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The Role of Extraversion, Sensitivity to Music Reward, and Music Tempo on Word Recall

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THE ROLE OF EXTRAVERSION, SENSITIVITY TO MUSIC REWARD, AND MUSIC TEMPO ON WORD RECALL

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Abstract

The Mozart Effect refers to the theory that exposure to classical music will make people more intelligent. This theory was inspired by Rauscher, Shaw and Ky (1993) who found spatial-temporal reasoning improved in college students after exposure to a Mozart sonata. Thompson and Schellenberg (2001) confirmed this finding however discovered individual differences in arousal was a mediating factor. Nantais and Schellenberg's (1999) also confirmed the results of Rauscher et al. (1993) except they found advantages were from individual differences in music preference. The present study explored whether the benefits of classical music extend to other memory processes such as recall, while considering individual differences. To test this, 56 first-year psychology students completed Eyesenck's Personality Inventory (Eysenck & Sybil, 1963), the Barcelona Music Reward Questionnaire (Mas-herrero, Marco-pallares, Lorenzo-seva, Zatorre, & Rodriguez-fornells, 2013), and a music experience questionnaire. Participants then were exposed to a three-minute Mozart excerpt from the "Eine Kleine Nachtmusik – Allegro" that was either slow, regular or fast tempo, then completed an immediate recall task. Participants received a 16-word list for 2 minutes, then wrote what they could recall. A 2X2X3 ANOVA showed no significant main effects, no interaction effect for tempo X music reward, extraversion X music reward, or for tempo X music reward X extraversion. A significant interaction effect was found for tempo X extraversion. Independent t-tests found low extraversion people performed significantly better with regular than the slow tempo and that low extraversion people performed significantly better than high extraversion people with regular tempo. Implications, limitations and future directions are discussed.

Keywords: extraversion, sensitivity to music reward, tempo, word recall

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Table of Contents

Introduction

Music is common in the environments most of us live in. By definition, music is the art of ordering tones or sounds in succession, in combination, and in temporal relationships, to produce a composition having unity and continuity (music, n.d.). For example, it can be heard in countless places, including in the stores in which we shop, in our vehicles when we drive, or on our cellphones when we exercise. Music can be used for calming purposes like relaxation before bedtime, or for excitation purposes like increasing one's energy level before a race. Research has shown people expose themselves to music for mood and arousal regulation, to achieve self-awareness and as a way to express social relatedness (Schafer, Sedlmeier, Stadtler, & Huron, 2013).

Exposure to music, such as classical music, can be associated with improved brain function. This phenomenon is often referred to as the Mozart Effect. Many products and programs have been created for since the 1990s based on the idea that classical music improves brain function. During this time, the Governor of Georgia helped establish a program that provided classical music CDs to new mothers to stimulate brain development in infants (Georgia's Provision, 1998). In addition, the State of Florida passed legislation requiring daycare programs for infants and young children to provide daily activities fostering brain development, including exposing the children to classical music (Infants, 2012). To capitalize on the trend, Don Campbell trademarked the "Mozart Effect" in 2016 for use in his best-selling book and CD series (The Mozart Effect, 2016). The "Mozart Effect" trademark, which remains active, is defined as "an inclusive term signifying the transformational powers of music in health, education and well-being" (Mozart Effect, n.d.).

Rauscher et al. (1993) conducted the research that first inspired the Mozart Effect phenomenon. Their research significantly changed the way people conceptualized and used classical music. The authors' study involved 36 college students who were exposed to either one of Mozart's sonatas in D-major, a relaxation tape, or silence, followed by the completion of a spatial memory task. The results showed that students who had been exposed to the Mozart piece had enhanced performance on the spatial task and higher task-related IQ scores compared to those who were exposed to either the relaxation tape or silence. These researchers posited a causal relationship between exposure to music and task performance. They published their results in *Nature*, which inspired the coining of the term "Mozart Effect" by journalists and the general public.

The finding by Rauscher et al. (1993) that music improved certain types of task performance was both popular and controversial. Since their pilot study, several researchers have attempted to replicate and expand their findings. Many studies were able to replicate the effect that exposure to classical music improved spatial task performance (Rauscher, Shaw, Levine & Ky, 1994; Thompson & Schellenberg, 2001). Although several studies found similar results as Rauscher et al. (1993), the mediating variable for the cognitive effects was often found to be not music but rather other factors such as individual differences in arousal (Thompson & Schellenberg, 2001), individual differences in music preference (Nantais & Schellenberg, 1999) and tempo (Husain, Thompson, & Schellenberg, 2002). The finding that many non-music factors are responsible for the Mozart Effect indicates the need for further evaluation into stable traits such as individual differences. A meta-analysis by Chabris (1999) led to the conclusion that the Mozart Effect was due to differences in arousal. Chabris (1999) concluded that individual differences in general arousal and music-related arousal responses all played a large role in the effects of music on cognitive task performance. The present research was designed to further explore the role of individual differences in arousal and the ability to perceive music experiences as rewarding on recall.

One way in which individuals can fundamentally differ in arousal levels is as a result of their levels of extraversion. Eysenck's Personality Theory posits that people high in extraversion have lower cortical arousal at rest compared to people low in extraversion (Eysenck, 1967). Eysenck's theory emphasized that individuals high in extraversion tend to seek external sources of stimulation to help them reach their ideal arousal level. Conversely, individuals with lower levels of extraversion are expected to have higher arousal naturally, so excess external stimulation can be exhausting. From Eysenck's Personality Theory one can predict that individuals high in extraversion are more likely to experience cognitive benefits from music in cognitive tasks, whereas individuals low in extraversion may not experience these benefits to the same extent. Another way to understand Eysenck's Personality Theory is by comparing it to the Yerkes-Dodson Law. This Law posits that individuals have an optimal performance level, and that too much arousal or too little can cause poor performance (Yerkes & Dodson, 1908). Eysenck's theory allows one to predict that people low in extraversion reach their optimal performance level more easily than people high in extraversion. This difference in optimal performance peak is predicted to be responsible for differences in improved cognitive effects post music exposure.

Music preference refers to what type of music a person most enjoys. Schäfer and Sedlmeier (2010) found that the main determinants of a person's music preference were the *cognitive effects* of the music (i.e., music as a method of communication and self-reflection) and the *arousal effects* elicited by the music. This finding showed that there was a relationship between how one experiences music and subsequent cognitive effects. Ferreri and Rodriguez-Fornells (2017) determined that music-related reward responses predicted better memory recall. Specifically, they found that music rated as more rewarding was significantly better recognized and remembered. Sensitivity to music reward is a dimension that can be measured to assess individual differences in response to musical experiences. The research by Schäfer and Sedlmeier showed that how receptive someone is to music reward can predict their arousal response to music.

Degree of extraversion, sensitivity to music reward, and response to tempo can be viewed as manifestations of individual differences in arousal. Previous research has determined that arousal contributes to improved spatial task performance (Thompson & Schellenberg, 2001). The researchers did not, however, examine what type of sources of arousal might have influenced the differences in spatial performances. In the present study, I predict that individual differences in extraversion, sensitivity to music reward, and manipulations to tempo all predict better recall. Specifically, people high in extraversion and sensitive to music reward are predicted to show greater word recall after exposure to fast tempo music compared to slow tempo music.

There currently exists a gap in the literature studying the effects of individual differences in arousal and sensitivity to music reward and music tempo on cognitive tasks, specifically memory tasks. While there is some research on the effect of tempo on recall, it has not been studied while considering extraversion and music reward sensitivity. This present study has been designed to further explore the Mozart Effect, with a focus on individual differences in extraversion, response to music reward and different music tempos. In the literature review below, possible explanations for why extraversion, sensitivity to music reward, and tempo may be related to word recall are discussed.

Literature Review

Music and recall

Previous research has shown conflicting results about the relationship between exposure to classical music and improved recall. It appears there is a lack of a unified approach in this area of study. Some studies have confirmed that classical music played before a cognitive task improves performance (Rauscher et al., 1993; Rauscher et al., 1994; Thompson & Schellenberg, 2001), but only in spatial-temporal tasks. Rauscher et al. (1994) confirmed that although classical music improved spatial-temporal task performance, no improvement was found on a recall task. They also concluded that repetitive music styles such as minimalist music, story, or dance music had no effect on spatial task performance. Although these studies all confirmed an effect of music on cognition, they found different reasons for the outcome. Several aspects of the findings by Rauscher et al. (1993) have faced criticism. The length of the time for which the Mozart music influenced spatial-temporal tasks is one area of concern. Rauscher et al. (1993) found that the Mozart Effect only lasted 10 to 15 minutes, which does not support the idea of a long-term effect of classical music. Although the researchers claimed to have found no order effects or experimenter bias, they did not discuss the possibility that the non-Mozart music conditions could have impaired memory. However, they suggested that the length of music exposure, music complexity, other measures of general intelligence (e.g., short-term memory) and musical experience could influence cognitive task performance. One of the most notable concerns of the findings by Rauscher et al. (1993) is the generalizability of the results. They inferred a casual relationship between exposure to classical music and cognitive abilities related to abstract operations like math and spatial reasoning. Some researchers including Husain et al. (2002) as well as Nantais and Schellenberg (1999) were able to repeat the findings of Rauscher et al. (1993), whereas others refuted their original findings. Steele, Bass and Crook (1999) performed an exact replication of the original study by Rauscher et al (1993). They failed to produce a statistically significant Mozart Effect and failed to find an effect size that indicated practical significance. Previous studies revealed that music definitely affects at least some memory processes; however, there is limited consensus on which processes are influenced by which factors, consistently. It is challenging to compare different studies involving the effects of music and memory when there is significant inconsistency across the types of music used and types of measures of memory. Thus, there appears to be a need for research that better controls the type of music used and type of memory task used.

The extent of the benefits of music on memory has been found to depend on factors such as music complexity, tempo, rhythm, and melody (Fererri & Verga, 2016). A possible explanation for this is that different aspects of music complexity affect different aspects of cognitive processing, which might lead to different cognitive outcomes. There is evidence that individual factors such as susceptibility to arousal and listener preference toward a music piece mediate recall. Nantais and Schellenberg (1999) replicated and expanded on the findings of Rauscher at al. (1993). They confirmed the original findings and determined that any cognitive benefits disappeared when the participants in the music condition were exposed to a narrated story instead of silence. They discovered cognitive performance was a function of listener's preference (music or story) and that better performance was seen when listeners were exposed to their preferred audio type. Their findings show that whether someone likes a piece of music can predict the effect of that music on performance on a cognitive task.

Thompson and Schellenberg (2001) evaluated the role of enjoyment, arousal, and mood, as mediators of the Mozart Effect. The researchers wanted to determine whether the cognitive improvements after exposure to Mozart music were due to individual differences in arousal and mood. They discovered that when individual differences in enjoyment, arousal and mood measures were kept constant using statistical methods, the Mozart Effect disappeared. They proposed that the Mozart Effect is the consequence of arousal and mood changes. Their findings suggested that individual differences in arousal can predict differences in cognitive performance.

Tempo and recall

One reason Rauscher et al. (1993) used Mozart music in their research was because of its known complexity. In their original study, the researchers predicted that music lacking complexity or with high repetition, would likely interfere with cognitive processes rather than enhance them. Percino, Klimek and Thurner (2014) considered music complex if it showed the property of having both high variety and low uniformity in instrumentation. According to Streich (2006), “Twinkle, Twinkle, Little Star” is low complexity compared to the much more complex “Pr´elude a L’apr`es-midi D’un Faune” by Debussy.

Tempo is the speed at which music is played and is the Italian word for “time.” Tempo helps music composers better convey their feelings to the audience, such as feelings of intensity and relaxation. Tempo is strongly related to the musical element of rhythm. Tempo is rarely static; rather, it is constantly changing in classical music and this helps create interest for the listener. Tempo can be slow, or fast, and may vary within one music piece. According to Fernandez-Sotos, Fernandez-Caballero, and Latorre (2016), tempo helps listeners interpret music in an organized manner, and tempo is the basis on which melodic-harmonic lines are built.

Complex music is the type of music often associated with improving cognitive function, such as is seen in the Mozart Effect. Past research has shown that the type of music an individual is exposed to can affect recall. Tempo, which typically varies by genre, can play a role in music's ability to affect memory. Bugter and Carden (2012) evaluated the effect of different music genres on a memory task. Participants were exposed to rap music, classical music or silence while playing the card game Concentration. In Concentration, players take turns flipping up two cards on each turn with the goal of flipping up two identical cards. Non-matching card pairs are flipped back face down. Matching pairs are removed from the table. The game continues until all pairs of cards have been removed. The winner is the person with the most card pairs. The number of flips required to complete the game was measured and used as the memory score. Bugter and Carden found that those exposed to classical music during the game required fewer flips to win, indicating greater memory for card locations. One limitation of this study is that although the results revealed which music type facilitated recall, mediating factors were not explored. It is important to be aware that this study used different tempos of music during the memory task rather than prior to the memory task. Most available research on tempo has used music as a background feature. No relevant research was found involving the role of tempo when is played prior to a memory task. The generalizability of the past research should be interpreted with caution. There may be differences in the memory outcomes when different tempo music is played prior or post task. Bugter and Carden (2012) also failed to control for the presence of lyrics, which may have affected the outcome.

The present study was designed to evaluate the effects of tempo on recall. Past research on the effects of tempo on recall has shown mixed results. Some studies have found improvement in recall due to exposure to music with a faster tempo. Ting and Karthigeyan

(2009) studied the effects of three music tempos (60 bpm, 120 bmp, 165 bpm) versus a no-music control on recall when two different learning strategies were used (maintenance rehearsal versus imagery techniques). They found that participants achieved the highest recall in the 120-bpm condition as compared to all of the other conditions, which, did not differ regardless what task type. Husain, Thompson and Schellenberg (2014) studied the effects of tempo and mode on spatial ability. They recorded a Mozart sonata and edited it to produce four versions that varied in tempo (fast or slow) and key (major or minor). Participants were exposed to one of the four altered sonatas and completed a measure of spatial ability. Results showed improved performance on the spatial task after exposure to music at a fast rather than a slow tempo. Sibley (2007) studied the effects of tempo (fast and slow), and vocal and non-vocal background music on recall in individuals with high and low extraversion. They found a main effect for music condition. People low and high in extraversion both recalled more words in the fast tempo vocal music condition. These studies all determined that fast tempo has an influence on subsequent task performance; however, this influence may depend on whether the music was in the background or played separately or prior to a task. This distinction is important because background music may have distraction effects, in addition to influencing arousal. Husain, Thompson and Schellenberg (2002) studied the effects of classical music on spatial task performance while controlling for music tempo and key. Participants were exposed to a Mozart sonata altered in tempo (fast or slow) or key (major or minor), and then measured spatial ability, arousal and mood. They found superior performance by individuals who were exposed to music at a fast tempo and when the music was in a major key. The researchers also concluded that tempo modifications affected arousal but not mood. The findings of Thompson and Schellenberg (2002) findings suggest that manipulating tempo can affect cognitive ability by altering arousal.

Some studies have found music with fast tempo worsens recall or has no effect. Mailov (2011) exposed participants to music with fast and slow tempos and to no music at all while they made duration estimations and content recall of a video advertisement. The results showed performance on the recall task was significantly lower in the slow tempo condition whereas no significant differences were found in recall for the fast tempo and no music conditions.

Conversely, other studies have found no significant effect of tempo on recall. Isarida, Kubota, Nakajima and Isarida (2017) re-examined the mood-mediation hypothesis for explaining background-music-dependent effects in free recall. In one of their experiments, participants learned a list of 20 unrelated words presented one by one for 5 seconds and then received a 30-s delayed oral free-recall test. Music was played throughout both the study phase and the testing phase. During recall, one third of the participants received the same piece of music with the same tempo as at study, one third were exposed to different piece with the same tempo, and one third were exposed to a different piece with a different tempo. The condition of the same piece with a different tempo or tonality was intentionally excluded. Isarida et al.'s (2017) results showed no effect of music tempo, only a background-music-dependent effect on word recall.

Jurkovic, Anderson, Myklejord, Levin and Lotz (2013) studied whether an individual's memory improved while exposed to music with a varied tempo. For the memory test, participants engaged in an online pattern-recall exercise. Participants were exposed to either fast or slow tempo music or to no music. Results showed there was no statistically supportive evidence that music tempo affected pattern retention. Jurkovic et al.'s (2013) results showed that in some circumstances music tempo has no significant effect on memory.

Extraversion and recall

The extraversion dimension of personality is related to how individuals respond to music (Vella & Mills, 2017). Extraversion has a relationship with what type of music individuals prefer exposing themselves to (Vella & Mills, 2017). It can explain how a person responds to arousal from different activities (Eysenck, 1967). Whether using the Big Five Personality assessment method or using the Personality Inventory by Eysenck (1967), research has consistently shown that extraversion is related to music preference (Tully, 2012; Vella & Mills, 2017; Miranda, Morizot, & Gaudreau, 2010). Eysenck and Eysenck (1967) proposed that a person's arousal level depends on their extraversion levels. Their theory predicts that these individual differences in preferred arousal levels can lead to interaction effects with background noise type and task type.

Furnham and Allass (1999) evaluated the effects of complexity in background music on performance on four tasks completed by individuals considered high and low in extraversion. Background conditions used were simple music, complex music, or silence. All participants completed a comprehension test (which tested understanding after reading a text), an observation task and a recall task (immediately or delayed by six minutes). In the observation task, participants saw patterns with a piece removed and had to choose the correct missing piece from eight choices. For the recall task, participants saw twenty familiar objects as simple line drawings and had to recall the name of the objects. With respect to the reading comprehension, no main effect of extraversion, no main effect of music condition, and no interaction between these two variables was found. The observation test revealed no main effect of extraversion or background music; however, it found an interaction effect between music and extraversion. In the memory test with immediate recall, a strong main effect for extraversion was found but no main effect of music emerged, and again an interaction between extraversion and type of music was revealed. Those low in extraversion scored highest after silence and lowest after the complex music, whereas the opposite was true for those high in extraversion. This finding is consistent with Eysenck's theory, which states that those low in extraversion do not need as much external arousal for optimal functioning. In the memory test for delayed recall, there was a marginally significant main effect of extraversion and no type of music effect, but there was an interaction between these two predictor variables. The delayed recall results showed that those low in extraversion scored worst in the complex music condition whereas those high in extraversion scored best. A paired samples t-test was conducted on the distraction levels reported by participants. A significant difference was found in the presence of complex background music, but not when music was simple or low in complexity. An independent samples t-test showed that participants low in extraversion thought complex music was significantly more distracting than simple music whereas participants high in extraversion did not report any significant difference in distraction between music types. These results continue to be consistent with the arousal differences in individuals with high and low extraversion proposed by Eysenck (1967).

Similar to Furnham and Allass (1999), Furnham and Bradley (1997) studied immediate recall and delayed recall in individuals with high and low extraversion who were exposed to background music or silence. They found both personality styles performed worse in the presence of music in immediate recall. Results of the delayed recall task showed participants low in extraversion with background music did significantly worse than those in the same condition and in the silence condition. These findings demonstrate that the dimension of extraversion can predict recall in the presence of background music. Most studies in the area of extraversion have focused on background music, which has been shown to have distractive effects (Furnham & Allass, 1999; Furnham & Bradley, 1997).

The effects of background music on individuals with high and low extraversion have been found to be different in non-North-American populations. Kou, McClelland and Furnham (2018) tested Chinese participants who primarily spoke Mandarin and were without long-term foreign experiences. They studied the effects of varying levels of background music and extraversion level. Background conditions used were Chinese pop songs, background office noise, and silence. Results showed no main effect of background noise on cognitive test performance (math and reading tasks), and no interaction effect between extraversion and background music. Kou et al. (2018) hypothesized that Chinese people are more used to noisy backgrounds thus less affected by sounds when performing complex cognitive tasks. This finding suggests habituation can potentially overcome the cognitive effects of background music on different extraversion levels.

Something to be cautious of when making generalizations from the research conducted on extraversion and music is whether the music was played before or during a task. Ideally, previous research should have focused on the recall performance post-exposure music; however, limited studies of this nature were found. Past research has suggested that music played during a task can have a distracting effect on recall (Furnham & Allass, 1999; Furnham & Bradley, 1997; Kou et al., 2018). Research involving the effects of music during a task on recall was included to add to the depth of the present study literature review. Some aspects of such previous research could potentially be applicable to the present study. To summarize, he cognitive effects of music may be different depending on whether music is played before or during a task.

Sensitivity to music reward and recall

Sensitivity to music reward is another way to refer to the individual differences in response to music. Although exposure to music is typically thought of as a pleasurable experience, some people may find it more enjoyable than others do. Mas-Herrero, Marco-Pallares, Lorenzo-Seva, Zatorre and Rodriguez-Fornells (2013) proposed that the music reward experience contains five factors: music seeking, emotion evocation, mood regulation, social reward and sensory-motor. They created The Barcelona Music Reward Questionnaire (BMRQ), which can be used to study individual differences in music perception and overall sensitivity to music.

The BMRQ allowed researchers to advance studies in the area of music reward response and memory. Prior to the BMRQ, few studies evaluated the role of sensitivity to music reward on memory. Ferreri and Rodriguez-Fornells (2017) used the BMRQ to investigate whether music-related reward response could modulate episodic memory. Participants both rated (in terms of arousal, familiarity, emotional valence and reward) and were exposed to, unfamiliar classical music excerpts. Participants were exposed to 24 excerpts lasting 20 seconds each. After 24 hours their memory was tested. Participants were exposed to 24 old and 24 new music excerpts lasting ten seconds each. Participants were tested on recognition (prior exposure vs no prior exposure). If the participant indicated they had been exposed to an excerpt before, they had to indicate a reason. Participants had to indicate whether they remembered something specific about the study episode, somehow knew they have had exposure to the song before or if they guessed. Results showed that excerpts rated by participants as more rewarding were significantly better recognized and remembered.

Lim and Park (2018) studied the effects of music on arousal and cognitive performance. Participants performed four different music-related tasks and one non-musical task. Participant ability to recall lyrics was measured, as well as their perception of enjoyment of the music. The researchers found that changes in arousal after a music task were related to enjoyment of the music task, and that this enjoyment mediated the relationship between arousal and recall by predicting recall. Although enjoyment was suggested as the mediating variable, differences in arousal could have led to differences in enjoyment. They concluded that a person's ability to enjoy a music experience plays an important role in the relationship between music-induced arousal and memory. Although Lim and Park (2018) did not evaluate sensitivity to music reward directly, their results emphasize the importance of being able to enjoy and be rewarded from music.

Present experiment

The present study will explore the role of music reward sensitivity, tempo and extraversion as predictors of recall. Music reward sensitivity and extraversion are quasi-independent variables not manipulated by the researcher innate to participants, whereas tempo was manipulated by the researcher. Degree of extraversion will be measured using the Eysenck Personality Inventory (EPI) created by Eysenck and Sybil (1963). Degree of music reward sensitivity will be measured using the BMRQ created by Mas-Herrero et al. (2013). Previous research has shown that that music reward sensitivity and extraversion both can predict recall, but the research has offered mixed conclusions about the role of music tempo in predicting recall. No study thus far has been conducted that evaluates the effect of tempo on recall while also considering variability in music reward sensitivity and extraversion. The present study will vary music tempo to stimulate cognitive arousal, which may interact with individual differences in extraversion and music reward sensitivity. It is predicted there will be an extraversion x sensitivity to music reward x tempo interaction. It is also predicted that individuals high in extraversion, high in music reward and who are exposed to fast tempo music before a recall task will perform best.

This present research is meaningful because it might reveal interaction effects that can help better understand the influence of music tempo on recall. Results could also reveal information that can help better understand why previous studies were not successful in finding effects of tempo on recall. This research idea was inspired by one of the future direction suggestions made by Ferreri and Verga (2016) in their literature review. They suggested testing special populations, such as individuals who receive little to no enjoyment from music (e.g. people with music anhedonia) as well as individuals with different responses to arousal (e.g., people with high and low extraversion). They believed that testing these groups would help better determine the extent to which the reward system is responsible for music-related memory facilitation. This can facilitate results generalization, as there will be fewer confounding variables like extraversion and music preference.

Method

Participants

The participants were 56 students recruited through the SONA system at Huron University College. The SONA system is cloud-based participant pool software for universities. Students recruited from the SONA system were all enrolled in a first-year psychology course and were compensated with one research participation credit toward their grade in the course. All data collected were usable for the study and no participant data were excluded. The final sample was 56 participants. No demographic information was collected, only information relevant to extraversion, music reward sensitivity and music experience. Information regarding music experience was collected in case it was determined to be a confounding variable requiring further evaluation.

Materials

The music excerpt selected for the study was from the piece called “Eine Kleine Nachtmusik – Allegro – 1° Mov” composed by Wolfgang Mozart and played by the Soundiva Orchestra. The music content selected was the first one and a half minutes of the piece. It was selected based on its higher complexity and tempo, which are factors important to the study. The three music excerpts exposed to all participants were controlled for content, length, melodic flow and volume with only the tempo being manipulated. To control for the length of music content participants were exposed to, those assigned to all tempo conditions were exposed to the same one and a half minutes of content at regular tempo. The music excerpt was cut exactly at one and a half minutes because it was the end of a melodic line. This was done to ensure good melodic flow in the music for participants hearing modified tempos and to better conceal the fact that the music was cropped. Slow tempo participants were exposed to the music slowed down by 50% (once repeated in 3minutes), whereas fast tempo participants were exposed to the music sped up by 50% (three plays in 3 minutes). Regular tempo participants were exposed to the music without tempo modifications (two plays in 3minutes). A 50% percent tempo change was selected because it was judged by me to result in music that still sounded natural to the experimenter. It was impractical to replicate previous studies involving tempo, such as the research of Husain, Thompson and Schellengberg (2002) due to resource and technical limitations. They had a skilled pianist play Mozart sonata sheet music at a regular tempo of 110 bpm and digitally altered it to a fast tempo (165 bpm) and slow tempo (60 bpm) music excerpt.

The word list used was created by Walker and Hulme (1999) and used in their own experiments on word concreteness and short-term recall. The word list contains 16 five-letter, one-syllable words.

The Eysenck Personality Questionnaire (EPI) (Eysenck & Sybil, 1963) asked yes or no questions about lifestyle and personality preferences of the participant. The present study used the EPI Version A. Participants answered 57 “yes or no” questions related to personality including measures of neuroticism, extraversion and lying. Test-retest reliabilities for the EPI are satisfactory ranging between .84 and .94 for the complete test and between .80 and .97 for the separate forms (Eysenck, 1968). Gabrys (1982) evaluated the validity of the EPI using an outpatient population. The conclusion was that EPI results for outpatients showed similar validity and reliability information as data published for randomized samples. Regarding coefficients for construct validity, the data for 577 adults correlated -.13 for Extraversion and Neuroticism scores and, -.80 for Extraversion and Lie scores (Gabrys, 1982). It was also found that internal consistency of the EPI was .89 for Extraversion.

The BMRQ by questionnaire (Mas-herro et al., 2013) used to measure music reward asked participants to rate on a numeric scale their views on various music related activities. Two example statements from the BMRQ: “In my free time I hardly listen to music” and “I inform myself about music I like.” Music reward score was determined by adding up the ratings for all 20 statements. For the music reward sensitivity questionnaire, participants rated how much they agreed or disagreed with 20 statements. The statements were rated from 1 to 5. Ratings of 1 meant “completely disagree”, ratings of 2 meant “disagree”, ratings of 3 meant “neither agree nor disagree", ratings of 4 meant "agree" and ratings of 5 meant "completely agree". The overall reliability of the test was found to be r = .92 (Mas-herrero et al., 2013). Several steps were taken by Mas-herrero et al. (2013) to ensure validity of the BMRQ. Mas-herrero (2013) created a pool of questions related to music experiences and tested them on three different samples. From this, they extracted the five latent variables of Musical Reward experiences: Music Seeking, Mood Regulation, Emotion Evocation, Sensory-Motor and Social Reward. These dimensions of music reward sensitivity were shown to be highly reliable in two different Spanish- and English-speaking samples. The final 20 BMRQ items were created using exploratory and confirmatory factor analysis.

For the music experience questionnaire, participants answered questions related to past experiences such as information about music involvement, education and experience. Participants completed five questions measuring music experience and one question regarding familiarity of the song they were exposed to. Questions 1, 2, and 4 were "yes or no" questions and Questions 3 and 5 required quantitative responses. These questions were selected to help control music experience as a confounding variable in the study. The familiarity question was positioned last on the music experience questionnaire.

Procedure

All participants were tested in the same area of the same psychology classroom. All participants participated in the study individually. Upon arrival, participants sat at a desk prepared with a Letter of Information, a Consent Form, and the three questionnaires outlined in the previous section that measured extraversion, music reward sensitivity, and music experience respectively. Participants were serially assigned to one of the three music tempo conditions. The first participant was assigned to the slow tempo condition, the second participant to the regular condition, and the third participant to the fast condition. The fourth participant was placed in the slow tempo condition, and so on. This pattern continued until the last participant had been tested. Post participation, all relevant experiment paperwork relevant to the participant submitted was marked with their tempo condition (i.e., slow, regular, fast).

After participants arrived, they were asked to read the Letter of Information and sign the Consent Form if they had no questions and wished to continue. Participants were told to complete the three questionnaires and to answer every question on every page except the last question on the last page that asked about song familiarity. All participants received the questionnaires in the following order: extraversion questionnaire, music reward questionnaire, and finally the music experience questionnaire. A question about familiarity was included in the music experience questionnaire. Participants rated on a five-point Likert-style scale how familiar sounding the music was that they were exposed to. Options ranged from 1 ("don't know it at all") to 5 ("highly familiar").

After participants completed every question on every page except the last question about song familiarity, participants were told they were going to listen to 3minutes of music. Participants were played 3minutes of the song at their assigned tempo conditions (either slow, regular or fast) on a Bose Soundlink 2 Bluetooth speaker. Everyone was exposed to the excerpt at the same volume. After exposure to the music, participants completed the last question about song familiarity. Next, participants were given a word list to review for 2 minutes. After 2 minutes, the word list was removed, and participants were asked to recall the words they could remember and write them on a blank page, with no word order requirements. Participants were asked to return their word recall results to the researcher when they were done. After the memory task, participants were given a debriefing form and thanked for their participation.

Results

Personality Questionnaire

Only questions related to extraversion and lying were scored for the purposes of this study. The participant EPI scores were determined by adding up the total number of extraversion related questions answered correctly. Extraversion scores were bisected at approximately the middle point of the data to determine high- and low-extraversion-score conditions. Those with extraversion scores of 13 or higher were designated “high extraversion” (55% of participants), whereas those with scores of 12 or lower were “low extraversion” (45% of participants).

Music Reward Sensitivity Questionnaire

Music reward scores of 72 or lower were deemed to be “low” (53% of participants), whereas scores of 73 or higher were deemed “high” (46% of participants).

Music Experience Questionnaire

Results of MQ #1 showed 33 of 56 participants (58%) reported they currently play music or sing. Results of MQ #2 showed 24 of the 33 participants (73%) who currently play music or sing reported receiving formal music training. The mean song familiarity rating was 4.11 out of 5.

Overall Analysis

A 2 X 2 X 3 between-subjects analysis of variance (ANOVA) was conducted with extraversion (high vs. low), sensitivity to music reward (high vs. low) and tempo (slow, regular and fast) as the predictor variables and the word recall score as the outcome variable. Results showed no significant main effect of extraversion on word recall, no significant main effect of music reward score on word recall and no significant main effect of tempo on word recall. The results also showed that the music reward X tempo interaction, the music reward X extraversion interaction, and the extraversion X music reward X tempo interaction all failed to reach statistical significance. The results did, however, show a significant interaction between extraversion and tempo which is depicted in *Figure 1*. This figure shows that low extraversion participants appeared to have performed better than high extraversion participants in the regular and fast tempo conditions. The graph also reveals that high extraversion participants appeared to have performed better than low extraversion participants in the slow tempo conditions. An independent-sample two-tailed *t*-test revealed that low extraversion participants performed significantly better at the regular tempo than at the low tempo (t (17) = 2.2, $p < .05$). An independent-sample two-tailed t-test also revealed that low extraversion participants performed significantly better than high extraversion participants at the regular tempo (t (15) = 2.5, $p < .05$).

A complete ANOVA summary table can be found in *Appendix 1*. The raw data for tempo, word recall scores, extraversion scores, and music reward scores can be found in *Appendix 2*.

Discussion

The goal of the present study was to evaluate the role of extraversion, music reward sensitivity and tempo on recall. It was predicted that there would be an interaction between extraversion, music reward sensitivity and tempo. The prediction that individuals high in extraversion, high in music reward, and who are exposed to fast tempo music prior to a recall task will perform best was not fulfilled. Overall, the prediction was not supported. This was

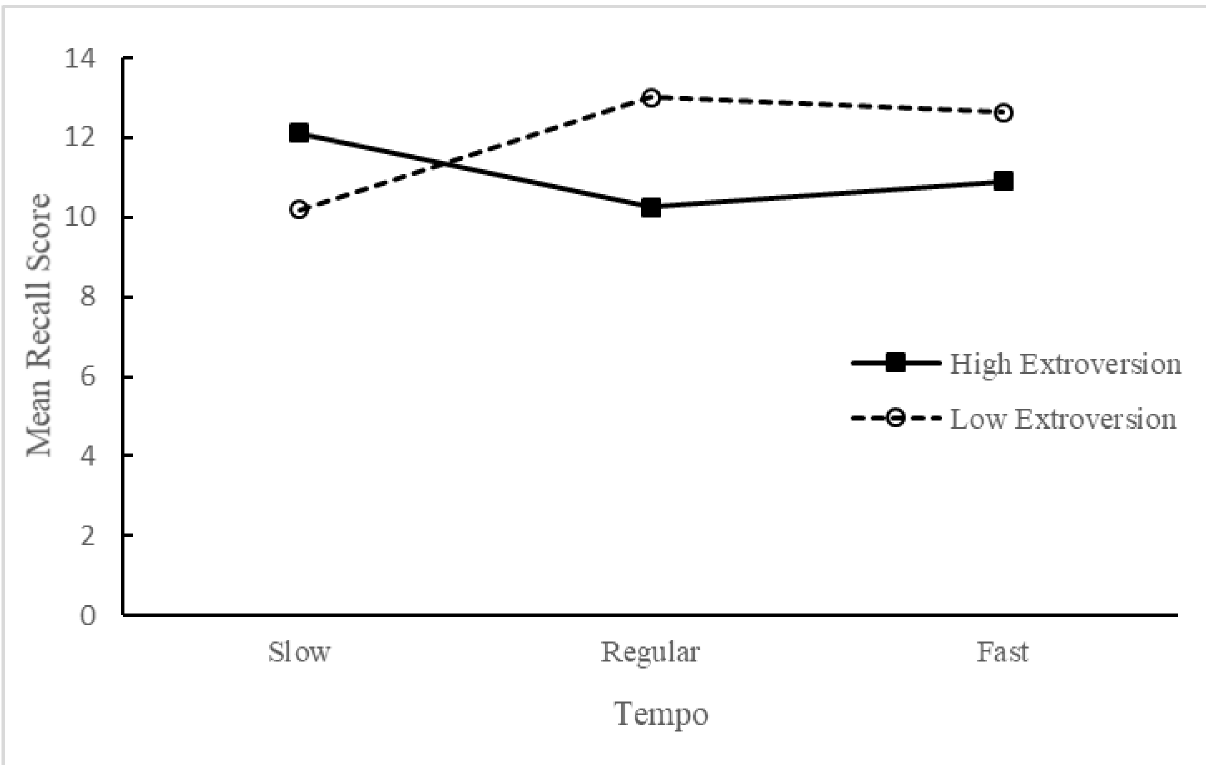

Figure 1. The means representing the interaction between tempo and extraversion.

confirmed when no significant interaction was found between tempo x music reward x extraversion. A significant interaction was found only between tempo x extraversion.

The findings related to the role of extraversion on recall is only partially consistent with past research. Something interesting is that the present recall results were in a different direction that what would be predicted by Eysenck's Theory. The present study found higher means for low extraversion people in the regular and fast tempo conditions. One possible explanation is that high extraversion people may have been distracted by something (even though music was played prior to the recall task).

The findings related to music reward sensitivity and recall did not support previous research. Ferreri and Rodriguez-Fornells (2017) discovered music excerpts rated as more rewarding were better remembered and recognized at a later time. They also found that individual differences in ability to experience music reward positively predict ability to recall and recognize the music excerpt. Ferreri and Rodriguez (2017) did not find an effect of arousal on memory, but they showed a strong correlation exists between arousal and music reward ratings. One possible explanation is that music reward sensitivity can influence recall of music excerpts and English words differently. Sensitivity to music reward is a new concept with limited relevant literature on the subject. Additional research using the BMRQ is encouraged to further the overall understanding of the role of arousal, personality and music reward on recall.

Similar to the past research in the area of music tempo and memory that has shown inconsistent findings, the present study results add to this conflicting information. Ting and Karthigeyan (2009) studied the effects of various tempos of music (60 bpm, 120 bpm, 165 bpm, control) on recall while using different learning strategies. They found participants in the 120-bpm condition had the best recall, compared to those in the other conditions. The present study used music rated Allegro for tempo, which is typically 120 to 160 bpm, but found no main effect of tempo. There may be something special about music at around 120 bpm. Further research is needed in the area of music tempo and its relationship with recall.

Limitations and Future Directions

One the most notable limitations of this study was the lack of statistical power due to the small N. The present study was analysed inclusive of all extraversion scores, unlike in past studies. Previous studies by Furnham and Allass (1999) and Furnham and Bradley (1997) used the semi-interquartile range to divide participants into high and low extraversion conditions through exclusion of the middle 50% of participants. Both these studies confirmed decreased recall performance in the presence of background music in low extraversion people more than high extraversion people. Using only participants with very high or very low extraversion scores potentially can make the effects of music more obvious; however, this is done at the cost of sampling representativeness or a reduction in sample size.

The method of separating high and low extraversion participants used by Furnham and Allass (1999) and Furnham and Bradley (1997) was not practical for the present study. Both sets of researchers had participants complete the Eysenck Personality Questionnaire as a pre-test and then contacted only the highest and lowest scoring quartiles to continue participating. For Furnham and Allass (1999) this process reduced participants from an initial 163 to only 48 after the pre-test. The present study was unable to replicate this method due to study design. The present study focused on completing all data collection in one session. In order to recruit the highest and lowest quartiles of participants, the personality questionnaire would have to have been scored immediately and the participants notified of their eligibility to continue, or participants would have to have been sent home with only some requested to return a second time.

Familiarity could have been a confounding variable. Currently, few studies exist focusing on the role of music familiarity on recall. Stull (2005) researched the effects of familiar music, unfamiliar music, and no music on a recall task in aging adults. Although no significant difference was found between the conditions, Stull (2005) determined that groups who were exposed to familiar music had higher recall than those exposed to unfamiliar music. It would be interesting to further explore the role of familiarity on recall in people of various ages and of varying degrees of extraversion.

Conclusion

The present research studied personality, music reward and tempo together to reduce the inconsistencies found across previous music-memory studies. Music tempo, volume, content, length and complexity were all carefully controlled for consistency. Participants were assigned to tempo condition. Volume, content, song length and complexity were the same for all participants. This type of consistency has been uncommon in the previous studies, which makes different variables difficult to compare. Past findings have been hard to compare and generalize due to varying choices of music, music presentation and memory task. Ferreri and Verga (2016) explained that these inconsistencies were due to the different approaches and paradigms used to measure music effects on memory. They emphasized music complexity as a major confounding variable across studies. They had reason to believe music parameters conveyed a variety of information that leads to varying cognitive effects.

The present study found a small interaction between extraversion and tempo. It is possible the strength of this relationship may change depending on the demographic evaluated. Age, gender, profession (e.g. musician vs non-musician) are all factors that could influence how a person perceives and responds to music they are exposed to, and which can influence recall. These factors should be considered into future studies evaluating the effects of individual differences on recall. In addition, it could be interesting to explore the influence of these individual differences on different types of memory tasks. Some examples of other memory tasks are recognition tasks, delayed recall tasks, facial recognition tasks, arithmetic-related tasks. The original study by Rauscher et al. (1993) and the present study can only generalize the results to the type of memory task used.

Even though the interaction between tempo and music reward and extraversion was not significant, its partial eta squared of 9% is promising. Given adequate statistical power, this three-way interaction could become statistically significant in the future. The results of the present study show that there is potential in studying the interaction effects of various individual traits on recall.

References

Bugter, D., & Carden, R. (2012). The effect of music genre on a memory task. *Modern Psychological Studies, 17,* 87-90. https://scholar.utc.edu/cgi/viewcontent.cgi?article=1214&context=mps

Chabris, C. F., & Steele, K. M., & Simone, D., & Peretz, I., & Dunlop, T. (1999). Prelude or requiem for the "Mozart effect"?. *Nature, 400*. doi:10.1038/23608

Eysenck, H.J. (1967). The biological basis of personality. Springfield, IL: Charles C. Thomas.

Eysenck, H., & Eysenck, S. (1967). On the unitary nature of extraversion. *Acta Psychologica, 26,* 383-390.

Eysenck, H. J., & Sybil, B. G. (1963). Eysenck Personality Inventory. doi:10.1037/t02711-000

Furnham, A., & Allass, K. (1999). The influence of musical distraction of varying complexity on the cognitive performance of extroverts and introverts. *European Journal of Personality, 13,* 27-38. doi:10.1002/(SICI)1099-0984(199901/02)13:1

Ferreri, L., & Verga, L. (2016). Benefits of music on verbal learning and memory: How and when does it work?. *Music Perception, 34,* 167-182. doi:10.1525/mp.2016.34.2.167

Ferreri, L., & Rodriguez-Fornells, A. (2017). Music-related reward responses predict episodic memory performance. *Experimental Brain Research, 235,* 3721-3731. doi:10.1007/s00221-017-5095-0

Furnham, A., & Bradley, A. (2019). Music While You Work: The Differential Distraction of Background Music on the Cognitive Test Performance of Introverts and Extraverts. Applied Cognitive Psychology, *11*, 445-455. doi:10.1002/(SICI)1099-0984(199901/02)13:1

Gabrys, J. (1982). Validity and reliability of the Eysenck Personality Inventory with outpatients. *Psychological Reports, 51,* 541-542. doi:10.2466/pr0.1982.51.2.541

Georgia's Provision (1998). Office of Legislative Research. https://www.cga.ct.gov/PS98/rpt%5Colr%5Chtm/98-R-0888.htm

Husain, G., & Thompson, W. F., & Schellenberg, E. G. (2002). Effects of Musical Tempo and Mode on Arousal, Mood and Spatial Abilities. *Music Perception, 2*0, 151-171. www.utm.utoronto.ca/~w3psygs/Husain.pdf

Infants (2012). 2012 Florida Statutes. The Florida senate. https://www.flsenate.gov/Laws/Statutes/2012/411.0106

Isarida, T. K., & Kubota, T., & Nakajima, S., & Isarida, T. (2017). Reexamination of mood-mediation hypothesis of background-music dependent effects in free recall. *The Quarterly Journal of Experimental Psychology, 70,* 533-543. doi:10.1080/17470218.2016.1138975

Jurkovic, A., & Anderson, C., & Myklejord, D., & Levin, C. & Lotz, A. (2013). The Effect of Music Tempo on Memory Retention. *University of Wisconsin Department of Physiology.* https://docplayer.net/32386913-The-effect-of-music-tempo-on-memory-retention.html

Lim, H. A., & Park, H. (2018). The effect of music on arousal, enjoyment, and cognitive performance. *Psychology of Music, 0,* 1-12 . https://doi.org/10.1177/0305735618766707

Maliov, L. (2012). The effects of musical tempo on time perception and memory. *MMU Psychology Journal (Dissertations) UK*. https://e-space.mmu.ac.uk/576754/

Mas-Herrero, E., & Marco-Pallares, J., & Lorenzo-Seva, U., & Zatorre, R., & Rodriguez-Fornells, A. (2013). Individual differences in Music Reward experiences. *Music Perception, 31,* 118-138. http://brainvitge.org/papers/Mas_MP_2013.pdf

Matias, L. (2014). The Effects of Music Complexity on Memory in Introverts and Extroverts. *The Huron University College Journal of Learning and Motivation, 52,* 132-151. https://ir.lib.uwo.ca/hucjlm/vol52/iss1/10/

Miranda, D., & Morizot, Julien, & Gaudreau, P. (2010). Personality Metatraits and Music Preferences in Adolescence: A Pilot Study. *International Journal of Adolescence and Youth*, *15,* 289-301. https://doi.org/10.1080/02673843.2010.9748036

Mozart Effect (n.d.). The Mozart Effect Resource Centre. https://www.mozarteffect.com/

Music (n.d.). Merriam Webster Dictionary. https://www.merriam-webster.com/dictionary/music

Nantais, K. M., & Schellenberg, E. G. (1999). The Mozart effect: An artifact of preference. *Psychological Science, 10,* 370-373. doi:10.1111/1467-9280.00170

Percino, G., & Klimek, P., & Thurner, S. (2014). Instrumentation complexity of music genres and why simplicity sells. *Physics and Society*. doi: 10.1371/journal.pone.0115255

Pilcher, N., & Cortazzi, M., & Jin, L. (2014). De capo: A musical technique to evoke narrative recall. *Psychology of Music, 42*. DOI:10.1177/0305735613480257

Pring, L., Walker, J. (1994). The Effects of Unvocalized Music on Short-Term Memory. *Current Psychology: Developmental, Learning, Personality, Social, 13*, 165-171. https://doi.org/10.1007/BF02686799

Rauscher, F. H., Shaw, G. L., & Ky, K. N. (1993). Music and spatial task performance. *Nature Magazine, 365*, 611. https://www.uwosh.edu/psychology/faculty...rauscher.../Rauscher_ShawKy_1993.pdf

Rauscher, F. H., Shaw, G. L., Levine, L. J., & Ky, K. N. (1994). Music and Spatial Task Performance: A Casual Relationship. *University of California Irvine.* Retrieved from: https://files.eric.ed.gov/fulltext/ED390733.pdf

Schäfer, T., & Sedlmeier, P., & Städtler, C., & Huron, D. (2013). The psychological functions of music listening. *Frontiers in Psychology, 4*, 1-33. doi: 10.3389/fpsyg.2013.00511

Schäfer, T., & Sedlmeier, P. (2010). What makes us like music? Determinants of music preference. *Psychology of Aesthetics, Creativity, and the Arts, 4*, 223-234. doi:10.1037/a0018374

Sibley, C. (2007). The Effects of Quick Tempo Vocal and Non-Vocal Background music on Memory for lists of nounds in Extroverts and Introverts. *The Huron University College Journal of Learning and Motivation, 45*, 290-302. https://ir.lib.uwo.ca/hucjlm/vol45/iss1/16

Steele, K., & Bass, K., & Crook, M. (1999). The mystery of the Mozart effect: Failure to replicate. *Psychological science, 10*, 366-369. doi:10.1111/1467-9280.00169

Streich, S. (2006). Music complexity: A multi-faceted description of audio content. *Universitat Pompeu Fabra.* mtg.upf.edu/system/files/publications/sstreichPhD_0.pdf

Stull, J. (2005). The Effects of Familiar Music, Unfamiliar Music and No Music on Face-Name Recall in Aging Adults. *Florida State University*. http://diginole.lib.fsu.edu/islandora/object/fsu%3A176039

The Mozart Effect (2016). Free Trademark Search. https://trademark.trademarkia.com/he-mozart-effect-87002155.html

Thompson, W. F., & Schellenberg, E. G., & Husain, G. (2001). Arousal, mood, and the Mozart effect. *Psychological Science, 12*, 248-251. doi:10.1111/1467-9280.00345

Ting, C. Q., & Karthigeyan, K. K. (2009). The Effects of Music Tempo on Memory Performance Using Maintenance Rehearsal and Imagery. *Sunway Academic Journal, 6*, 114-132. https://www.researchgate.net/publication/235338088_THE_EFFECTS_OF_MUSIC_TEMPO_ON_MEMORY_PERFORMANCE_USING_MAINTENANCE_REHEARSAL_AND_IMAGERY

Tully, D. (2012). Examining the Relationship Between Music Preference and Personality Type. *School of Arts Dublin.* Retrieved from: https://pdfs.semanticscholar.org/db83/915a043fd41f3771693b0bac8b9e2f104775.pdf

Vella, E. J., & Mills, G. (2017). Personality, uses of music, and music preference: The influence of openness to experience and extraversion. *Psychology of Music, 45,* 338-354. https://usm.maine.edu/sites/default/files/psy/Vella%20%26%20Mills%20%282017%29-1.pdf

Walker, I., & Hulme, C. (1999). Concrete words are easier to recall than abstract words: Evidence for a semantic contribution to short-term serial recall. *Jounral of Experimental Psychology: Learning, Memory, and Cognition, 25,* 1256-1271. doi:10.1037/0278-7393.25.5.1256

Yerkes, R., & Dodson, J. (1908). The Relation of Strength of Stimulus to Rapidity of Habit Formation. *Journal of Comparative Neurology and Psychology, 18*, 459-482. doi:10.1002/cne.920180503

Appendix 1

2 X 2 X 3 ANOVA Summary Table

Source	SS	*df*	MS	*F*	*p*	Partial η^2
Tempo	8.93	2	4.46	0.77	.47	.03
Music Reward	2.85	1	2.85	0.49	.49	.01
Extraversion	6.90	1	6.89	1.19	.28	.02
Tempo X Music Reward	17.22	2	8.61	1.49	.24	.06
Tempo X Extraversion	40.36	2	20.18	3.49	.04	.14
Music Reward X Extraversion	0.07	1	0.07	0.01	.91	.00
Tempo X Music Reward X Extraversion	25.07	2	12.54	2.165	.12	.09
Error	254.77	55	4.79			

Appendix 2

Participant data for Tempo, Recall Scores, Extraversion Scores, and Music Reward Scores.

Participant	Tempo	Recall	Extraversion	Music Reward
1	F	9	13	55
2	F	12	13	75
3	F	13	6	83
4	F	14	20	73
5	F	13	19	88
6	F	14	4	69
7	F	9	17	72
8	F	9	13	78
9	F	14	16	67
10	F	13	10	66
11	F	7	12	62
12	F	11	14	73
13	F	15	10	66
14	F	13	12	69
15	F	8	14	56
16	F	9	18	63
17	F	15	11	79
18	F	11	8	85
19	R	11	14	77
20	R	5	16	81
21	R	6	17	82
22	R	15	8	77
23	R	11	13	76
24	R	9	16	83
25	R	12	9	83
26	R	8	14	73
27	R	14	7	72
28	R	13	9	59
29	R	11	15	82
30	R	10	8	62
31	R	13	12	67
32	R	13	15	69
33	R	15	18	87
34	R	9	13	73
35	R	11	14	67
36	R	14	9	57
37	R	14	15	70
38	S	8	11	62
39	S	11	16	84

Participant data for Tempo, Recall Scores, Extraversion Scores, and Music Reward Scores.

Participant	Tempo	Recall	Extraversion	Music Reward
40	S	11	10	64
41	S	12	20	77
42	S	15	14	92
43	S	11	8	74
44	S	16	4	90
45	S	9	10	80
46	S	14	14	77
47	S	9	17	64
48	S	8	12	75
49	S	7	11	79
50	S	15	17	90
51	S	10	15	68
52	S	10	10	73
53	S	10	7	72
54	S	12	6	70
55	S	11	13	71
56	S	12	14	65

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