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Assessing the impact of the awareness level on a co-operative game

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ABSTRACT

Context: When playing a co-operative game, being aware of your collaborators (where they are playing, what they are doing, the abilities they have, etc.) is essential for achieving the game's goals. This led to the definition of *Gamespace Awareness* in order to guide in the identification of the awareness needs in the form of a compilation of the awareness elements that a co-operative game should feature.
Objective: Gamespace Awareness does not establish how much awareness information players must be provided with. This constitutes the main motivation for this work: to assess the impact of different levels of Gamespace Awareness elements on a co-operative game.
Method: A multiplayer action game was developed that supports three different awareness configurations, each one featuring different awareness levels (high, medium and low). The impact of these awareness levels was measured as regards game score, time, players' happiness while playing, enjoyment and perceived usefulness. Several techniques such as subjective surveys and facial expression analysis were used to measure these factors.
Results: The analysis of the results shows that the higher the awareness, the better the game score. However, the highest level of player happiness was not achieved with the most awareness-enabled configuration; we found that the players' enjoyment depends not only on their awareness level but also on their expertise level. Finally, the awareness elements related to the present and the future were the most useful, as could be expected in a multiplayer action game.
Conclusions: The results showed that the medium level awareness obtained the best results. We therefore concluded that a certain level of awareness is necessary, but that excessive awareness could negatively affect the game experience.

1. Introduction

The golden age of video games is back. If the original one took place from 1978 (with the release of Space Invaders [1]) to the mid-1990s [2], it can be said that a new boom is here since the popularization of smartphones [3]. Indeed, looking at the figures, the U.S. video game market has grown from sales of $7b in 2003 to $15.4b in 2014, according to the ESA annual report [4]. The reason for this growth is not only the popularization of smartphones (almost everyone now carries around a portable video game platform) but also because the children of that the first golden age, now adults, are still playing and making the sales figures grow. In fact, in 2015 the average game player was 35 years old, so this is no longer just child's play. Furthermore, forecasts suggest that this trend will continue in 2016 with the revival of Virtual Reality [5,6]. It has been estimated that consumer spending on Virtual Reality hardware and software could reach $21.8b by 2020 [7].

Moreover, not only has the sales figures of games grown during the last years, but also the effort devoted to define and apply new Software Engineering techniques that help to manage the increasing complexity of their development during their whole lifecycle. Ampatzoglou and Stamelos stated this need clearly "software engineering techniques are needed for game development in order to achieve greater flexibility and maintainability, less cost and effort, better design, etc." [8]. Games are not just projects that finish whenever they are released, but they are products they are evolved with a reduced time to market.

In this new age, not only has the game platform changed, but also the way people play. In the last century, people tended to play alone or with only one partner at a time. Nowadays, thanks to Internet, we are able to play with an almost unlimited number of players at the same time. As a matter of fact, according to the ESA report, 54% of the most

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frequent gamers play in multiplayer mode at least once a week. Indeed, it is common to play games where players are organized in groups to achieve collaborative game goals such as World of Warcraft's team quests [9]. Nevertheless, as has happened with other serious scenarios [10], these collaborative games have made it clear that there is a need for awareness, i.e. players need to know what is happening in the game space, who is connected, who the collaborators/enemies are, what they can do, etc. In other words, they must be aware of what is going on in the multiplayer game. *Gamespace Awareness* (GA) was developed to identify this awareness by compiling the awareness requirements of collaborative computer games [11] as a set of elements, along with questions that will help developers to identify them. GA has been empirically evaluated by using a survey filed in by 89 fourth-year Computer Science students. In this survey, the participants were asked whether the presence of the awareness information (GA awareness elements) would improve their enjoyment when playing two different games, namely a First-Person Shooter and a Real Time Strategy one. Finally, by analyzing the participants' answers, it was found out that most of the GA elements would improve the players' enjoyment when featured those games. However, it does not establish how much awareness information players should be provided with in order to not only play properly but enjoy the game as well. Therefore, the core contribution of this work is to assess the impact of the awareness level on a co-operative game, that is how much awareness information players perceive as satisfying and useful as well as help them to be effective and efficient.

In order to carry out this assessment we created an *ad hoc* co-operative action game that supports three different configurations of awareness. It is worth noting that co-operative games are a specialization of collaborative games where teams that players belong to are typically temporal [12], being players reassigned to a new team at the beginning of every match. This behavior is typical on trendy best-selling games such as Splatoon [13] or Call of Duty [14]. Each configuration of the developed game has a different awareness level, i.e. a different number of GA elements. The game score, time, player happiness, enjoyment and perceived usefulness of the GA elements of these three configurations were evaluated by means of a controlled experiment carried out in Amsterdam on 14 undergraduate students and replicated in Albacete on 29 undergraduate students to validate the original results. The awareness level was assessed by different empirical techniques such as analysis of game results and post-game surveys, as well as by facial analysis. The results revealed that the higher the awareness level, the better the game results. We also found that a high happiness level depended on both the players' expertise and their awareness level. However, happiness was not correlated with higher awareness. These results are broadly detailed in Section 5.4.

This work is organized as follows: after this Introduction, Section 2 describes *Gamespace Awareness*, the awareness interpretation that have been used throughout this work to evaluate the impact of the awareness levels. Next, Section 3 presents the related works. Section 3.3.3 describes the design of the experiment carried out using a co-operative game. The results are presented in Sections 5. Section 6 outlines our conclusions and future work. Finally, the appendix illustrates the detailed results of the experiment as well as the documents used during the external validation of the game.

2. Background: gamespace awareness

When playing a collaborative game, being aware of your collaborators (i.e. their locations, abilities, status, etc.) is paramount to achieving both your own and the shared game goals. Nevertheless, not only do we have to be aware of our collaborators, but also of information about ourselves, the game scenario, its mechanics and even about our rivals. This constitutes the main motivation of Gamespace Awareness (GA) [11]. GA is a collection of 40 awareness elements aimed at helping game developers and designers to gather together the awareness requirements of collaborative computer games in order to enable players to play together effectively. These elements are as follows:

As can be observed in Table 1, GA elements are classified into 3 different temporal categories (present, past and future) and a non-temporal one related to social and group dynamics. In order to help game practitioners to identify the awareness requirements of a collaborative game, GA also features a set of questions related to each awareness element (Table 1, "Specific questions" column). Finally, it is worth noting that GA does not provide guidance on how to implement each one of its elements, but leaves this decision to the game designers.

3. Related work

As was stated in the Introduction, Games is one of the most challenging and complex domains of software development because they cannot be just considered as finished projects once they are delivered. Rather the opposite, they should be considered as products that must be evolved with a reduced time to market in order to provide players with a unique user experience so that they tie up with the game during its full lifetime. For this aim, the development and assessment of a game should be carefully planned and examined, in order to provide players with the best game experience. Awareness is one of the keys for such success.

Considering that the main aim of this work is to evaluate the influence of the awareness level regarding the game experience, the related work is analyzed in the following two sections from two different perspectives. First, in Section 3.1, the most relevant papers related to the assessment of awareness are presented. Second, in Section 3.2 it is analyzed which approaches and metrics are more widely used for the assessment of games. Finally, in Section 3.3 a summary of the presented proposals is presented, and the novelty of this work is discussed.

3.1. Awareness assessment

As was stated in the Introduction, the majority of the most successful games have awareness as one of their main features because players need to know what is happening in the game space, who is connected, who the collaborators/enemies are, what they can do, etc. In other words, they must be aware of what is going on in the multiplayer game. Multiple studies have been carried out about awareness, providing a constellation of awareness interpretations. Among them, the most widely accepted interpretations are Collaboration Awareness [15], Situational Awareness [16], Workspace Awareness [17], Location Awareness [18], Context Awareness [19], Social Awareness [20], Activity Awareness [21], Knowledge Awareness [22] and Shared-Knowledge Awareness [23]. Other interpretations have also been defined that focus on specific domains but, as far as we know, the only awareness interpretation specifically defined for computer games is Gamespace Awareness (GA) [11], which was already presented in Section 2.

Workspace Awareness is the interpretation most widely used among the computer science community, since it focuses on Computer Supported Cooperative Work systems [24,25]. This has led to some researchers [26] to evaluate the impact of Workspace Awareness elements on a serious collaborative game. Researchers concluded that the teams who used the awareness-enabled version of the game obtained a higher score than those who used non-awareness-enabled versions. However, these researchers evaluated only the effect of awareness on the game score without considering awareness levels. Only other work, Khanal et al. [27], has evaluated the impact of awareness on serious games. Specifically, their aim was to compare a classic non-computer-assisted procedure with a virtual reality (VR) serious game for learning an Advanced Cardiac Life Support procedure. This game had two different configurations. The first configuration featured some limited feedback support (awareness), meanwhile the second one provided full feedback. Khanal et al. concluded that the VR version with full-