The effect of Music on Learning in Virtual Environments - Initial Results

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ABSTRACT

In this paper we discuss the effect of music on learning in virtual-immersive environments. Auditory stimuli were presented within a specialized display system in which seventy-two undergraduate students watched a 3-D computer animated video. This video included narrated historical information and background music. Background music was experimentally manipulated to create six versions of the video: No Music; original tempo/pitch; fast-tempo music; slow-tempo music; low-pitched music; and high-pitched music. After watching the video, participants were tested on the historical material presented, and answered a number of other questions about the video and background music. Data analyses revealed that people under the influence of one particular computer game soundtrack remembered information better than their peers at statistically significant level. Also, those participants who were more immersed into the virtual environment performed significantly better. Further encouraging results are reported in this paper, however, follow-up experiments are needed.

1. INTRODUCTION

These days we can find music in almost every situation of our lives. Be it in the car or bus on our way to work, at work itself, in shopping malls, movies, the Internet or in computer games. For the iPod generation music is becoming more pervasive every day. At the same time Virtual Realities (VR) are becoming ever more ubiquitous, in fact it is becoming increasingly hard to distinguish between what is reality and what is virtual reality. For example, does sending an email, text-chatting or video-telephony with another person via Skype[2] or MSN[3] still belong to what we commonly refer to as the 'real world' or is it already part of the virtual realm? We might not be able to answer this question here but VR can take up different forms and some are text- and picture-based, like Facebook[4] for example. Other VR are fully animated 3-D computer games or so called "Massive Multiplayer Online Role Playing Games" (e.g. World of Warcraft, Lineage 2) or their single-player role-playing equivalent (e.g. The Elder Scrolls 4 – Oblivion, Ultima, Dungeon Siege). These computer games are becoming increasingly popular and especially teenagers spend a lot of their time in front of computer screens. Quite often they are completely occupied by these games and their attention is so intensely focused on the fantasy world in which they are roaming about, that almost nothing can disturb them and get them out of these worlds and back into reality. One explanation for this engagement could be Csikszentmihalyi's 'Flow' theory which involves the "feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfillment" [1]. Another explanation could be that "video game play is an activity which lies in the domain of intrinsic motivation" [2].

Furthermore, music seems to have an effect on motivation or as Eady and Wilson [3] cite an unpublished doctoral thesis by Weisskoff [4] "students who received the music condition scored significantly higher with regard to continuing motivation" when reporting about a study of children receiving language lessons – with or without background music.

We too argue that a major source of total immersion into the above mentioned fantasy-game-worlds is the music that is played throughout the course of the games. Consequently, the aim of our research is to examine effects of music on memory for events and facts that are learned during game experiences and to explore the significance of music for feelings of immersion in game-like virtual-immersive environments.

2. BACKGROUND

When one looks for evidence of improved memory through the use of background music in VR, specifically computer based role-playing games, such investigations are hard to find, due to the fact that computer based role-playing games and the associated soundtracks are a rather new phenomenon in society. For this reason, the best possibility to find relevant existing work is to look for such evidence in related areas in which more research has been conducted. The closest and most obvious similarity to computer game music exists in the area of film music and there seems to be evidence that music does have an effect on memory of visual stimuli.

For example, Boltz et al. [5] investigated the effects of background music on the remembering of filmed events and found that participants remembered visual information (i.e. movie scenes) better if such information was accompanied by mood-congruent music. Further experiments showed that mood-congruent pairings of video and audio are "jointly encoded into the cognitive system" [6, p 1199].

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[4] http://www.facebook.com/

A study conducted by Rauscher, Shaw and Ky [7] stirred broad public interest for the so called 'Mozart Effect'. During their tests Rauscher *et al.* investigated the effect of listening to classical music before subjects were taking a spatial reasoning test. They found that 36 college students who listened to 10 minutes of Mozart's Sonata for two pianos in D major, K448, scored on average 8 - 9 points higher in a subsequent spatial ability IQ test, compared to when they listened to a relaxation tape or to no audio stimulus at all. The results are heavily discussed and other researchers have tried to replicate the results, some were successful, others were not. According to McKelvie and Low [8], who failed to replicate the Mozart effect in a modified experiment, the most active researchers in this field are Bruce Rideout and Kenneth Steele of whom Rideout, together with others, has been able to replicate the Mozart effect and Steele along with colleagues has failed to do so. However, in a follow-up study, Rauscher and Shaw, together with other colleagues [9], investigated the effect of musical training on spatial-temporal reasoning which is "used in higher brain functions of math" and "in chess when we have to think ahead several moves, developing and evaluating patterns in space and time totally in our mind" [10]. The study was conducted with young children aged 3-4.9 years old. Note that the emphasis is on musical training unlike listening to Mozart as investigated before. 78 children from both genders were included in the tests and 34 of the children were given piano lessons for a two hand piece on the piano while the other children were given singing lessons, computer lessons or no lessons at all. What they found was that the group that was given the piano lessons "scored 34% higher on tests designed to measure spatial-temporal reasoning skills" [11].

In their experiments, Thompson, Schellenberg and Husain [12] found that participants performed significantly better in an associated paper-folding-and-cutting task when they listened to a "pleasant and energetic" Mozart piece in major mode as opposed to a second group who listened to a "slow, sad" Albioni piece in minor mode. However, in contrast to Rauscher's earlier experiments, Thompson *et al.* conclude that the 'Mozart Effect' is more likely to be a result of mood and arousal which are heightened by the mode (major) and they say that:

> It is possible, then, that the Mozart effect has little to do with Mozart in particular or with music in general. Rather, it may represent an example of enhanced performance caused by manipulation of arousal or mood. [12]

The type of music that is being used during such experiments seems to be another interesting factor. For example, Allen and Blascovich found that task performance of surgeons in a backward counting task improved if they listened to specific music [13]. It is of importance that Allen and Blaskovich gave some participants pre-selected music (by the investigators) while others were allowed to bring their own favorite music. There was a control group with a music-free condition. Notably, the participants who were allowed to bring their own music performed significantly better than those participants who listened to the investigator-selected music or did not listen to any music at all. While Allen and Blascovich indicate that the surgeons' emotional state might have been influenced by the fact that they were listening to their own favorite music (which in turn improved their speed and accuracy), we actually want to point out that all participants who brought their own music, chose instrumental music (46 Classical, 2 Jazz, 2 Irish folk).

Further evidence for the usefulness of music for educational purposes comes from McFarland and Kennison [14] who found in their study that subjects who had to solve a tactual maze task with either their right or left hand performed badly when they were listening to music with the ear that was on the same side of the body (ipsilateral) as the hand they were performing the task with. McFarland and Kennison state that this is due to the fact that two tasks are performed by the same brain half at the same time which causes 'intrahemispheric competition' in that brain half. The most interesting finding however was that participants performed best when listening to music on *both* ears and using their right hand. Their explanation for this outcome is that instrumental music is pre-dominantly processed in the right brain half. This means that listening to and processing the music occupies the right brain half so much that it does not have time (and the necessity as with vocalised music (language and lyrics are mainly processed in the left brain half)) to communicate with the left brain half. Thus the left brain half is freed of 'interhemispheric competition' and has more processing power available to solve the original (maze) task. We think that this is quite an interesting finding and at this point we want to emphasize again that the music used in all conditions of McFarland and Kennison's experiment was classical, instrumental music.

Mary Ann Davies states that "Music evokes emotions which in consequence enhances the learning effect" [15] and Frederic Vester says that we learn and remember more, the more senses are included in the learning process [16]. While Davies only refers to the use of music when she says that "heightened involvement creates a stronger neural connection, which in turn makes it easier to remember information" [15], we think that this is even more true if the visual and the aural senses are combined. In our earlier work [17], we found evidence for the benefit of the inclusion of the visual sense by testing the impact of the visual sense on learning. Our study included 'The Virtual Memory Palace', a 3-D environment which offers the possibility to freely explore a virtual 3-dimensional architectural representation of an ancient Greek (and formerly purely mental) memory technique. The results showed a higher remembrance rate of items learned in the Virtual Memory Palace (and thus supported by the visual channel) as compared to a wordlist.

All of these results demonstrate that music can greatly influence memory for events in movies, an IQ test, a paper-folding-and-cutting test and performance in backward counting and maze tasks. We note that most of the research presented considers the benefits of music for spatial-temporal tasks. In contrast, our work looks for effects in recognition/recall and is a less explored area of research. Our focus stems from evidence from our earlier study [17] where we found that virtual realities can be beneficial for remembrance of visually supported memory systems. This led us to investigate whether similar effects could be observed in computer games which feature both conditions. Firstly, they are computer generated virtual worlds and secondly almost all of them have a soundtrack or background music implemented in the game. In the present study we want to look for evidence if the combination of highly immersive 3-D environments and appropriate background music is beneficial for learning.

3. METHOD

In the design of our study it was important to ensure that an environment be created which allowed us to measure the effects of music on memory. To provide a learning environment we chose to create a computer-animated video presenting the history of the Macquarie Lighthouse which, as well as being recognised as the icon of our university, is also the first lighthouse of Australia and the southern hemisphere. Despite of this importance to Australian settlement, the history of the Macquarie Lighthouse is not widely known and is thus an ideal topic for evaluating learning of historical facts. While computer games are interactive, we choose to create a non-interactive computer generated 3-D history lesson to provide better experimental control of the variables. The interactions which occur within computer games can be highly complex and if interactivity (which is all about exploration, options and choice) were allowed it would be impossible to draw valid conclusions regarding the effect of background music on memory. For example, if Participant A wanders around freely in the virtual world and interacts with 3 different 'Avatars' (virtual personas) it could not be ensured that Participant B visits the same Avatars in the same order and listens to the same piece of music at the same time that the year of construction of the lighthouse (or another fact) was conveyed. Despite the restriction of non-interactivity, the course was created as similar as possible to a typical conversation with an Avatar in a full-feature computer role-playing game.

3.1. PARTICIPANTS

The participants were 72 undergraduate students (45 female, 27 male) from 19 to 56 years old (mean 24.2 years of age). The students were recruited by advertisement on campus and from introductory statistics and computing classes at Macquarie University, Sydney. Participants received 10 AUD for their involvement. 15 participants indicated English as their first language while 57 participants answered that English was their 'second or other' language.

3.2. APPARATUS

A 3-D computer animated video narration (subsequently called 'the Macquarie Lighthouse', '3-D' and 'virtual history' course) was created (See Figure 1) with the free modding (to **mod**ify/develop) extension for 'The Elder Scrolls IV - Oblivion'[5] game in which an Avatar explains the history of the Macquarie Lighthouse. The video narration is 11:38 minutes long. Six different versions of this history course were produced according to different background musical stimuli, which will be explained in more detail after describing the visual aspect and the physical set-up of the 3-D history course and experiment.

Figure 1: A fictional descendant of the first lighthouse keeper delivers the history of the Macquarie Lighthouse

3.3. VIRTUAL-IMMERSIVE DISPLAY SYSTEM

The virtual history course was displayed by means of a display system called a 'Cone' to increase the level of visual immersion. Figure 2 shows a pilot-tester who is watching the video narration and listening to the Avatar.

Figure 2: A pilot-tester watching and listening to the 3-D narration about the history of the Macquarie Lighthouse

The Cone-display system consists of 3 projectors which display the virtual world onto a semi-cylindrical screen canvas. The user is positioned slightly off centre towards the canvas to allow a 160° field of view (FOV) which simulates almost the maximum of 180° of the natural humans FOV. Through this setup the virtual reality occupies most of the user's visual sense and the user gets the impression that the world displayed on the screen canvas is almost real, he or she feels immersed in this virtual reality. For this reason such an environment is called a 'virtual-immersive environment'.

3.4. EXPERIMENT STAGES AND PHYSICAL SET-UP

The experiment consisted of three stages. Figure 3 shows the physical set-up of the experiment room with the participant's location within the room for each stage of the experiment. Participants started by answering a short pre-experiment questionnaire about biographical data (see position 1 in Figure 3). In Stage 2 of the experiment, participants were asked to sit in the center of the display system where they watched and listened to the stimuli. The audio part of the 3-D animated narration was presented through a pair of Sennheiser HD 280 stereo headphones and the participants were given the option of using a volume dial to adjust the volume of the narration (and embedded background music) to their individual comfort-level. The Sennheiser headphones are closed,

[5] http://www.elderscrolls.com/home/home.php and http://cs.elderscrolls.com/constwiki/index.php/Main_Page

circumaural headphones and were specifically chosen to reduce noise associated with the display system (namely the projectors) and to eliminate aural distraction from other participants and researchers in the room as much as possible.

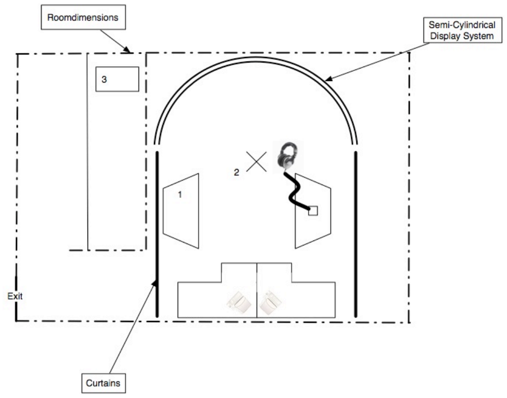

Figure 3: The physical set-up of the virtual-immersive display system

After participants finished watching the 3-D history course they answered a post-experiment questionnaire (see position 3 in Figure 3) by means of multiple choice questions about facts that they just learned in the history course (e.g. what was the name of the first lighthouse keeper, in which year was the first lighthouse built, how many people were stationed at the lighthouse, etc.).

Other parts of the questionnaire asked about feelings of immersion (how much did you loose track of time, how much did you forget about yourself/problems, etc.) and further biographical data (years of experience with computer games, involvement with music and musical training, etc.)

One participant watched the Macquarie Lighthouse course at a time. Previous participants sometimes answered the post-experiment questionnaire in a separate section of the laboratory. To reduce visual distraction the main display area was protected by curtains. For stage 3 participants were asked to wear noise-canceling earmuffs to reduce aural distraction.

3.5. STIMULI AND MEASURES

In order to gain a somewhat representative sample of the computer role-playing game genre, the soundtracks from 4 contemporary computer role-playing games, namely 'Oblivion', 'Baldur's Gate', 'World of Warcraft' and 'Icewind Dale' [6], were selected for manipulation. From each soundtrack of each game 3 musical pieces were pre-selected. These 3 pre-selected pieces were then presented to a group of pilot-testers who were selected from the Department of Computing at Macquarie University. All of the pilot-testers have extensive experience with computer role-playing games and the associated soundtracks. The pilot-testers were asked to rank the musical pieces on a scale from 1 to 5 as being a) not representative (1) or representative (5) for the role-playing game genre and b) not suitable (1) or suitable (5) for the 3-D animated video presentation. The musical pieces that scored the highest overall value in both categories were then selected for further experiments. The selected musical pieces are:

- Oblivion — **town_03**.mp3 (to be found in the install directory of the game, e.g. C:/Program Files/Bethesda Softworks/Oblivion/Data/Music/Public/)
- Baldur's Gate — **The Friendly Arms Inn** (to be found on the Soundtrack CD (Music by Michael Hoenig))
- World of Warcraft — **Temple (Intro Cue)** (to be found on the Soundtrack CD (Blizzard Entertainment))
- Icewind Dale — **Easthaven In Peace** to be found on the Soundtrack CD (included in "Icewind Dale – The Ultimate Collection"))

3.6. TEMPO AND PITCH MANIPULATIONS

The above musical pieces were then manipulated in order to investigate which attributes show which effects on learning and immersion. Two musical attributes that have powerful effects on emotion and mood (which in consequence would have an effect on learning and immersion) are pitch height and tempo [12]. Hence, the selected pieces were manipulated in tempo and pitch according to Ilie & Thompson's earlier work [18] in which they reduced/increased tempo by 21% / 26% and lowered/increased pitch by 2 semitones respectively. The manipulations were created on a Macbook Pro in Ableton Live 6.0.7. Ableton Live is a professional DAW (Digital Audio Workstation) software, which allows convenient and high quality tempo and pitch manipulations. We note that manipulation of the original musical attributes alters the inherent musical cues which potentially could create an adverse effect on the applications of the music. Our results did not show any evidence of this. Further, to address this issue prior to our study, the manipulated pieces were presented to experts from the Department of Contemporary Music Studies at Macquarie University. None of the experts found irritating distortions or could identify the manipulations as such.

Figure 4 shows a 3x3 matrix according to which the musical pieces were manipulated and subsequently used for the experiment conditions. Tempo manipulations are shown horizontally (Slow (reduced by 21%), Medium (original tempo, unaltered) Fast (increased by 26%)). Pitch manipulations are shown vertically (low (reduced by 2 semitones, medium (original pitch, unaltered) high (increased by 2 semitones)). Again, medium indicates that the musical piece remained at its original pitch. For reasons of practicality (size of participant pool, available lab time, etc.) it was decided to use the 'corner' and 'center' conditions (Conditions 1, 3, 5, 7, 9 (color-coded)) in order to still receive interaction effects.

[6] http://www.elderscrolls.com/
http://www.bioware.com/games/baldurs_gate/
http://www.worldofwarcraft.com/
http://www.blackisle.com/ or
http://www.mobygames.com/game/icewind-dale/

Grey boxes indicate tempo/pitch combinations for the selected experiment conditions as follows:

- Experiment Condition 1: S/L – Slow Tempo/Low Pitch
- Experiment Condition 3: F/L – Fast Tempo/Low Pitch
- Experiment Condition 5: M/M – Medium Tempo/Medium Pitch (Tempo and Pitch unaltered)
- Experiment Condition 7: S/H – Slow Tempo/High Pitch
- Experiment Condition 9: F/H – Fast Tempo/High Pitch

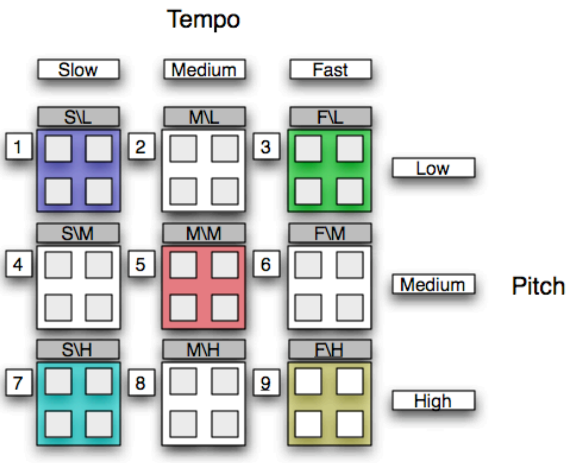

Figure 4: The musical pieces were manipulated according to a 3x3 tempo and pitch matrix. Conditions 1, 3, 5, 7, 9 (color-coded) were used for the experiments.

The 4 smaller boxes inside each of the bigger boxes represent the 4 different musical pieces from the different computer game soundtracks (Oblivion, Baldur's Gate, World of Warcraft, Icewind Dale) indicating that all musical pieces received the same tempo/pitch manipulation.

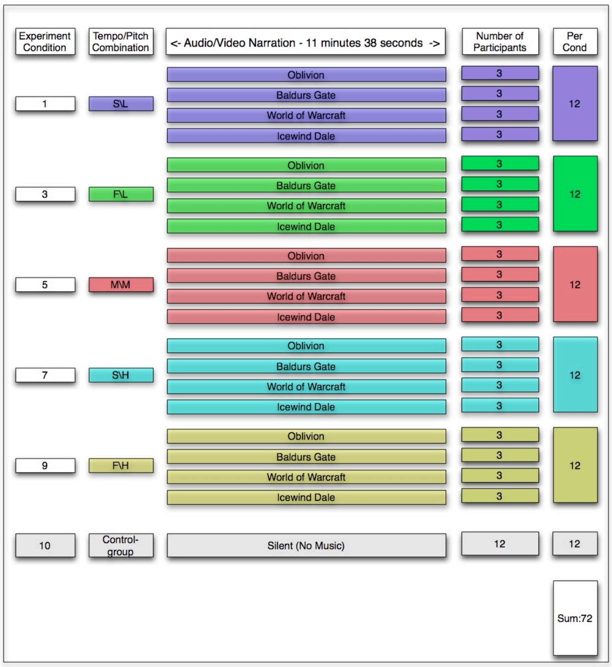

Figure 5: The overall experiment design – 5 different musical conditions (color-coded) according to the tempo/pitch matrix (See Figure 4)

The music was played in the background of the narration with the volume being chosen so that it was clearly audible but did not compete with the narration. A control group (Experiment Condition 10 in Figure 5) received a 'No Music' condition and during the 3-D history course they only listened to the voice of the Avatar without any musical background.

In Figure 5 we can see the experimental groups in a different display to illustrate the experiment design from a different angle. The experimental tempo and pitch manipulations from Figure 4 are combined with the 4 different soundtracks and grouped in the 5 (+1 Silent) tempo/pitch combinations/experiment groups.

4. RESULTS

Participants were asked 29 questions from the 3-D history course of the Macquarie Lighthouse. The mean number of questions answered correctly for each of the experimental conditions is illustrated in Figure 6 and Figure 7.

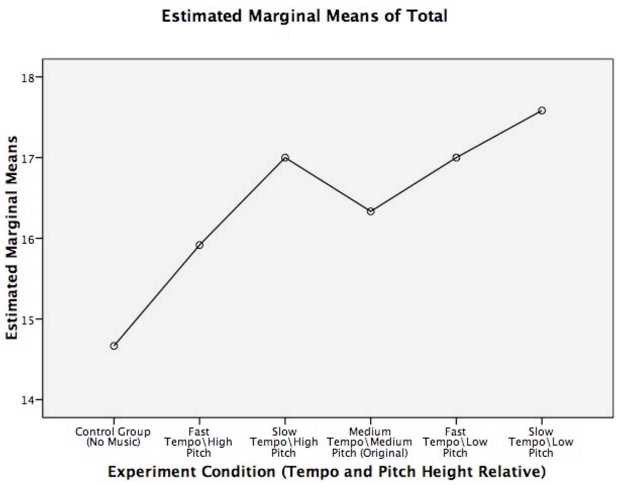

Figure 6: Tempo and pitch combinations in relation to the mean number of questions answered correctly

Figure 6 shows all experimental conditions (Control Group, Fast Tempo/High Pitch, Slow Tempo/High Pitch, Medium Tempo/Medium Pitch, Fast Tempo/Low Pitch, Slow Tempo/Low Pitch) and it is clearly visible that the number of correctly answered/remembered facts increases at slower tempo and lower pitch.

Descriptive statistics in Figure 7 show the mean scores and standard deviations for each experimental condition. They ranged from a minimum of 14.7 questions answered correctly by the control group without music (grey box – experiment condition 10) to a maximum of 17.6 questions answered correctly by the group under the slow tempo/low pitch condition (purple box – experiment condition 1). The magnitudes of the mean scores are close to each other and the variations are wide therefore it is hard to detect any statistically significant difference between the means. For example, the difference between musical condition 1 (slow tempo/low pitch) which has the highest number of learned facts (17.6 facts remembered correctly) and musical condition 9 (fast tempo/high pitch) which has the lowest (15.9 facts remembered correctly), is less than two facts (1.7).

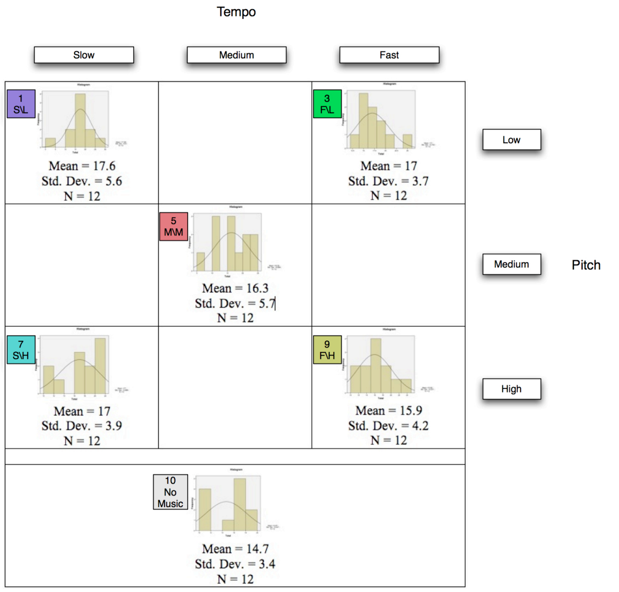

Figure 7: Comparison of the mean number of learned facts in the virtual-immersive 3-D narration

Even though the participants who listened to background music during the Macquarie Lighthouse course performed better than their peers in the no-music control group, a one-way analysis of variance (ANOVA) showed that the experimental (music) conditions were not a significant main effect for remembrance ($F_{(5,71)}$=0.63, p=0.68). In other words, we were unable to detect any statistically significant difference between the mean number of questions remembered by participants under the six experimental conditions.

Furthermore, we investigated the effects of tempo and pitch on remembrance of facts. The absolute tempo of the soundtracks under different conditions can be seen in Figure 8. For this analysis we removed the original soundtrack condition (experiment condition 5 - medium tempo/medium pitch) and the 'No Music' condition (experiment condition 10). Instead we focused on the four tempo (Fast, Slow) and pitch conditions (Low, High) (experiment conditions 1, 3, 7 and 9 in Figure 7).

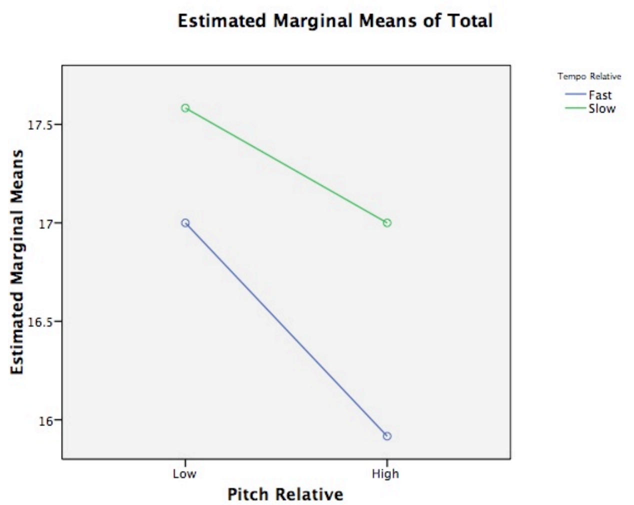

Figure 8: The mean number of questions answered correctly (y-axis) for 2x2 (tempo x pitch) matrix (original soundtrack condition (medium tempo/medium pitch) removed)

Figure 8 shows that the mean number of questions answered correctly was higher under the low pitch condition than under the high pitch condition. Figure 8 also shows that the slow tempo had a better effect on learning than the fast tempo (regardless of the pitch).

Two-way Analysis of Variance (ANOVA) was used to investigate the effects of tempo and pitch on learning which showed no statistically significant effect of either (both $F_{(1,45)}$ = 0.44, p = 0.51) and no significant interaction ($F_{(1,44)}$ = 0.04, p = 0.85).

We also tested the effects of game music (Oblivion, Baldur's Gate, World of Warcraft, Icewind Dale) against the 'No Music' condition (disregarding tempo and pitch all together). We found a significant difference between the 'Oblivion' soundtrack and the 'No Music 'condition using Dunnett's two-sided t-test (p=0.034). Those participants who listened to the 'Oblivion' soundtrack, on average answered 4.4 (95% confidence intervals 0.3 – 8.5) questions more correctly than their peers in the 'No Music' control group.

Moreover, to investigate the feeling of immersion into the virtual reality, we asked participants how much they lost track of time in the virtual-immersive environment. They answered on a 5 point scale from 0 being 'Not at all' and 4 being 'Completely'. Loosing track of time was highly correlated with the total number of questions answered correctly (Pearson's correlation = 0.374, p=0.003). This correlation was statistically significant at 0.01 level. The linear regression showed that 35% of variation in the total number of questions answered correctly was explained with the degree of losing track of time (R^2 = 0.347). Based on the linear regression, we conclude that on average if participants did not loose track of time, they answered 11.8 questions correctly. For each further level of loosing track of time (i.e from 1 to 4 on the scale) the total number of questions answered correctly increased by 1.9. For example, if a participants completely lost track of time then on average they would have answered 19.4 questions correctly which is 7.6 questions more than those participants who did not loose track of time at all. We could not find a significant relationship between tempo of the soundtrack and loosing track of time.

5. DISCUSSION

The results show that some aspects of our experiments had effects and other did not. For example, changes in tempo and pitch did not show a statistically significant difference on the amount of correctly answered questions. Nor did 'Music' versus 'No Music' if all soundtracks were combined in the same (Music) category.

However, when we looked at each individual soundtrack and compared it to the 'No Music' control group we found a statistically significant difference between the 'Oblivion' soundtrack and the control group. Furthermore, we found a statistically significant effect between the number of questions answered correctly and participant's feeling of immersion into the virtual-immersive environment. Those who said that they were more immersed (by saying that they lost track of time) in the 3-D history course remembered more facts than those who said that they did not loose track of time.

A problem that became obvious during analysis of the data was that the absolute and relative tempo of the various soundtracks differed quite widely from each other (Table 1). What is medium (M) *relative* tempo for one soundtrack can be fast (F) *absolute* tempo for another soundtrack. For example, the medium tempo of World of Warcraft (WoW) is 142 beats per minute (BPM). This is quite different from the slowest soundtrack in the same (medium) category – Icewind Dale (IWD) with 95 BPM. Also, the medium tempo of WoW (142 BPM) is just as high as the Oblivion soundtrack in the fast condition (146 BPM).

Table 1: Absolute tempo in beats per minute (BPM) and relative tempo after manipulation (S/M/F=Slow, Medium, Fast)

Tempo	S	M	F
Oblivion ->	92	116	146
Bal Gate ->	82	104	130
Wow ->	111	142	174
IWD ->	81	95	114

Although we have not investigated this in detail the same problem occurs with pitch height. What is medium relative pitch for one soundtrack can be low absolute pitch for another, et cetera.

Another problem was that the number of participants in each of the experimental conditions was small which complicates statistical analysis. Therefore, further experiments are needed to provide evidence for any significant differences between learning under the 'Music' and 'No Music' conditions. Furthermore, it needs to be investigated why we found a statistically significant difference between the Oblivion soundtrack and the 'No Music' condition but not for the other soundtracks.

For this reason, we will eliminate the problems of differing *absolute* tempo and pitch height for the follow-up experiments by using only two soundtracks with similar features, therefore, controlling variability of tempo and pitch. This experiment design will also decrease the number of participants needed in these conditions which will result in higher participant numbers - and therefore more conclusive results - for each of the (new) conditions. Also, despite the fact that the results from the investigations of the tempo manipulations did only show a beneficial tendency and no statistically significant results, we will focus on the slow tempo condition. However, this means that the results of the subsequent experiments might not be generalisable for the whole genre of computer role-playing games but instead on one particular tempo for one or two of the soundtracks.

6. ACKNOWLEDGEMENTS

Thanks to the anonymous reviewers for their helpful comments. This project is partly funded by Australian Research Council Discovery Grant coded DP0558852 and Macquarie University Research Infrastructure Grant titled "Virtual Reality Engine". The principal author is funded by iMURS (international Macquarie University Research Scholarship).

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