participants were then given eight minutes to complete as many of the second set of 20 questions as possible (in silence). Listening to Mozart improved the scores of the non-musicians but not the musicians. Although musicians scored higher overall, listening to Mozart did not significantly increase their scores from pre-exposure to post-exposure. These results suggest that exposure to Mozart's music only increases performance on spatial tests for people whose processing of music is still lateralized to the right hemisphere (non-musicians), where spatial processing also occurs. Musicians do not benefit from listening to Mozart during spatial tasks because they process music in both hemispheres. The results of this study support the decision to ask participants in this thesis whether or not they have played an instrument, since musicians respond to background music differently than non-musicians.

Su, Kao, Hsu, Pan, Cheng, and Huang (2017) studied the Mozart effect using child participants. The study consisted of 62 Taiwanese elementary school children divided into two groups who read two reading passages: "The Glacier" and "Rock Climbing." In the first phase, Group One read "The Glacier" without background music and Group Two read "Rock Climbing" without background music. Both groups then took a learning anxiety and cognitive load scale assessment, followed by a reading comprehension test. One week later, Group One

read “Rock Climbing” with background music and Group Two read “The Glacier” with background music. Both groups then took a learning anxiety and cognitive load scale assessment, followed by a reading comprehension test. Mozart’s K488 was used in the background music condition for both groups. The reading passages were presented on a touch screen monitor, and the students were asked to follow along with their finger as they read; the touch screen recorded their touch and used it to calculate words read per minute. The study found that learning anxiety was much lower when the participants listened to Mozart compared to silence, and both reading rate and level of reading comprehension were significantly higher for the Mozart condition than for the silence condition. However, the study attributes increase in reading rate and reading comprehension mainly to a decrease in learning anxiety rather than the processing of music in a particular hemisphere of the brain, which suggests that Mozart’s music can affect learning in other ways than processing (such as improved mood or decreased learning anxiety).

A 2009 meta-analysis of Mozart effect studies found that there is very little support for a specific Mozart effect. Pietschnig, Voracek, and Formann (2009) performed a comprehensive literature search for research on the Mozart effect, cognition, and spatial memory in both English and German articles. The search results were organized based on categories such as conditions used in studies, publication status, and lab affiliation. In order to be included in the meta-analysis, the studies had to meet five criteria. First, the study had to have employed a measure of spatial ability. Second, the study had to have provided “sufficient statistical information for all treatment groups.” Third, the participants had to have performed tasks after different treatments had been administered. Fourth, at least two of three possible treatments (listed in the meta-analysis as “Mozart sonata KV 448, other music, no music”) had to be administered in the study.

Fifth, data from a potential study could not have been reported in any study that was already included in the meta-analysis, in order to assure statistical integrity and independence. Over two hundred studies were identified as "possibly relevant for inclusion," but the final product only analyzed 39 studies. Roughly 200 studies were excluded due to factors such as irrelevant dependent variables, poorly reported statistics, lack of relevance to the target of the meta-analysis, and inclusion of duplicate data. The meta-analysis found very little support for a specific Mozart effect in both published and unpublished work. It also found "rather strong evidence" for publication bias, which suggests that the Mozart effect has been blown out of proportion. While exposure to Mozart's music does result in a slight increase in performance on spatial tasks in relation to a control, the same effect can be seen with other musical stimuli compared to a control.

Effects of Language

The previous studies used instrumental music in their experimental design. The goal of this research thesis was to determine the specific effect of language in music on recall and recognition. A recent study found that music with lyrics has a negative effect on reading comprehension and working memory, even when the lyrics are in a foreign language (Chew, Yu, Chua, & Gan, 2016). One hundred and sixty-five undergraduates from James Cook University in Singapore were recruited based on their competency in English and their unfamiliarity with Italian. The participants were divided into five conditions: familiar English language song, the Italian version of that song, an unfamiliar Italian song, the English version of that song, and no music. The familiar English song was "My Heart Will Go On" by Celine Dion, and the Italian version was sung by Sarah Brightman. The unfamiliar Italian song was Volare by Luciano Pavarotti, and the English version was sung by Engelbert Humperdinck. All of the participants

performed the following tasks: an arithmetic test, a reading comprehension test, and a memory test. For the reading comprehension test, the participants were given five minutes to read the passage followed by another five minutes to answer seven multiple choice questions. For the memory test, the participants were given one minute to memorize a list of twenty English words; then the list was replaced with a different list containing fifteen words from the original list and five new words that were related to the concepts in the songs. The participants were given three minutes to identify the words they recognized from the first list. For the arithmetic test, the participants had fifteen minutes to complete ten math problems without a calculator. For the participants in the music conditions, the music played through the public announcement system in the classroom at a fixed volume for the duration of the tests. The study found no significant effect of music familiarity and language compared to the control (no song), but it found that music as a whole had a negative effect on performance overall, except for familiar music (which had no effect). The main issue with this study is that the different versions of the same song are sung by different people in different keys and at different tempos, which introduces several confounding variables. Dion and Brightman sing "My Heart will Go On" at different tempos, with different singing styles, and with different instrumental backgrounds. The same can be said of Pavarotti and Humperdinck. Therefore, it is impossible to make accurate comparisons between the two versions of each song. In order to improve this study design, the researchers should have used Italian and English versions sung by the same person or two people with similar voices, with the same instrumental background.

Some studies have produced results that contradict the study by Chew, Yu, Chua, and Gan. For example, de Groot and Smedinga (2014) compared the effects of familiar and unfamiliar music on foreign language vocabulary learning. Forty-one psychology students from

the University of Amsterdam participated in the study. All of the participants were native Dutch speakers with a high level of English language competence who were not familiar with the Greek language. A total of 15 songs were used in the study: five with Greek lyrics, five with Dutch lyrics, and five with English lyrics. All of the participants performed a vocabulary learning task in silence and while songs with Greek lyrics played in the background. Twenty of the participants additionally performed a vocabulary learning task while songs with English lyrics played in the background, while the remaining 21 participants performed an additional learning task while songs with Dutch lyrics played in the background. The participants studied word pairs on a monitor while the music played from the computer speakers. One week after the experiment, the participants were given a recall test of the word pairs in silence without studying them again. The study found that songs in a familiar language impaired recall while songs in an unfamiliar language did not. These results suggest that familiar language is more distracting during a learning task than unfamiliar language. A potential explanation is that the familiar language was categorized in the brain as potentially relevant and therefore was more distracting than the unfamiliar language, which was more easily disregarded.

Effects of Cognitive Task Type

Another variable to consider is the type of question used to test memory (in this case, multiple choice versus short answer). Short answer questions require the test-taker to recall the answer with no visual cues, while multiple choice questions require the test-taker to recognize the answer from a list of potential answers. Kang, McDermott and Roediger (2007) compared test performance on multiple choice tests to test performance on short answer tests. Forty-eight undergraduates from Washington University participated in this study. The participants were given four papers from the journal *Current Directions in Psychological Science* to study. Eight

facts/concepts were selected from each paper and converted to multiple choice questions, short answer questions, and one-sentence statements. A 4 (intervening task: multiple choice, short answer, read statements, or control) x 2 (final test format: multiple choice or short answer) within-subjects design was used. The order of the intervening tasks was kept constant (multiple choice test after the first paper, short answer test after the second paper, a list of statements corresponding to the answers to test questions after the third paper, and a filler questionnaire after the fourth paper), but the order of the papers was counterbalanced. Three days after these tests, the participants were tested on all four papers with a mixture of multiple choice and short answer questions. The questions were organized so that each paper was tested with a total of four multiple choice and four short answer questions. The facts tested in this second test were the same facts from the first test. The study found that performance on short answer questions was significantly lower than performance on multiple choice questions over the same material: 54% and 86%, respectively These findings suggest that short answer questions are more difficult compared to multiple choice questions. Therefore, performance on a recall test might be more affected by environmental factors (such as music) than performance on a recognition test.

This thesis focused on the effect of both English and foreign-language, specifically Italian, music on memory and comprehension of a passage in English. The study contained three different music conditions (instrumental music, vocal music in Italian, and vocal music in English) as well as a negative control (white noise). In the study, students were asked to read two short passages and then complete an assessment of their memory of the content. Memory was measured using questions designed to test either recall or recognition of concepts presented in a given passage. Overall performance on the test was measured by number of questions answered

correctly. Participants took the test after studying the passage in the presence of the song "How Far I'll Go" in either English, Italian, or with instruments only.

Hypotheses

The following hypotheses were tested:

Hypothesis 1: Vocal music in English will negatively impact performance on tests of both recall and recognition of a passage written in English compared to vocal music in Italian, instrumental music, and white noise.

Hypothesis 2: Performance will be higher on recognition questions than on recall questions regardless of music condition.

Hypothesis 3: Music type will have a more noticeable effect on performance with recall questions than on performance with recognition questions; there will be very little or no difference in performance among music conditions with recognition questions.

Hypothesis 4: Participants who play an instrument will perform better on the memory assessment than participants who have never played an instrument, regardless of background condition.

Methods

Design

The study used a 4 (music condition) x 2 (question type) mixed design. Participants chose a timeslot from a Google Drive document, and each timeslot was randomly assigned to one of four different conditions: instrumental music, vocal music in English, vocal music in Italian, and a negative control (white noise). For each of the four conditions, the same two reading passages were used, but they were counterbalanced among the participants in all four conditions. The participants were given 10 minutes to read the passages, then up to 10 minutes to take a single

test containing 24 questions designed to measure their ability to remember the information in the passages. The total time for participation was approximately 30 minutes.

Participants

This study included 53 undergraduate college students from 18 to 22 years of age, who identified English as their first language. Participants were recruited from entry-level psychology classes at a liberal arts university in Kentucky. Participants were informed that they were participating in a study of environmental ambience (e.g. smell, lighting, and sound) and its effect on comprehension. There were 14 participants in the English music condition, 12 participants in the Italian music condition, 14 participants in the instrumental music condition, and 12 in the white noise condition. Participation was voluntary, and participants were not paid or compensated for participating. However, professors offered extra credit as an incentive for participation. Participants were debriefed after their completion of the test and post-test survey.

Materials

The materials needed for this study were the background sounds, two reading passages, two sets of questions, and a post-test survey. All of the written materials were combined into a single packet in the following order: consent form, reading passages, assessment questions, post-test survey.

Background sounds. The song "How Far I'll Go" from the movie *Moana* was used for the three music conditions: English, Italian, and instrumental. For each condition, a CD was made that played the song or white noise on loop for 10 minutes. Italian was chosen for the foreign language background condition because it has a similar cadence to English but has not been learned by most college students as a foreign language. In fact, only two participants had ever taken an Italian language course, and neither of those participants was randomly assigned

into the Italian lyric background condition. This song was chosen due to its relative familiarity to college students. Familiarity with the song was assessed using a 1 to 5 scale (1 = not at all familiar, 5 = very familiar). Participants indicated that they were very familiar with the song (*M* = 4.08, *SD* = 1.33). The fourth condition was the white noise condition.

Reading comprehension passage. Two different reading passages were used in this study. Reading passages were used because college students are often required to read materials and later be tested over the readings. The two passages were randomly selected paragraphs taken from two sources: the theology textbook *Off the Menu* (2007) and a news article from Space.com (2018). These passages were chosen in order to provide diversity of reading content; the theology passage was arts-based, while the Space.com article was science-based.

The theology passage was a 665-word excerpt from a chapter in *Off the Menu* about ancestral veneration in East Asian cultures (see Appendix 1, p. 39). This passage was chosen based on the assumption that the topic was unfamiliar to the participants, which is supported by data from the post-test survey.

The Space.com article was a 674-word passage about newly discovered rock formations called “blueberries” on Mars (see Appendix 1, p. 41). This passage was also chosen based on the assumption that the topic was unfamiliar to participants, which was supported by data from the post-test survey.

Familiarity with each passage was assessed using a 1 to 5 scale (1= not at all familiar, 5= very familiar). For the *Off the Menu* passage, *M* = 1.43 (*SD* = 0.91). For the Space.com article, *M* = 1.79 (*SD* = 1.26). These data confirm that the students were not familiar with the passages that were presented and therefore it is unlikely that prior experience or knowledge had an impact on the results.

Recall. As noted in the introduction, recall questions require individuals to produce the answers to questions. There were 12 short-answer "recall" questions which required the participants to remember specific words or phrases from the passage without any visual cues. There were six questions from each of the readings (see Appendix 1, p. 44) and a score of 0-12 for this category based on how many questions were answered correctly.

Recognition. As noted in the introduction, recognition occurs when individuals have to identify the correct answer. Examples of recognition include identifying words or images that were previously presented or responding to multiple choice questions. In the present study, 12 multiple choice "recognition" questions were written in order to assess the participants' ability to recognize the correct answer to a question based on what they read. There were six questions from each of the readings (see Appendix 1, p. 43) and a score of 0-12 for this category based on how many questions answered correctly.

Music preferences and experience. In addition to examining the effects of background music, the study sought to examine college students' music preferences for studying. Music preferences were assessed by asking participants how often they listen to several genres of music (instrumental, rock, pop, country, alternative, R&B, and hip hop) while studying. Participants were also asked how often they listened to those same genres of music when not studying. The participants were asked to rate each genre on a 1 to 5 scale (1 = never, 5 = always).

As part of the study, participants were also asked about their experience playing an instrument. They were specifically asked if they had played or currently play an instrument, how long they played or have been playing, and what instrument(s) they play/have played.

Survey. In addition to questions on the passages, the participants were given a brief post-test survey (see Appendix 1, p. 46) to collect data on their gender, major, self-reported GPA,

dominant hand, first language, level of fluency in Italian, hours of sleep the night before, familiarity with the song "How Far I'll Go" and the two passages, and normal study habits in relation to music and other distractive stimuli. Level of fluency in Italian was assessed by asking the participants if they had ever taken an Italian language class, and if so, for how many years. Hours of sleep was assessed by asking the participants to choose from four options describing how many hours of sleep they had gotten the night before: 0-2, 3-5, 6-8, or $\geq$ 9. Next, participants were asked to rate how often they watched TV, listened to music, or needed a quiet room to study on a 1 to 5 scale (1 = never, 5 = always). Finally, participants were asked about their music preferences, as explained above.

Procedure

After attaining IRB approval, Bellarmine professors were contacted and asked for permission to advertise the study to their students and assistance with recruiting students. Participants used a Google Sheets spreadsheet to choose a timeslot, and each timeslot was randomly assigned to one of the four background conditions. The maximum number of participants in one timeslot was five in order to limit the effects of class size on testing condition. The same classroom was used for all participants, and all external conditions were kept constant to avoid confounding variables such as room size or ambience. All of the participants in the room at a particular time were in the same condition group.

When the participants entered the classroom and sat down, no music was playing. They were given a testing packet containing a consent form, the passages, the questions, and the post-test survey. They were first instructed to read the consent form, ask any questions they had, and sign the form. They were then informed that they had 10 minutes after they were signaled to begin in order to read both passages. They were instructed to sit quietly or reread the passages if

they finished reading before the 10-minute mark; they were asked not to move on to the questions until time was called. The researcher played the music or white noise at the same time that the participants were signaled to begin reading. When time was called, the music or white noise was stopped. They then had up to 10 minutes to complete the 24 questions and the post-test survey in silence. The questions started on a separate page from the passages, and the participants were instructed not to look back at the passages. No music played while they answered the questions. After they finished the questions and survey, they were thanked for their participation, and then they were free to leave. Data were entered into SPSS for analysis.

Results

After the participants completed the memory assessment and the post-test survey, the data were entered into SPSS. Once all data had been entered into SPSS, scores of the dependent variables were calculated, and distributions of the variables were examined. Prior to analyzing the data, all data were reviewed. Data for two participants who were not native English speakers were removed from the data set. Then, the four hypotheses were tested using a 4 (background condition) x 2 (question type) mixed-model ANOVA. Please note that all tables and figures are included after the reference section.

The post-test survey provided a substantial amount of descriptive statistics for the participants, which is summarized in Table 1 (see Table 1, p. 31). Most of the participants (79.2%) were women, and a majority of them (52.8%) were psychology majors. Only 26.4% had never played an instrument, and only 7.1% had ever taken an Italian language course (two participants, neither of whom were randomly assigned into the Italian background condition). On average these participants do not usually watch TV (M = 2.08, SD = 1.05) or listen to music (M =

2.81, *SD* = 1.13) while studying, and they sometimes need a quiet room in order to study (*M* = 3.89, *SD* = 0.993).

After the participants took the memory assessment and the post-test survey, the data was entered into SPSS. Once all data had been entered into SPSS, scores of the dependent variables were calculated and distributions of the variables were examined. The four hypotheses were tested using a 4 (background condition) x 2 (question type) mixed-model ANOVA. The post-survey data were analyzed using t-tests.

To review, the first hypothesis was that vocal music in English would negatively impact performance on tests of both recall and recognition of a passage written in English compared to vocal music in Italian, instrumental music, and white noise. The 4 (background condition) x 2 (question type) mixed-model ANOVA showed no effect of background condition on memory assessment performance, $F(3,49) = 0.66$, $p = 0.58$ (see Figure 1, p. 33).

The second hypothesis was that performance would be higher on recognition questions than on recall questions regardless of music condition. The 4 (background condition) x 2 (question type) mixed-model ANOVA showed a statistically significant effect of question type on memory assessment performance, $F(1,49) = 137.28$, $p = 0.001$ (see Figure 2, p. 34).

The third hypothesis was that music type would have a more noticeable effect on performance with recall questions than on performance with recognition questions. The effect of the interaction between background condition and question type on memory assessment performance was not statistically significant, $F(3,49) = 0.56$, $p = 0.65$ (see Figure 3, p. 35).

The fourth hypothesis was that participants who had played an instrument would be less affected by background music than participants who had never played an instrument, regardless

of background condition. The data showed no significant effect of playing an instrument on memory assessment performance, $F(1,49) = 1.826$, $p = 0.185$ (see Figure 4, p. 36).

In addition to completing the memory assessment, participants were asked to rate their preferences for listening to various types of music while studying. They were also asked to rate their preferences for each type of music normally (while not studying). Comparing music preferences while studying and music preferences outside of studying produced several significant findings (see Figure 5, p. 37). More specifically, participants reported a higher likelihood of listening to instrumental music while studying ($M = 2.76$, $SD = 1.48$) than when not studying ($M = 1.71$, $SD = 0.932$). For all other types of music, the pattern was reversed (see Table 2, p. 32 for *M, SD,* and *t* statistics).

Discussion

The results of this research study failed to support the first hypothesis that vocal music in English would negatively impact performance on tests of both recall and recognition compared to vocal music in Italian, instrumental music, or white noise. According to the data, listening to music while studying had no detrimental effect on test performance.

With respect to the second hypothesis, it was shown that participants' performance was statistically better on the recognition questions compared to the recall questions. Across all background conditions, participants scored significantly higher on the multiple choice section of the assessment than on the short answer section of the assessment. This result supports findings from previous literature.

The results of the study failed to support the third hypothesis that music type would have a more noticeable effect on performance with recall questions than on performance with

recognition questions. Although recall scores were lower than recognition scores overall, no significant difference was found between the background conditions for either question type.

The data does not support the fourth hypothesis that participants who play an instrument will be less affected by background music than participants who have never played an instrument, regardless of background condition. Playing an instrument does not seem to have a significant effect on participants' ability to study under the conditions of this research.

These results contradict several studies outlined in the introduction (de Groot, 2006; Angel, Polzezza, & Elvers, 2010; Ferreri et. al, 2013). Several potential explanations for this discrepancy exist. For one, the background song was held constant for all three music conditions; the only difference between the three versions was the presence/absence/language of lyrics. This consistency contrasts previous studies which used songs that differed vastly in cadence, tempo, and singing voice from condition to condition (Chew, Yu, Chua, & Gan, 2016). Holding the song constant ensured that the only variable between the three music conditions was the presence/ absence/language of lyrics, not other factors related to composition.

Another potential explanation for these results was the diversity of reading material used in the memory assessment. Many memory tests ask participants to memorize and recall or recognize lists of words (de Groot & Smedinga, 2014). This research study asked participants to read two unrelated passages, one science-based passage and one arts-based passage, and answer multiple choice and short answer questions about the passages. This setup can be more accurately compared to a true study/test situation than memorizing lists of words, and it is distinct enough to potentially explain the contradiction of the results. This study was designed so that the results could be more relatable to students studying for exams.

Limitations

Several limitations of this study could also provide an explanation for the results. First, the sample size of the study was very small (only 53 participants total and less than 15 participants for each condition). It is possible that the small sample size could have contributed to the lack of significant main effect of background condition. Previous studies that found a significant effect of background noise had a much larger sample size than the current study. A specific example of the effect of small sample size can be seen in the Italian music condition. Overall a majority of participants (73.6%) had played an instrument at some point in their life. However, due to random assignment and small sample size, the Italian language condition ended up with a majority of participants who had never played an instrument. With a larger sample size, each condition, including the Italian music condition, would have had a majority of participants who had played an instrument. The significance of this discrepancy is unknown, but it cannot be discounted as definitively unimportant. In the future, adding to the sample size could potentially change the results of the study.

Additionally, many of the participants noted on their post-test surveys that they preferred a quiet room when studying, but the experimental design for this study did not include a silence condition. The addition of a silence condition to the experimental design could be beneficial in order to determine whether white noise is a sufficient negative control. It would also have likely been beneficial to recruit only those students who regularly listened to music while studying. This detail would have involved prescreening the participants in order to determine what their normal study preferences were.

Another aspect of the experimental design that could be improved is the area of testing conditions. Although reading two passages and answering questions about them is a more

accurate portrayal of student studying, it is still not directly applicable to studying. The participants only have 10 minutes to read both passages, which is not enough time to truly "study" the reading material. Also, the students answered the questions immediately after reading the passages, which does not reflect a true testing situation. Ideas for future improvement include introducing a distraction task between reading and answering questions as well as giving the participants a longer timeframe during which to study the passages.

Another important limitation to consider is the memory assessment itself. The participants as a whole performed very poorly on the assessment; the means for all conditions were considerably lower than 50 percent. A possible explanation for this poor performance is the fact that the questions were written by the author of this thesis and might have been unreasonably difficult. In the future, this test could be repeated using a different memory assessment which results from several pilot studies to balance question difficulty.

Future Directions

Overall, this study found that listening to music with lyrics while studying does not have a significantly detrimental effect on test performance. However, post-test survey data indicates that students prefer to listen to different genres of music while studying than they prefer to listen to normally, which suggests that students find familiar songs/songs in their native language to be distracting. In order to explore that relationship more fully, this research could be repeated with a larger sample size, an added silence condition, and a redesigning of the experimental design to include a distractor task between studying and answering the questions. These factors should allow future researchers to have a better understanding of how music may impact memory.

Implications and Applications

Although the results of this study are statistically insignificant, the data show a slight trend in support of the hypotheses. With further research, it is highly possible that the data will show that background music does have a significant effect on memory assessment performance. This finding would have important implications in the areas of learning and memory, especially pertaining to studying. Research in this area is important because it helps to determine the most productive way to study in regards to background conditions. Students could use the results of this study to better understand how background conditions affect studying in order to choose studying conditions that are conducive to memory and learning.

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Table 1: Descriptive statistics for research participants

Survey Question	Background Condition				
	English	Italian	Instrumental	White Noise	Combined
Sex (Male)	N= 4 (28.6%)	N= 1 (8.3%)	N= 3 (21.4%)	N= 3 (23.1%)	N= 11 (20.8%)
Sex (Female)	N= 10 (71.4%)	N= 11 (91.7%)	N= 11 (78.6%)	N= 10 (76.9%)	N= 42 (79.2%)
Major (psychology)	N= 8 (57.1%)	N= 6 (50.0%)	N= 5 (35.7%)	N= 9 (69.2%)	N= 28 (52.8%)
Major (not psychology)	N= 6 (42.9%)	N= 6 (50.0%)	N= 9 (64.3%)	N= 4 (30.8%)	N= 25 (47.2%)
Never Taken an Italian Language Course	N= 13 (92.9%)	N= 12 (100%)	N= 13 (92.9%)	N= 13 (100%)	N= 51 (96.2%)
Have Played an Instrument	N= 13 (92.9%)	N= 5 (41.7%)	N= 11 (78.6%)	N= 10 (76.9%)	N= 39 (73.6%)
Have Never Played an Instrument	N= 1 (7.1%)	N= 7 (58.3%)	N= 3 (21.4%)	N= 3 (23.1%)	N= 14 (26.4%)
Watch TV While Studying	M= 1.64 (SD= 0.633)	M= 2.25 (SD= 1.29)	M= 2.14 (SD= 1.10)	M= 2.31 (SD= 1.11)	M= 2.08 (SD= 1.05)
Listen to Music While Studying	M= 2.29 (SD= 1.20)	M= 3.08 (SD= 1.16)	M= 2.86 (SD= 0.949)	M= 3.08 (SD= 1.12)	M= 2.81 (SD= 1.13)
Need a Quiet Room to Study	M= 4.36 (SD= 0.633)	M= 3.75 (SD= 1.22)	M= 3.86 (SD= 0.864)	M= 3.54 (SD= 1.13)	M= 3.89 (SD= 0.993)

Table 2: Results of *t* Test Comparing Music Preferences Normally and While Studying

Music Type	***M***	***SD***	***t*(52)**
Instrumental (Studying)	2.76	1.48	5.82
Instrumental (Not Studying)	1.71	0.932	
Rock (Studying)	1.79	1.15	-7.51
Rock (Not Studying)	2.94	1.36	
Pop (Studying)	2.19	1.09	-9.45
Pop (Not Studying)	3.64	1.15	
Country (Studying)	1.91	1.28	-5.02
Country (Not Studying)	2.72	1.49	
Alternative (Studying)	2.28	1.29	-6.21
Alternative (Not Studying)	3.26	1.39	
R&B (Studying)	1.61	0.841	-7.68
R&B (Not Studying)	2.98	1.38	
Hip Hop (Studying)	1.62	0.945	-5.09
Hip Hop (Not Studying)	2.98	1.38	

Figure 1: Main Effect of Background Condition on Memory Assessment Performance

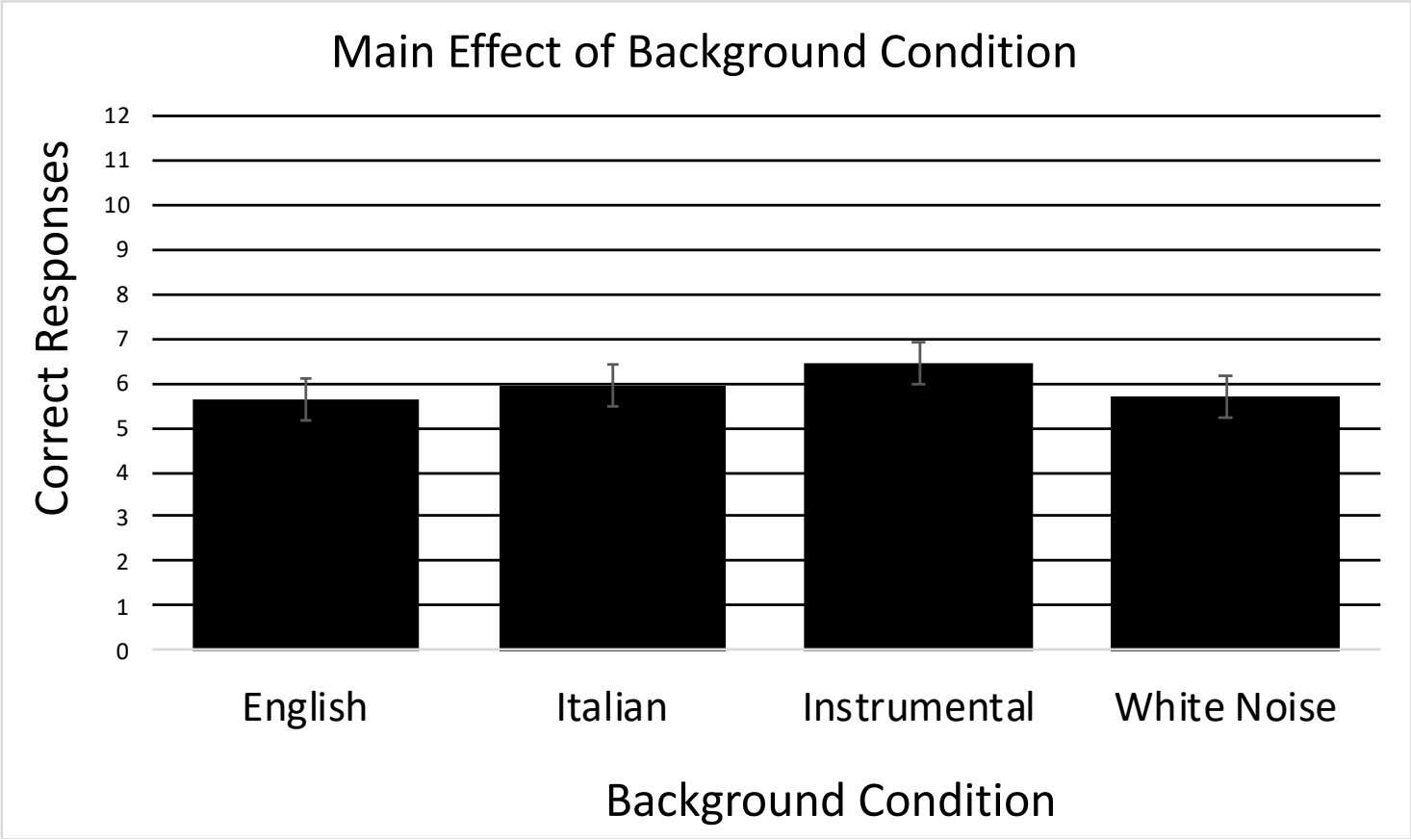


Figure 2: Main Effect of Question Type on Memory Assessment Performance

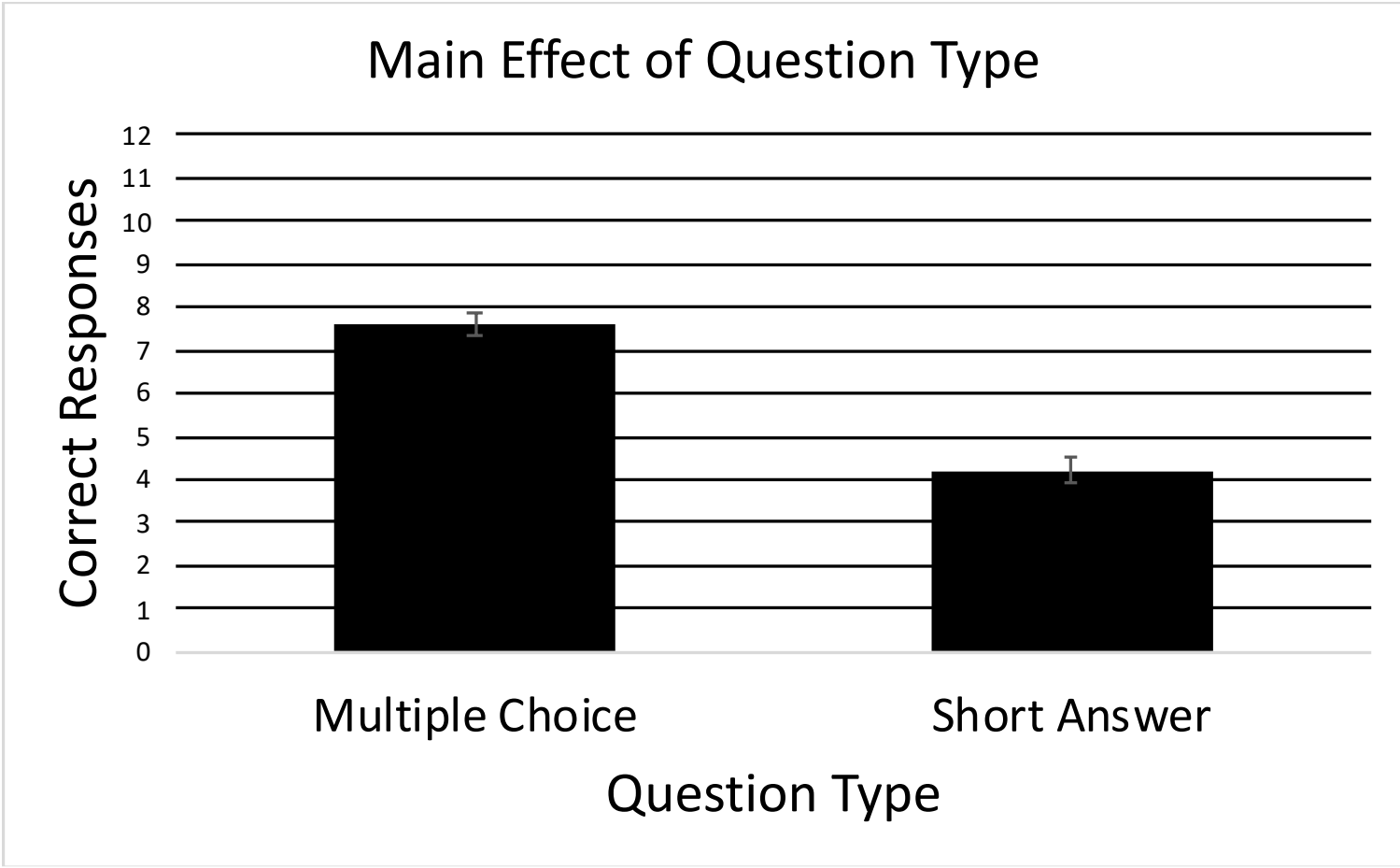
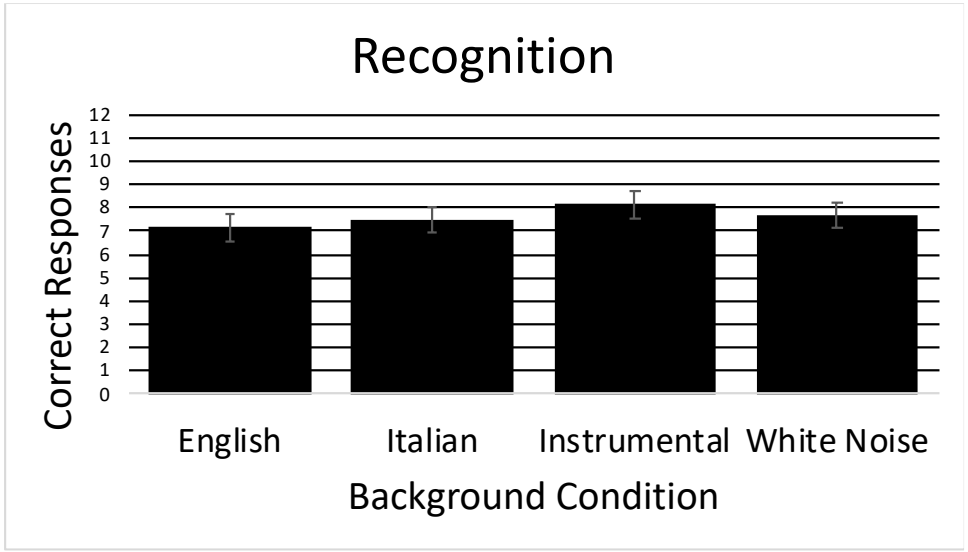


Figure 3: Interaction Between Question Type and Background Condition



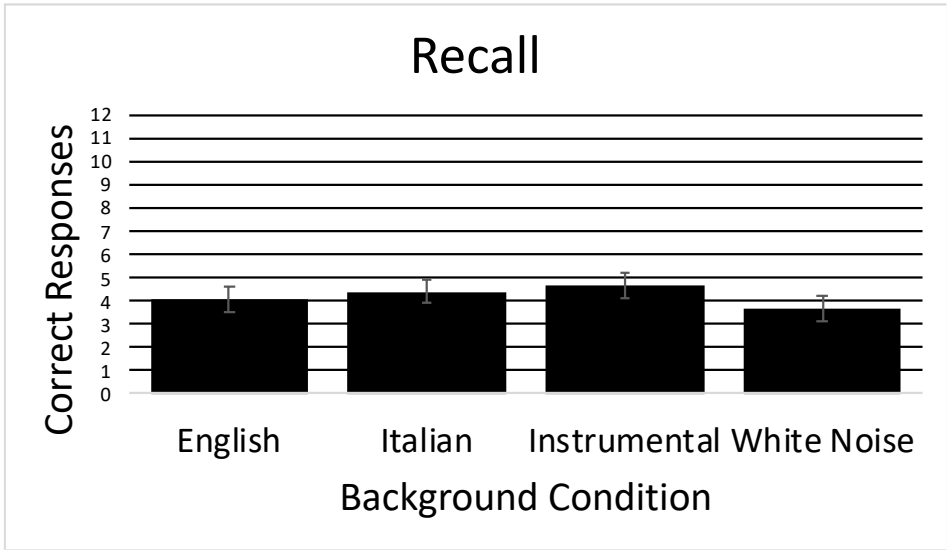


Figure 4: Interaction Between Playing an Instrument and Memory Assessment Performance

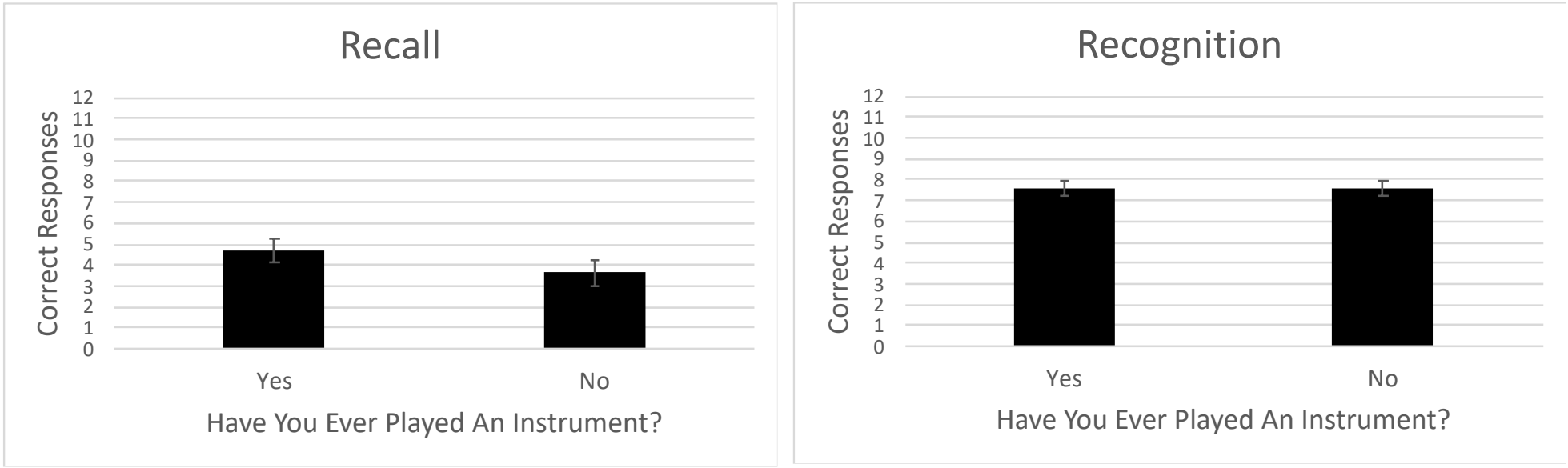
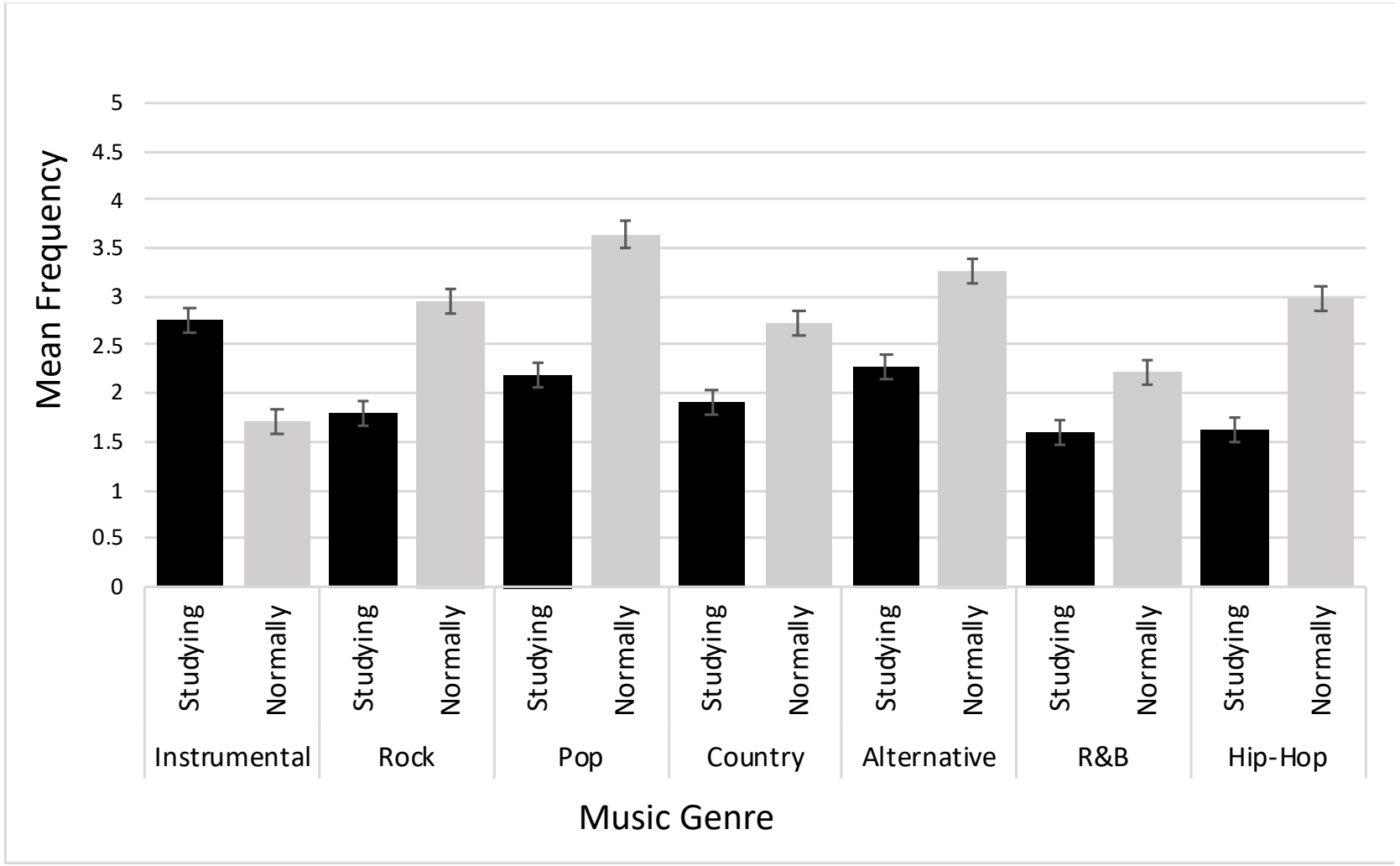


Figure 5: Music Preferences Normally Compared to While Studying



APPENDIX 1: MEASUREMENT INSTRUMENT

You will have 10 minutes to read the following two passages. You may write on the passages. If you finish reading before time is called, you may reread the passages, but do not move on to the questions until instructed to do so.

OFF THE MENU: ASIAN AND ASIAN NORTH AMERICAN WOMEN'S RELIGION AND THEOLOGY (2007) p.107-109

Ancestor veneration—rituals that honor the dead and ensure their continued existence—is an integral part of East Asian religious systems. Its expression takes on many forms: from *jingzu* in China to *chesa* for Koreans to Vietnamese *ngay gio* and Japanese *senzo kuyo*. The specificities of these various rituals in different Asian and Asian American contexts range from offering various sacrifices to deities on behalf of the ancestors and to the ancestors themselves in order to sustain their existence to performing ritual acts that remind us of their lives and deeds and the web of interdependence that links us to one another. We would not be here if not for our ancestors, and they would easily pass away if it were not for us. Such acts of veneration also instill in the practitioner a sense of the dialogic relationship between the past and the present—one that is intimate and binding.

While the majority of Asians now living in the United States are Christian, practical and psychic remnants of these traditions linger. It is not uncommon for Asian Americans to observe ancestral rites alongside their Christian faith and honor the dead in transformed ways (memorial services and filial piety "preached from the pulpit"). The significance of family and ancestors still greatly informs the ethos of Asian American religious life and underwrites structures of feeling that uniquely shape Asian American religious identity.

Christian or non-Christian, however, Asian Americans—especially second and subsequent generations—often hold ambivalent views toward ancestor veneration and Asian religious folk practices. There is a multitude of reasons for this (some of which I explore in this chapter). It is true that religious practices and identities are bound to change given the impact of migration, acculturation, and other social forces, as well as the decisions we make in our everyday lives. However, it is important to think about what we have given up in the process and consider ways that we can retain the spiritual legacy of our Asian ancestors and maintain our commitments to them, while remaining true to ourselves and our contemporary environment.

My Japanese American immigrant grandparents and great-grandparents traveled to the United States with ancestors in tow. While only one of my grandmothers ever made it back to Japan, their families

were never too far away. Through their stories and spiritual practices, they nurtured bonds that stretched across time and space to link samurai and rice farmers (in Japan) with engineers and peach farmers (in the United States). With my grandmother's passing (as well as that of my mother), I, too, hear their query: "Who will light incense for us now that we have gone?"

In 1993 I had just finished my master's degree in theological studies at Harvard Divinity School. While I had become familiar with the works of such philosophers of religion as Hegel, Feuerbach, Kierkegaard, and Kant, and also with the contemporary theological efforts of Gordon D. Kaufman, Sallie McFague, James H. Cone, and Virgil Elizondo, my connection to these Christian-based thinkers was always somewhat remote. Only when I was asked to organize a panel on religion for the Association for Asian American Studies (AAAS) did I begin to explore sources closer to home. For my presentation on the panel, I harnessed my training in theological method and invoked the spirit of my grandmothers—both devout Buddhists—to speak on a phenomenon that was close to my heart: the notion of ancestors.

My aim in bringing these two seemingly disparate traditions together—Christian constructive theology and Japanese American folk religion—was threefold: (1) to call attention to the spiritual and physic loss we suffer in a white Christian society, (2) to address the need for a theological vision that takes Asian religious frameworks seriously, and (3) to offer a practical method for (re)creating this vision. Ideally, such a method would challenge essentialized notions of Asian religions as well as ward off the temptation to appropriate these notions uncritically with little consideration of their history and use.

“‘BLUEBERRIES’ ON MARS HAVE A WATERY PAST. BUT SCIENTISTS ARE STILL BAFFLED.” NEWS ARTICLE FROM SPACE.COM (2018).

It was just a few months after NASA's Opportunity rover touched down on Mars in 2004 that it spotted a geological curiosity: tiny, iron-rich spheres scattered across the rock surface near the robot's landing site. Snack-loving scientists working with the mission dubbed these objects "blueberries," but the features were easier to name than to understand. Their recipe remains something of a puzzle.

Trying to sort out the origins of these blueberries has always involved studying similar-looking spherical formations here on Earth. New research takes its inspiration from these terrestrial analogs to offer a new idea of the chemistry that may have gone into whipping up these Martian blueberries. In turn, this research helps reveal what ancient Mars may have looked like.

The blueberries are tantalizing for more than just their whimsical name; they also constituted some of the earliest evidence we had that Mars was once incredibly wet. "No matter what the exact chemistry of these spherules was to start, the fact that they're there tells us [that] a lot of liquid water moved through these rocks over time," Briony Horgan, a planetary scientist at Purdue University in Indiana, told Space.com.

And if scientists can parse out precisely how the blueberries formed, that may help us understand what Mars was like back when the features formed — and what sort of life could have theoretically thrived in those circumstances, Horgan said.

So, the team behind the new research traveled to two different terrestrial destinations in search of rock formations that resemble Martian blueberries: Utah and Mongolia. These formations aren't identical to those on Mars, which are about a tenth the size of the Earthly equivalents. Our planet's formations are also less orderly than the Martian versions. "They're all blobbed together. They're different sizes," Horgan said of the terrestrial features.

But it's much easier to get to Utah and Mongolia than to Mars, so scientists use these features despite the imperfect comparison. The researchers found that the formations seemed to have been built around cores of a mineral called calcite, with iron-rich material in only the outer

shell. "That moment [of discovery], it was very exciting," geochemist co-authors Hidekazu Yoshida of Nagoya University and Hitoshi Hasegawa of Kochi University in Japan, wrote in an email to Space.com.

Based on those observations in the field and chemical modeling, the scientists suggested that floods of iron-rich, gently acidic water washed over the original calcite structures. Unlike the terrestrial versions, Martian blueberries seem to be made of hematite all the way through, no longer sporting any calcite heart. But that could point to a long period of overwash that ate through all the calcite, the researchers said.

The nagging details of chemical reactions that may or may not have taken place on early Mars have larger implications. First, these details are relevant to scientists' natural interest in all that water that flowed through rocks to form the blueberries. "The chemistry of water tells us about the habitability of the environment," Horgan said.

The second potential implication would relate to another long-standing debate about Mars — what happened to its once-thick atmosphere. The authors in the new study argued that this atmosphere could have gone into the carbonate ions locked in calcite precursors to the blueberries.

But that wouldn't solve the atmospheric mystery, Steve Ruff, a planetary geologist at Arizona State University who works on the Opportunity mission, told Space.com. "My sense of what we know about the area of the hematite that we can map from orbit is it's not a huge area," covering less than 1 percent of Mars' surface, he said. There just aren't enough blueberries to pack away very much atmosphere.

He said he also worries that Earth's formations aren't similar enough to those on Mars for scientists to learn about the blueberries. But Ruff didn't dismiss the new paper. "I'm intrigued by this idea," he said. "The formation of these little concretions on Earth and certainly on Mars has always been a bit of a mystery, and there's multiple ideas about how you form these things."

Once you have finished reading,
please wait until you are instructed to continue.

Please answer the questions below by circling the correct response.

1. The Martian "blueberries" are _____ all the way through.
    a. iron
    b. hematite
    c. sulfur
    d. calceolate

2. NASA's rover touched down on Mars in:
    a. 2004
    b. 2006
    c. 2008
    d. 2010

3. The presence of the blueberries suggests that Mars was once very:
    a. Hot
    b. Dry
    c. Wet
    d. Cold

4. The structures on Earth are _____ the "blueberries" on Mars.
    a. Smaller than
    b. Larger than
    c. The same size as
    d. Denser than

5. How large is the area of the hematite on the surface of Mars?
    a. More than 25%
    b. About 10%
    c. Less than 1%
    d. None of the above

6. The "blueberries" are potentially related to the debate about Mars':
    a. Core
    b. Distance from the sun
    c. Seasonal changes
    d. Atmosphere

7. Which of the following terms is matched correctly to its culture of origin?
    a. *jingzu* → Japanese
    b. *chesa* → Korean
    c. *senzo kuyo* → Vietnamese
    d. *ngay gio* → Chinese

8. What word did the author of *Off the Menu* use to describe the relationship between past and present?
    a. Dialogic
    b. Disjointed
    c. Comparative
    d. Disheartening

9. A majority of the Asians currently living in the United States are:
    a. Atheists
    b. Buddhists
    c. Christians
    d. None of the above

10. What still greatly informs the ethos of Asian American religious life?
    a. Tolerance and acceptance
    b. Sacrifice to deities
    c. The significance of family and ancestors
    d. Practices from other cultures

11. The author of *Off the Menu* earned her master's degree at:
    a. Princeton Divinity School
    b. Yale Divinity School
    c. Harvard Divinity School
    d. Chapel Hill Divinity School

12. Both of the grandmothers of the author of *Off the Menu* were devout:
    a. Christians
    b. Muslims
    c. Jews
    d. Buddhists

For the following questions, please write the answers in the space provided.

1. Which two places on Earth have similar formations to the "blueberries" on Mars?

2. What was the name of NASA's rover?

3. The rock formations on Earth have a center made of a specific mineral. What is this mineral called?

4. What is the last name of the planetary geologist from Arizona State University who works on the Opportunity mission?

5. What mineral was the water that flowed over the original structures to form the "blueberries" was probably rich in?

6. At which university is Indiana is Briony Horgan a planetary scientist?

7. What tradition does the author of *Off the Menu* call "an integral part of East Asian religious systems"?

8. From which country did the parents and grandparents of the author of *Off the Menu* immigrate?

9. What did the mother and grandmothers of the author of *Off the Menu* rhetorically ask her to light in their honor after they passed away?

10. What word does the author of *Off the Menu* use to describe how second-generation Asian Americans feel about Asian religious folk practices?

11. In the reading, the author describes a "web of _____" that joins living Asians with their ancestors. What word completes the phase in quotation marks?

12. How many goals did the author of *Off the Menu* have in bringing her two disparate traditions together?

Please continue on to the next page. Once you continue, you may not change your answers on the previous questions.

Below are a series of questions about you, your study habits, and the task you just completed. Please complete the questions. When you are finished, turn the packet over.

1.	Sex (circle one): M F
2.	Major(s) at Bellarmine:
3.	Minor(s):
4.	GPA:
5.	Are you right-handed or left-handed (circle your response)? Left Right
6.	Is English your first language (circle your response)? YES NO
7.	Have you ever taken an Italian language class (circle your response)? YES NO
	If yes, how many years total? _____
8.	Have you ever played a musical instrument(s) (circle your response)? YES NO
	If yes, which instrument(s)? _____
	If yes, how many years total? _____
9.	How many hours of sleep did you get last night (circle your response)? 0-2 3-5 6-8 $\geq$ 9
10.	Which sound was playing in the background while you were reading the passages (circle one)?
	Music with words in English
	Music with words in a foreign language
	Music without words
	White noise
	I didn't notice any sound

For the following questions, please indicate how familiar you are with each.

Use a scale of 1 to 5 where 1 = Never and 5 = Always. Circle your response for each answer.

	Not all Familiar		Somewhat Familiar		Very Familiar
Song "How Far I'll Go" from the movie *Moana*	1	2	3	4	5
Passage titled "Off the Menu"	1	2	3	4	5
Space.com Article	1	2	3	4	5

Which of the following conditions are a normal part of your study routine?

Use a scale of 1 to 5 where 1 = Never and 5 = Always. Circle your response for each answer.

When I study I:	Never		Sometimes		Always
Watch TV, a show, or other media	1	2	3	4	5
Listen to music	1	2	3	4	5
Need a quiet room to study.	1	2	3	4	5
Other (please explain) _____	1	2	3	4	5

If you listen to music when you study, how likely are you to listen to each of the genres below?

Use a scale of 1 to 5 where 1 = Never and 5 = Always. Circle your response for each answer.

When I study, I listen to:	Never		Sometimes		Always
Instrumental (no words)	1	2	3	4	5
Rock	1	2	3	4	5
Pop	1	2	3	4	5
Country	1	2	3	4	5
Alternative	1	2	3	4	5
Rhythm and blues (R&B)	1	2	3	4	5
Hip hop	1	2	3	4	5
Other (please list) _____	1	2	3	4	5

If you listen to music outside of studying, how likely are you to listen to each of the genres below?

Use a scale of 1 to 5 where 1 = Never and 5 = Always. Circle your response for each answer.

When listening to music, I listen to:	Never		Sometimes		Always
Instrumental (no words)	1	2	3	4	5
Rock	1	2	3	4	5
Pop	1	2	3	4	5
Country	1	2	3	4	5
Alternative	1	2	3	4	5
Rhythm and blues (R&B)	1	2	3	4	5
Hip hop	1	2	3	4	5
Other (please list) _____	1	2	3	4	5

Thank you for your participation!