Effects of Music Genre and Music Tempo on False Memory Formation

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ABSTRACT

This research examined students' proportion of words correctly and falsely recognised when listening to background music whilst memorising. It was conducted to examine whether there is an interaction between music genre (classical vs rock) and musical tempo (slow vs fast). It was hypothesised that rock genre and fast tempo will have greater false recognition. 60 participants were randomly allocated to one of the four conditions. A two-way between subjects ANOVA was applied. The results show: (1) words correctly and falsely recognised did not differ between classical-genre and rock-genre music; (2) words falsely recognised were significantly higher when listening to slow-tempo than in fast-tempo music; (3) there was negative correlation between genre and tempo on both correct and false recognition. When asked to do recognition test, participants in slow-tempo condition falsely recognised more lures than in fast-tempo, but there was no genre differences in the words correctly and falsely recognised.

Keywords: false memory, cognitive psychology, music, experiment, quantitative

INTRODUCTION

False memory has been one of the most interesting debated areas of the past decades in many of cognitive psychological research literatures, and psychologists (Lindsay & Read, 1994; Loftus, 1993; Roediger & McDermott, 1995) have been studying false memories in several laboratory settings for years. Research in cognition, cognitive development, and false memory formation in children and adults boomed in the late 1980s and continues until today. The centre of this debate have been reported based on real-world issues by both young children and adults that have been through traumatic experiences, for example, sexual abuse from their childhoods that had been forgotten or 'repressed' (Bjorklund, 2000; Mollon, 2000). Women who have been sexually abused from their childhood will provoke more false memories than those women who have not been sexually abused. The processes of 'remembering' are both complex and reconstructive, rather than a process of accessing a precise record of an actual event. The driving force for this recent surge of interest is the increase in the number of cases reported by Roediger and McDermott (1995) in which memories of unrecognized abuse in the past are reported during the course of therapeutic treatment. Some researchers have contended that certain treatments can result in the formation of false memories. Therefore, the apparent "retrieval" of memories throughout the course of treatment may actually cause the formation of false memories or fallacious narratives of an individual's childhood (Lindsay & Read, 1994; Loftus, 1993). The questions that were worth investigating in the nature of false memory were: were the adults really recovering repressed memories under the supervision of psychotherapists, or were the memories being "formed" by repeated suggestion? Were children enlightening specialists concerning events that actually occurred, or were the interviewing methods used to obtain information at unpleasant occasions serving to embed memories that in the end became their

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(株) リナアンドルナインターナショナル, 小山市、日本.
ISSN: 2186-8476, ISSN: 2186-8468 Print
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own? There has been evidence to support these both claims in the psychological research literature (Bjorklund, 2000).

False memory syndrome is a phenomenon in which individuals 'remember' events that never happened, or 'remember' events that occurred differently from the actual event (Roediger & McDermott, 1995). For example, a memory of an eyewitness falsely believing his classroom teacher throwing a mathematics book to the school principle when in fact it was the school principle who threw the book is a false memory based upon an actual experience. The eyewitness may remember the tragedy vividly and be able to "see" the action in details, but only with verification by another reliable eyewitness can determine the occurrence of actual event. Deese (1959), Roediger and McDermott (1995) presented a popular technique for investigating correct and false memory in the laboratory setting that is widely known as the DRM paradigm. In this paradigm, participants are presented with lists of 15 items that seem to be the strongest related to a non-presented critical word in free association norms (Russell & Jenkins, 1954). For example, participants were presented with the following list of associated words: *desk, cushion, couch, bench, sit, swivel, sofa, recliner, rocking, sitting, legs, table, seat, wood,* and *stool,* in which the non-presented critical word to the list is *chair.* In the next phase of memory tasks, participants were required to recall or recognize as many of the presented list words as they could remember in any order (i.e., free recall with a warning against guessing). During the course of free recall or recognition tasks, participants tend to have false memories for the non-studied critical lures *(chair)* at the same rate as their correct memories of the studied list items (*desk, cushion, couch etc)*. They also have the same phenomenological direct experience and knowledge in their life about the false memories with respect to the correct memories (Sherman & Moran, 2011). In other studies (Schacter, Verfaellie & Anes, 1997b; Sommers & Lewis, 1999; Watson, Balota & Roediger, 2003, cited by Gallo, 2006, p. 35), have determined that *"words can be falsely recalled or recognised based on orthographic and / or phonological confusions (e.g., veil, bail, gale, rail, etc.)."* These effects of false memory creation are similar to those in the DRM paradigm, in which all of the stimuli have pre-existing mental association, principle of "relatedness." In the DRM paradigm the association between the stimuli is mostly conceptual or semantic, based on prior knowledge. In simplest term of this paradigm, people 'remember' words that have never been presented.

In the standard form of the DRM paradigm, Roediger and McDermott (1995) presented participants with lists of words and after each list requested participants either to recall the words they had just studied or perform a distractor task (e.g simple maths tasks) in order to give short delays between study and test. As soon as the presentation of study lists had been presented, participants were to do a *Remember* or *Know* recognition memory task, where the word lists used contain of associates of the non-studied critical lure (Tulving, 1985, cited by Sherman & Moran, 2011). In this current experiment will use a slightly different scoring responses; participants will be required to circle either *Yes* or *No* on a recognition memory task. In a study by Underwood (1965), he introduced a method to study false recognition of words in lists. He presented participants with a constant recognition task in which they have to make decisions whether each presented word had been studied previously in the list or not.

Listening to background music has become a common interest when performing tasks in in people's day-to-day lives, and sometimes it could increase or decrease the complexity of the task. For example, using music for teaching alphabet through alphabet song. The alphabet song helps young children to learn alphabet more easily, and sometimes leads young children to falsely believing that there is a letter in the English alphabet sounded 'ellemmennoo' for l, m ,n, o. The mutual relationship between music and learning still remains of an area of

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(株) リナアンドルナインターナショナル, 小山市、日本.
ISSN: 2186-8476, ISSN: 2186-8468 Print
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interest to study for cognitive researchers for many years. It is important to develop an understanding on effects of background music on studying. In a study conducted by Giles (1991), he looked at background music as part of learning aids that could be used to deliver a pleasant environment during learning. Giles (1991) stated that by tuning appropriate background music during learning enables students to perform better, keeps them relaxed, less stressed, makes them in good mood and more productive.

Some studies have shown that music has the ability to enhance the activity for mental processes (Hall, 1952, cited by Hallam & Price, 1998, p. 88), that in the presence of background music in classroom during reading comprehension tests could significantly improved the performance; "58% of the 245 8^{th} and 9^{th} graders taking part in the study, showed an increase in scores on the Nelson Silent Reading Tests." Others have demonstrated that it can impair the processing activity when complex cognitive tasks are presented but not for simple task (Fogelson, 1973). BrunerII (1990) claimed that background music is like a chemical catalyst to our brain, which may induce mood and various responses. Effects such as these were explained in the context of a neural network approach to human cognition. Nevertheless, Martindale and Moore (1988, cited by Yeoh & North, 2010) contend that the brain is made up of inter-connected cognitive parts that differ in the strength and ability with which they can become activated. Jackson and Tluaka (2004, cited by Harmon, Troester, Pickwick & Pelosi, 2008) carried out a study on the effect of presenting classical music during learning, and the effect showed that there may be a significant connection between particular types of background music (e.g Mozart) and learning.

The current study on musical genre's aspect aims to investigate the influence of musical genre manipulation upon correct and false recognition of words or critical lures. In musical terminology, genre is a musical classification that identifies pieces of music to groups of common tradition or set of conventions (Samson, n.d.). Classical music has become a part of popular study being used to test cognitive functioning on many different types of tasks. A study done by Harmon et al. (2008) found that when participants are played rock music during the encoding stage of reading comprehension (which is a complex cognitive process), participants are more susceptible to produce significantly lower test scores than those in classical music and silence conditions. Therefore, rock music serves as a larger distractor to the participants. A research carried out by Hallam, Price and Katsarou (2002) demonstrated that primary school students who listened to calming and relaxing music led to better performance on arithmetic and memory task, and they were able to complete more problems correctly than those in silence condition. Hallam and colleagues also reported that aggressive and unpleasant music disrupted performance on the memory task. Similar study by Bowman (2007) that looking at whether Mozart music boosted performance on listening comprehension. Many literatures like Wilson (2006) have shown classical soundtracks can enhanced cognitive test. Presumably upbeat music is disrupting and calm music could reduce anxiety. A possible explanation for this could be due to the fact that upbeat music contains more notes and less gaps of silence during the duration of music and thus, upbeat music have been shown to decrease attention and increase distraction. However it would be inappropriate to assume from a stereotype point of view, by ignoring the concept of individual differences and not taking it into consideration; because there are some people who feel calm and relaxed when listening to upbeat or heavy metal music.

Tempo has been considered representative of a fundamental extent of music and has gained wide consideration in previous research (BrunerII, 1990; Kellaris & Rice, 1993). Another aspect of this current study aims to examine on musical tempo, whether tempo or the speed of music have any effects on words (or lures) correctly and falsely recognised. Musical tempo

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concerns the speed at which a musical passage progresses. Here, tempo is indicated as a number of beats per minute (abbreviated bpm) written over the music (Tagliarino, 2006). It is one of the most heavily researched fields in the psychology of music due to the relative ease where comparative, quantifiable measurement can be carried out, that is, either by tapping to the number of beats per minute or by the use of a metronome to monitor (Sloboda, 1997). Many research like Furnham and Allas (1999) found that fast tempo increase level of arousal than slow tempo music. This could possibly due to additional musical 'occurrence' to be processed by the brain in a given duration of time. In a study conducted by Oakes and North (2006), they examined whether the manipulation of musical tempo and timbre (quality of a musical sound, e.g pitch & intensity) of background music influenced responses towards advertisement content recall (radio ad provided by a local radio station). They expected that the fast tempo condition will result in significantly lessened advertisement content recall than in slow tempo due to the nature of cognitively disturbing of information processing activity, hence making the presence of a negative correlation between increased information load and advertisement content recall. North, Hargreaves, and Heath (1998) carried out a study on the effects of musical tempo (slow vs fast) on retrospective estimates of time duration during exercise in a gymnasium. They found no significant difference of musical tempo on time duration estimates, but that music with slow tempo was perceived as less accurate in estimations compared to fast tempo. Further, Milliman (1982) determined that fast tempo music serves as a catalyst to accelerate the movement of in-store traffic flow and increases daily gross sales volume than slow tempo background music. Fast tempo music also has been found to shorten restaurant customers' eating time (Milliman, 1986), and accelerate the speed of drinking (McElrea & Standing, 1992). Unfortunately, the current approach on the effects of tempo background music tends to be more empirical than theoretical based.

This current study examined the effects of music genre and musical tempo in the formation of correct and false memories; listening to music as a secondary mental task to the main task (visually). The study investigated whether false memories (recognition) for DRM paradigm could be elicited using different types of background music, and specifically to find out if there is any impact upon both words (or lures) correctly and falsely recognised. The laboratory study manipulated both genre (classical & rock) and tempo (slow and fast) of the music on studying word lists (DRM task); by presenting either slow classical, fast classical, slow rock or fast rock music. Word memorisation places considerable demands on cognitive resources. As stated in the previous research about the different types of background music on memory performance reported that there is minimal effect to it. Tucker and Bushman (1991) examined whether rock and roll background music had an effect on learning tasks with comparison to a condition without background music. Based on their results, rock and roll music worsened mathematical and verbal tasks, but had no impact on reading comprehension.

There were 3 hypotheses in this current study. With reference to the main effect of the music genre, it was hypothesised that rock music condition will have a greater effect on words (lures) falsely recognised than those listening to classical music. Secondly, with respect to the main effect of musical tempo it was hypothesised that fast tempo condition will elicit the most false recognition compared to slow tempo condition. Thirdly, the interaction between music genre and musical tempo was hypothesised, that words falsely recognised will be greater for fast tempo music than in slow tempo because fast music tends to distract more individual's attention, and as a result it will be difficult to focus and perform recognition tasks. Hence, it was hypothesised that the difference in the proportion of words falsely recognised between fast classical and fast rock music will be greater compared to the

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difference in false recognition of critical lures (words) between slow classical and slow rock music.

METHODOLOGY

Participants

Sixty (35 male) Keele University undergraduates (except level II & III psychology students) voluntarily participated in the experiment. The mean age of the participants was 20.77 years (SD = 1.77). The recruitment process of research participants was easily managed through opportunity sampling. The Keele University School of Psychology Research Ethics Committee approved the study.

Stimuli

Four sets of MS PowerPoint slideshows (DRM word lists), consent form, debrief form, recognition sheet and songs were used as stimuli in this experiment. The stimulus goes through the same procedure for all the four conditions.

All the MS PowerPoint (word lists) presentations have the same design except for its audio content (varies in genre and tempo). Word lists were taken from DRM False Memory Lists in Deese (1959). Only six 15-item lists (critical lures: *chair, black, sweet, needle, mountain and rough*) were tested. 90-items were presented in total, each 3-9 letters long, since, each list consisted of 15 associated words, the presentation of study word lists, such as; the list corresponding to chair was *desk, cushion, couch, bench, sit, swivel, sofa, recliner, rocking, sitting, legs, table, seat, wood,* and *stool*. All the six lures were chosen as a result of those word lists produced the highest intrusion rates in Deese's (1995) experiment, except for *sleep* word list which was replaced to *black* list; providing reason that *sleep* list is more familiar in most research examples. This is to prevent effects of individual prior knowledge and expectation towards the nature of the experiment.

Words were presented at the rate of two seconds per word, with no delay between words, except for the last word in each list (2 seconds of time delay showing a plain white screen before proceeding to the next list); words were positioned in the centre, with Calibri (Headings) theme font and a 44-font size, in black colour. The background of the slide presentation was designed in plain white.

The recognition sheet was presented the same for each condition. This test contained 42 words printed in 2 columns on a test sheet. The 42-item recognition test comprised of 12 presented items from the original stimuli (drawn from random serial position based on the strong relatedness to the related lure) and 30 non-presented items. The non-presented items, or lures were divided into threefold: firstly, the 6 related critical lure words from each studied list (e.g, *chair*), in order to measure false recognition of related lures; secondly, 12 words (2 per list) generally unrelated (filler words) to any items on the six lists; thirdly, 12 words (2 per list) that are weakly related to the lists. The example of weakly related words to chair list were *floor* and *material*. The purpose of including unrelated words was to make it more realistic.

The recognition test's sequence was designed in blocks; there were 7 items per block, and each block corresponded to a list of words (e.g., block 1 consisted of 2 presented words: *sofa & sitting*, 2 non-presented weakly related words: *floor & material*, 2 unrelated words: *dolls & pear*, and one critical non-presented lure: *chair*). The arrangement of the test blocks corresponded according to the arrangement in which lists had been presented. For example, each block of test items started with a presented word (block 1: *sofa,* block 2: *color,* block 3:

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ISSN: 2186-8476, ISSN: 2186-8468 Print
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sugar, block 4: *sharp,* block 5: *climber* & block 6: *bumpy*) and concluded with the critical lure (block 1: *chair,* block 2: *black,* block 3: *sweet,* block 4: *needle,* block 5: *mountain* & block 6: *rough*), respectively. Another one of the two presented words was positioned in this way: second position of block 1 (*sitting,* for *chair* lure), third position of block 2 (*dark,* for *black* lure), fourth position of block 3 (*candy,* for *sweet* lure), fifth position of block 4 (*injection,* for *needle* lure), sixth position of block 5 (*peak,* for *mountain* lure), and second position of block 6 *(sandpaper,* for *rough* lure). The unrelated and weakly related (both non-presented) words occurred randomly in between the second 6 positions of the block.

The songs included were such as Handel 'Largo' performed by The London Symphony Orchestra (Slow Classical, 60 bpm), Italian Concerto by Bach (Fast Classical, 180 bpm), Knockin' on Heaven's Door by Bob Dylan (Slow Instrumental Rock, 58 bpm), and Jesus of Suburbia by Green Day (Fast Instrumental Rock, 176 bpm). The songs' tempo was measured and determined by the use of a metronome. The metronome mark conveys the number of beats per minute (bpm). The slow (60 & 58 bpm) and fast tempos (180 & 176 bpm) were decided according to these tempo meter categories: *Largo* – slow, broad (in range between 40 - 60 bpm) and *Presto* – fast (160 – 200 bpm), respectively (Tagliarino, 2006). Nevertheless, the slow classical music could also be considered as *Larghetto* – somewhat slow (60 – 70 bpm) and *Adagio* – slow (60 – 80 bpm) since the song's bpm is 60. The volume of the music being played was set at 80%, and only presented whilst memorizing the list of words.

Apparatus

The apparatus used for the experiment consisted of an Apple 13-inch MacBook Pro running MS PowerPoint 2011 software, pen, metronome, stopwatch, and headphones.

Design

This experiment was conducted in a laboratory setting. The design of this experiment was an independent two-factor (2 x 2) between-subjects design (which would be analysed using unrelated ANOVA). The independent variables manipulated in this experiment were music genre and musical tempo. Each factor has two levels; classical or rock for music genre, with slow or fast for musical tempo. The dependent measures were mean number of words falsely recognised and correctly recognised; taken as the mean of each participant's number of words falsely and correctly recognized at recognition test.

One-fourth of the participants (15 participants) were randomly allocated and tested either in slow classical, fast classical, slow rock, or fast rock conditions. Prior to starting the experiment, participants were partly informed on the procedure and nature of the experiment. The order of presentation of the word lists presented in the slides were kept constant across participants and arranged in the order of critical lure groups (*chair, black, sweet, needle, mountain and rough*) for all conditions, and took 3 minutes and 15 seconds of presentation. Participants were not fully informed about the nature of the study when they received their consent, but were given a full debrief at the end of the study. In the consent form, they were only told that this study aims to look at effects of auditory and visual tasks on cognitive test; by requiring them to memorise lists of words, and testing them to decide whether the words were originally present in the study list. Most importantly, participants were not informed that the lists were designed to get them to think of a non-presented critical lure, although they did know that the purpose was to assess their memory accuracy. It was predicted that rock genre and fast tempo conditions will have greater effect on words falsely recognised.

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Procedure

At the beginning of the experiment, participants were asked to memorise the words presented whilst listening to music according to their randomly assigned condition; by means of a MS PowerPoint for study task and via headphones for music. Each list contained the first 15 associates (e.g, *table, sit, legs,* etc.) to a critical non-presented lure (e.g., *chair*). Each word was presented to the participants at a rate of 2 seconds per word. After the last word of each list was presented, participants were shown a blank white screen for 2 seconds in order to provide time lag for the next list. Upon completion of the presentation of study list, participants moved to next stage. In the second phase, all participants performed a distractor task that is counting backwards starting from 499 by threes for one minute. They counted it out loud. This is to provide a time lag between the first (study) and the next stage of the experiment (test); function as to prevent clear memorization of the task in order to measure memory of the participant. In the third phase, participants were given instructions for a recognition test. They began the 42-item recognition test simply by circling either *"Yes"* when they think the word existed (those presented in the slides) or *"No"* when not presented. Participants worked through the recognition test at their own pace. The test typically took 3 min or less. During phase four, all participants were questioned whether they "knew what the experiment was about." Only one participant reported that they had realised that there were 15 words in each lists and the lists were designed to get them to "remember" of a non-studied word (or lure), and the data from this participant was eliminated and replaced. In the last stage, participants were then debriefed about the study in general (the lists were designed to get them to falsely remember of non-studied words), and they were given a debrief form for completing their voluntarily participation.

RESULTS

Two-way between subjects ANOVA tests were used to analyse the results. The total number of words correctly and falsely recognised by participants were added in each condition, omitting the scores for unrelated and weakly related words.

The actual number of words correctly and related lures falsely recognised scores for each condition were calculated, which then converted into proportion of responses (e.g., the proportion rate: actual number of correctly recognised scores were calculated in terms of $n/12$, and lures falsely recognised scores were calculated in terms of $n/6$, where n is the number of scores/ false judgement). Both of the mean recognised scores for each condition were analysed and these are presented in Table 1 and 2.

Each of these correctly and falsely recognised scores was run in two separate ANOVAs: the first was to analyse the effect of tempo and genre of music (the two IVs) on correct recognition, and another one to analyse the effect of the two independent variables on critical lure false memories.

Table 1. Means and standard deviations of the number of actual words correctly recognised under the four conditions

	Classical		*Rock*	
	Slow	*Fast*	*Slow*	*Fast*
Mean	.761	.711	.722	.706
SD	.147	.147	.148	.164

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Table 1 presents the descriptive statistics for means and standard deviations of the number of actual words correctly recognised under the four conditions, and Table 2 presents the number of critical lures falsely recognised across the four conditions.

In correct recognition of actual words, a two factor fully independent (univariate) analysis of variance showed that there was no significant main effect of Genre as the scores did not differ between the classical (M = .736, SE = .028) and rock condition (M = .714, SE = .028), F (1,56) = 0.316, $p > .05$. There was neither a main effect of Tempo as the scores also did not differ between the slow (M = .741, SE = .028) and fast condition (M = .709, SE = .028), F (1,56) = 0.696, $p > .05$. There was no significant interaction found between music Genre and musical Tempo factors, F (1,56) = 0.181, $p > .05$.

Table 2. Means and standard deviations of the number of critical lures falsely recognised under the four conditions

	Classical		*Rock*	
	Slow	*Fast*	*Slow*	*Fast*
Mean	.687	.567	.699	.579
SD	.226	.235	.180	.243

In false recognition of critical lures, a two factor fully independent analysis of variance showed that there was no significant main effect of Genre as the scores did not differ between the classical (M = .627, SE = .041) and rock condition (M = .639, SE = .041), F (1,56) = 0.046, $p > .05$. However, there was a main effect of Tempo, as the scores for fast tempo (M = .573, SE = .041) were lower than for slow tempo (M = .693, SE = .041), F (1,56) = 4.405, $p < .05$. There was no significant interaction between music Genre and musical Tempo, F (1,56) = 0.00, $p > .05$.

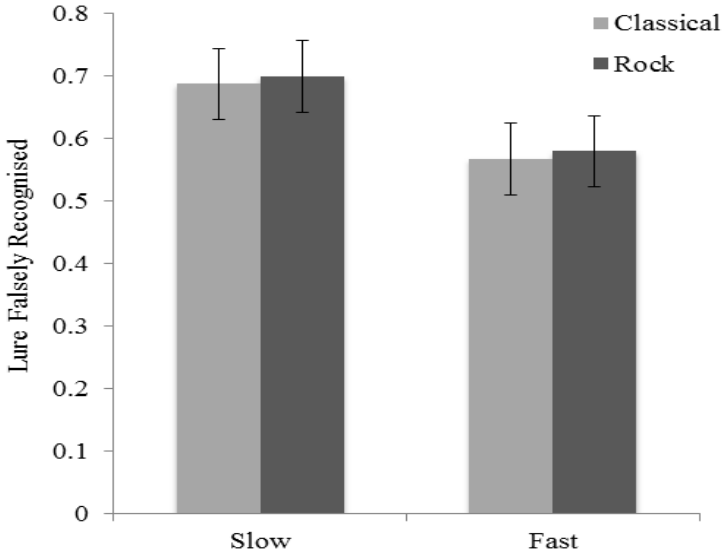

Figure 1. Mean of critical lure falsely recognised for Classical and Rock genres in both the Slow and Fast tempo conditions. Error bars denote one standard deviation around the mean

In general, the results showed that correct recognition of actual words (the hit rate, M = .725, SE = .020) was significantly greater than for false recognition of non-presented critical lures (M = .633, SE = .029), F (3,56) = 0.632, $p > .05$.

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DISCUSSION

The purpose of the present study was to investigate whether or not music genre and musical tempo have effects in the formation of correct and false memories. The results revealed the genre effect, such that performance on correct recognition and false recognition scores were not affected by the manipulation of music genre. Based on the results obtained, this current study does not support the first hypothesis that musical genre of rock music elicits the most false recognition. It was previously thought that there might be differences in the number of words correctly and falsely recognised between classical and rock music because it was previously expected that the types of background music could influence the activity for cognitive processes; either enhance or hinder the memory performance. It was thought rock genre is more distracting than classical music due to the fact that rock music contains more notes and less gaps of silence during songs than classical music, and thus, rock music require more aural data processing which then increase processing activity along with the musical stimulus interferes the listener, and draws resources from processing the content. More explanations about the differences between the nature of music genres will be further discussed later. Kirkweg (2001) claimed that certain types of music genre could stimulate certain parts of the brain and body, which can causes alteration in the way memory processes. In a previous study carried out by Tucker and Bushman (1991) has shown an effect of rock and roll music on mathematical and verbal tasks. However, a study done by Harmon et al. (2008) showed when participants are played classical music or in silence condition during reading comprehension (which the encoding stage is a complex process), participants are more likely to produce significantly higher assessment scores than those in rock music. A possible explanation for these current findings could be that music genre (rock songs) causes more interference only for complex cognitive activities (reading comprehension tasks), but not on simple task (memorising of word lists). This current study found no significant effects in both correct and false recognition of word (or lure) scores for music genre variable. Simultaneously, there was also no significant interaction effect between genre and tempo on correct and false recognition. Therefore, this study accepts the null hypothesis stating that there is no relationship between the correct (or false) recognition scores of the participants and the types of music genre the participants were exposed to. It was determined that it is necessary to conduct further studies for genre effect in this area of research.

With referring to the second hypothesis of this experiment, it was hypothesised that fast tempo will have a greater effect on words falsely recognised. The results revealed that slow tempo have greater effect on false recognition of critical lures than in fast tempo. However, tempo effect was not affected on correct recognition of actual words. False recognition of critical lures has produced a conflicting result regarding the influence of tempo, such that participants performed better in fast tempo condition with less likely to make false recognition of lures than in slow tempo condition; slow tempo appeared to have more false memories. This might suggests that slow tempo music makes people to feel more relaxed and significantly limit the function of the brain capacity to encode information, as a result from too much attention places on the music rather than the task. A fast tempo makes people to feel more alert and energetic, and this suggests that it enhanced the brain to function more effectively and focus their attention on the task, and hence decrease the likelihood of making wrong judgement (false memories). To support current research's findings, there is a study examined by Day, Lin, Huang and Chuang (2009), which their study based on an eye-tracking approach on the influence of music tempo and task difficulty on the performance of multi-attribute decision-making with respect to two levels: background music as the arousal inducer and the distractor. Their findings supported the arousal inducer standpoint of which, when the level of decision time was kept constant, *"participants made decisions more*

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ISSN: 2186-8476, ISSN: 2186-8468 Print
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accurately with the presentation of faster than slower tempo music" (Day et al., 2009: p. 130). Furthermore, they found music with fast tempo was found to increase the number of correct complex decision-making only, but not in simple decision-making. These conflicting results also supported the study made by Husain, Thompson and Schellenberg (2002), where fast tempo enhanced performance on the spatial task. This current findings could have been attributed to the study task is too simple, only involving word memorisation, such that future research should focus upon the type of study task; can be improvised by adding image lists or changing the test method to recall task. This might contribute to different findings with this methodological improvisation. Therefore, these findings of the musical tempo showed that there is only a significant effect on correct recognition of actual word scores, but not on false recognition of critical lure scores.

Overall, correct recognition of presented words was significantly greater than false recognition of non-presented critical lures. This difference reflects the impact of studying the list on subsequent correct recognition of words from the presented list. As this was the case in recognition, correct recognition of some list words was extremely high – at least as great as false recognition of related lures. Another important finding was that false recognition was accompanied by judgments of actually "remembering" details about the word's presentation (or vague feelings of familiarity), instead of remembering the actual words being presented. In fact, the rate of "*Yes*" judgments for presented words was almost similar to that for critical lures. These findings suggest that false recognition of the critical lures was subjectively compelling, pretty much the same as a perceptual illusion that feels real. The compelling subjective nature of this effect of false memory creation is one of the many reasons why it has become such a well-known method of investigating false memories.

It is difficult to conclude into a definite judgement based on a single piece of music, as musical pieces varies in terms of articulation, beats per minute, dynamic, harmony, intonation, melody, rhythm, and tone. Two musical pieces could have the same tempo (number of bpm) but differ in all other features. In order to increase the reliability of the results, more musical pieces of the same genre or tempo could be included and tested to find out how music genre and tempo influence the brain's ability to process and recognise information. Since this current experiment only presenting one musical piece in each condition for a time frame of 03:15 minutes, it is perceived to be short to manipulate the participants to produce the desired effects. Further recommendation for further research should include 3 different songs of the same genre and tempo for every condition with music play for around ten minutes to test participants after a series of long exposures. For example, fast classical soundtracks that categorised under *Presto* group (fast tempo, 160 – 200 bpm) are such as: Symphony No. 3 in E-Flat Major, Op. performed by London Symphony Orchestra & Josef Krips (170 bpm); Over the Rainbow / Simple Gifts by The Piano Guys (170 bpm); Ascolta by Ludovico Einaudi (168 bpm) (Jog.fm, 2014). With this alternative method, it will make the experiment more reliable as the participants being tested with different songs of the same genre and tempo. This current laboratory experiment only presented background music during the learning of word lists, and the environment was cut to silence during recognition task across the four conditions. According to Balch and Lewis (1996), changing a particular environment (e.g tempo) in the first task to another environment in the second task could lead to decrease in memory recall. By presenting the same background music over the stages of study task and the recognition task, it would probably lead to significant results.

Furnham and Allass (1999) remarked that different individuals have different preference of music, and thus, the randomly selected musical pieces may increase or decrease participants'

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ISSN: 2186-8476, ISSN: 2186-8468 Print
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level of arousal. This current study did not acknowledge the possibility that individual's preference types of music may have confounded genre and tempo effects. Oakes and North (2006) elaborated that musical liking may play roles in participants' responses, more 'enjoyed music' provokes increased cognitive processing load causing to decreased content recall due to the nature of 'enjoyed music' tend to be more distracting; because in 'less-enjoyed music,' participants tend to limit their attention on the music and more focus on the task presented. For example, participants who perform a task in a 'less-enjoyed music' may filter out the 'less-enjoyed music' in a genre even though they are familiar with it. Since the study used two different music genres (which varies completely in the art style) as stimuli, it is possible to perceive that genre effects confounded the results for music preference due to the different use of musical instrument (rock music generally use louder instruments such as electric guitar, drums & etc). In contrast to classical soundtracks, it is classified as easy listening; whereas rock music is much more popular than classical music, and thus, serve as a larger distraction. Consequently, the present research proposes that 'enjoyed music' during a study task will lead to poorer words recognition due to the disturbance to attention and storage of written data. Therefore, further research would be worth investigating about familiarity and preference of individual's types of music before handling the experiment.

This present research attempted to compare and contrast the mixed effects of music genre (classical and rock) and musical tempo (slow and fast) on memory performance on both correct and false memory formation. From this study, it has added to the growing literature on false memory in the present of background music. This creates implications for further research as exploring other types of musical genres (jazz, country, opera, trance, rap) or tempos (very slow, slow, medium, fast, very fast) could be investigated. For example, the use of very fast tempo (prestissimo, 200 bpm and over) in classical genre may become a distraction to participants. This may lead to more words falsely recognised if very fast classical music thought to be more distracting. As mentioned in the above paragraph, it might be helpful to think about whether the types of music could create different emotions or moods. For example, rock music makes listeners angry while classical music makes listeners more sad? According to Storbeck and Clore (2005), mood can influence individuals' processing activity; participants with pleasant moods tend to have more false memory effect than those in unpleasant moods. Griffin (2006) suggests that slow tempo is associated with feelings of sadness, deep emotions and solemnity whereas fast tempo is associated with feelings of happiness, joy and playfulness.

This study reported statistically significant relationship between word lures falsely recognised and tempo effect. It can be concluded that when a person is presented with a simple task (memorising words) whilst listening to fast tempo music, they are less likely to make mistake in their test. The findings from this present study might help students to decide which type of music to listen to when they are studying or memorising. The influence of background music on learning still worth investigating further research.

ACKNOWLEDGEMENTS

Rsearcher would like to thank to Ministry of Education, Brunei Darussalam for granting scholarship to study at Keele University, UK.

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ISSN: 2186-8476, ISSN: 2186-8468 Print
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