DOES BODY MOVEMENT AFFECT THE PLAYER ENGAGEMENT EXPERIENCE?

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ABSTRACT

Full-body controllers have recently become a regular feature in the gaming industry. Presumably, the idea has been to create a more natural and engaging experience in the players and perhaps to make it accessible to a larger population of users. Indeed, it has been shown that body movement supports cognitive processes, regulates emotions, and mediates affective and social communication. As such it is a very important communication channel that technology should exploit for achieving a more positive user experience. This raises a number of research questions among which are: can body movement as an interaction modality affect or change the quality of user experience? And, how should technology be designed to support such modulation process? This paper aims to propose and discuss a model of the relationship between body movement, controller type and quality of engagement based on the lessons learnt from the author's previous attempts to explore how body movement required and afforded by new game controllers affects the quality of the player's experience. The discussion is grounded into and supported by the literature on the regulatory properties of body movement on emotions.

Keywords: *Body movement, Engagement, Computer Games, Affective states, Social engagement*

1. INTRODUCTION

Full-body controllers have recently become a regular feature in the gaming industry. Presumably, the idea has been to create a more natural and engaging player experience and perhaps to make it accessible to a larger population of users. The Nintendo Wii has been one of the most successful video consoles for this type of games and it is still among the top 4

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games sold[2]. Recently, researchers have been investigating the possibility of using this type of games to tackle various health and psychological issues in our society, such as fitness, rehabilitation, social interaction [1-3]. Whilst part of the reason of the success of these games is the physical activity that they promote, we argue that another reason for this success is that body movement also affects cognitive and emotional processes. Indeed, it has been shown that body movement supports cognitive processes, regulates emotions, and mediates affective and social communication. As such it is a very important communication channel for technology to exploit and create a more positive user experience.

This consideration raises various possible lines of enquiries among which are: can body movement as an interaction modality affect or change the quality of player experience? And, how should game technology be designed to support such a modulation process? The quality of the user experience is commonly described using a variety of terms: immersion, engagement, presence or fun, to name just a few [4]. Since it is not our aim to give a precise characterization of how these terms relate to one another, in this paper, we follow the work of Lazzaro [5] and consider engagement in computer game as being characterized by four components: hard fun, easy fun, emotional (altered state) and social experiences (person factor). In [6-9], we described experiments carried out to shed light on how body movement required and afforded by new game controllers affect the quality of experience of the player. Here, we briefly summarize these experiments (the reader should refer to the related publications for details) to present and discuss a hypothetical model of the complex relationship between body movement, controller and playing experience, and discuss design implications.

The paper is organized as follows. Section 2 reports on the literature related to this study by introducing the key terms: engagement, body movement and affective and social experience. Section 3 introduces the model that relates movements to the player's type of engagement in the game. Sections 4-7 briefly describe the experiments we run and discuss how they support and extend the model. Finally, section 8 discusses the overall model and future directions.

2. BACKGROUND

2.1. Engagement

In the context of games, the definition of engagement, and its related terms, is still unclear. According to Malone [11], the qualitative factors for engaging game play are challenge, curiosity, fantasy and flow. Csikszentmihalyi's [12] theory of "flow" depicts a state of mind in which a person feels so engaged by an activity that his/her actions and awareness merge. Also known as optimal experience, this phenomenon is closely linked with motivation and attention, and is essential in games. An optimal level of challenge is necessary to maintain motivation in game players. When skills improve, a new level of challenge is required for challenge to meet the improved skill level [13]. Whilst Brown and Cairns [4] defined the

[2] http://www.independent.co.uk/life-style/gadgets-and-tech/features/the-10-bestselling-games-1784793.html (published on 12 September 2009)[retrieved on 21 September 2009]

relationship of engagement as the first step in immersion then to engrossment and then to full immersion, Chen et al. [14] used fidelity, immersion, and engagement. Although these cannot be compared directly, both introduce three steps in a person's level of involvement. Brown and Cairns suggested that control of the game is a barrier in their definition of engagement to move to the next level, and game structure is a barrier for engrossment. Chen et al. [14] also considered similar aspects of the aural and visual interface to influence fidelity and game structure to influence immersion. In their model of immersion, Ermi et al. [15] identified three different types of immersive experience: sensory, challenge based, and imaginative immersion. Whilst the challenge based immersion and the imaginative immersion are also captured by the previously mentioned models in terms of flow and character identification, the sensory experience is the type that most relates to our work. However, although this last model specifically refers to sensory immersion, what is generally understood by this is a visual, aural or tactile sensorial experience without any reference to proprioceptive (e.g. sensory input from joints and muscles) experience.

Thus, none of these game-immersion models contains movement-specific items and the measurements used to study engagement do not take into account the role played by physical activity [16]. Yet, body movement has been shown to have an effect on the sense of presence in virtual reality environment [17]. Presence in virtual reality occurs when a person behaves and responds as if s/he was in the place represented by the virtual environment. The authors of the study reported in [17] observed that when participants are asked to move within the virtual environment in a way that is related to the task they have to accomplish or to the world they have entered, their sense of virtual reality experience is enhanced. Further in this direction, we will argue that movement has a strong influence not only on the sense of presence of the player but also on the overall experience and that it provides the means to modulate such experience.

2.2. Body movement and affective experience

In a qualitative study based on observations and surveys of players, Lazzaro [5] identified four components characterizing a player's engagement experience: hard-fun (i.e., winning the game and testing one's own skills), easy-fun (i.e., entering a fantasy world), emotional and social experience. Similar factors were also identified by Malone [11]. What these authors did not explore, however, is how body movement is involved in these different types of experience.

Work investigating the relationship between physical activity and mood suggests that changes in posture can induce changes in affective states or have a feedback role affecting motivation and emotion. For example, Riskind and Gotay [19] showed that "*subjects who had been temporarily placed in a slumped, depressed physical posture later appeared to develop helplessness more readily, […], than did subjects who had been placed in an expansive, upright posture*." Furthermore, Richards and Gross [20] demonstrated that simply keeping a stiff upper lip during an emotional event had effect on the memory of the event, and exacted a cognitive toll as great as intentional cognitive avoidance.

Body movement based games appear to have a beneficial effect on food intake and self-image. A study presented in [21] compares food intake of people playing movement-based games vs. no-movement-based ones. The results showed that participants ate less in the Wii condition, and ate more healthy food and had higher self-evaluated performance. Physical activity has also been shown to have an effect on social bond. The experiments run by Muller et al. [22] suggest that the arousal associated with physical movement might support social interaction. Participants who played sports through movement based distance technology reported a significantly greater social bond than players who used a keyboard interface.

3. BODY MOVEMENT AND ENGAGEMENT MODEL

Whilst the above results showed that movement-based games have the potential to elicit a positive effect on self-image by promoting positive emotion, increasing motivation and favoring social interaction, the question remains of how games should be designed to maximize this potential. In this paper, we propose a model that relates body movement to the way a player engages with or through a computer game. Our model considers five different classes of body movements that can be displayed by the player during a game. We argue that these movements do play a role in the way the player engage. We list below the five classes of movements we propose and describe their relation with the four Lazzaro's engagement components.

Task-control body movements. These movements are defined by the game controller or by the game interface. They are necessary to control the game and/or to gather points. As shown by [4] in the case of desktop-games, a good mastering of the control commands is necessary to facilitate immersion in the game and let the player engage in winning the game. Hence, a good command of these body movements (i.e. control commands) is essential to enable immersion on whole-body computer games and to facilitate hard fun.

Task-facilitating body movements. These movements are not recognized by the game interface. They are consciously or unconsciously selected by the player to facilitate the control of the game. As previously shown in [23], when the complexity of a game is high, players may distribute the control of the game over the resources that are available to them. In this study, the authors show that in Tetris, players continuously rotate an element to facilitate the decision on how to position it. In whole-body movement games, a new type of resource is made available: the body. Hence, according to the game interface's affordance and according to the player's skills, body movements can be used as a resource to explore new strategies and test new skills to win the game (i.e., hard fun).

Task(role)-related body movements. These movements are typical of the role adopted by the player in the game scenario. As in the previous case, the game interface does not generally recognize or react to them (unless they are also task-control movements). However, differently from the task-facilitating movements, they do not necessarily facilitate the control of the game. In fact, they can even interfere with the game play. They are acted by the player who endorses the role offered by the game and enter the fantasy world. Hence, this type of movements can favor an easy fun type of engagement where the player explores a new reality of being.

Affective expressions. This class of gesturing expresses the affective state (emotional or mental state) of the player while playing the game. They are spontaneously expressed or acted by the players and generally not recognized by the game interface. These expressions represent a window on the experience of the player but, as discussed in Section 2, they are also a means to change the player's state of mind (the third factor of Lazzaro).

Social behavior. These are movements used to interact with the co-player but are not required to play the game. They are spontaneously expressed by the players and are not generally recognized by the game controller. These movements indicate the level of awareness of other players in the game and facilitate social interaction, i.e., the person factor of Lazzaro.

These five classes of movements represent an important means of steering the engagement of the player towards a certain type of experience. Hence, it is important to understand if and how the game controllers influence the player in exploiting them. As illustrated in Figure 1, we argue that: 1) the design of the game controller in relation to the type of movements that it requires or affords affects the way the player engages in the game; and 2) each class of movements can facilitate or inhibit the emergence of another class of movements and hence affects the type of engagement. In the next section, we briefly report on a set of experiments we carried out aimed at exploring how different game controllers affect the way players engage in the game through their body. Finally, we discuss the experiments results in relation to our model.

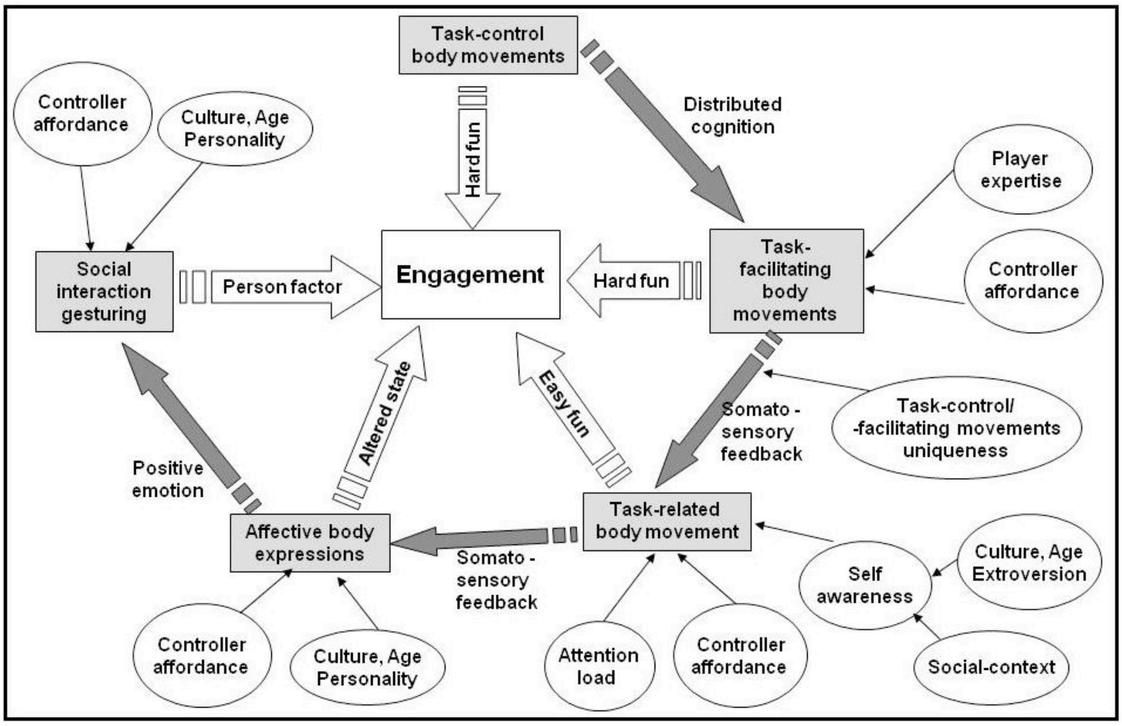

Figure 1: Engagement interaction model. Grey rectangles: body movement types; circle: inhibiting/facilitator factors; grey arrows: engagement shift triggering mechanisms.

4. BODY MOVEMENT EXPERIMENTS

4.1. Experiment 1: low-immersion vs. high immersion games

This experiment reported in [6] involved two different types of desktop computer games. The first game was a very low-immersion game in which the user simply had to click on a randomly appearing target. The second game was an immersive first person shooter game, Half-Life. The primary modality of input was the keyboard with some additional commands involving the mouse. 20 participants were randomly assigned to one or the other game, and were interrupted after 10 minutes of play to fill an immersion questionnaire. The sessions were videotaped to provide a view of the subject in the saggital plane where most of the motion was expected to take place. Major changes in body postures were used to discriminate between levels of immersion and/or affective states. The "clicking" group, who returned very low immersion scores was characterized by many shifts in the sitting position, alternating between a very relaxed position (e.g., arm stretched behind the head and body leaned back) or a very attentive one, with a forward leaning body and still head. These body movements can be categorized as affective expressions in our taxonomy. The "shooting" group, which returned significantly higher immersion scores, revealed a different pattern of changes in body posture. Participants showed very few changes in posture, with those that showed more game-unrelated changes scoring lower in the immersion questionnaire. Interestingly, some players also displayed head motion as if the player was following the main character in its digital environment. These last types of movements can be categorized as both task-facilitating movements, since they help the player controlling the game, and as task-related movement since they could be an index of presence in the virtual world.

4.2. Experiment 2: dual-pad controllers vs. movement-based controllers

In this experiment [7] participants were asked to play Guitar Hero, a music game for PlayStation. This game sees the player "play" the song by pressing in sequence a number of colour-coded buttons on a guitar-shaped controller. 18 players were randomly assigned to two different playing conditions. In one condition (called D hereafter), the guitar-shaped controller was used as a dual-pad controller, i.e., the participants were taught all of those features that are controlled solely with the hands (i.e., fret buttons, strut bar and whammy bar). In the second condition (called G hereafter), instead, the participants were also informed that to gain "star power" they could make use of a tilt sensor in the neck the guitar, i.e., by raising the guitar upward. The participants were fitted with a lightweight exoskeleton so as to provide angular measurements for each of the upper-body joints. In addition, a video camera was placed in front of them to record their body movements during play. After playing, a player's engagement level was assessed using a gaming engagement questionnaire. The engagement scores were analyzed using a t-test revealing that the G condition returned significantly higher engagement scores ($t=5.123$, $p<.001$). This suggests that body movement imposed in the G condition affected the player's engagement level. To further clarify this finding, we correlated the engagement scores with the amount of motion of the players measured with the motion capture system. We identified a negative correlation in the D condition and a positive correlation in the G condition. By analyzing the video footages, we observed that in condition G, players displayed more, even if brief, guitar-like player movements (e.g., dancing) showing a tendency to enter in the fantasy-role (task(role)-related movements). They also showed expressions of higher level of arousal and positive experience, such as expressions of excitement (affective expressions). Instead, in condition D, players seemed more driven by a desire to win the game (hard fun), leading to an increased focus on the display and emotional expressions of frustration when a mistake was made. They displayed some rhythm-keeping foot behavior (task-facilitating movements) that may have facilitated the control of the game.

4.3. Experiment 3: dual-pad vs. movement-based controllers in a social context

Levels of engagement and the degree of social interaction between players were explored in a game of Donkey Konga [8]. The input devices were bongos and a standard dual-pad controller. When bongos were used players were encouraged to tap the bongos and clap their hands in time with the music; when the dual-pad controller was used these actions were performed through button presses using fingers and thumbs. 10 pairs of participants were asked to play in both conditions: bongos controllers and dual-pad controller. The order of the two conditions was counterbalanced across the pairs. The playing sessions were video-taped and an engagement questionnaire was used to measure the engagement score of each participant. The scores for the participants in each pair were summed. The participants' verbal and non-verbal behaviours were coded. The length of time that each participant spent producing speech and other utterances was measured. Non-verbal behaviours were also classified according to two categories. Instrumental gestures were defined as those in which the action conveys a clear meaning or directs attention (e.g., pointing, shrugging, and nods of the head). Empathic gestures were defined as those in which the action is emotive. The participants produced more speech ($Z = -1.478$, $p = .08$) and significantly more other utterances ($Z = -2.599$, $p < .01$) when using the bongos. Participants also made significantly more instrumental ($Z = -1.895$, $p < .05$) and empathic ($Z = -2.5273$, $p < .01$) gestures when using the bongos rather than the wireless controller, lending further weight to the idea that there was more social interaction in this condition. The participants rated themselves as experiencing a significantly higher level of engagement ($Z = 2.803$, $p < .01$) when using the bongos (μ=248.8, σ=23.03) rather than the wireless controller (μ=198.5, σ=25.33).

4.4. Experiment 4: movement patterns in Nintendo Wii sports games.

Through a triangulation of qualitative and quantitative methods, movement patterns adopted by players when playing Nintendo Wii sports games were explored in [9]. Players were either interviewed and/or observed and their movement measured while playing. The interviews highlighted three important issues related to body movement: type of movement patterns, realism of the simulation, movement feedback. First of all, expert players intentionally chose movement patterns according to the experience they wanted to achieve. When the motivation was to win, expert players used tiny and carefully controlled movements that bore little resemblance to the sport being simulated. Instead, when the motivation was relaxation, these patterns changed to sport simulation patterns. In such case, the player produced movements that clearly pertained to the sport being simulated even if at the expense of the game score. A quantitative analysis performed through observation and motion capture data confirmed the existence of these two main clusters of movements along with an intermediate cluster that seemed to reflect poorer game skills, poorer knowledge of the sport and/or lower fitness. A different level of realism of the type of movements necessary to play the game was considered important to the engaging experience. Less skilful players commented that in the tennis game the control was sufficiently complex and that adding more realism to the movement (e.g, run to catch the ball) would have made the game too challenging. The opposite view was brought up by experienced tennis players. Particularly relevant to this discussion was the observation that there was a gap between the proprioceptive feedback the players was receiving from their own movement and the movement feedback provided by the game interface through the computer character. This gap was often considered a barrier to fully engage with the body in the game.

5. DISCUSSION

The experimental results show that, when task-control movements and the task-facilitating movements are also role-related movements, the player can transition from a pure attention-based and hard fun experience to an easy-fun one. Furthermore, if the game controller affords task(role)-related types of movements, the player can experience a broader set of emotions than the ones typical of hard-fun. As a consequence of a broader emotional experience, social interaction between players is facilitated. On the contrary, when controllers do not require and do not afford task(role)-related body movements, we observe a complete lack of movements other than those to facilitate the control of the game. The emotions typically observed are hard-fun emotions, e.g., frustration and triumph. Social interaction is also limited.

The mechanism that facilitates the shift from hard fun to easy fun could be the proprioceptive system that provides sensory motor feedback from the body configuration and movement. In fact, we have seen in experiment 4 that incongruent movement feedback from the game interface was a barrier to player engagement. It would be interesting to investigate the characteristics that the movements should have to facilitate such a shift, e.g., the uniqueness of the moment with respect to the role, the fluidity/naturalness with which the movement is performed, the duration of the movement with respect to the time necessary to experience the role. Another strong obstacle to engaging with the body in a role-like manner is the attention load imposed on the players. In our experiments, the players' attention to the display was required at all time and hence any distraction from it was very expensive from a game-score perspective. Indeed, players only briefly engaged in task-related movements that interfered with playing the game.

By taking up the role offered by the game, the player is led to experience not only emotions typical of the hard fun experience, but also emotions that are related to the experience of the role. Dancing and other music playing gestures may have increased the arousal of the player and the sensory motor feedback may have had an effect on the mood of the player thus facilitating positive emotions. It is possible that a different game role may trigger a different set of emotion, but the important message here is that by entering the fantasy role, a broader emotional experience than the typical hard-fun one can take place. As seen in experiment 4, expert players decide to enact the sport movements if their aim is to change their mood. In the Wii scenario, the loose movement control the game provides facilitates this shift in engagement experience.

By analyzing the players' behavior in the Donkey Konga experiment, it was observed that verbal and non-verbal social interaction in the movement condition was significantly more frequent than in the control-pad condition. It is possible that movement stimulated positive emotional experience and that positive emotional experience favored a shift from an individual-based type of experience to a social-type of interaction in the game context. Studies in evolutionary psychology have shown that positive mood facilitates social interaction [24].

5.1. Game design issues.

Our findings support the idea that controllers that afford the five categories of body movements listed in Section 3 could result in a more complete game experience. This is an important finding for game designers as the selection of the body movements involved in the game and the degree of freedom offered by the controller will have an effect on the player experience. Some design guidelines can be derived from these studies and from this model.

First of all, in order to trigger this loop, these body movement categories need to be carefully designed. The first two categories of movements as well as the movements afforded by the controller should be related as much as possible to the gameplay to facilitate the suspension of disbelief and the entrance in the world. Slater et al. [17] showed that by having the participant walking in the virtual environment, the sense of presence was enhanced. The same result was not obtained with other walking metaphors (e.g., simulated by the movement of the hands). The challenge from an implementation point of view is about simulating such movements when the physical space available does not reflect the virtual space. In relation to this, it is also important to carefully design the movement feedback provided by the interface. As Ermi and Mäyrä [15] pointed out sensory experience support immersion by leading the players to forget about the sensory input from the real world and focus on the sensory input from the virtual world. In movement-based game, movement is an important sensory input and hence the interface should provide believable movement feedback that leads the player to feel part of the virtual word [18].

Second, there are factors that need to be considered when designing for such realistic movements. Various studies have shown that either the controller [4] or the level of challenge of the game [12] can be a barrier to immersion or optimal experience. In our context, physical challenge can be an additional barrier. Designers need to consider not only the mental load coming from the game and the difficulty of using a button-based controller. An extra challenge is posed by the difficulties in performing certain types of movement and also by the level of energy and fitness required. As shown by experiment 4, different levels of realism should be tailored to the player's fitness, movement coordination skills and knowledge of the simulated scenario. This is particularly important not only from an immersion perspective but also from an ergonomics point of view to avoid injuries.

Finally other factors, not explored in these experiments but highlighted in the model, need to be considered: personality, age, culture and environment could have an effect on the loop taking place. These factors are in fact related to a person's willingness to express their emotion through their body language. Studies [e.g, 10, 25] have shown that cultural differences exist in the way people express and suppress emotions. One element that we consider important for our loop to take place is the fact that emotion expression triggers emotions.

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