The Virtual Hero: the influence of narrative on affect and presence in a VR game

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Abstract. Entertainment media, such as video-games, often make use of a narrative to invoke an emotional reaction and draw people into the experience. A narrative can add layers of emotional complexity to even quite simple forms of game-play. In immersive virtual reality people are surrounded by the game environment, making their sense of presence and immersion highly salient to the perceived quality of the game. This pilot study investigates how game performance, satisfaction, arousal and sense of presence are affected when a pre-game background story is introduced to a virtual reality zombie shooter game. Several trends were observed, indicating that people might be more involved in the game-world and more prepared for the virtual experience. Participants who were exposed to a short pre-game back-story tended to achieve higher game scores and experience a higher sense of presence, although these differences were not significant. We examine the measurements used in this study and theorize how affect and presence interact with respect to the use of narrative devices in virtual reality games.

Keywords: affect, virtual reality, video game, presence, narrative, arousal

1 Introduction

In modern entertainment media, few things are as ubiquitous as story. Narrative devices such as drama, conflict and characterization transport audiences into alternate worlds. The impact of stories on human attitudes and behaviors [3], identity [18] and relationship with self and others [8] are well known and the power of storytelling is particularly evident in the domain of entertainment computing and game-based interaction.

A number of studies provide evidence that adding narrative to games helps players become more involved and engaged in the game-play [3, 4]. An empirical study by Schneider, Lang, Shin and Bradley [17] showed that players of story-based games experience a heightened sense of identification, positive feelings and immersion in the game world. The use of narrative devices such as character development have also been shown to increase the sense of enjoyment players derive from the playing experience [6].

1.1 Narrative and Affect

Emotional experience is a core element of game-play, and emotions are a critical consideration in game design [7]. A number of studies have incorporated affect-inducing

elements into various aspects of a game to investigate their effect on game players experiences. Many of these elements are story-based, as narrative is a reliable way to add emotional complexity [10]. One of the mechanisms through which narrative operates on affect is by evoking emotional memories, influencing the way in which the person subsequently experiences the narrative [11].

In many games, players emotions are actively manipulated through increasingly difficult tasks, shifts of setting, the types of characters faced throughout the game, and the use of music, all to ensure sustained engagement in the game-play [7]. Schneider, Lang, Shin and Bradley [17] studied the impact of adding a story to a first-person shooter game. Results showed significantly more identification with the protagonist and general heightened arousal for participants involved in the story-based game. This suggests that both the affective state of the player and their immersion in the game are influenced by the addition of a narrative element.

Characterization is a particular form of story-telling. VR games are often presented from a first-person perspective and may involve a virtual avatar that is incorporated by the player [21]. An avatar's characteristics and representation can change how individuals behave [21], and there is evidence that participants' cognitive processing and thought patterns are influenced by their avatars [14]. In virtual reality games, therefore, the players' sense of embodying their avatar is vital and giving them an idea of their character can transform the experience. An empirical study by Hefner, Klimmt and Vorderer [6] showed a connection between identification with a game character and overall enjoyment of the game.

1.2 Affect and Presence

Presence can be described as the subjective experience of being in an environment, even when one is physically situated in another place [20]. It involves complex cognitive and affective processing of sensory data. It is unclear how exactly narrative, affect and presence relate to and interact with each other. In virtual reality a highly emotionally engaging experience could induce the player to focus their attention on the world within the environment, consequently elevating their sense of presence. Narrative could therefore influence presence directly or through influencing affect.

Affect and presence seem to influence and strengthen each-other. Virtual environments that are manipulated to induce certain emotional states have been shown to successfully induce these states based on the level of presence, but also heighten the level of presence through adding the affective content [15].

Similarly, Gorini, Capideville, De Leo, Mantovani and Riva [2] used a virtual reality hospital experience to study the impact of affect on presence. Participants were tasked with finding a vial of blood inside a virtual hospital. In one condition they were told that another character walking around was trying to harm them. A physiological measure in the form of heart-rate was used to assess their emotional response. Overall, adding an element of fear had a significant effect on self-reported sense of presence and on heart-rate variability. These studies suggest that presence and affect interact within a virtual environment, but although narrative elements were indeed used to induce affect, it is unclear how these contribute specifically to presence.

1.3 Narrative and Presence

Work by Park, Lee, Jin and Kang [13] suggests that a pre-game story can act as a type of bridge into the game world and has a positive effect on the participants' sense of presence. Many studies on presence in VR focus on the effects of the interactive technology, such as haptic systems or visual stimuli, but purely cognitive affective factors also have an impact on the sense of presence of game players [13].

It can be theorized that narrative induces a more complex affective response in players, going beyond the basic emotions that can be conjured up by simple interactions, visuals or audio. This in turn acts as a bridge into the game world, heightening presence and immersion. We devised a pilot study to research these mechanisms in relation to each other in a zombie shooter game. Zombie shooter games already have potential basic elements of fear and anger in them, but a narrative might add layers of complexity to these emotions and thus draw the player further into the game world. If a story is added before the game, adding context and characterization, the game itself would not change but the way the player experiences it might. We expect that virtual reality game players exposed to a pre-game, character-based back-story will experience higher levels of arousal and presence than participants not exposed to the story.

2 Methods

2.1 Participants

Participants (N = 10, 5 female) were recruited using convenience sampling at a Dutch university. In this between-subject design, five random participants (3 female) were exposed to a back-story before playing.

2.2 Materials

The participants played an existing VR game called Zombie Riot. This game presents a bright and colorful village street where the protagonist is attacked by zombies that walk or run up to them. The player is provided with two virtual guns, operated through the Occulus Rift motion control system.

The experiment was conducted in the DAF technology lab at Tilburg University. The DAF-lab consists of two spaces: the Research Room and the Experience Room. The Experience Room has facilities that allow the researchers to observe, register and analyze the data. An Oculus Rift head mounted display (HMD) was used to display the game to the participants. The Oculus has 110 degree field of view and rotational and positional tracking. The integrated headphones provide 3D audio. The Experience Room in the DAF lab is outfitted with four position tracking sensors which allowed the participants to stand, walk or jump in the VR environment.

The back-story was written specifically for this experiment. It was based on the zombie-story archetype of a 'lone surviving group', and provided some details about the apocalyptic state of the world and the protagonists' current position as a leader of a small band of human survivors seeking a safe zone. The protagonist is tasked with protecting these survivors. The story was recorded rather than presented as a written text, as this has been shown to be more effective [13].

2.3 Measurements

Four different types of measurements were taken: (1) a post-game self-report questionnaire for presence assessment and game-play experience, (2) a game performance score taken from the game itself at the end of the game-play session, (3) a baseline heart-rate and heart-rate recordings during the VR experience and (4) a short, 2-question interview post-experience.

Heart-rate was recorded with a Grove ear-clip sensor. A baseline measurement was taken before each participant entered the VR environment, where heart-rate was recorded during the entire game-play. For our evaluation we looked at the raw physiological measures, and also used these two measurement points to create deltas that were then compared. Heart-rate and heart-rate variability were treated as an indication of arousal [5, 12] and affective experience [1].

We used an adapted version of the Presence Questionnaire [20], consisting of seven items on a 7-points Likert scale. An additional post-test questionnaire was used with a total of 14 items on a 5-point Likert scale, based on The Game Experience Questionnaire [5]. Finally, participants were asked two open interview questions at the end of their VR experience: "How was you Virtual Reality experience?" and "How well do you think you performed?". Participants in the experimental condition were also asked if they thought the story influenced their performance.

2.4 Procedure

On arrival, the participants read and signed a consent form, after which a one minute baseline heart-rate recording was made. The head-mounted display was placed on the participants' head and they were given a short tutorial on using the controls. Half of the participants were then exposed to the pre-recorded back-story. Participants commenced playing the game and were given a playing time limit of six minutes. If they were 'killed' by zombies before this time limit, participants were not permitted to restart the game but concluded their session and progressed to the post-test measures and interview.

After playing the game, participants were asked to fill in the post-test self-report questionnaires, and the short interview was conducted and recorded. Finally, participants were debriefed.

3 Results

3.1 Sense of presence

Initially, the sense of presence questionnaire showed poor reliability ($alpha = 0.69$) and, therefore, the first item ("How natural did your interactions with the environment seem?") was eliminated to enhance its reliability ($\alpha = 0.75$). An independent t-test revealed no statistical significance. There was a non-significant trend observed towards participants in the experimental group reporting a higher self-reported sense of presence (M = 5.97, SD = 0.30) than the control group (M = 4.67, SD = 0.49). See figure 3.

3.2 Heart Rate

The heart rate was recorded in milliseconds between heartbeats. A lower value therefore corresponds to a higher heart rate. Analysis of the base line measure was performed with the middle 30 seconds of each participants recorded heart-rate data. For analysis of the heart rate during game-play the last 60 seconds of the measurement were disregarded, and the 30 seconds before that were taken for analysis.

This means that the analysis focused on the end of the game when participants were acclimatized to the game-play and the (often first-time) experience with immersive VR, but did not include any measurements taken while the participants 'died' in the game and/or took their HMD off.

For participant 5, the heart-rate sensor was displaced towards the end of game-play so the final 30 seconds were selected for analysis without taking a buffer of 60 seconds first.

The control group had a baseline measurement with a mean of 724.79 (SD = 127.94). The mean of the heart-rate during the game for the control group was 619.31 (SD = 107.11). The experimental group had a higher mean for the baseline measurement (M = 794.19, SD = 84.06) and had a slightly lower mean during the game (M = 617.85, SD = 77.41) but none of these differences were statistically significant (see figure 1).

An independent t-test was performed on the delta of averages whereby the control group had a smaller change in heart-rate average between baseline and game (M = 105.47, SD = 91.45) than the experimental group (M = 176.35, SD = 114.62), but this test showed no significance (p=0.711).

A mixed ANOVA was conducted on heart-rate variability. Baseline heart-rate variability in the control group was lower (M = 18456.37, SD = 14556.04) when compared to heart-rate variability in the baseline readings for the experimental group (M = 26386.14, SD = 13366.82). During game-play, the means were more similar, with the control group averaging a variance of M = 31145.52, SD = 31582.93 and the experimental group averaging a variance of M = 27355.59, SD = 26611.41. No significant differences were found for both time (p=.804) and condition (p=.553) (see figure 2).

3.3 Game performance

Game performance was measured by collecting the game scores that were automatically generated within the game. Figure 4 presents the game scores of the control group and the experimental group. The experimental group had a higher mean game score (M = 9390, SD = 4530.94) compared to the control group (M = 2914, SD = 2742.88). No significant difference was found.

3.4 Game experience

The game experience was measured with three categories of items (Sensory and Imaginative Immersion, Flow, and Positive Effect) on a 5-point Likert scale which had a high reliability ($\alpha = .74$) after eliminating the item "I was interested in the game's story", considering the control group had not been provided with a narrative. No significant difference was found between the control group (M = 3.03, SD = 0.26) and the group exposed to the pre-game narrative (M = 2.94, SD = 0.27). See figure 5.
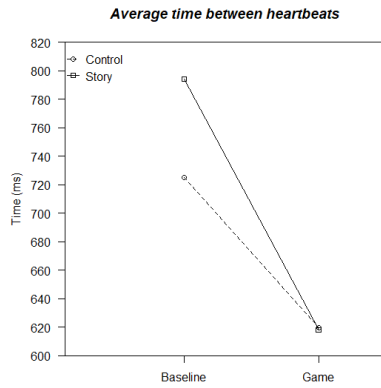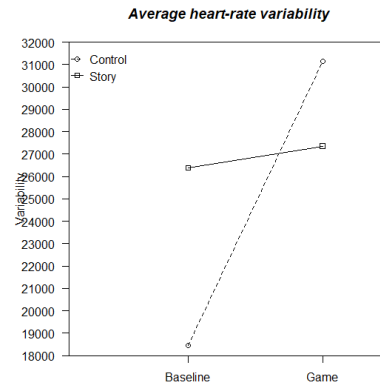
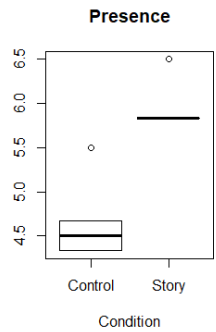**Fig. 1.** Average time between heartbeats.

Fig. 2. Heart-rate variability.
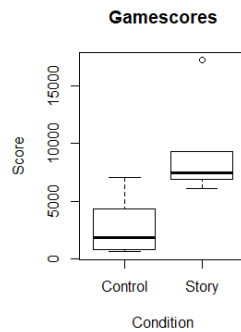

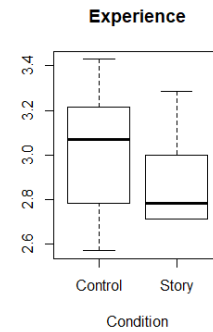**Fig. 3.** Sense of presence

Fig. 4. Game scores

Fig. 5. Game experience

3.5 Interviews

When participants were asked about their gaming experience, the majority of participants stated that they felt immersed into the virtual environment. As one interviewee said: 'It was nice, I enjoyed myself a lot, was completely into it, was naturally moving around and I was using the guns which I really liked they were coming onto me and it felt real. I felt immersed. The story prepared me for the game, but I did forget the story when I entered the virtual environment'. This notion of the story preparing them for the game was brought up by several participants. When asked about their game-performance the answers were very diverse. Some interviewees were very positive about their performance, while others thought they had performed poorly.

Participants in the experimental condition indicated that their game-performance was not influenced by the emotional impact of the pre-game character back-story, but that the narrative may have had unforeseen effects and provided participants with valu-

able game context which helped them to prepare mentally for what waited for them inside the VR experience. Participants who heard the pre-game character back-story reported feeling more comfortable entering the game world as they felt they knew what to expect.

4 Discussion

The aim of this pilot study was to assess if a pre-game narrative could positively affect the sense of presence, game satisfaction and performance, and affective experience. We intended to study how these attributes of game-play experience can be measured to reveal underlying mechanism and causal relationships.

Results do identify some interesting trends, although the nature of the pilot-study means that sample sizes were insufficient to confirm these as significant. On average, participants who were exposed to the pre-game story had a better game score and a higher sense of presence, which is in line with expectations from the literature. Trends in the heart-rate data suggest that heart-rate speeds up during the game, and might undergo a bigger change after exposure to the narrative, indicating higher immersion and arousal. The heart rate variability however showed a trend of heart rate being more level in the experimental condition. If this effect really does occur, it could be due to the sense of being better prepared which many participants indicated they had after hearing the story. The VR environment would then arguably hold less surprises for those participants. The sense of context that the story provided could have an impact on how participants approached the game and influence their sense of presence and game performance.

4.1 Limitations

The sample size of this pilot study was naturally limited and therefore the study had low statistical power. Another potential issue is what Wells, Campbell, Valacich and Featherman [19] describe as the novelty effect, when a fundamental characteristic of an innovation is its novelty, the newness or freshness of the innovation in the eyes of the adopter. Most participants in this experiment had never experienced VR gaming before and it is possible that the novelty effect drowned out any other interesting effects.

The pre-game story was written specifically for this study, and not further tested. It is therefore difficult to determine the impact the story itself had on the participants. Elements such as the language used, the story structure and the specific characteristics given to the avatar may have influenced the experience in ways not captured in this study.

For example, gender associations may have influenced the interpretation of the back-story. Gender roles and norms can be seen in a variety of ways depending on factors such as race, culture or religion [9] [16]. Such associations and expectations may have influenced the perception of the protagonist in the back-story, who was not explicitly gendered but had certain characteristics that can be strongly culturally gendered. This might have influenced the degree to which participants could identify with the character.

5 Conclusion and future work

This pilot study offers some important considerations for future research and implies a possible effect of narrative to either provide important contextual framing or as a way of strengthening the sense of identification with an avatar and providing a greater sense of engagement and presence through affect.

Future research could focus on differentiating between these two distinct roles of back-story to understand the underlying mechanism at work when a pre-game story is utilized by a player and its impact on their sense of presence or their understanding of the unknown virtual world through narrative contextual framing. It could be interesting to study the differences in how various types of games utilize narrative and whether they fulfill the same objective for the players. The way in which the narrative is delivered to the player, as well as the timing, could influence its effects.

It should be noted that in this study, no difference was found in how positively players rated the game experience, and some players indicated that they forgot about the story during the game. Especially in the interest of game-design it is vital to consider how elements of affect and storytelling actual influence the game-playing experience.

Storytelling in games has co-creative elements where the player is called upon to recreate, stage and reconstruct the story, based on their own understanding of the virtual world and their place in it. This interactive element of storytelling would also be interesting to study more closely in relation to affect and presence, especially since memories associated with the affective state might influence a players perception of the narrative.

A full-scale follow-up study could hopefully further elucidate the way in which narrative, affect and presence interact and what the causal relations are between these elements. However, these elements might need to be separated further in order to observe their relations to each-other more clearly. This could possibly be achieved by adding a control condition where even the basic emotional content is removed, allowing for direct comparison between the effects of basic affect-induction, and more complex, narrative based induction.

There is clear evidence in the literature that stories support the perception that the virtual world is real and can therefore support greater immersive experiences for individuals, and understanding how these effects are established allows us to build better virtual experiences and games.

6 Acknowledgements

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