

# Embodiment in Video Games and its Effect on Player Behaviour: A Pilot Study

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**Abstract**—This pilot study aims to research embodiment in video games and its effect on in-game behaviour. The study explores the potential of using a screen-based first-person video game to study this subject. Participants were observed playing through two versions of a short screen-based video game designed for the experiment, varying in playable character speed, height, and sounds. Participants' sense of embodiment, choice of path, and the reasons behind choices were studied through participant observation and questionnaires. Participants' in-game choices were not found to be affected by the nature of their virtual character. Instead, factors such as allure of paths had a large impact on choices made by participants. Participants' experience of embodiment partly corresponded to the intended design of the virtual characters. Higher gaming experience of participants was found to be beneficial in providing useful data during participant observation. For a larger-scale experiment, extensive preliminary studies are needed to determine the optimal design of virtual characters and path choices.

## I. INTRODUCTION

The complex process of understanding and sharing the feelings of others is one of the traits that sets us humans apart from many other mammals. It is not improbable that the ability to put oneself in the footsteps of others and to resolve conflicts by seeing issues from others' perspectives was a vital one as the social groups of humankind grew larger and larger. One of the ways this reaching of a mutual understanding through perspective-taking can be accomplished is through storytelling. The telling of stories of all sorts can be accomplished through numerous types of media. Be it through oral storytelling, books, or movies, these stories allow us to experience often complex narratives with multidimensional characters, the behaviors of which can be understood through knowing their previous experiences and motivations. A storytelling medium that has great potential in allowing consumers to take on the perspectives of others and has not yet been mentioned is the medium of the video game.

One of the benefits of the video game as a storytelling medium is its ability to immerse and engage players in their narrative and gameplay. Due to their interactive nature, video games allow the players to feel as if they themselves are the force that propels the events of the game forward, which in a way, they are.

This is, in part, due to something that commonly occurs during the playing of video games known as agency, the feeling of controlling a body (Rosa et al., 2017). In order for the sense of agency to be felt by the players, a correlational relationship between players' intentions and the results of their action is required (Gorisse et al., 2017). The players' sense of agency in the game inevitably causes the players to have some sense of self in the video game itself. They could feel as if they are playing an extension of themselves, interacting with the game's events. This might be the case in video games such as the *Skyrim* (2011), *Fallout 4* (2015), and *Dark Souls 3* (2016) where it is possible for players to create detailed versions of themselves using a character creator. The same character creators, however, can be used to create personas the natures of which can diverge greatly from that of the players. Additionally, many games abstain from such character creators and require players to play specific characters created for the video game, potentially allowing for the players' embodiment of those characters, perhaps resulting in the players' sense of embodiment affecting their in-game behaviour.

Playing a video game very often involves players experiencing a virtual world through a virtual character, often through its very eyes. This involves an embodied experience where players use their avatar as a surrogate mind and body to accomplish their in-game goals (Gee, 2008). Video games often have elaborate backstories and motivations that describe why it is that the game's protagonist, and in turn, the player's avatar does what they do. This can be accomplished through cinematics, in-game conversations, and in-game texts. Furthermore the characteristics and identity of the virtual character is accomplished in much the same way, with the addition of the character's appearance giving some indication as to what kind of person the player is playing. Ranging from a rugged, muscular soldier or a wacky cartoonish humanoid, the possibilities are virtually endless, pun intended.

Showing the players graphical representations of the virtual character might be the most straightforward way to give players a sense of the identity of that character they are playing. However, a potential downside of these graphical representations that needs to be considered are the possible negative effects that the various qualities of graphics and

perspectives through which the game is experienced can have on the players' embodiment of that virtual character (Lugrin et al., 2015) and immersion in the game (Denisova & Cairns, 2015). Often, even if the character's appearance is not visible during gameplay, such as in video games that utilize the first-person POV (point-of-view), it is still accomplished through cinematics or media related to the video game. But in some instances of video games the nature of the virtual character has not been established through any media and is not visible at all during gameplay. In those cases, the players' perception of the virtual character they are playing relies entirely on in-game variables such as sound, camera movement, and character speed. This brings us to our topic of this research intended to study the extent of which these factors can, by themselves, have an effect on the sense of embodiment that players experience, potentially causing the player's perception of their virtual character to be affected. Our research question and hypotheses are the following:

**Research Question: In what way can video game players' embodied experience be influenced in a first-person POV video game when the virtual character is not visible and how, if at all, does it affect their in-game behaviour?**

**H1:** Despite the lack of any graphical depiction of a virtual character, players will be able to infer details and characteristics about their virtual character through sense of embodiment when playing a video game.

**H2:** Players are affected by their embodied experience to the extent that they will base their in-game decisions on what they feel is appropriate for their virtual character.

In this pilot study, the possibility of using a video game to study this is explored. Participants of the study were observed while playing through two implementations of a video game, varying in the playable character's characteristics. Care was taken that participants' in-game actions were being influenced by an embodied experience rather than the inference of designer intentions. To this end they were asked to think out loud while playing the game and then answer a questionnaire about their in-game experience. This proved to be helpful in collection of insights about the strengths and weaknesses of the design of the aforementioned video game as a tool to study embodiment. The data gathered through questionnaires provided further knowledge about possible external influences on participants' in-game behaviour. The combination of participant observation and questionnaire data demonstrated that the design of a virtual character intended for a study such as this needs to be carefully realized through preliminary testing in order for it to be successfully implemented.

This paper will begin with literature relevant to the method and subject of the study being reviewed and discussed. This includes studies and literature on embodiment, body ownership, perspective-taking, identity, and the bidirectional nature of the relationship between the player and the video game. After the literature review the methods of a proposed experiment, utilizing a short, screen-based video game to seek answers to the aforementioned research question will be described thoroughly. This includes the design of a video game created for this study, the experiment conditions, and the procedure of the experiment. Subsequently we will describe and discuss the results of this pilot study. There, insights gathered through the study will be reflected upon, providing suggestions for potential improvements for a larger-scale study. Lastly, the paper will end with further research and conclusions.

## II. LITERATURE REVIEW

### EMBODIMENT IN VIDEO GAMES

A consistent issue in literature about embodiment and video games is that researchers do not always seem to agree on how exactly to define 'embodiment' (Farrow & Lacovides, 2013). The definition is consistently ambiguous and varies throughout the field which calls for a concrete definition in the context of this research. For the purposes of this research the definition of embodiment is one established by Rosa et al. (2017) where they describe embodiment as "[t]he process of adjusting one's internal body representation to the current circumstances". Furthermore they define player embodiment as "[t]he experience that the avatar has changed the internal body representation and phenomenal body of the player". The definition serves well to address some of the weaknesses of other definitions which often fail to account for the bidirectional relationship that exists between the player and the video game.

Arjoranta (2013) illustrates this well by describing how instead of being submerged in a virtual world and blocking out the real world completely, a two-way relationship exists between the player and the virtual space. On one hand, this relationship involves the virtual space existing in the player's mind, on the other, the player "is part of the environment in the sense that they are part of the virtual space" (Arjoranta, 2013). Arjoranta calls this an embodied approach to the relationship between the game world and the player. The definition of embodiment by Rosa et al. (2017) suits the subject of this research quite well since they entail the players' feeling of their body having been extended to that of the playable character, which is precisely what this research is aiming for. In the case of this research, the playable character is unseen, meaning that information about it can only be derived through experiencing the video game through the character's

perspective. Furthermore, according to the definition, the internal body representation of video game player is altered by the avatar, but that begs a few questions about the way in which it is altered. Do players sense the virtual character's body as their own in such a manner that they feel as if they are playing themselves in the video game, despite the virtual character's characteristics and manner of movement potentially being profoundly different from that of their own? Or do players feel as if they are taking on the identity of another and experiencing the video game through their eyes? And are they able to infer their characteristics despite not being able to see them?

Body ownership, or the sensation of owning a body, can be regarded as one of the components that aid in the occurrence of the sense of embodiment (Rosa et al., 2017). A common topic of research related to body ownership is the illusion of body ownership over a virtual body. One study on that subject manipulated conditions such as visuotactile and visual sensorimotor stimulation, visual perspective, and realism of body appearance (Maselli & Slater, 2013). Results showed that the first-person perspective was essential to induce the sense of body ownership. Furthermore, it was found that if participants' virtual body was realistic enough and located in the same place and posture, that by itself was found to be enough to induce the illusion and multisensory and sensorimotor contingencies were not necessary.

A study utilizing a similar kind of body ownership illusion, but doing away with computer-generated graphics, researched the link between body satisfaction and perceived body size (Preston and Ehrsson, 2014). In the study, illusory body ownership was induced in participants using head-mounted displays. Through the displays, participants were presented with a first-person perspective view from the perspective of mannequins, which alternated in body width. The perceived body size and body satisfaction of participants were measured before and after the experiment. Results showed that participants who were shown the perception of a slimmer mannequin reported higher body satisfaction and perceived their actual bodies as being slimmer.

Another research studied the effects of varying degrees of anthropomorphism of participants' virtual characters on the experience of the illusion of virtual body ownership (Lugrin et al., 2015). The results showed that the anthropomorphism of the virtual characters had a slight negative effect on the degree of which participants experienced the illusion of body ownership, perhaps due to a visual Uncanny Valley effect.

The essentiality of the first-person perspective for the body ownership illusion to work suggests how potent the manipulation of perspective is in affecting people's perception of themselves. Furthermore, people's self-perception can apparently be influenced by the taking of a different first-person perspective and

those changes in self-perception seem to linger amongst the participants after their experience in the experiment. This suggests that people's real-life self-perception can be influenced through video games, showcasing the relevance of further study into the nature of this altered self-perceptions and the possibilities that the manipulations of virtual embodiment entail. In addition, the fact that the realism of the graphics as well as the degrees of anthropomorphism are factors that seem to influence the study's participants' sense of embodiment, invites the examination of what happens when we remove the indicators of the virtual characters' appearance altogether.

## A BIDIRECTIONAL RELATIONSHIP

A considerably large body of research exists already that relates to the cognitive experience of video gaming, though the focus of each research varies. A large part of the findings of this research suggests that the relationship between the video games and the players themselves are more complicated than the video games just being a unidirectionally flowing form of entertainment. Klimmt et al. (2009) created a model to describe how video game players are affected by playing video games, more particularly, the identification that occurs through gameplay and how players' self-perception is affected. They argued that when playing video games, players' self-perception is affected in such a manner that they perceive their own attributes as being more similar to those of the virtual character that they are playing as.

Empirical evidence for the model was found in a study by Klimmt et al. (2009), demonstrating these changes in self-perception that occur during video game play. In the study, participants were asked to either play a first-person shooter or a racing game. The study was designed to research changes in players' implicit self-concept which would be hard to research through interviews with participants. Instead, the study utilized the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) to measure how strong the associations between certain concepts were amongst the participants. The results showed that the participants who had been tasked with playing a first-person shooter had stronger associations with military-related concepts and that the participants who had been tasked with playing the racing game had stronger associations with racing-related concepts. Similar to the previously discussed study involving mannequins and perceived body size (Preston and Ehrsson, 2014), the results of this study demonstrate how players' perception of their actual selves can be affected by playing video games. This indicates, yet again, that the embodiment that occurs in video game play is a complex, and potentially useful, phenomenon. In the case of this study by Klimmt et al. (2009), players had plenty of visual indicators about what kind of virtual character it was they were playing, i.e. they were either soldiers shooting guns or

drivers racing cars. In the experiment presented in this paper, however, the absence of narrative and any visual representation of their character causes the players to draw conclusions about their character solely based on movement and sound.

Video game-playing has been suggested to be beneficial when negotiating own identities in regards to peer groups, family, and gender (Bassioumi & Hackley, 2016). In Bassioumi and Hackley's research they utilized interviews and discussions with children in the UK. Their findings illustrate well how large of a role video games play in the social lives of young children. The research showed that through playing and discussing video games with their peers, children negotiated their age and role (and in the case of boys, masculinity) in their social group. Playing specific games became a rite of passage in the social group and the status of individuals in the group could be improved by playing games meant for more mature audiences. In the study it was also apparent that there was a difference between genders in what types of games were preferred, indicating that the games also played a part in negotiating gender identities in the group. A limit of this study is that the participants were such a small convenience sample of children that the research is not statistically generisable.

Another case of video games playing a role in the negotiation of social identities is a study involving people with gender dysphoria playing video games (Griffiths et al., 2016). By using case studies relating to people who attended an assessment at the National Centre for Gender Dysphoria in Nottingham, examples were found of gaming being a useful way to deal with their gender identity issues. Through gender swapping in video games, both online and offline, people were able to come to terms with their gender identities in a safe environment. The apparent fact that video games play a part in the negotiating of peoples' social roles and identities shows how video games, instead of being merely a form of entertainment, play a large social role in many of today's communities. Furthermore, since the changes in self-perception that video games are able to induce seem to be able to have positive psychological benefits for people, the relevance of this paper's research into how this self-perception can be influenced is evident.

It has been shown that the embodiment that occurs in video games is not always necessarily a solely mental and invisible phenomenon. In an effort to research the embodied and embedded aspects of cognition, Chisholm et al. (2014) aimed their attention at spontaneous natural behaviours that emerge in the context of a cognitive task (i.e. the natural behaviour approach). They applied the natural behaviour approach in the context of teleoperation in an effort to study the overt representation of remote action, i.e. visible embodied cognition. Teleoperation is a concept which can be described as the use of controls to navigate through a remote space via an intermediate actor. In the

case of the research of Chisholm et al., the teleoperation in question was the controlling of a virtual car in a racing video game.

What the research was intended to study was a phenomenon where the players of a video game tend to physically replicate movement occurring in the virtual space, even though the behaviour has no functional benefit. The method they used to investigate this was that they had participants play a car racing video game which they modified so that for some participants the controls were reversed, meaning that when the control stick was pushed to the left, the car moved to the right, and vice versa. Participants were observed to lean into turns that they made using the virtual car when playing the game. Instead of the participants' bodily movement matching the physical action needed from the participants, it matched the desired movement of the virtual car they were controlling. Chisholm et al. argue that this behaviour is a case of visible embodiment. While the research involves visible instances of embodiment as opposed to the covert kind of embodiment that is the subject of this paper, it shows how commonplace video game-playing behaviour can be further scrutinized to reveal informative details about the cognitive process resulting in novel findings.

### III. METHODOLOGY

This pilot study's goal is to research the possibility of using a video game to examine how players of a first-person, screen-based video game can be influenced to experience varying senses of embodiment and how those varying senses of embodiment would influence their in-game behaviour. For the purpose of attaining answers to this research a short video game was created. Participants were asked to play through this video game while describing their thinking process about their playthrough out loud. Subsequently they were asked to answer a questionnaire about their experience.

#### A. Playthrough of the Game



*Fig. 1. The player's view in the beginning of the game. Note the neutral design of the level and its colors*

In the beginning of the game, the player finds themselves in a corridor leading up to a door marked as 'WAITING AREA' (see fig. 1). Upon approaching the door, they encounter an obstacle that they are required

to jump over. After successfully jumping over the obstacle, the door automatically opens when approached and lets the player through.



Fig. 2. The waiting area.

Upon passing through the door into the next room, the player is faced with a sign explaining that the test area itself is being prepared and invites the player to play ball while they wait. This large room that the player has found themselves in contains four signs, three balls scattered around the room, and a basketball hoop accompanied by a scoreboard sign located by one of the walls (see fig. 2 & 3). On the far end of the room there is a door marked as ‘TEST AREA’. Beside this door a countdown timer has started counting down from three minutes, indicating that access to the test area will be granted in three minutes time. Signs in the middle of the room explain the controls behind picking up and throwing the balls and challenge the player to attempt to score four points. The player starts attempting to score points by throwing the balls into the basketball hoop and each successful throw prompts a celebratory sound and visual effect as well as the score on the scoreboard being increased by one point. Regardless of whether the player has been able to reach the score or not, an alarm sounds when the preparation time of the test area has finished counting down, indicating that the player can now enter the next room.



Fig. 3. The waiting area.

The test area that the player enters is a slightly smaller room than the one they just left. On the left side of the wall facing the player there is a door and on the right side of the wall there is a hole in the wall (see fig. 4). Texts above each of those indicate that the mode of entry into the next room is to either walk through the door or jump through the hole. In the middle of the room

there is a sign instructing the player to choose either path. Both paths lead to the same room, although this is not apparent to the player.

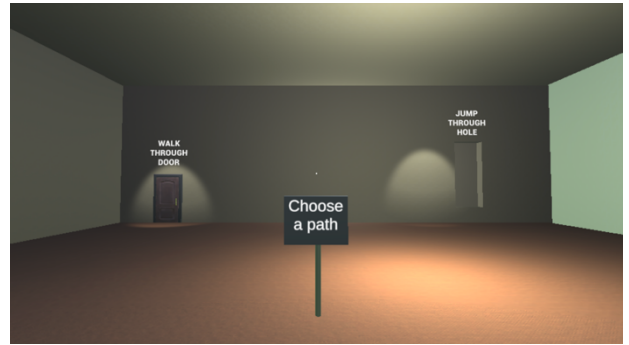


Fig. 4. The first path choice.

The room that follows has a similar structure to the previous one (see fig. 5). On the wall facing the player as they enter there is a path marked as ‘REGULAR WALKWAY’ on the left side and a path marked as ‘MOVING WALKWAY’ on the right side. A sign in the middle of the room instructs the player to choose either path. Then, depending on the player’s choice, they either walk down the regular walkway or enter the moving walkway which allows them the option of not walking at all and allowing the walkway to move them forward or walking despite being moved forward by the walkway.

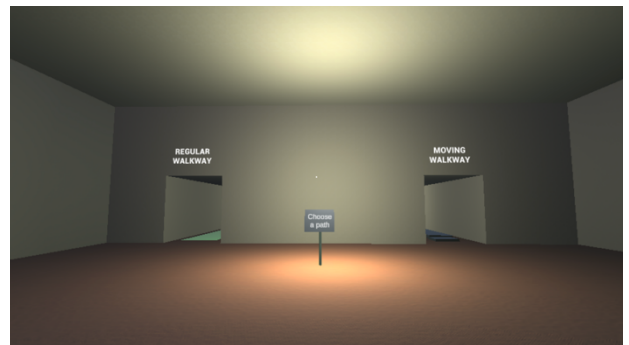


Fig. 5. The second path choice.

No matter the choice of path, the player now enters the final room which is the largest one of all the rooms. In this room the player is congratulated on a job well done, instructed to write down a number and to step on a green square to finish the game (see fig. 6).



Fig. 6. The final area.



## B. Choice of Equipment

For our study we opted for classic methods of controls and display, more specifically, a keyboard, a mouse, and a conventional monitor. This is due to the fact that a significant majority of gamers play through screen based technology (The Entertainment Software Association (ESA), 2020). Additionally, an important factor in the experiment is that one of the methods that will be utilized to influence the embodiment of players will be the manipulation of head bobbing of the virtual character, i.e. how the player camera bobs up and down when the player makes the virtual character walk, replicating the virtual character's head movement. The extent of which head bobbing movement was being manipulated was deemed to be more effective and natural when utilized in a screen-based game and theorized to potentially cause an uncomfortable, if not nauseating, experience for the player if presented in VR. This is in large part because the camera, which in the case of VR should be controlled by the player's own head movement, is being manipulated by external in-game factors, which has been found to cause motion sickness in VR (Munafo et al., 2017).

## C. The Visual Design

The visual design of the game's virtual environment is meant to be as neutral and unremarkable as possible, in an attempt to not distract the participants with external factors. The least distracting interior design that was conceived of while designing the environment was the neutral design of an everyday office space. Thus the virtual environment ended up being that of slightly off-white walls and ceiling accompanied with dark wall-to-wall floor carpets. Despite some of the objects appearing in the game not typically belonging to such an environment, it was deemed to be the least distracting and most neutral.

## D. The Conditions

Since the goal of the game was to research the embodiment that occurs in first-person video games, different conditions needed to be created. For the purposes of this experiment, two separate conditions were created. With the game being one that plays through the first-person perspective, other components than the visual appearance of the virtual character itself needed to be manipulated. These components included height of player perspective, movement speed, sound of steps, jump height, intensity and speed of head bobbing, and grunting sounds when jumping or throwing. Each condition had the players playing as a virtual character that was created by manipulating these components in an attempt to replicate characteristics of a archetype chosen due to their contrasting nature (see fig. 7).

	Character 1 The Tall, Young Man	Character 2 The Small Old Woman
Movement	Brisk	Slow
Player perspective	High	Low
Footstep sounds	Brisk	Slow
Grunt sound (when jumping or throwing)	Male	Female

Fig. 7. The archetype characteristics.

If the manipulation of these components is implemented in a realistic enough manner, they should be able to portray the desired characteristics of the virtual character to the player. Thus, care was taken to prevent the selected manipulated components from being too exaggerated in an effort for them to seem plausible as movements and sounds that someone would make. They would nevertheless need to be exaggerated enough to be noticeable and to have an effect on the player's perception of their virtual character. How successful and realistic the implementation of these components is important for the results of the experiment.

## E. The Gameplay Design

There are multiple tasks that players are asked to perform during the playthrough of the game. The first tasks of the game, i.e. jumping over the obstacle and scoring points by throwing the balls into the basketball hoops, serve as familiarization phase of sorts. The players are able to engage in meaningful interaction with the game through the basketball playing and the added challenge of trying to score four points. Furthermore, these first tasks allow the players to not only get acquainted with the controls of the game but also to experience the specific traits, nature, and abilities of their virtual characters. That is, how fast their character moves, how high it jumps, and what sounds it makes when throwing the ball and jumping. This is done to make sure the players get a clear sense of their character and possibly influence the decisions they make.

What follows after this familiarization phase is the presentation of path choices to players. Two consequent rooms both require the players to choose one of two paths to proceed forward. In both instances, one of the two paths can be perceived to be more physically demanding for the virtual character than the other, i.e. jumping through the hole and walking down a long walkway unassisted. These path choices are intended to demonstrate whether there is any correlation between how players perceive their virtual character and the choices they make. Both of the aforementioned path choices are permanent in the way that once taken, players cannot turn back and choose the other path. The permanence of the players' choices is designed in an

effort to increase the players' feeling of experiencing the virtual world through the eyes of their virtual character.

### *F. The Questionnaire*

The purpose of the questionnaire is to investigate the effects of the aforementioned manipulations of player camera and sounds on the players' embodiment. The participants are asked to answer questions about the details of their character (see appendix 1). These include details such as age, height, fitness and gender, and an open question allowing participants to describe their character further. The purpose of the open question is to see whether there are additional characteristics and details about the virtual character that participants had sensed some through playing the game, and that had not anticipated. If there are reoccurring answers to the open question, it could prove relevant to the research. Then players are asked what choices they made, and why they made them. Care had to be taken when choosing the metrics for each detail that participants were asked to provide. When asking about age, for example, instead of asking participants to rate the age with phrases such as 'very young' and 'very old', we asked them to rate the age with years. This is due to the fact that, depending on the age of the participants, the meaning of 'very young' and 'very old' can vary differently. For instance, a woman of sixty years can regard a man that is twenty years old as being very young.

Even though participants rated these details using these phrases in the questionnaire, each scale was assigned the values 0-100 for use in the processing of the data. The participants were later asked questions about their own real-life characteristics such as age, gender, fitness, and whether they are used to playing video games. The recorded in-game behaviour of the participants will help to assess the reasons behind players' choices. The questionnaire will provide answers as to how the sense of embodiment was affected by the design of the video game. Together, the questionnaire and the in-game behaviour will answer the question of how player embodiment can be affected in a first-person screen-based video game (based on non-visual cues) and whether there is any correlation to their perceived in-game identity and their in-game behaviour.

### *G. Procedure*

For the experiment to succeed participants were asked to play the video game while being observed, after which they were asked to answer a questionnaire inquiring about their experience. The procedure for each of the participants was as following:

## EXPERIMENT PREPARATION

1. The participant registers for an online appointment via an online appointment scheduler.
2. The online appointment scheduler provides the following information via email:
  - a. How to access the online appointment when the time comes.
  - b. What files to download before the appointment.
  - c. A short description of what to expect during the appointment.

## EXPERIMENT

3. Participant attends an online chatroom with the researcher.
4. The researcher instructs the participant to download the correct files if they have not already.
5. Participant is asked to read a document informing them about the design of the research and about what is asked of them during the experiment.
6. The researcher asks the participant to share their screen with them and walks participant through the installation of the video game and informs them which file to open.
7. The researcher instructs the participant to start playing the game and reminds them to think out loud during their playthrough.
8. The researcher observes the gameplay of the participant, writing down noteworthy behaviour of the participant such as comments about their virtual character's nature and the reasons behind the participant's choices.
9. During gameplay, the researcher is present for assistance, if needed.
10. At the end of the game, the participant is asked to write down a number that indicates which of the two virtual characters they were playing.
11. Immediately after the game ends, participants are asked to answer the questionnaire.

## PROCESSING DATA

12. The data collected from participants during observation is examined to identify re-occurring behaviour amongst those who played the same virtual character.
13. The JASP software is used in this research to analyze the questionnaire answers and to explore the hypotheses.

## H. A Pilot Study Within A Pilot study

A pilot study was conducted with four participants to examine the practical aspects of the experiment procedure and whether the results indicated any correlation between the virtual personas and the sense of embodiment that the participants experienced. The results of the pilot study revealed some limitations of the state of the video game at that time. Since participants of the pilot study were not regular players of video games, some instructions given in the game were uncovered to be insufficient. Adjustments were made according to the feedback acquired through conversations while participants played the game as well as through the answering of a preliminary draft of the questionnaire (see fig. 8). The adjustments made ensured that the game was accessible to regular gamers as well as those who do not play video games at all.

Issue	Solution
Players pick up balls in corner of screen.	Instruct players to face balls when picking them up
Player uses arrow keys to move around, thus have difficulty using mouse to look around.	Instruct players to use w, a, s, d keys to move around.
Player camera moves too quickly, disorienting players.	Lower camera sensitivity.
Players playing as Tall, young man thought he did not move that fast.	Increased movement speed of Tall, young man

*Fig. 8. Alterations to the game according to pilot study participants' feedback.*

## IV. RESULTS

A convenience sample of 24 people, 12 of them male and 12 female, were recruited to be participants for the experiment. The prerequisite for participants was that they had access to a relatively recent computer or laptop. 12 participants played through the video game as Character 1, The Tall, Young Man, and 12 participants played through the game as Character 2, The Small Old Woman.

### A. Participant Observation

The observation of participants proved to be an imperative part of the experiment. Almost immediately after beginning the experiment it became apparent how vital a factor gaming literacy was to this method of experiment. While participants who were used to playing video games had no problems with navigating through the game, some participants who were not regular gamers at all had great difficulty to understand what was going on. When prompted to approach a ball and pick it up, one participant even went so far as to asking to the researcher "but where am I?", indicating that the self-location in the virtual space was not as evident to him as previously assumed.

Interestingly, even participants who weren't experienced gamers seemed to be able to perceive the height of their virtual character. This seemed to be, in part, due to the placement of doorways in the game and the different angles from which both versions of the virtual characters viewed them. An example of this is when one participant stated that she needed to "duck through here" when she passed through one of the doorways.

Another factor that revealed itself among all participants was that their choices in the game were being affected by various elements other than their in-game sense of embodiment. The factors that influenced the choices that participants made were numerous. Many participants opted for the moving walkway rather than the regular walkway simply because they found it to be more interesting. There were also more unexpected and unusual factors that had an influence on players' choices. One participant explained that she had not exercised herself that day so they would do it through her virtual character, thus choosing the regular walkway. Another participant declared that one of his rules of life is to, when faced with multiple options, always choose to option that is the furthest to the left.

### B. Questionnaire results

The results yielded by the questionnaire revealed that despite what was observed during the experiments, the gaming experience of participants did not significantly affect any of the dependent variables. Furthermore, most (79%) participants experienced their virtual character as being male, no matter which virtual character they were playing.

T-tests were conducted for each of the dependent variables to explore whether there were statistically significant differences between the two groups and therefore, whether participants' sense of embodiment was affected by their virtual character. According to the questionnaire responses, participants' sense of the virtual character's fitness was affected (see fig. 9). Participants seemed to experience The Tall, Young Man at a higher fitness level ( $M = 34.08$ ,  $SD = 20.05$ ) than The Small, Old Woman ( $M = 18$ ,  $SD = 13.93$ ), and the difference was statistically significant,  $t(22) = 2.28$ ,  $p = .033$ . This is in accordance with what



was observed during the experiments when participants repeatedly complained about the slowness of their character while playing as The Small, Old woman.

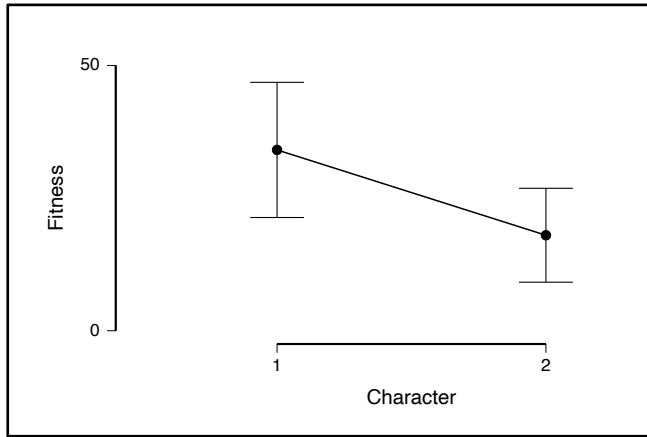


Fig. 9. The graph illustrates the means for character fitness for each group with 95% confidence intervals.

Both the questionnaire results and the observation indicated that the participants seemed to sense the height of the virtual character correctly (see fig. 10). The type of virtual character had a statistically significant effect on the participants' perception of the character height,  $t(22) = 7.48, p < .001$ , where participants experienced The Tall, Young Man as taller ( $M = 76.7, SD = 25.7$ ) than The Small, Old woman ( $M = 15, SD = 12.4$ ). The type of character did not, however, significantly effect participants' perception of their character's age (see fig. 11),  $t(22) = -1.25, p = .226$ , where participants did not experience The Small, Old Woman as significantly older ( $M = 46.5, SD = 26.64$ ) than The tall, Young Man ( $M = 35.92, SD = 12.56$ ).

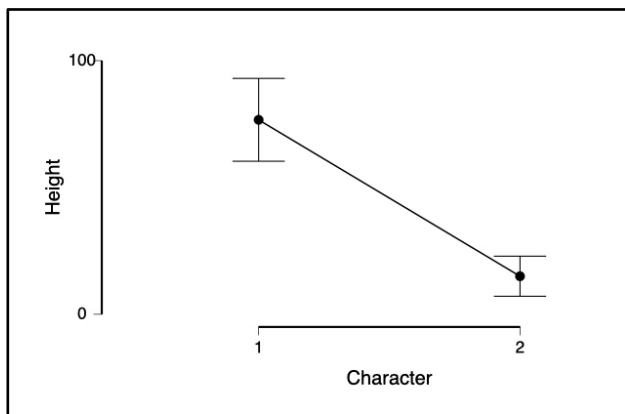


Fig. 10. The means for character height for each group with 95% confidence intervals.

Results of the questionnaire confirmed what was observed during experiments. This was that people tended to base their choices on what was interesting and exciting rather than what would be appropriate for their virtual character. Thus, most participants opted to jump through the hole (75%) and use the moving walkway (92%), and when asked to explain their choices in the

questionnaire, most answers explained the apparent excitement and interest provoked by their choice.

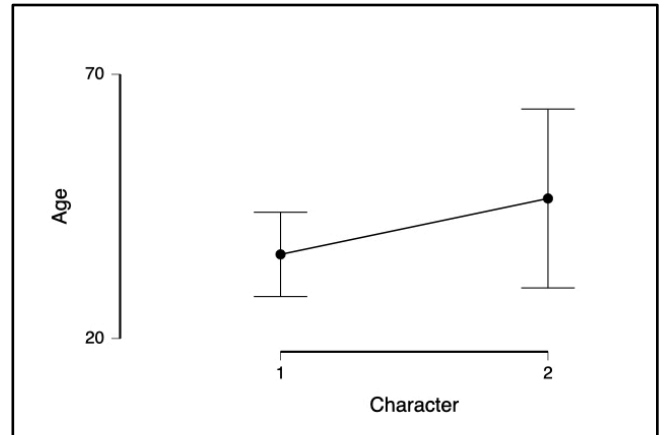


Fig. 11. The means for character age for each group with 95% confidence intervals.

## V. DISCUSSION

Even though the gaming experience of participants had no significant effect on any of the dependant variables, the fact whether people were regular or experienced gamers turned out to be a vital factor during participant observation. Experienced and regular gamers seemed to provide more helpful details and insights about their experience of their virtual characters. This indicates that for a larger-scale research on the same subject that also relies on participant observation it might be viable to solely recruit participants from a sample of experienced gamers.

Participants' ability to correctly determine their height suggests that the placement of commonplace and familiar items such as the doors, in the case of this study's experiment, allowed players to compare their in-game experience of passing through it to the real-life experience of themselves passing through a doorway. For a larger-scale study this placement of commonplace items in the experiment could help participants orient themselves to the virtual environment and get an idea of their virtual character's nature.

The influence that the difference in the appeal had on player choices is something that would need to be refined in a larger scale experiment. Care would need to be taken to make sure that the allure of choices would be the same for participants. These differences in allure can be unexpected. Additionally, the more unusual external elements that can affect players' choices, such as always choosing the option to the left, should be anticipated. This could perhaps be accomplished through filtering participants' explanations for their choices and accounting for those who had clear external and irrelevant causes for their decision-making. Additionally, extensive preliminary research and testing is needed before a final design decision is reached about which choices to present to participants in the experiment itself.

The fact that most participants experienced their virtual character as being male combined with the fact that there was an equal amount of male and female participants, indicates that the game's design could be improved. A possible explanation for this, which surfaced during participants observation, was the sound of the footsteps of the virtual character. One participant observed that "these [were] manly footsteps", even though the grunting sounds of the character were that of a woman. When designing the variables for the virtual characters the only varying aspect between character concerning footsteps was the speed of which they sounded. Instead, this could be mended by altering the nature of sound of the virtual character's footsteps. The sounds could, for example, be designed to replicate the footstep sounds that a person wearing high heels would make. Furthermore, extensive preliminary testing of sounds alone should be performed to determine their perceived nature.

Even though there was a statistically significant difference in participants' sense of the virtual characters' fitness. The study could still benefit from improvement in the implementation of the variables designed to affect the fitness characteristic of the virtual characters, making their fitness more apparent for a larger-scale research. This could involve the addition of sounds of exhausted breathing made by the virtual character.

The lack of a statistically significant difference in the participants' sense of their virtual character's age shows that the game's design needs improvement in that respect. This might be mended with the addition of another activity during the familiarization phase. The intention of the familiarization phase was to allow players to gain a sense of their character's characteristics through interaction with the game. It was unanticipated that the nature of the activity that players were asked to do might possibly have an effect on their perception of their characters. Allowing players to choose between two activities to pursue, however, could prove beneficial in reinforcing the players' sense of their virtual character's characteristics. This could be achieved by making the second activity one that is more typically associated with the type of character the game is intended to emulate. In the case of this research, one of the virtual characters was intended to be perceived as old. To this purpose, a sport such as boccia could be included as a choice of activity during the familiarization phase.

## FURTHER RESEARCH

The prospect of studying player embodiment and its effect on players' choices through screen-based video games seems promising, although the design of choices and virtual character characteristics needs to be done with caution. Care has to be taken so that none of the choices presented to the players are inherently more interesting than the others since what can appear more

interesting to participants is not always obvious when designing the choices. Furthermore, the manipulation of variables of virtual characters need to go through extensive preliminary testing before performing a large-scale study, to determine how their nature is perceived by others.

The implementation of further variables to reinforce players' experience of the video game could be introduced in further research. The presence of another character, possessing the characteristics of the opposite virtual character, in the same virtual space as the participants find themselves could have that reinforcing effect. Alternatively, players could be allowed to play through the game as both virtual characters. Both would allow them a direct comparison of characteristics.

In this pilot study, the assumption was made that data collected through participant observation and questionnaires about participants' identification of character attributes were due to an embodied experience. In further studies, using an embodiment scale, such as the one developed by Lankoski (2016) to determine whether the experience of participants was due to an embodied experience could be beneficial. This could be valuable in comparing experiences between those who had no embodied experience at all and those who did.

## VI. CONCLUSION

This pilot study examined how video game embodiment can be researched using screen-based video games. The study examined whether players are able to infer details and characteristics about their virtual character through embodiment and whether their in-game decisions were affected accordingly. A pilot study was conducted where 24 participants were divided into two groups and each group played through a version of a short video game. The two versions differed in that the virtual characters had different characteristics such as height, movement speed, and sound.

The results showed that participants experienced the height and fitness of the virtual character as they had been designed to be experienced. Participants' choices, however, were not affected by the nature of their virtual character. Instead they were affected by the apparent difference in the allure of the in-game choices.

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Questionnaire

1. What number did you write down at the end of the game?

- a. 1
- b. 2

2. What was your virtual character's height?

Very short                      Medium                      Very Tall

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3. How old was your virtual character?

0                                      50                                      100

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4. How physically fit was your virtual character?

Very unfit                      Medium fit                      Very fit

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5. What was your virtual character's gender?

- a. Male
- b. Female
- c. Non-binary / third gender

6. Any additional details about your virtual character?

7. In the first room after the waiting room, which path did you choose?

- a. I chose the door
- b. I jumped through the hole

8. Why did you choose the door / the hole?

9. In the second room after the door, which path did you choose?

- a. I chose the regular walkway
- b. I chose the moving walkway

10. Why did you choose the regular walkway / the moving walkway?

11. What is your height?

Very short                      Medium                      Very Tall

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12. How old are you?

0                                      50                                      100

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13. How physically fit are you?

Very unfit                      Medium fit                      Very fit

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14. How much experience do you have playing video games?

- a. None at all
- b. A little
- c. A moderate amount
- d. A lot
- e. A great deal

15. How much time, on average, do you spend on video games weekly?

- a. Less than one hour
- b. 1-4 hours
- c. 5-10 hours
- d. 11-19 hours
- e. 20+ hours