Attention, Time Perception and Immersion in Games

A. Imran Nordin
Department of Computer Science
University of York, UK
imran@cs.york.ac.uk

Jaron Ali
Department of Computer Science
University of York, UK
jra511@york.ac.uk

Aishat Animashaun
Department of Computer Science
University of York, UK
ama531@york.ac.uk

Josh Asch
Department of Computer Science
University of York, UK
jms556@york.ac.uk

Josh Adams
Department of Computer Science
University of York, UK
ja814@york.ac.uk

Paul Cairns
Department of Computer Science
University of York, UK
paul.cairns@york.ac.uk

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Abstract
Immersion is a phenomenon experienced whilst playing digital games. Some argue that it is linked to time perception, where gamers claim that they are losing track of time while they are immersed in the game. In this work in progress, we describe an attempt to investigate the relationship between immersion and time perception. We manipulated attention because it is known to influence immersion and time perception differently. The results suggest that the experimental manipulation only affects time perception but not immersion. We therefore argue that there is a dissociation between immersion and time perception but further work is needed to investigate this in detail.

Author Keywords
Immersion; Time Perception; Attention

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H.1.2 [User machine systems: Human information processing]: Games.

Introduction
Immersion is a phenomenon people experience whilst playing digital games. It is a commonly reported term to describe the experience of playing digital games among the gaming community including gamers, designers and

reviewers of games [3]. Studies on immersion have revealed that lots of factors influence it such as the touch-screen size [14], the effect of challenge and player's expertise in the game [7], realism and behaviour [6] and other things, but there is no unified theory to describe immersion. Indeed, different field of studies explain immersion differently [3].

Anecdotally, immersion is linked to time perception. In fact, one of the said consequences of immersion is gamers losing track of time [9]. This being said, however, experiments done to investigate the relationship between immersion and time perception do not strongly show the link between the two [13]. Therefore, this work in progress reports on our initial attempts to investigate the issue of immersion and time perception in digital games. The preliminary results suggest that immersion and time perception are not sharing the same cognitive mechanism and both work differently. Further work is required to investigate details of these mechanisms.

Immersion in Digital Games

Colloquially, immersion is understood to be the sense of being "in the game" where players invest all of their attention, thoughts and goals in the games as opposed to their surroundings [13]. Attention is necessary to attain total immersion– the highest level of engagement [3]. But, what would happen to immersion if players were performing another task whilst playing games? Clearly, performing a secondary task splits the attention and this reduces the immersive experience. This suggests a high investment of attention on the game will guarantee players to experience immersion whereas having a secondary task whilst playing digital games distracts their attention and reduces immersion. This therefore affects the overall gaming experience.

Previous research suggest that immersion can be differentiated based on game genres [8]. With a model they call the SCI-model, Ermi and Mäyrä [8] divide immersion into Sensory, Challenge-based and Imaginative immersion. They argue that all games have these three type of immersion but one of them has the strongest effect based on the type of the game. For example, *Half-Life 2* has the strongest sensory immersion out of the 13 games they looked at. With the aid of this model, they describe how the three-dimensional screen (3D) and latest sound system influence our sensory by overpowering the noise from surroundings and allow us to focus all of our attention on the games.

Similar to this recent finding on immersion, Calleja [5] proposes a model called the "player involvement model" to explain immersion. His model describes immersion as caused by some game dimensions, particularly: kinesthetic, spatial, narrative, shared, affective (emotional), and ludic involvements.

Immersion is argued to directly interact within these dimensions which then leads to "incorporation", a richer account of gaming experience which is superordinate to immersion. With incorporation he argues that a player is able to integrate (incorporate) the gaming environment into their conciousness and thus be incorporated into the environment as an avatar. The model also suggests that immersion is about the attention that moves within these dimensions. Attention is shared across these dimensions. Any changes in the game influence attention and thus affect the involvement with the game.

Considering all these studies, it appears that attention plays a major part in immersion. It is an essential component and without attention, it is difficult to attain immersion.

Time Perception in Digital Games

Time is a shared significant experience in humans [11]. Our everyday activities are consciously and unconsciously coordinated as a result of the understandable importance of time management. The general perception of time seems to be highlighted by the common idioms, "time flies when you are having fun" and "a watched pot never boils"– amongst others!

Judging time duration accurately is a difficult task. It requires a high level of attention and information processing by an individual and any distraction will lead to a greater error in estimating time accurately. The concept of attention when trying to estimate time involves "alertness, vigilance and selectivity" [16]. This therefore can mean that shared attention due to carrying out one or more tasks means lesser ability to judge time duration accurately. Thus playing a game and carrying out a secondary task should reduce the attention of a gamer to the judgement of the duration of time, more than a gamer that is just playing the same game without a secondary task.

The complexity of the methods to investigate time perception whilst playing digital games makes it challenging to pick out what exactly is happening to a player's perception of time. However, [15] and [12]'s attempts at studying players' time estimation of how long they have been playing–in relation to their gaming experience–suggest that although players generally underestimated time, there is not a significant difference between their time duration judgement and the correct time. This falls in agreement with the finding of [16], who were found that the higher the level of distraction from judging time duration–which in this case is the videogame–the less time a subject will judge to have elapsed during an objective period.

Also, [13] studied the psychological time perception of videogame players whilst altering their immersion using music. Music is used in the study to make the game more immersive and time perception is measured using both retrospective and prospective paradigms of duration judgement. From the study, it is established that increased immersion in a videogame alters time perception, when music is added to the player's experience. However, immersion for each of the players is dependent on whether they liked the music or not, and therefore was not altered uniformly.

In addition, they [13] argue that time perception paradigms namely–prospective and retrospective–use different cognitive processes to estimate time. The prospective paradigm uses attention to monitor time passing. If players are given two tasks to perform, one temporal and one not, then there is a strong interference effect with the secondary task causing the time estimation to become shorter [4]. In contrast, retrospective paradigm uses memory to estimate time. Players have to look back at the duration taken whilst playing and they are required to come up with the estimation [2].

Therefore, to investigate the link between immersion and time perception in games, we decided to manipulate attention as it is a very important element for both immersion and time perception. We asked arithmetic questions whilst playing games as the secondary task that they must complete by the end of the session.

At the same time, we inform players that they have to play for 7 minutes and stop playing when they feel they have reached the time. This is called the production

method and is related to the prospective paradigm [17]. We expect to see by completing the secondary task whilst playing the game contributes to an earlier finish. This is because of their lack of attention on the temporal task whilst playing which also reduces engagement in the game.

Experimental Investigation

The aim of the experiment was to see if having a secondary task whilst playing games would affect player's immersive experience and ultimately whether it affects their perception of time. The hypothesis was that participants in the experimental group (with secondary task) get lower immersion scores and will stop earlier (having larger time difference) than those without.

The experiment was between participants, and set with two conditions. The independent variable was whether the participant had a secondary task whilst playing game or not. The dependent variable is the level of immersion from the Immersive Experience Questionnaire (IEQ) [10] and also the measure of time perception given by the difference in time from how long they played to how long they were meant to play (to count time difference $= player's\ time\ estimation - correct\ time$).

In total 19 students (11 females, 8 males) aged 18-20 (mean = 18.3) – all from the University of York took part in the experiment. The game used was *Tetris* [1]. This is because of its simple controls and familiarity to most game players. All participants apart from one had played the game before. All of them play digital games several hours a week. A consent form was signed and an IEQ was used to measure the level of immersion. A smartphone was used to measure time during the experiment.

[1] www.freetetris.org

Participants were randomly allocated into two groups: with the secondary task and without the secondary task. They were asked to fill in a consent form and given an instruction sheet. To get familiar with the controls of the games, they were given a trial. After they were confident to start, they were told that the experiment was starting. Participants in both conditions were asked to stop when they felt 7 minutes had elapsed. Those in the experimental group were also asked to answer the arithmetic questions at the same time as playing the game. The experimenter recorded their game scores at the end of each session.

Once participants had stopped playing, the time was recorded and they were given the IEQ to fill in. Once this was completed they were asked if they had any further questions before being given a debrief of the experiment.

Results

To see if there is any effect of attention on immersion and time perception, the total score from IEQ and the total difference in time were calculated. Table 1 shows the mean (and standard deviation) of immersion scores, time difference and game scores for both conditions.

Components	With Secondary Task	Without Secondary Task
Immersion Scores	85.90 (11.77)	87.11 (19.52)
Time Difference(s)	-102.90 (112.11)	-47.89 (76.80)
Game Scores	2564 (2344)	11307 (8910)

Table 1: Mean (and standard deviation) for immersion scores, time difference and game scores in both conditions

Using the Mann-Whitney test from the SPSS statistical package, the results were tested further to find whether the differences between conditions were significant with an

alpha level of 0.05 or less. There was no significant difference for both immersion scores $U(9, 10) = 61, p = 0.540$ and time difference $U(9, 10) = 61, p = 0.211$.

Further analysis was done using one-sample t-test with test value 420 seconds (7 minutes) to investigate the underestimation of time in both conditions. The results show participants in the with secondary task were having a significant underestimation $t(9) = -2.90, p = 0.016$. On the other hand, participants in the without secondary task condition were only just approaching significant underestimation $t(8) = -1.87, p = 0.098$. Additionally, there was a significant different in the game scores $U(9, 10) = 71, p = 0.035$.

Discussions

The results, however, do not support our hypothesis that participants have lower immersion scores and larger time differences in the experimental group.

There was no different in immersion scores in both conditions. This could be participants with the secondary task treat the task as a part of the game. Answering arithmetic questions whilst playing games–perhaps–makes the whole activity become more engaging. What we could do in future study is to design a secondary task that require participants to pause the game at a single point and complete the task before they continue playing. This helps to produce a secondary task that is difficult to be included in the gameplay.

Although there was no significant difference for time difference between conditions, the results suggest that participants in both conditions were underestimating time. They stopped playing before 7 minutes. This is because they could not focus all of their attention to estimate the time. Having to play the game distracts attention on the need to estimate time. And therefore, having a secondary task whilst playing the game reduces more attention on the need to estimate the time. That is why, participants in the experimental group are showing a larger underestimation of time compare to those in the control group. When you are distracted from monitoring the time, it contributes to the difficulty to measure time and influence participants to stop earlier before the correct time.

Not only that, since attention is divided into several tasks, participants in the experimental group could not achieve high scores. Clearly, players need to invest a lot of attention to play the game and get a high score. When they were given a secondary task, they need to split their attention between the two. Their attention on the game was distracted. Therefore, they could not perform well in the game. Similar for time perception, the more attention that is invested to estimate the duration, the more accurate the estimation of time [1]. However, in this work attention did not affecting immersion as predicted.

Hence, our work suggests that there is dissociation between immersion and time perception. Given that attention is very essential for both, our work in progress shows attentions work differently in both notions. But as this is a work in progress, more investigation is needed to understand the relation between immersion and time perception in digital games.

Conclusion

In short, the results suggest the dissociation of immersion and time perception. It shows attention works and affects immersion and time perception differently–contradicting common expression of immersion. More work is required

to understand these two notions especially on how they are affecting each other. Understanding the relationship of immersion and time perception is important to give an insight into what is actually happening to gamers when they immersed and play the game for a long time.

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