Engagement Impact: Projection of Player Attributes onto Avatars

Jake York*

University of New South Wales (UNSW), Canberra

Engagement in video gaming is a subjective measure of player immersion, presence, flow and psychological absorption. When a person is highly engaged, they dissociate with the real environment around them and instead focus on their interactions within the game. This research report demonstrates that in character based video gaming, the engagement level of a player can be influenced by how much that player identifies with and relates to the avatar in the game. A multi-stage experiment was conducted, beginning with a demographic questionnaire which was completed by 293 respondents. From these respondents, 19 subjects were selected for subsequent experiment stages. Static and dynamic physical characteristics of these subjects were encoded onto individual avatars in a video game. The subjects conducted gameplay testing in which they controlled an avatar with their own physical characteristics and as an avatar with the physical characteristics of another person. They then completed a short form questionnaire based on the User Engagement Scale, which measured their engagement with each avatar. The results of the experiment indicate that when playing with a self-similar avatar, subjects were more engaged (25%), identify more with the avatar (47%) and are more drawn into the video game experience (21%) than when playing with the other avatar. These results can then be applied to 39% of the demographic respondents.

I. Introduction

For video game companies and throughout the entertainment industry, maintaining a high level of audience engagement is a primary consideration. In video games, tools such as unique gameplay, empathetic character construction, graphics, online community and replayability are used by companies to recruit and retain players for the longest time possible. In character based gaming, the player avatar - the 'digital self-representation' of the player in the game environment - is a tool in itself to influence player engagement (Ewell et al., 2016).[a] Depending on the game, the avatar can be fixed (no elements can be customised), partially customisable (elements such as clothing can be changed) or highly customisable (many elements such as body type/shape can be changed). This high level of customisation is attractive to a particular group of people and is also prevalent in online dating simulators and virtual worlds such as *Second Life* or *ourWorld*. It has been discovered that when players can customise their avatars, they often do so to have the avatars mirror their own behavioural and physical characteristics where possible (Dunn and Guadagno, 2012; Ewell et al., 2016). It is also understood that players can develop relationships with their avatars and invest in them emotionally over long periods of play (Li et al., 2013).

This paper details the findings of a multi-stage experiment investigating the engagement levels of players in character based video gaming. Specifically, the experiment investigated player engagement with avatars that featured static and dynamic characteristics of the people playing the game. Here, static characteristics relate to how avatars looked and dynamic characteristics relate to style and speed of avatar movements. To contextualise the research questions (section III), design of the experiment (section IV) and the results (section V), a detailed review of the relevant literature was conducted.

*CAPT, School of Engineering and Information Technology, ZEIT4901

[a] In this paper, the terms 'character' and 'avatar' are used interchangeably.

II. Literature review

A. Engagement

In character based video gaming, the player interacts 'with a virtual world by controlling a token, which is the protagonist in the game and, consequently, the most important entity that inhabits the world' (Fabricatore et al., 2002). In terms of this world, it has been argued that the first person shooter genre is the most engaging experience one can have (Black, 1984). This can be an ideally immersive experience as the player can feel as though they occupy the avatar directly, seeing the game world through the eyes of the avatar (Black, 1984; Lewis et al., 2008). When investigating a contrary player perspective, Wauck et al. (2018) found that photorealistic avatars in a third person search and rescue game had no effect on either player experience or performance in the game. Before being able to accurately measure player engagement in video games generally, the component parts of the term 'engagement' must be quantified. The subjective experience of a video game player is distilled into four elements as detailed below (Brockmyer et al., 2009):

- Immersion: 'the experience of becoming engaged in the game-playing experience while retaining some awareness of one's surroundings' (Brockmyer et al., 2009);
- Presence: experiencing a virtual environment while still exhibiting a normal state of consciousness;
- Flow: enjoyment resulting from rewarding gameplay (skill relative to challenge);
- Psychological absorption: an altered state of consciousness, in which thoughts and feelings related to the real world are more difficult to access.

Flow and psychological absorption both indicate deeper levels of engagement in a game. It is when these states are achieved that a player can lose track of real time and space, being dissociated from the physical environment they inhabit (Brockmyer et al., 2009). To achieve these levels of engagement in players, video games must follow rules that run parallel to real life. Players expect to interact with a consistent world and to understand what is possible, what boundaries exist and what the goals are in a game (Fabricatore et al., 2002). Failure in a game should be possible but not due to inconsistencies in the game world such as incomplete environments or gameplay glitches (McMahan, 2003). Some players expect the ability to explore game boundaries and exercise curiosity (Lazarro, 2004). For a high level of engagement in a game, players should lose awareness that they are participating through a medium (Federoff, 2002; Zhong and Yao, 2013). The best medium is one that the player is unaware of (Federoff, 2002). To this end, the argument has been made that poor resolution or visual quality can disrupt the player's experience (Procci et al., 2018; Smyth, 2007). Csikszentmihalyi (2014) posited nine principles that allow players to experience elevated engagement levels in a game (Csikszentmihalyi, 2014; Hull et al., 2013):

- Balance between activity challenge and player ability;
- Merging of action performance with player self-awareness;
- Possession of clearly set goals;
- Provision of unambiguous performance feedback;
- Having full concentration on the current task;
- Feeling a sense of being in control;
- Loss of self-consciousness;
- Acquisition of a sense of time distortion;
- Feeling like goals are self-generated.

Fabricatore et al. (2019) describe that through gameplay, 'the player self-defines or accepts externally defined goals, evaluates environmental conditions, plans a course of action to attain the goals, executes the plan, and evaluates results'. Depending on past successes, a new course of action is determined and the player continues in the game. As demonstrated by Hoffman and Nadelson (2010), 'gaming promotes intrinsic motivation, positive affect, and many aspects of the flow experience'. If achieved, the player loses (some degree of) awareness of their surroundings and focusses on the goals in the game.

The above elements of engagement have been clearly defined for some time (Brockmyer et al., 2009; Csikszentmihalyi, 2014; Fabricatore et al., 2019; Hull et al., 2013). However, the academic community

remains divided on how this engagement is best measured and analysed objectively. The most common method is through direct questioning of participants about their experiences. The primary divider, therefore, is what questions researchers should ask.

B. Questionnaires

O'Brien et al. (2018) establish that in order for research questionnaires to be valid, they must be independently evaluated and address research questions in such a way that the variable(s) of interest can be identified and determined unambiguously. It has been identified by Fabricatore et al. (2019) that regardless of which questionnaire or delivery method is used to gather information from participants, if there is room for misunderstanding, participants should be provided with an explanation or completed examples. They should also be allowed to ask questions of fact to confirm definitions and meaning. These are methods to prevent data skewing due to poorly constructed studies or participant misinterpretation of scales. Further, to mitigate or reduce the Hawthorne effect,[b] research subjects must be made aware of the objective goals of a study, their role and what expectations (if any) the researchers have of them (Adair, 1984; Hashimoto et al., 2011).

Researchers have employed numerous different assessment scales when delivering questionnaires to participants. For example, Hoffman and Nadelson (2010) used four collated instruments to collect their data. Lewis et al. (2008) developed a 17 item questionnaire which was revised from 95 items by experienced video game researchers. The questionnaire was proposed to be valid in their related paper (Lewis et al., 2008). Li et al. (2013) carried out a study with a 23 item Player-Avatar Identification Scale. Their goal was to analyse adolescent player identification with avatars in games. A major proposal based on their research was that players can experience long term identity development as a result of avatar interaction. In the development of their own questionnaire, Brockmyer et al. (2009) conducted analysis on several other questionnaire models used when assessing video game players' experiences. The nine item Player Experience of Need Satisfaction questionnaire developed by Ryan et al. (2006) was considered invalid due to its short nature and unexplored psychometric properties (Brockmyer et al., 2009), despite later research validating a short form questionnaire (O'Brien et al., 2018). The Immersive Tendencies Questionnaire developed by Witmer and Singer (1998) was also analysed; however, this questionnaire related not to games specifically, but to virtual environments and media in general. It was not necessarily transferrable across research topics. Following this evaluation, Brockmyer et al. (2009) developed a 19 item Game Engagement Questionnaire, using Rasch analysis as the measurement framework. Not to be confused with this, in a detailed literature review conducted on 147 academic sources, Law et al. (2018) have established that a large number of researchers have misused the Game Experience Questionnaire (GEQ), originally developed by IJsselsteijn et al. (2007). Despite its widespread use since 2007, the GEQ has psychometric properties that are not clearly established and it has been recommended that other tools be used in its place (Law et al., 2018). In fact, Law et al. (2018) were forced to exclude 74 of the discovered sources from their analysis due to miscitation, misrepresentation of the GEQ or no actual use despite citation.

In several of the studies mentioned above, researchers offered partial credit for tertiary education in return for participation (Brockmyer et al., 2009; Ewell et al., 2016; Hoffman and Nadelson, 2010). In all other studies, incentives to participants were not provided.

In contrast to the GEQ, O'Brien et al. (2018) recently published a study that verified the structure of two questionnaires, the User Engagement Scale (UES) and the UES short form (31 and 12 items respectively). The study builds on previous work regarding the UES and is peer reviewed. The proposed short form comes as a response to misuse of the full UES or research concentration on sub-scales (O'Brien et al., 2018). The wording of the short form can be adjusted to suit the specific needs of researchers as user experience is a broad category. O'Brien et al. (2018) have also recommended the short form for comparison studies.

C. Research gap

Despite the rich literature base on definition and measurement of player engagement as well as player relationships with game avatars (Dunn and Guadagno, 2012; Ewell et al., 2016; Hull et al., 2013; Lewis et al., 2008; O'Brien et al., 2018), there exists very limited research into how players interact with self-similar avatars (Wauck et al., 2018). Research on player engagement levels when they interact with self-

[b] This is generally understood to be the phenomenon in experiments where subjects' knowledge of being in an experiment affects their behaviour in the experiment (Adair, 1984).

similar avatars may lead to new player-avatar interaction approaches within the video game industry. This could also have implications for other, more serious areas of research such as technical training, mental health and military or law enforcement simulation.

The purpose of this paper is to address this knowledge gap by investigating how players react when their avatars exhibit static and dynamic characteristics that are directly based on them.

III. Research questions

The intent of this report is to address two key research questions:

- Is engagement significantly increased when static and dynamic characteristics of the player are projected onto the game avatar?
- Is there a specific type of person for which engagement levels are increased this way?

These research questions lead to the construction of a pair of null hypotheses to be tested:

- H_0: the engagement level of test subjects playing a game with a self-similar avatar is not significantly different to the engagement level when playing with an avatar that is different;
- H_1: if H_0 is rejected, test subjects are demographically similar to a larger group of respondents.

Both of these null hypotheses were tested at the 5% significance level. As no research has previously been conducted to investigate such engagement influence, the researcher followed a standard design of experiment using questionnaires and direct subject trials (Christensen et al., 2014).

IV. Experimental design

A multi-stage experiment was conducted, beginning with a demographic questionnaire. The responses to this questionnaire were then used to select a subset of participants for the subsequent stages of the experiment. Upon selection, second stage subjects provided static body dimensions and conducted motion capture trials for a series of actions in the motion capture studio at UNSW Canberra. This data was used to construct self-similar avatars based on the subjects. The subjects then participated in gameplay testing of a short game, both with an avatar based on them and one based on another person. Finally, the subjects answered a questionnaire based on the above UES short form regarding their experiences with each avatar.

At each stage, research subjects read and signed participant information statements and consent forms for the relevant area of participation. Any subject that completed the demographic questionnaire and continued their participation was deidentified through the use of a unique four digit label. These subjects were provided with a copy of the video game that they played as compensation for participation.

A. Game development

1. General design

A simple video game was developed by the researcher with the goal of allowing subjects to focus on the game avatar. The game was made in the Unity game engine with avatar design and implementation conducted in Blender and Autodesk MotionBuilder (Autodesk, 2019; Blender, 2019; Unity, 2019). The game was designed in a minimalist fashion and played in third-person view so that subjects could observe their avatars with limited distraction. In the game, subjects played two levels: one with an avatar based on themselves and one with an avatar based on another person.

In keeping with the principles of flow laid out in section II, the goal of the game was to collect a set of objects by navigating through a simple maze (Csikszentmihalyi, 2014; Hull et al., 2013). The game featured a minimalist user interface to keep track of collected objects. Once all objects were collected in the first level (as per Figure 1), subjects could progress to the second level. Once all objects were collected in the second level, subjects were then prompted to end the game session.

2. Research specific dynamics

In order to measure player engagement relative to an avatar, it was necessary for subjects to play both as their own avatar and as one based on another person.[c] The levels included platforms and height restricted zones that forced subjects to use different actions that were available to the avatars. This was necessary for subjects to be able to see differences between the two avatars and to be able to engage with them. The game was played using a gamepad (Xbox One controller) to allow fidelity in speeds of movement (walk, jog, run) that are not easily transitioned between with a keyboard and mouse.

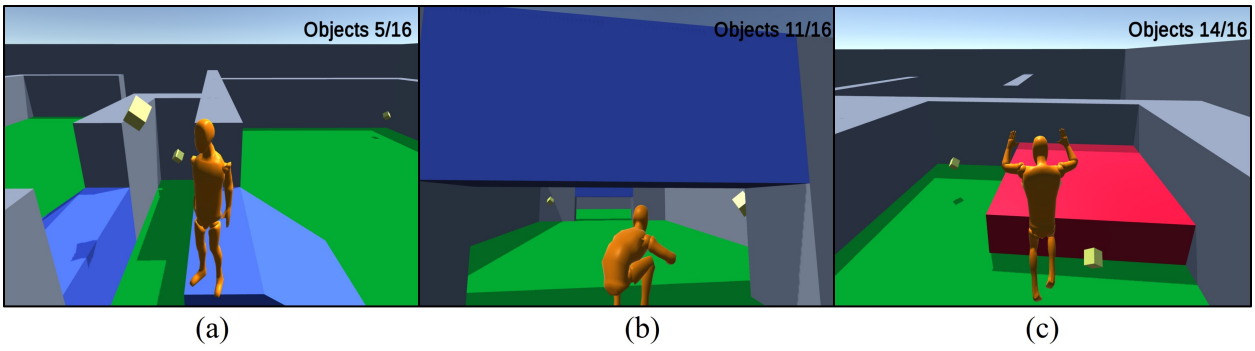

Figure 1. Gameplay images showing collectible objects and different avatar movements: (a) standing, (b) crouching, (c) jumping.

B. Demographic questionnaire and selection to second stage

A demographic questionnaire was employed to collect information from a large and diverse societal group and to ensure a relevant subsection of respondents could be approached for further participation. Participants were recruited online (primarily through Reddit) and offline through direct flyer handouts, with the only exclusion criteria being that respondents must be at least 18 years old. The questionnaire was hosted by Qualtrics, an online secure research survey tool (Qualtrics, 2019). Questions were related to demographic information, video game habits and expectations. The full questionnaire is provided at Appendix A.

Subjects were recruited for participation in the second stage of the experiment if they lived within the greater Canberra area, left their contact details to be reached for further participation and were at least 18 years of age and able bodied.

C. Static dimensions, avatar construction and motion capture data

Second stage subjects provided a set of static body dimensions and front and side profile photographs so that avatars could be constructed based on them. These were constructed true to subject height and scale but in a lower polygon, non-identifying way in Blender.[d] Figure 2 shows some variation in avatars between subjects, despite being deidentified. A collection of screenshots of all avatars in a standing position is contained at Appendix C.

Subjects also attended motion capture sessions at the motion capture studio at UNSW Canberra. The studio has 17 cameras and was used to record a set of eight actions for each subject. Subjects wore a motion capture suit comprising 39 evenly distributed infrared markers, which the cameras recorded during each action. The motion capture software, VICON Nexus, used a camera calibration as well as the positions of the markers recorded by individual cameras to create a three dimensional representation of each subject during motion capture. Subject body dimensions were also required by Nexus (VICON, 2019a). In order to allow subjects to successfully navigate the game levels with their avatars, the following actions were recorded: idle,[e] crouching idle, walking, jogging, running, vertical leap, horizontal leap (with a small run-up) and crawling/monkey running.

[c] This avatar was based on the researcher, but subjects were simply told that it was a different person.

[d] Avatars were made up of 600-700 polygons compared to some high quality video games which have up to 100,000 polygons per character model.

[e] This is the animation for when an avatar is not being directly controlled. In reality, people do not stand perfectly still between movements and therefore, neither do their avatars.

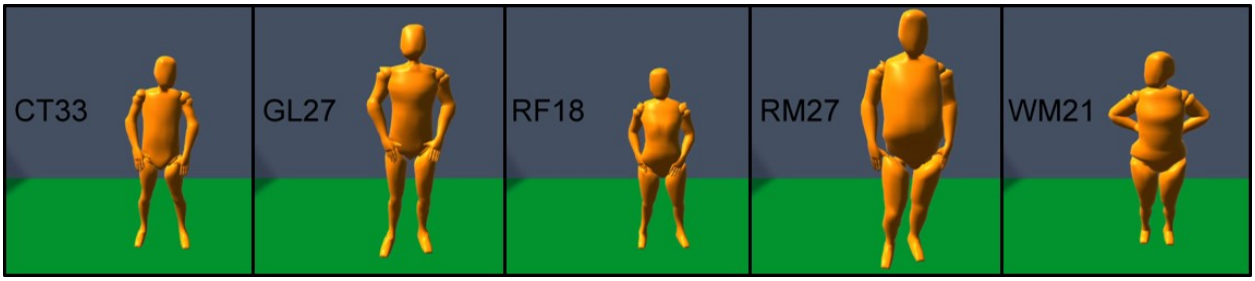

Figure 2. A sample of different avatars of second stage research subjects (heights respectively in cm: 170, 189, 153, 193, 165).

Upon successful capture, recorded actions were cleaned[f] in Nexus before importing into MotionBuilder (VICON, 2019b). In MotionBuilder, actions for each subject were applied to the avatar model. This two-stage process allowed each action to be encoded as a looped animation in MotionBuilder and for the subject avatar to then be animated in Unity.[g]

D. Gameplay testing and final questionnaire completion

The key element of the experiment was gameplay testing, in which participants played the game and then answered a questionnaire on their experiences with each of the two avatars. Subjects were instructed on the game objectives and provided with the controller button layout. They were given an opportunity to ask questions of fact before being requested to remain silent until all subjects had completed both game testing and questionnaire. Additionally, subjects were instructed that they should answer the questionnaire honestly and not provide answers that they thought the researcher wanted. This last instruction was intended to reduce any influence from the Hawthorne effect (Adair, 1984; Hashimoto et al., 2011). The final questionnaire on subject experiences is contained at Appendix B. Likert scale responses were scored on increments between 0% and 100%.

Subjects took approximately five to ten minutes to complete the gameplay testing and questionnaire. Upon completion, they were provided with a digital copy of the game to take home.[h] Subjects were not given an opportunity to see or experience an avatar relating to any other subject.

V. Results

A representation of initial questionnaire respondent locations is provided at Figure 3 (overpage). The majority of responses originated from North America, Europe and Australia. The results found in this paper are therefore most likely applicable to those populations.

In total, there were 463 recorded responses to the demographic questionnaire. 170 of these responses were excluded due to the questionnaire not being completed in its entirety, resulting in a total of 293 demographic respondents. There were 83 Canberra-based respondents to the questionnaire. In line with the selection criteria mentioned above, 34 respondents were invited to continue to the second stage of the experiment. 20 of these respondents were able and willing to continue in the experiment after being contacted by the researcher. Later, due to lack of response and attendance to testing, one subject was excluded. The final number of subjects tested during the second stage was 19.

A. General statistics

Based on their responses to the demographic questionnaire, multivariate analysis of variance (MANOVA) was used to compare the 19 second stage subjects with the 293 total demographic respondents as well as a subset of 114 respondents. This respondent subset was selected based on how much respondents wanted

[f] Any gaps in data collection were interpolated for individual frames.

[g] In video games, actions like walking or running are often looped so that avatars can do those actions continuously and seamlessly.

[h] Each subject only received a copy of the game that included their own avatar and that of the researcher (as the second avatar).

Figure 3. Locations of demographic questionnaire respondents.

to play a game with a self-similar avatar. Any respondent with a score of 50% or less to this question was excluded from the subset. Table 1 provides information on the gender distribution of respondents.

Gender	General group [n=293]	Second stage only [n=19]	Controlled subset only [n=114]
Male	75.1% [n=220]	73.7% [n=14]	68.5% [n=78]
Female	23.2% [n=68]	26.3% [n=5]	30.7% [n=35]
Non-binary	1.7% [n=5]	0% [n=0]	0.8% [n=1]

Table 1. Gender distribution of each group of respondents.

In Table 2, the means and standard deviations for each question in the demographic questionnaire are provided. Answers to the first question were given a binary score, where a zero indicated console preference and a one indicated PC preference. All other answers were scored between 0% and 100% as they were mapped onto a percentage scale from the Likert scale in the questionnaire (Appendix A).

MANOVA compares the multivariate means of dependent variables between two or more independent groups. In the case of this report, the answers to the questions in Table 2 were considered dependent variables of the groups. Two one way MANOVAs were performed on the responses at the 5% significance level, comparing the general responses with the second stage and comparing the controlled subset with the second stage. In the first test, the dimensionality was unity (p=0.0013), meaning that the multivariate means can be rejected as being different based on normally distributed randomness. Therefore, the answers from the second stage subjects do not represent the answers of the general population of respondents to the demographic questionnaire. However, in the second test, dimensionality was zero ($p = 0.5003$), meaning that the null hypothesis of the groups being different cannot be rejected. It can be said that the second stage subjects represent 114 (39%) of the general respondents in terms of their responses to the initial questionnaire.

The significance of this is to show that the second stage subjects may represent this controlled larger group in their engagement levels during gameplay testing as well.

B. Engagement in gameplay testing

Subjects answered 10 questions relating to their engagement with each avatar in the game. The questions are contained in Appendix B and are aligned with the wording flexibility for the UES short form proposed by O'Brien et al. (2018). As per their original work, an engagement score was applied based on an average score to the questions (with the second and third questions being reverse coded) relating to each avatar.

	General group [n=293]		Controlled subset only [n=114]		Second stage only [n=19]	
Question	Mean	Std	Mean	Std	Mean	Std
Do you prefer gaming on a console or a PC?	0.59	0.49	0.5	0.5	0.5	0.5
For how many years have you played video games?	19.7	8.1	18	7.4	23	6.7
Indicate how many hours per week you play video games.	12.3	7.8	11	7.5	13	7.1
Indicate how important graphics in a game are to you.	57.4	26.5	63	25.2	71	21
Indicate how much you enjoy the RPG game genre.	78.2	25.9	79	27.1	79	27
Indicate how much you enjoy the Adventure game genre.	73.5	24	78	22	80	20
Indicate how much you enjoy playing games with characters you create versus those that are fixed.	49.1	27.7	45	28.6	38	26
Indicate how much you feel an emotional connection to avatars that you create.	53.7	31.3	68	25.5	72	14
Indicate how much you would like to play a game where the avatar is fully based on you (looks, abilities, style of movement).	48.8	35.5	87	12.5	86	19
Indicate how well you think an avatar fully based on you would perform in a game like Tomb Raider or Skyrim.	34.4	28.8	48	28.5	58	28

Table 2. Means and standard deviations of demographic questionnaire responses from different groups.

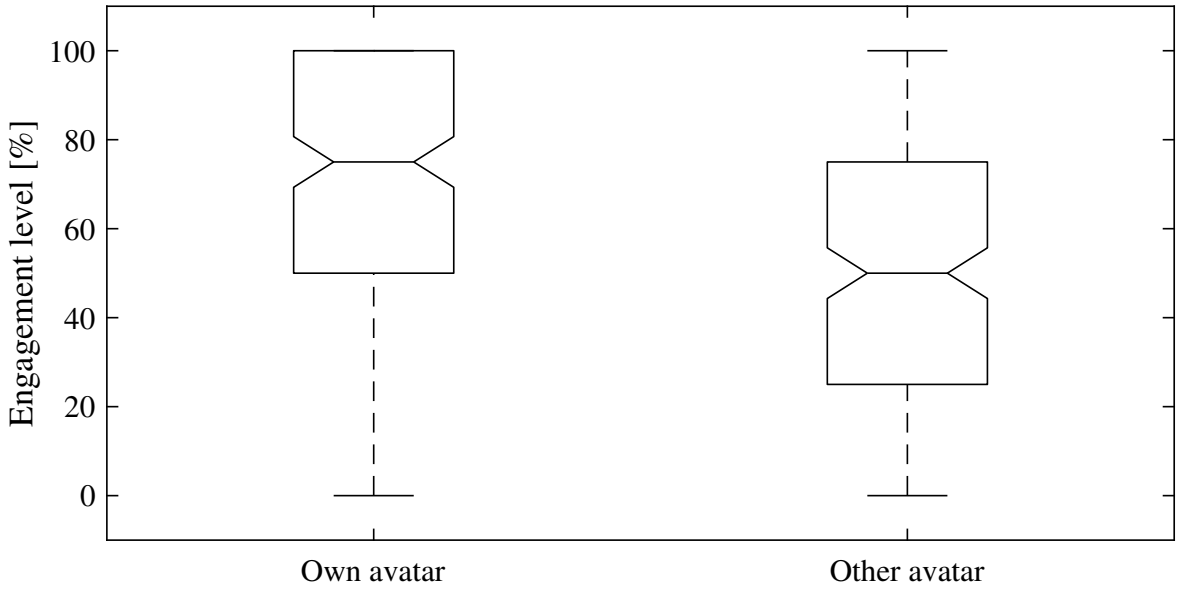

Figure 4. Confidence interval for engagement level relative to own and other avatar.

A confidence interval for this engagement score was then applied and is shown in Figure 4. The mean engagement score of the subjects was 75% for the physically self-similar avatar and 50% for the other avatar. A variance estimate was conducted on the original UES short form data provided by O'Brien et al. (2018)

and determined to be approximately 5% (given the limited use of the UES short form since its publishing). Therefore, when this variance was taken into account, the mean engagement was at least 15% greater when subjects played with the self-similar avatar.

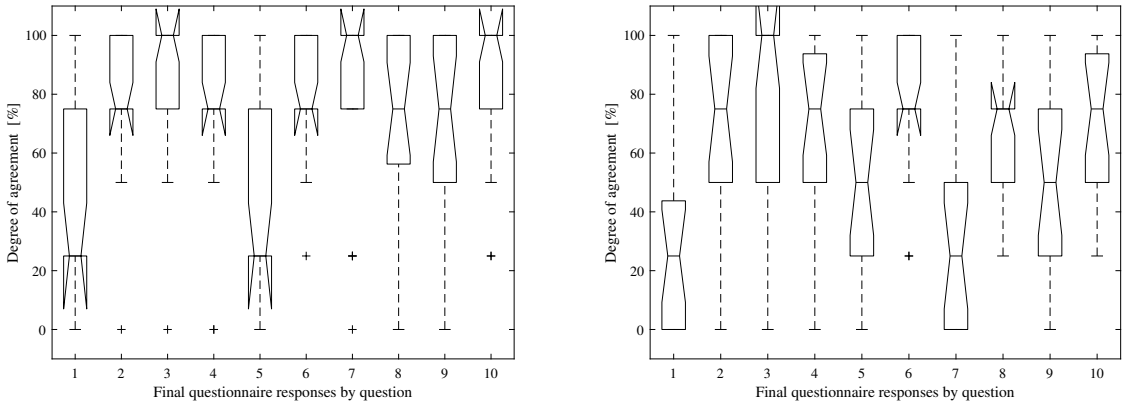

Figure 5. Confidence intervals for question responses relative to self-similar (left) and other (right) avatar.

Despite subjects being instructed that they should not give skewed answers based on what they think is the 'correct' way to respond, this may still have been a factor in their responses. In discussions with subjects after testing, the majority had quickly identified the self-similar avatar and tested the animations. This could provide a need for future work as the novelty of being able to play with a self-similar avatar for the first time may have been an influential factor on the engagement of the subjects.

As shown in Figure 5, self-similar avatar engagement scored more highly on all questions except for question six relating to understanding avatar limitations, which was scored equally for both avatars. Particularly strong is question seven, relating to 'identifying' with the avatars. Only one subject identified with the avatar that was not self-similar. All others identified with the self-similar avatar (47% increase over the other avatar) and were drawn into the experience with that avatar more (21% increase over the other avatar). As some of the confidence intervals for the means are quite large in Figure 5, it is assessed that more data would be beneficial to determine more accurate means and mean differences between the avatars.

C. Answers to research questions

Based on the above results, H_0 was rejected. Player engagement was significantly (25%) higher when playing with a self-similar avatar. When compared to related work such as by Wauck et al. (2018), the key difference is the integration of dynamic characteristics of players being projected onto their avatars and the measurement of engagement using a verified measurement tool - the UES short form. H_1 was rejected with respect to the complete group of demographic questionnaire respondents. The second stage subjects (n=19) did not represent the larger group of respondents (n=293). However, when respondents were excluded based on giving a score of 50% or less to wanting to play a game with a self-similar avatar, H_1 could no longer be rejected. With such a high probability value (p=0.5003), it can be concluded that the second stage respondents represented this subset (n=114). This is significant as the subset also represented 39% of the total demographic respondents. Therefore, based on this information, the research questions were both answered in the affirmative. Engagement was significantly increased by static and dynamic characteristics of the player being projected onto the avatar. It is likely that engagement levels can be increased this way for people that enjoy Role Playing and Adventure video games, and games with avatars that can be created by the player. This group of people would like to play games with self-similar avatars and consequently, would be more engaged with video games if they did. Furthermore, this conclusion is most applicable to North American, European and Australian populations as these are the parts of the world from which the majority of demographic data was collected.

VI. Future work

Based on the above assessment of the potential influence of the Hawthorne effect, it is recommended that longer follow-up experiments be considered. Further work should consider addressing the limited sample size of the second stage and test subjects over a longer period of gameplay to ensure that engagement with the avatar is not affected by novelty and first time experience. A useful method to measure this would be to take engagement samples at intervals during play over longer periods of time, provided the game used in testing was a continuously engaging experience as dictated by Csikszentmihalyi (2014). An experiment like this could be implemented over a period of weeks or months and include subjects logging in to conduct testing on devices in their own homes. The use of multiple avatars rather than just two would also be useful to test the confidence that subjects could correctly identify the self-similar avatar and reduce the likelihood of this being related to chance.

Other experimental variations could include avatar static self-similarity adjustment such as testing over a spectrum from the deidentified avatars presented here to the photorealistic avatars presented by Wauck et al. (2018) to truly photorealistic high polygon avatars. This testing would not necessarily require a dynamic gameplay element but could be implemented through questionnaires alone. The goal of such a study would be to gain understanding of expectations and perspectives of video game players without the need for full interactive testing.

This experiment considered a simple platforming game style. However, future work that considers dynamic avatar morphology could examine the adjustment of gameplay settings. Role Playing games, Adventure games, sports and even fighting games could all yield very different engagement results in players as the dynamic avatar requirements are very different in each genre.

VII. Conclusion

Player-avatar literature in video games has been developed consistently over the past two decades. However, little investigation has been conducted into how players interact with physically self-similar avatars. In this report, findings were presented from a multi-stage experiment where 19 research subjects played a video game with an avatar based on them and an avatar based on another person. Subjects provided physical measurements and motion capture data so that avatars could be accurately constructed. After gameplay testing, it was shown that there was a mean 25% increase in engagement when subjects played with the self-similar avatar. It was also shown that these subjects identified with and were more drawn into the experience (47% and 21% respectively) with the self-similar avatar when compared to the other avatar. Although not fully representative of the wider population of respondents (n=293), it was found that the second stage subject group closely correlated with a controlled group (n=114) of demographic respondents that would be interested in playing video games with self-similar avatars. This group made up 39% of total respondents to the demographic questionnaire.

Ethical clearance for this research was provided by the UNSW Canberra Human Research Ethics Committee, reference number HC190396.

References

J. Adair. The Hawthorne Effect: A Reconsideration of the Methodological Artifact. *Journal of Applied Psychology, Vol 69(2) 334–345*, 1984.

Autodesk. 3d Character Animation Software | MotionBuilder | Autodesk. `https://www.autodesk.com/products/motionbuilder/overview`, 2019. Accessed on 11 Sep 2019.

D. Black. Why Can I See My Avatar? Embodied Visual Engagement in the Third-Person Video Game. *Games and Culture, Vol 12(2) 179–199*, 1984.

Blender. blender.org - Home of the Blender Project - Free and Open 3d Creation Software. `https://www.blender.org`, 2019. Accessed on 11 May 2019.

J. Brockmyer, C. Fox, K. Curtiss, E. McBroom, K. Burkhart, and J. Pidruzny. The Development of the Game Engagement Questionnaire: A Measure of Engagement in Video Game-Playing. *Journal of Experimental Social Psychology, Vol 45(4) 624–634*, 2009.

L. Christensen, R. Johnson, and L. Turner. *Research Methods, Design and Analysis*. Pearson, 2014.

M. Csikszentmihalyi. *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi*. Springer, 2014.

R. Dunn and R. Guadagno. My Avatar and Me? Gender and Personality Predictors of Avatar-Self Discrepency. *Computers in Human Behavior, Vol 28(1) 97–106*, 2012.

P. Ewell, R. Guadagno, M. Jones, and R. Dunn. Good Person or Bad Character? Personality Predictors of Morality and Ethics in Avatar Selection for Video Game Play. *Cyberpsychology, Behavior and Networking, Vol 19(7) 435–440*, 2016.

C. Fabricatore, M. Nussaum, and R. Rosas. Playability in Action Videogames: A Qualitative Design Model. *Human-Computer Interaction, Vol 17 311–368*, 2002.

C. Fabricatore, D. Gyaurov, and X. Lopez. An Exploratory Study of the Relationship Between Meaning-Making and Quality in Games. *Multimedia Tools and Applications, Vol 78(7) 1–26*, 2019.

M. Federoff. Heuristics and Usability Guidelines for the Creation and Evaluation of Fun in Video Games. Master's thesis, Indiana University, 2002.

S. Hashimoto, P. Sterk, and E. Bel. Pragmatic Trials: How to Adjust for the 'Hawthorne' Effect. Correspondence to Dr George Konstantinou, 2011.

B. Hoffman and L. Nadelson. Motivational Engagement and Video Gaming: A Mixed Methods Study. *Educational Technology Research and Development, Vol 58(3) 245–270*, 2010.

D. Hull, G. Williams, and M. Griffiths. Video Game Characteristics, Happiness and Flow as Predictors of Addiction Among Video Game Players: A Pilot Study. *Journal of Behavioral Addictions, Vol 2(3) 145-152*, 2013.

W. IJsselsteijn, K. Poels, and Y. de Kort. The Game Experience Questionnaire: Development of a Self-Report Measure to Assess Player Experiences of Digital Games. *Eindhoven University of Technology*, 2007.

E. Law, F. Brühlmann, and E. Mekler. Systematic Review and Validation of the Game Experience Questionnaire (GEQ) - Implications for Citation and Reporting Practice. In *CHI PLAY 2018*, 2018.

N. Lazarro. Why We Play Games: Four Keys to More Emotion in Player Experiences. XEODesign, 2004.

M. Lewis, R. Weber, and N. Bowman. "They May Be Pixels, But They're MY Pixels": Developing a Metric of Character Attachment in Role-Playing Video Games. *Cyberpsychology and Behavior, Vol 11(4) 515–518*, 2008.

D. Li, A. Liau, and A. Khoo. Player-Avatar Identification in Video Gaming: Concept and Measurement. *Computers in Human Behavior, Vol 29 257–263*, 2013.

A. McMahan. *Immersion, Engagement, and Presence: A Method for Analyzing 3-D Video Games.* The Video Game, Theory Reader, 2003.

H. O'Brien, P. Cairns, and M. Hall. A Practical Approach to Measuring User Engagement with the Refined User Engagement Scale (UES) and new UES Short Form. *International Journal of Human-Computer Studies, Vol 112 28–39*, 2018.

K. Procci, C. Powers, F. Jentsch, V. Sims, and R. McDaniel. The Revised Game Engagement Model: Capturing the Subjective Gameplay Experience. *Entertainment Computing, Vol 27 157–169*, 2018.

Qualtrics. Request a Live Demo of the Qualtrics Experience Management Platform. `https://www.qualtrics.com/au/`, 2019. Accessed on 11 May 2019.

R. Ryan, C. Rigby, and A. Przybylski. The Motivational Pull of Video Games: A Self-Determination Theory Approach. *Motivation and Emotion, Vol 30 347–363*, 2006.

J. Smyth. Beyond Self-Selection in Video Game Play: An Experimental Examination of the Consequences of Massively Multiplayer Online Role-Playing Game Play. *Cyberpsychology and Computing, Vol 10(7) 717-721*, 2007.

Unity. Unity - Unity. `https://www.unity.com`, 2019. Accessed on 11 May 2019.

VICON. Take Subject Measurements for Plug-In Gait - Nexus 2.5 Documentation - Vicon Documentation. `https://docs.vicon.com/display/Nexus25/Take+subject+measurements+for+Plug-in+Gait`, 2019a. Accessed on 16 may 2019.

VICON. Fill Gaps in Trial Data - Nexus 2.5 Documentation - Vicon Documentation. `https://docs.vicon.com/display/Nexus25/Fill+gaps+in+trial+data`, 2019b. Accessed on 23 Sep 2019.

H. Wauck, G. Lucas, A. Shapiro, A. Feng, J. Boberg, and J. Gratch. Analyzing the Effect of Avatar Self-Similarity on Men and Women in a Search and Rescue Game. In *CHI PLAY 2018*, 2018.

B. Witmer and M. Singer. Measuring Presence in Virtual Environments: A Presence Questionnaire. *Presence, Vol 7 225–240*, 1998.

Z. Zhong and M. Yao. Gaming Motivations, Avatar-Self Identification and Symptoms of Online Game Addiction. *Asian Journal of Communication, Vol 23(5) 555–573*, 2013.

A. Demographic Questionnaire

Name								
Gender	Male	◯	Female	◯	Non-binary	◯		
City and country of residence								
Q1. Do you prefer gaming on a console or a PC?	Console	◯	PC	◯				
Q2. For how many years have you played video games?								
Q3. Indicate how many hours per week you play video games.	0-5	◯	6-10	◯	11-15	◯		
	16-20	◯	21-25	◯	More than 25	◯		
Q4. Indicate how important graphics in a game are to you.	Not at all	◯	◯	◯	◯	◯	Very much so	
Q5. Indicate how much you enjoy the RPG game genre.	Not at all	◯	◯	◯	◯	◯	Very much so	
Q6. Indicate how much you enjoy the Adventure game genre.	Not at all	◯	◯	◯	◯	◯	Very much so	
Q7. Indicate how much you enjoy playing games with characters you create versus those that are fixed.	Characters I create	◯	◯	◯	◯	◯	Characters that are fixed	
Q8. Indicate how much you feel an emotional connection to avatars that you create.	Not at all	◯	◯	◯	◯	◯	Very much so	
Q9. Indicate how much you would like to play a game where the avatar is fully based on you (looks, abilities, style of movement).	Not at all	◯	◯	◯	◯	◯	Very much so	
Q10. Indicate how well you think an avatar fully based on you would perform in a game like Tomb Raider or Skyrim.	Not at all	◯	◯	◯	◯	◯	Very much so	

B. Final Questionnaire

Q1. When I was playing with the first avatar, I lost track of the world around me.	Not at all	○	○	○	○	○	Very much so
Q2. I felt frustrated when playing with the first avatar.	Not at all	○	○	○	○	○	Very much so
Q3. I felt taxed when playing with the first avatar.	Not at all	○	○	○	○	○	Very much so
Q4. I felt in control when playing with the first avatar.	Not at all	○	○	○	○	○	Very much so
Q5. I could not do some things I wanted to do when playing with the first avatar.	Not at all	○	○	○	○	○	Very much so
Q6. I easily understood the limitations of the first avatar.	Not at all	○	○	○	○	○	Very much so
Q7. I identified with the first avatar.	Not at all	○	○	○	○	○	Very much so
Q8. Playing with the first avatar was worthwhile.	Not at all	○	○	○	○	○	Very much so
Q9. I was really drawn into the experience when playing with the first avatar.	Not at all	○	○	○	○	○	Very much so
Q10. Playing with the first avatar was fun.	Not at all	○	○	○	○	○	Very much so
Q11. When I was playing with the second avatar, I lost track of the world around me.	Not at all	○	○	○	○	○	Very much so
Q12. I felt frustrated when playing with the second avatar.	Not at all	○	○	○	○	○	Very much so
Q13. I felt taxed when playing with the second avatar.	Not at all	○	○	○	○	○	Very much so
Q14. I felt in control when playing with the second avatar.	Not at all	○	○	○	○	○	Very much so
Q15. I could not do some things I wanted to do when playing with the second avatar.	Not at all	○	○	○	○	○	Very much so
Q16. I easily understood the limitations of the second avatar.	Not at all	○	○	○	○	○	Very much so
Q17. I identified with the second avatar.	Not at all	○	○	○	○	○	Very much so
Q18. Playing with the second avatar was worthwhile.	Not at all	○	○	○	○	○	Very much so
Q19. I was really drawn into the experience when playing with the second avatar.	Not at all	○	○	○	○	○	Very much so
Q20. Playing with the second avatar was fun.	Not at all	○	○	○	○	○	Very much so

C. All subject avatars

Note: YJ30 is the avatar of the researcher.