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HOW DO TEMPO AND PITCH SHIFTS OF SOUNDTRACKS FOR ROLEPLAYING GAMES INFLUENCE MEMORY OF FACTS CONVEYED IN VIRTUAL-IMMERSIVE ENVIRONMENTS?

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ABSTRACT

In this paper we discuss potential effects of background music on the perception and memory of events experienced in virtual-immersive environments and computer-based roleplaying games. We describe an empirical study of whether memory for factual information is influenced by changes in the pitch and/or tempo of soundtracks used for a computer supported presentation on the history of the Macquarie lighthouse. The study involves presenting participants with a computer-generated educational 3D animation, while exposing different groups of participants to soundtracks that vary in pitch height (high, medium, low version) and tempo (fast, medium, and slow versions). Memory for factual information will then be examined, and implications discussed.

1. INTRODUCTION

Computer games are becoming increasingly popular and especially teenagers spend a lot of their time in front of computer screens. When they are playing games, it is quite common that they are playing so called "Massive Multiplayer Roleplaying Games" (e.g. World of Warcraft, Lineage 2) or similar single-player Roleplaying variants (e.g. The Elder Scrolls 4 – Oblivion, Ultima, Dungeon Siege). 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 to get them out of these worlds and back into reality.

We argue that a major source of this state of total immersion into these game-fantasy-worlds is the music that is played throughout the course of the games. 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 intense 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 computer based Roleplaying Games, such investigations are hard to find, due to the fact that computer based Roleplaying 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. [1] 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" [2, p 1199].

These results demonstrate that music can greatly influence memory for events experienced in movies. Consequently, there is a chance that similar effects can be observed in computer games. Hence, we want to test if such effects can be examined in Roleplaying Games and Virtual-Immersive Environments.

3. EXPERIMENT DESIGN

The current research involves a virtual course about the history of the Macquarie Lighthouse (Australia's first lighthouse). The important historical facts are delivered by an Avatar (virtual representation of a human character) in a virtual-immersive environment.

3.1 Visual Framework

The virtual course is being developed with 'The Elder Scrolls Construction Set'[1] which is a modding (to mod = to modify) expansion to the game 'The Elder Scrolls IV - Oblivion'.

[1] Bethesda Softworks:
http://www.elderscrolls.com/home/home.htm

Figure 1: An Avatar delivering the history of the Macquarie Lighthouse

This construction set allows the creation of complete virtual scenarios and supplies the developer with the necessary tools to design a virtual world in his or her own style. Figure 1 shows the Avatar in front of the 3D model of the Macquarie Lighthouse which was imported into 'The Elder Scrolls Construction Set'. Together with the 3D model of the lighthouse we have created 10 minutes of spoken dialogue about the Macquarie Lighthouse history. The narration of the history by the Avatar is being displayed in a virtual-immersive display-system, commonly known as an 'iCone™' or 'Cave™' (Cave Automatic Virtual Environment).

The iCone-like 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 a human's natural FOV. Through this setup the displayed virtual reality occupies most of the users' visual sense and the users get the impression that the world displayed on the screen canvas is almost real, they feel immersed in this virtual reality. Hence, such an environment is called a 'virtual-immersive environment'.

Figure 2: The Avatar delivers historical facts about the lighthouse to a user in a virtual-immersive environment

In Figure 2 we can see how the Avatar is delivering the history of the Macquarie Lighthouse to a user in such a virtual-immersive environment.

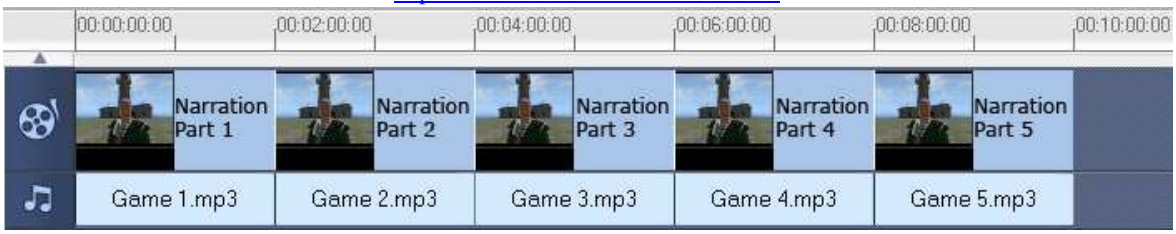
3.2 Audio Stimuli

For the background music condition we have decided to use the original music that is being played in contemporary computer roleplaying games. This music is quite often fantasy-themed classical music and thus it does not come as a surprise, that the musical genre is similar to that of fantasy movies. For example, the soundtrack that is played in the computer game 'The Elder Scrolls IV - Oblivion' sounds very similar to the score of 'The Lord of the Rings' movie trilogy. Both soundtracks are composed in a Celtic-style arrangement of classical music and both stories take place in a fantasy world with Wizards, Elves and Orcs.

Jason Hill writes in the Sydney Morning Herald that "there is evidence [that] games encourage the young to appreciate classical music" when he talks about kids who hear about a new band through a computer game soundtrack [3]. Unfortunately, the author of the article does not supply any further information, but we can also see, that the popularity of movie and computer game soundtracks is on the rise by looking at developments within society that mirror the newly found interest in this musical genre. For example, the Eminence Symphony Orchestra and Choir [4] performed a selection of soundtracks from popular video games during April 2007 in Sydney's Town Hall. The music that they presented is taken from popular game titles like 'World of Warcraft', 'Final Fantasy', 'The Legend of Zelda' and even 'Super Mario Bros.'. Imagine what our children would say if we would put a classical music CD (Compact Disc) in front of them and tell them to listen to it? They would probably declare us mad. However, they are listening to Celtic-style classical music for hours at a time without thinking about it. Sometimes, in the case of hardcore gamers the listening time of classical music can be months and in very rare cases (and probably pathologically addicted) even years.

Another reason why we decided to use original game music is that it is instrumental in character. There is evidence that instrumental music has a positive influence on cognitive processes and concentration. For example, Allen and Blascovich found that task performance of surgeons in a backward counting task improved if they listened to specific music [5]. 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). We think this is quite an important detail which strengthens our decision to use (instrumental) classical music in our experiments.

Furthermore, two musical attributes that have powerful effects on emotion and mood are pitch height and tempo (e.g. Ilie & Thompson [6]), which together with the findings of Boltz *et al.* [1, 2]



suggests that there is a high chance for a similar effect within the game-like computer animation presented in the virtual-immersive display-system (as described above).

Consequently, we will investigate how changes in pitch and tempo of soundtracks of computer based roleplaying games affect the memory of the historical facts that are delivered by the Avatar. For this purpose, we will underlay the 10 minute spoken dialogue with different musical stimuli. These stimuli will consist of 5 samples from different popular computer roleplaying games rather than only one example. By doing so we aim to get a representative sample of the computer roleplaying game genre.

In Figure 3 we can see the combination of the audio-visual *narration* stimulus together with the *representative music samples*. The narration continues for approximately 10 minutes and since there are 5 music samples from different games in the background, this results in two minutes length for each music sample.

Figure 3: Five sections of narration will be accompanied by five representative samples of game music taken from contemporary roleplaying games

As mentioned, we want to investigate how the change in pitch and tempo of the background music of contemporary computer roleplaying games influences the memory of facts learned in virtual worlds. In order to test this we will create 9 musical stimuli. The musical stimuli will consist of a 3x3 matrix of low, medium (normal), and high pitch and slow, medium (normal) and fast tempo. This results in 9 possible combinations of the involved variables as shown in Table 1.

Tempo \ Pitch	Low	Medium (Normal)	High
Slow	S\L	S\M	S\H
Medium (Normal)	M\L	M\M	M\H
Fast	F\L	F\M	F\H

Table 1: All of the representative samples will be encoded according to the above table

Notice that all 5 musical samples are being changed in the same way and assigned as the background music condition. They should be seen as one block of genre-typical music with the respective musical variation that is being exchanged. For example, if the music of Game 1 is manipulated to be lower in pitch and slower in tempo, the music of Games 2 – 5 will also be reduced to the lower pitch and the slower tempo. All five manipulated music stimuli will then be exchanged at the same time. Since this means that every participant will listen to only one version of the above matrix (e.g. Low Pitch\Slow Tempo (S\L) or High Pitch\Fast Tempo (H\F) for all representative musical samples) the experiment will result in a between subjects design with 12 participants for each condition. Additionally, there will be a control group which will receive a silent condition with only the audio-video narration but no background music. Participants will be recruited from the body of University students and after the 10 minute presentation of the audio-video narration together with the (manipulated) musical stimuli, the participants will answer a questionnaire that asks about details from the audio-video narration. The questionnaire will ask questions about biographical data (i.e. Gender, Age, cultural background, English language proficiency, experience with computers and games), immersion into the virtual-immersive environment (e.g. "Did you forget about yourself/other problems", "How much did the virtual environment occupy your attention?", etc.) and about factual data from the content of the course and the music conditions (e.g. "What was the name of the first lighthouse keeper and when was the first lighthouse built?", "Do you think that some of the music/sound conditions helped/distracted you from learning the topic matter?")

Through this experiment design we hope to get an indication under which musical condition (from L\S to H\F) participants remember more of the information they were given in the virtual-immersive environment. Additionally, we hope to gain insight through the control group whether the music is beneficial for memory of facts at all.

By gaining more insight into the two areas, the usefulness of virtual-immersive environments for teaching and the effect of music on learning, remembrance and motivation in such virtual-immersive environments we hope to contribute to the knowledge in these fields.

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