

# Final Report

Do exercise games increase motivation to exercise?



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## **Abstract**

The overweight and obese population is rapidly increasing in the UK, causing a large strain on the NHS. In an attempt to combat this, exercise games have been created to encourage individuals to participate in a more fun and user-friendly form of exercise. There is a vast body of previous work addressing exercise games and their ability to impart weight loss, however, there is limited knowledge incorporating both quantitative and qualitative views surrounding the comparison of participating in traditional exercise and exercise games. This study builds on the current research surrounding exercise motivations and the attitudes towards exercise games to form a set of recommendations for future developers to reference when tackling the overweight and obesity issue.

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## 1.0 Introduction

The quantity of overweight adults in the UK has been steadily increasing, with obesity rates almost tripling since 1993 (Ching, 2021). This has resulted in a total of just over 60% of the UK's adult population being classified as overweight with a further 25% classified as obese in 2019 (Anon, 2019). The same statistics can be found when extracting the Welsh data for analysis (National Survey for Wales, 2020). The decline in physical activity is most likely the main factor attributing to these shocking figures (Roberts et.al (2014). It has been found that much of the UK adult population are not completing the recommended target of 30-minutes per day of moderate intensity exercise set by Public Health England. Inactivity occurs when this recommended target is not met, and stands at 33% for the general adult population in Wales; thus, placing the UK second in the world obesity rankings and first for countries in Europe.

Physical inactivity directly contributes to one in six deaths in the UK: the same number as smoking (Varney et.al, 2014). Furthermore, by becoming obese, the risk of developing many potentially serious health conditions such as type 2 diabetes, high blood pressure and high cholesterol increases rapidly. If left untreated, these conditions could lead to coronary heart disease, stroke and cancer (NHS, 2021). Alongside this, obesity has also been linked to an increased risk of cardiovascular diseases and in some cases, infertility (Wang, 2011). It therefore comes as no surprise that obesity has directly resulted in roughly 876,000 hospital admissions per year: an increase of 20% over the past 5 years. Moreover, obesity is causing an unnecessary strain on NHS services (Gillies, 2020).

The measures being taken to contain COVID-19 in the UK include social distancing, isolation, and nation-wide lockdowns (Cabinet Office, 2021). These quarantine actions have resulted in the drastic change of the entire populations daily routines. During the COVID-19 pandemic 73% of adults spent more time sitting down than before lockdown thus resulting in a 23% rise in obesity levels (Robinson et.al, 2021, Boseley, 2018). Consequently, this has caused an even larger strain on the NHS as it has been found that, up until the time of writing, 66% of COVID-19 hospitalisations were classified as overweight or obese (NHS, 2020, Hamer, 2020). However, potentially due to a lack of other activities and the promotion of exercise games, the amount of time spent exercising since before the UK's initial lockdown has increased by a small margin (Robinson et.al, 2021).

Before technology was so readily available, exercise games were unknowingly carried out as simple childhood games. Typical UK children's school playground games, such as TAG and bulldog, incorporate one form of exercise, running, into fun and simple activities. However, with the introduction of video games, the quantity of time spent outside playing these types of games has decreased over the past 50 years (Kennedy, 2018). It has been found that children now spent up to 50% less time playing outside in comparison to their parents. A United States computer company, named Atari, noticed this trend and began working on the very first computer aided exercise game in an attempt to keep individuals engaged in exercise (Maass, 2014). The Atari "Joyboard" was released in 1982 combining exercise and video games in a similar way to the current Wii Fit Balance Board. The term exergame would later be used to define a video game that incorporates rigorous physical exercise as an intended work-out.

Over the years, technology has developed rapidly and is becoming imperative to function in modern day society. Since the initial venture into exergames, there have been many companies making this critical shift to digital in order to stay competitive within the market. It was found that almost 8.7 million households in the UK had access to at least one games console in 2020; an increase of 11% from the previous year (Anon, 2020). Of these consoles, Sony PlayStation proved to be the most popular brand as it was found in the greatest number of homes (4.4 million). Xbox appeared to be the second most common boasting 3.9 million households with consoles, whereas Nintendo consoles were only found in 1.5 million households. These three console brands are the main producers for the UK and dominate the market. Collectively, they have sold over 1.5 billion consoles worldwide (Yaden, 2021).

Wii Sports was one of the first exergames developed by Nintendo created for the purpose of the launch of the Nintendo Wii in 2006 (Anon, 2021). Despite the initial success of Wii Sports, researchers quickly came to the conclusion there were limited exercise benefits to gain from playing this exergame. However, this did not deter Nintendo as their exergame Just Dance was released shortly after in 2009. This game ensured fully engaged users were properly exercising, however, it was, again, only accessible to those with a Nintendo Wii. Furthermore, due to the success of these exergames, competitors became inspired to do the same with Microsoft introducing the Xbox Kinect system and Sony announcing the launch of the Eye Camera (THFF, 2021). Since these products reached the market, the number of exercise games has increased dramatically.

Exergames have been studied in relation to health benefits including their value in aiding rehabilitation or as a means of engaging the elderly to become more active. In this regard, exercise games have proved successful (Gorsic et.al, 2017, Ferraz, 2018). However, there has been little research conducted to understand if exercise games do increase motivation towards exercise (Yim, 2007).

This study was therefore designed to expand on the current research surrounding individuals' motivations towards exercise. This was achieved by investigating individuals' motivations before and after enduring two separate exercise conditions via both quantitative and qualitative methods. Furthermore, analysis of this data enabled a set of recommendations to be produced in order to aid the future design of exergames to ensure they inspire motivation towards exercise. In turn, by encouraging the general public to exercise more frequently via a medium they prefer, this will support the combat of physical inactivity within the UK and therefore reduce the strain placed upon the NHS due to obesity.

## 2.0 Background

### 2.1 Obesity and the NHS

Knowing obesity is on the rise, the health of the worldwide population is of grave concern. Worldwide obesity has almost tripled since 1975, with more than 1.9 billion overweight and over 650 million obese in 2016 (Anon, 2020). Physical inactivity is responsible for one in six UK deaths and is estimated to cost the UK £7.4 billion annually, including £0.9 billion to the NHS alone (Anon, 2019). These costs are predicted to increase, as many individuals are unaware of the significant physical and mental health benefits that physical activity can provide. Some lesser-known benefits of regular physical activity include reducing the risk of dementia by up to 30%, hip fractures by up to 68%, breast cancer by 20% and depression by up to 30%. There have been many campaigns to encourage both healthy eating and to increase exercise, but in an ever-changing climate in which technology prevails, we must utilise its influence in order to secure a promising future.

### 2.2 COVID-19 UK Exercise Habits

Recently, technological advancements have soared due to the global pandemic COVID-19. In March 2020, the UK was forced into its first ever lockdown requiring the entire population to stay at home (Johnson, 2020). Consequently, school, work and general communications had to be completed via the internet, therefore accelerating the quantity of individuals granted access to multiple distinct technologies. With this newfound freedom and lack of responsibilities, most of the UK took this lockdown as a surprise holiday, sleeping and resting more than usual, spending an increased time gardening, and completing DIY projects alongside spending a significant amount of time watching TV and playing computer games (Vassiley, 2020). Due to this 'holiday' feeling, there have been several different findings in regard to time spent participating in physical activity or exercise.

One study conducted after the first UK lockdown had ended explored the impact that COVID-19 had on weight related behaviours (Boyland, 2020). Their results showed that the percentage of individuals exercising or being physically active were almost completely evenly spread between each amount of time from the given options. For instance, 14% of participants said they exercised less whereas 15% said they exercised more than before lockdown. This implies there may be other factors such as age or ethnicity affecting the amount of exercise or physical activity being completed.

Another study conducted around a similar time, investigated the perceived impact the COVID-19 induced lockdown had on the eating, exercise, and body image of adults within the UK (Robertson, 2020). Conversely, this study found that over 50% of participants either agreed or strongly agreed to exercising more than before lockdown. However, this study had significantly less participants than the previous, most of which were women. This therefore poses the question; does gender affect these perceptions?

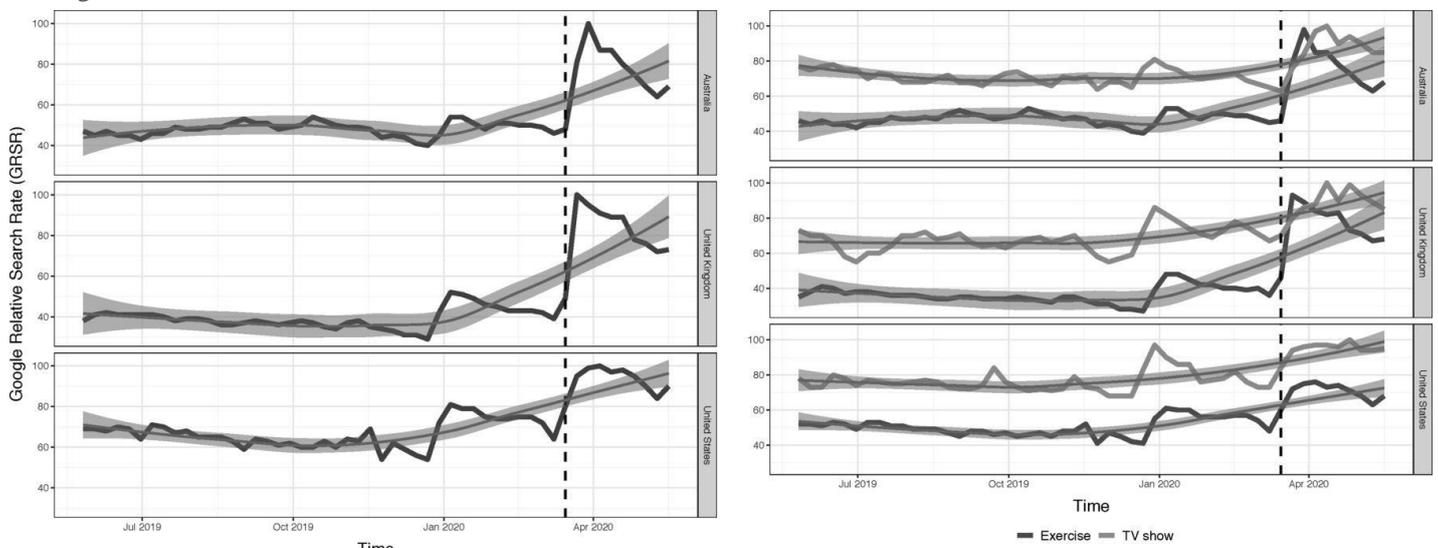
Furthermore, an additional study conducted just before the first lockdown ended, considered the moderate to vigorous aerobic physical activity (MVPA) and strength

training (MSA) from before to during the UK's first lockdown (Herbec, 2021). Their findings showed that there were a variety of responses in terms of exercise continuation. For example, they ascertained that over 45% of individuals who were active in MSA pre-COVID-19 decreased their MSA. Contrarywise, 16% of individuals who engaged in no MSA pre- COVID-19, increased their MSA. This study indicates that the quantity of exercise achieved regularly before lockdown affects the quantity of exercise achieved throughout.

Moreover, it has been noticed by Sport England that activity levels for adults had been increasing until COVID-19 restrictions were put in place with the most distinct decline (7.1%) appearing between March and May 2020 when compared to the same period of time during the previous year (Anon, 2021). These statistics have since been looked into by research fellows Hayes et.al (2021) where they proposed the changing geographies of exercise have created a large impact on an individual's frequency to exercise.

In a big data analysis, Google Trends (GT) was used to extract the Google Relative Search Rate (GRSR): normalised search data within a defined time frame and geography on a scale of 0-100, based on a topic's search proportion out of all searches (Ding, 2020). In this study, the topic 'exercise' was compared to the topic 'television show' over the period of 12-months showing the trends both before and after national lockdown within three different countries. Figure 1 clearly shows an initial surge across all three countries for exercise interest as the lockdown began, however within less than one month, this interest had peaked and already begun its decline. This trend seems to imply that individuals initially took an interest in exercising, but as the lockdown continued with no foreseeable relaxation of rules or restrictions, motivation to exercise started to dwindle and television shows began to look more compelling.

Figure 1



### 2.3 COVID-19 Screen Time Worldwide

Many reviews of behaviour during the COVID-19 pandemic have shown a rise in the amount of screen time reported worldwide. Canadian families with young children

reported an increased screen time in mothers, fathers, and children by 74%, 61%, and 87%, respectively (Carroll, 2020). Another Canadian study uncovered that both genders from all age groups increased their time spent on video games with the average increase arriving just above 21% (Colley, 2020). Likewise, a longitudinal study carried out in the US noticed 30% of university students were gaming more while 75% were watching more tv/movies (Keel, 2020). It should also be noted that over 50% of students reported participating in less physical activity. Furthermore, a study conducted in China found that the time spent looking at screens increased by almost 70%. Similar results were found in Turkey, Poland, and India with a 49%, 72% and 63% increase in screen time respectively (Sultana, 2021).

In Europe, one study was carried out across nine countries (excluding the UK) in which researchers explored the basic segments of individuals everyday lives (Pisot, 2020). Their findings concluded that 50% of participants had a longer physical inactivity time and 65% had a longer screen time during the COVID-19 pandemic as opposed to before. Further exploration by another group of research fellows established that UK citizens spent an average of 7.2 hours with a screen per day where adults aged 18-34 years spent the most time with 8.8 hours (Smith, 2020). Considering these large screen times and increased usage, it is clear the general population enjoy spending their free time using screens. With this in mind, it should be considered that screens may encourage individuals to exercise.

## **2.4 Video Games and Exercise**

Video games are so often associated with the latest technology, that it is commonly forgotten their first appearance was in the late 1940's (Bachell, 2014). The more popularised video games became, the more easily accessible they became leading to a larger quantity of individuals using them as a technique for fulfilling purpose in their lives. In recent years, the study of video games has become a serious endeavour and their legitimacy has been recognised by governments in the UK, France, Canada, and the US.

As technology has advanced, so has the quantity and quality of video games alongside the increase in cultural significance resulting in the UK leading the video game industry in Europe (Clement, 2021). In 2019, the UK industry was worth £5.35bn in sales (Anon, 2020). The trend following video games gradually increased from 2010 until it peaked in 2014 where 88% of UK adults were playing games at home or elsewhere on any device (Clement, 2021). During the period of 2014 -2017 this percentage dropped to 72% at its lowest but began to rise again throughout 2018 and 2019 to reach 78%. Despite this percentage in 2019 being lower than its original in 2014, during 2020 the UK video games market hit a record £7bn as lockdown fuelled an unprecedented boom in the popularity of mobile games, consoles and virtual reality headsets (Sweeney, 2021). During this period, one of the most popular games sold was an exercise game named Ring Fit Adventure. Based on the games physical sales alone, it made it into the UK weekly game charts for 36 weeks with 24 of these weeks bringing Ring Fit Adventure into the top 10 (Anon, 2020). Another exercise game that has been in the same charts since its release in November 2020 is Just Dance 2021. This game stayed in the charts for the rest of the year, coming in the top 10, 4 out of 6 weeks. These exercise games evidently show that not only can they encourage exercise whilst being entertaining, but also, that they are capable of competing against other non-exercise games for a chance at the top of the charts.

Video games involving an aspect of exercise have been investigated for multiple purposes in the hope that they will be able to benefit a wide range of target groups. Some example target groups include rehabilitation patients, obese children/adults, the elderly, cerebral palsy patients and physiotherapy patients. Numerous studies have been conducted in these areas with a large proportion of them finding sufficient evidence suggesting there are benefits to playing video games with elements of exercise (Smeddinck, 2019). The focus of this study, however, is to begin to understand the benefits within the general adult population.

One study was conducted over a period of 6 months in order to determine the effects of an active video game on children aged 10-14 years (Mhurchu, 2008). Their findings revealed that children given the active video game would spend significantly less of their spare time (47 minutes) playing inactive games when compared to the control group (99 minutes). Not only do these results imply the intervention group were exercising more, they also imply that the children were more likely to spend more time away from a screen.

A similar experiment, carried out again, for 6 months, focused on the weight loss of children aged 8-16 years based on their engagement with a group of several exercise games (Christison, 2011). They were also educated on healthy nutrition and psychosocial aspects of being or becoming overweight. The findings reported showed that the average weight loss was 0.19kg; an exceedingly small figure highly unlikely to have impacted the weight class of the children. It was also found that a distinct proportion of the participants did not fully complete this study potentially indicating the chosen exercise games were not captivating enough for the young audience. On the contrary, further research in the same field exhibited that overweight or obese children aged 10-14 years lost 50% of their excess body fat when spending 6 months playing an active video game (Maddison, 2012).

Another study examined the energy expenditure and heart rate response of participants while playing active video games (O'Donovan, 2012). By looking at the different sports available on the game Wii Sports, they found the highest heartrate achieved was from free jogging resulting in a maximal heart rate percentage of 71%. Free jogging appeared to be the only moderate level activity among those tested indicating that the other sports would not be sufficient in achieving the recommended 30-minutes of exercise and therefore should not be considered as an alternative to exercise. The low activity levels of the games also suggest that they would not aid effectively in weight loss and may need to be reclassified simply as video games as opposed to exercise or active games.

An additional study conducted with a group of young adults involved the participants playing 2 games on Wii Fit: one balance and one aerobic (Lyons, 2012). Their results revealed that the aerobic games produced a greater energy expenditure and would therefore lead to weight loss quicker than balance games in normal weight males, although, found no differences in overweight and female participants. Another interesting outcome presented by their results was the enjoyment level and consequent motivation to participate in the different exercise games. These results showed that aerobic games produced a lower enjoyment level than balance games. It was also revealed that games simulating exercise were completed and enjoyed far less by all participants in contrast to games that did not simulate exercise and presented themselves merely as games.

A longitudinal study conducted with children from ethnic minority backgrounds investigated the situational interest of the students during physical education activities (Sun, 2013). It was found that the students experienced a higher situational interest in all dimensions when partaking in exercise using exergames and retained these levels throughout, as opposed to exercising via a series of aerobic circuits. However, they also found that the activity levels recommended for health benefit were not met whilst using the exergames. This was supported by a follow up of the same experiment including the same students the following semester (Sun, 2013). The findings of this experiment validated the knowledge that the chosen exergames did not meet the required exercise standards for health benefits whilst also showing the students' situational interest had decreased dramatically.

Furthermore, a study comparing the different motivations that encourage participation in exercise, gaming and exergaming found that intrinsic motivation (internalised motivation from enjoyment) was the highest regulation for both playing computer games and exergaming (Osorio, 2012). It was also found that exergaming is perceived to be a social activity meaning the need for competence was the lowest across all conditions with the exercise condition having the highest levels. Nevertheless, these results may have been heavily biased as their samples for each group were selected due to their previous knowledge and enjoyment of the condition. This meant that for example, the gaming group consisted of individuals already strongly interested in and regularly playing computer games.

The first attempt to link exercise motivation literature to requirements for exercise was written in 2007 (Yim, 2007). The researchers found that there were six requirements needed for exercise games which are to integrate music, facilitate leadership for novice players, provide achievable short and long-term goals, hide player's fitness level avoid systemic barriers to grouping and actively assist players in forming groups. By following these recommendations, the exercise game *Life is a Village* was created as a multi-player computer-aided exercise game taking place within a virtual world. However, these recommendations may not be extensive and may have become outdated. It should also be noted that their exercise game was never tested with participants, so it is still unclear as to whether *Life is a Village* was a more motivating exergame than those already on the market.

Despite these collaborative interesting conclusions the previous studies have presented, for the most part, they have focused on children or young adults with very little inquiry into the general adult population. This could imply that the motives or results found may only be applied to the same sample, thus indicating they cannot be generalised to the typical adult population. The study devised and carried out as part of this research will therefore compile data on the motivations of the general adult population. By collating said data, a set of accurate recommendations can be created in order to appeal to the average UK adult. Consequently, this should encourage them to participate in exercise. In turn, this will drive down the strain on the NHS, notably important during the COVID-19 pandemic.

## 3.0 Project Scope and Justifications

### 3.1 Project Scope

The initial scope of this project was to carry out a short study with a handful of participants however, as the project progressed, this scope evolved. Originally, this study was proposed to consist of a one-week experiment in which half of the participants completed a yet to be specified exercise game whilst the other half completed an exercise video series. After conducting some background research into exercise motivations, exercise games and exercise videos, it became apparent that this method would not be suitable. To ensure the results were able to produce a more comprehensive understanding into individuals' motivations towards exercise, a repeated measures design would be desirable. This experimental design requires each participant to undergo both conditions; in this study, exercise game and exercise video series, allowing a truer comparison to be made. With this design in mind, the timeline of the study doubled.

The study provides a comprehensive set of recommendations for future developers to abide by when creating new games. These recommendations were formed from the participants thoughts and feelings whilst using their exercise game or the exercise video series presented within their daily logs and the focus group. Due to the time restrictions of this project, it was not possible to produce a prototype demonstrating these recommendations, however, this leaves room for future developers' creativity and imagination to incorporate into a new exercise game.

It is commonly understood that there are two main factors that contribute towards effective weight loss: nutrition awareness and physical activity. To fully explore both elements, this project would need a longer time frame, therefore this project will simply focus on the physical activity: specifically, technology influenced physical activity. This was decided upon due to previous research reporting that in 2019, over 20% of adults in the UK were classified as inactive (Anon, 2019). Despite the focus on physical activity within this study, it should be noted that for long-term weight loss, a combination of both nutrition awareness and physical activity has been found to produce longer-term success (Hill, 2001). Future research may benefit from considering nutrition alongside physical exercise to produce an extensive set of recommendations when considering the development of a new exercise game.

### 3.2 Justifications

The exergames presented within the screening questionnaire were selected based on their frequency among a set of five independent ranking websites (Hood, 2021, Jurkovich, 2020, Freeman-Mills, 2021, Tech Desk, 2020, Tyrer, 2020). Each game mentioned in at least three rankings was analysed by researching the total number of sales each game produced and its release date. Those with a combination of the latest release date and the highest number of sales were selected to produce the short list presented in the screening questionnaire. One exception to the latest release date was the exergame Wii Fit due to its exceedingly large number of sales. The screening questionnaire was used to determine which exergames were used in the main study by inspecting the responses. It was later determined (due to a lack of responses from potential participants to further

partake) that the exergame condition would consist of three exergames; Wii Fit, Ring Fit Adventure, and Beat Saber to allow for a larger sample size.

The exercise video series was created by the researcher following a similar process to that of the exergame selection. Six independent websites were consulted for their rankings of fitness videos to produce a short list of three video accounts (Chon, 2021, McCoy, 2020, Noble, 2020, Evans, 2020, Anon, 2020, Sassos, 2020). These accounts were chosen due to their frequency throughout the set of six rankings. Accessibility issues were addressed with the short list accounts: one account required the purchase of an app whilst the other did not satisfy the length of time required resulting in one final account. MadFit's 7 most popular 30-minute videos that didn't require equipment were combined to create the playlist used within the study.

The MPMA-R scale was selected to understand participants initial motivations towards exercise before participating in this study. This allowed comparison analysis of their previous attitudes to those after the study. The SIMS questionnaire was selected to be presented after both exercise conditions as it takes sports motivations towards a specific exercise and breaks down the motivation into the different types. The results gathered from this scale were then able to be directly compared for each participant after completing each exercise condition.

This project was based heavily on experimental research and its subsequent outcomes; therefore, the scientific approach was applied. The scientific approach involves manipulating one or more independent variables and applying them to one or more dependent variables to measure the effect the independent has on the dependent. These effects are observed and recoded over a specified period of time in order to gain an understanding allowing a rational conclusion to be made regarding the relationship between the variables. In this study, the dependent variable was the individual's motivation towards exercise, and the independent variable was the medium in which they were exercising. There were four independent variables in total; three exergames and one exercise video series. Each participant undertook two of these independent variables; one exergame and the exercise video series.

To ensure the risk of any bias was reduced, the participants were unaware of one another and could not view each other's daily log entries. The participants were also unaware of the aim of the experiment and leading questions were not used during the questionnaires nor the focus group. Furthermore, other precautions and measures were taken to avoid unnecessary bias. However, this experiment cannot be completely free of bias as to partake, the participants must already own one of the afore mentioned exercise games, instantly producing an omission bias. If this project was entitled to funding, exercise games could have been delivered to participants therefore eliminating the omission bias. This is something for future researchers to consider when conducting further analysis into exercise motivations.

## 4.0 Methods

### 4.1 Participants

Responses to an initial screening questionnaire available to Cardiff University staff and students, email connections and social media connections produced a total number of 87 responses, of which 37 left contact details. After the removal of repeat responses and those without the required games, 29 potential participants remained. 23 participants gave consent to participate in the study. Over the course of the study 1 participant dropped out for unknown reasons and another was too ill to participate after the first week bringing the final number of participants to 21 all of which were adults (Age: mean= 30, SD=13, 11 male, 10 female). 7 participants took part in a voluntary extra focus group after the completion of their 2 weeks of exercise. All participants lived in the United Kingdom (Wales= 6, England=15). The demographics of the participants can be seen visually from graphs in the appendix section 12.1 Personal Data Responses.

### 4.2 Apparatus

In order to access the stimuli within this experiment, participants were required to own one of the following exergames: Wii Fit, Beat Saber, Ring Fit Adventure. Each participant was also required to have the correct equipment to play the exergame therefore enabling full involvement. For Wii Fit, participants were required to have the Nintendo Wii with controllers, Wii Fit game and Wii Fit balance board; Beat Saber participants were required to have the PlayStation with VR and controllers, VR headset and equipment; Ring Fit Adventure participants were required to have the Nintendo Switch and controllers, Ring Fit ring and accessories. Each participant was also required to have access to a screen connected to these devices, access to the internet, YouTube, and a Google account. Due to COVID-19 restrictions, participants self-reported owning or having access to all these requirements. A link to a series of exercise videos was sent to the participants and can be found in the appendix section 12.2 Exercise Videos.

### 4.3 Materials

A series of questionnaires, 18 in total, were given to the participants over the course of the study. The initial 2 questionnaires were titled 'Personal Data' and 'Motives for Physical Exercise' and were presented at the beginning of the study before participants were exposed to the two exercise conditions. After participants had experienced each condition, they received a questionnaire titled 'The Situational Motivation Scale' which were adapted from the SIMS by Guay et. al (2000), adding another 2 questionnaires to the total. Finally, 14 questionnaires were titled 'Daily Log' and were required to be completed once per day by each participant.

The Personal Data questionnaire consisted of 9 questions and asked the participants if they were willing to disclose personal information such as their gender, age and ethnicity. The Motives for Physical Exercise questionnaire, on the other hand, was slightly longer with 31 questions and focused on what motivated each participant to exercise and was adapted from the longer MPAM-R validated by Ryan et. al (Albuquerque, 2017, Ryan, 1997).

The Situational Motivation Scale questionnaires consisted of 20 questions after experiencing the exergame condition and 21 questions after completing the exercise video condition. The extra question asked participants if they had exercised using and of MadFit's videos before. The SIMS questionnaire also contained an extra question across both conditions after the first week of exercise inviting participants to be considered to participate in the focus group with other participants to further discuss their thoughts, feelings, and experiences throughout the study. The aim of these questionnaires was to require participants to reflect on their week using their exergame and to reflect on the exercise video series.

The Daily Log questionnaires were relatively short, consisted of only 4 to 5 questions based on the participants response, and acted as a diary entry each day. The participants were required to state their participant number, the date of exercise and whether they completed their exercise that day or not. There were also options to select the time in which their exercise was completed and to leave any comments.

The focus group session consisted of 5 questions including items such as 'If you could change/improve anything about your exergame, what would it be?' and 'Which features of your exergame did you find the most encouraging/off putting?'. A full list of all the questionnaires and their ensuing questions used in this study can be found in the appendix section 12.3 Questionnaires.

#### **4.4 Design**

This study used a repeated measures experimental design meaning each participant underwent each condition. The dependent variable measured was the individual's motivation to participate in exercise and the independent variable was the medium in which the exercise was presented. The dependent variable was measured using the SIMS questionnaire with the subsequent types of motivation assessed being amotivation, intrinsic, identified regulation and external regulation. The conditions each participant experienced as their independent variables were an exergame and a series of exercise videos. The participants were all subject to the same series of exercise videos, while their exergame condition consisted of exercising with the exergame they already owned. The exergames were different based on the responses from the screening questionnaire. The order in which the participants undertook each condition was based on a counterbalanced random allocation. Participants allocated to group 1 would be completing their first week of exercise using their exergame and the second week using the series of exercise videos. Group 2 participants completed their exercise in the opposite order, using the exercise video series in their first week and the exergame in their second week.

In an attempt to control some extraneous variables, standardisation of all correspondence was upheld, and the participants were blind to one another. This meant that the participants were unaware of how many others there were taking part, which condition they were in and did not know there were participants using different exergames. In an endeavour to mitigate the investigator effects, especially within the focus group, the interviewer did not participate in the discussions, ask leading questions or give hints for suggested answers, this also helped to reduce the demand characteristics.

## 4.5 Procedure

To begin this study, the screening questionnaire was sent out via social media, to Cardiff University email addresses and other contacts of the researchers. After 1 week had elapsed, the results of this questionnaire were analysed to enable the choice of exergame to be selected. Once the second week had passed and consent had been received from all 23 participants, individual and group emails were sent out regarding participant numbers and their purpose within the study. The first of these group emails consisted of links to 2 questionnaires: Personal Data and Motives for Physical Exercise. A brief explanation about each questionnaire and an approximate time for completion was given. The individual emails followed and consisted of their individual participant number and instructions about the condition they would be completing for their first week of exercise. The instructions explained how long they were required to exercise for, which was a total of 30 minutes. Wii Fit participants were asked to incorporate their daily exercises provided by the game into this time so as not to unnecessarily exercise for longer. The instructions also contained information on what level or intensity to set their exergame at, how to locate the series of exercise videos, what to do if they miss a day of exercise and where and how to fill in their daily logs. The intensity level was set to medium for Beat Saber and Ring Fit Adventure whilst the Wii Fit would automatically choose the level depending on the ability of the user. It was stressed to participants that they were only required to exercise for 30 minutes per day, however, they could extend this time if they wished. It was also highlighted that there was no penalty for not completing their exercise on any given day. Participants were asked to follow the order of the series when exercising using the videos and if a day was missed, to just skip to the correct day's video. Full details of the correspondence and instructions given to participants can be found in the appendix section 12.4 Participant Instructions.

Each day during the first week, a reminder email was sent to each participant asking them to fill out their daily log and the link to the questionnaire. On the final day of the first week, another individual email was sent to each participant congratulating them on completing their first week alongside instructions about the next questionnaire to fill in. The participants were informed that they should complete the SIMS questionnaire whilst thinking about the exercise medium they had been using for the past week and brief instructions on the medium they would be required to use for the following week.

Reminder emails about the daily log were sent each day of the second week and those answering positively to being considered to partake in the focus group were contacted for their availability. A date was chosen, and each potential focus group participant was informed. At the end of the second week, a similar email was sent to each individual participant thanking them for their participation and how they should fill in the next SIMS questionnaire thinking about the exercise medium they had used within the second week.

The focus group interview was carried out with 7 participants (6 having used Wii Fit and 1 having used Ring Fit Adventure as their exergame) giving their views on the different exercise mediums and the session was recorded with verbal consent.

## 5.0 Results

### 5.1 Data Overview

Participants completed and returned each questionnaire on the platform Google Forms where their results were stored. This data automatically updated itself based on the responses and could be easily viewed privately by the researchers via a spreadsheet. Each questionnaire created its own spreadsheet so data could be distinguished. This was then analysed for each participant and comparisons were made. Each questionnaire brought different data meaning they were all treated differently. Initially data from participants 18 and 19 were included, however, participant 18 dropped out early on so their data was never completed and therefore instantly discarded. On the other hand, participant 19 continued to respond to their questionnaires despite being ill and bed bound. The researchers decided to discard this participants data as they were not physically able to complete the exercise and may therefore have a different view on how they think they may have felt as opposed to actually completing the different mediums of exercise.

### 5.2 Screening Questionnaire

The screening questionnaire produced a total of 87 responses, each of which self-reporting to own one of the exergames presented. The 6 exergames (compatible devices) available within the options were Ring Fit Adventure (Nintendo Switch), Zumba Burn it Up! (Nintendo Switch), Just Dance 2021 (Nintendo Switch), Fitness Boxing 2 (Nintendo Switch), Beat Saber (PS VR), and Wii Fit (Nintendo Wii). After the removal of repeat responses, it was clear most respondents (over 65%) owned Wii Fit. Ring Fit adventure was the second most popular with 12 (11%) responses, Beat Saber and Just Dance were next with 9 (8%) responses, Fitness Boxing received 3 (<3%) responses and finally Zumba Burn It Up! received 2 (<2%) responses.

Removing the responses without a name or email address to contact for further participation resulted in 37 potential participants with the following exergames shown in Table 1.

*Table 1*

	Wii Fit	Beat Saber	Fitness Boxing	Just Dance 2021	Zumba Burn It Up!	Ring Fit Adventure
<b>Number of Respondents Leaving Contact Details</b>	24	5	1	2	0	5

These individuals were contacted to obtain the 23 participants that took part in this study. The majority, 18 participants, exercised using Wii Fit. Of these participants, ten had played the game over 10 years ago, three had played over 5 years ago, another three had played over 2 years ago and the final two had played within the past year. There were 3 participants that used Ring Fit Adventure as their exergame, all of which had recently

started playing the game since December 2020. However, one participant's data was discarded resulting in the total using Ring Fit Adventure dropping to 2. Finally, the last 2 participants used Beat Saber, both of which had begun using the exergame in January 2021. However, one participant's data was discarded resulting in the total using Beat Saber dropping to 1.

### 5.3 Motives for Physical Exercise (MPAM-R)

the Motives for Physical Exercise questionnaire assessed each participant's motives towards exercise based on 5 subcategories; enjoyment- being physically active just because it is fun, makes you happy, is interesting, stimulating and enjoyable; competence/challenge- desire just to improve at an activity, meet a challenge and to acquire new skills; appearance- in order to become more physically attractive, have more defined muscles, look better and to achieve or maintain a desired weight; fitness- desire to be physically healthy, strong and energetic; social- in order to be with friends and meet new people. The subcategory totals were calculated to find the mean for each question, standard deviation, and 95% confidence interval for the sample. These can be seen in Table 2.

Table 2

Motivation Subgroup	Mean	SD	CI (95%)
Enjoyment	4.51	1.63	[4.25, 4.77]
Competence/Challenge	4.58	1.79	[4.30, 4.87]
Appearance	5.25	1.82	[4.94, 5.56]
Fitness	5.78	1.43	[5.51, 6.05]
Social	3.44	1.92	[3.08, 3.80]

The sample population captured within this study showed a high fitness motivation towards exercise with a mean Likert score of 5.78 out of a maximum score of 7. Despite its standard deviation being the lowest out of all motivation subgroups, it is still considered high as its value exceeds 1. Fitness motivation was closely followed by appearance motivation (5.25) whilst social motivation (3.44) was found to be the least motivating subgroup.

Women were found to have a much higher mean Likert value of social motivation (4.20) towards exercise when compared to men (2.67). Similarly, the women's appearance motivation was higher (5.82) than the men's (4.6). Their mean Likert values for fitness, enjoyment, and competence/challenge motivations, however, were almost the same. It was also found that participants aged 30 or over had a marginally higher Likert score for enjoyment (4.69), competence/challenge (4.78) and social (3.57) motivations compared to the participants aged under 30 who's Likert scores were 4.43, 4.50 and 3.37 respectively. The participants aged 30 and over had a higher fitness motivation (6.09) than those under 30 (5.64) however, their appearance motivations were almost identical (5.24 and 5.26 respectively).

## 5.4 Daily Log Entries

Participants declared their daily exercise completion through the self-reported daily log. Table 3 presents the mean, standard deviation and 95% confidence interval for the number of days exercised when using the exergame and using the exercise video. Table 4 presents the breakdown of Table 3 into the mean, standard deviation and confidence intervals for weeks 1 and 2.

Table 3

	<b>Exergame</b>	<b>Exercise Video</b>
<b>Mean</b>	6.19	3.67
<b>SD</b>	0.66	1.61
<b>CI (95%)</b>	[5.91, 6.47]	[2.98, 4.36]

Table 4

	<b>Exergame Week 1</b>	<b>Exergame Week 2</b>	<b>Exercise Video Week 1</b>	<b>Exercise Video Week 2</b>
<b>Mean</b>	6.36	6.00	3.80	3.55
<b>SD</b>	0.48	0.77	1.83	1.37
<b>CI (95%)</b>	[6.08, 6.65]	[5.52, 6.48]	[2.66, 4.94]	[2.73, 4.36]

The mean number of days participants completed exercise was higher when using the exergame as opposed to using the exercise video when both combined and separated. It can also be seen that there was a decrease in exercise in the second week over both conditions. Overall, 0% completed all 14 days of exercise, however, just over 33% (7) completed all days of the exergame whereas only 4.8% (1) of participants completed all days of the exercise video.

A paired *t*-test was carried out on the combined totals of each exercise condition to test whether the number of days completed during the exergame week compared to the number days completed during the exercise video week was significant. Their effect size was calculated using Cohen's *d* with the correction factor for sample sizes under 50 applied. Paired *t*-test results (df=20) produced a *p* value of <.0001 (*t*= 6.54) indicating there was a significant difference between the number of days exercise was completed when using the exergame as opposed to the exercise video. The Cohen's *d* value for this data was just over 1.83 meaning the effect size was exceptionally large. The mean number of days completing exercise with the exergame was almost double the mean number of days completed when using the exercise video series (mean difference= 2.52). Figure 2 shows the mean values for each condition and their error bars.

Average Number of Days Completed During Each Condition

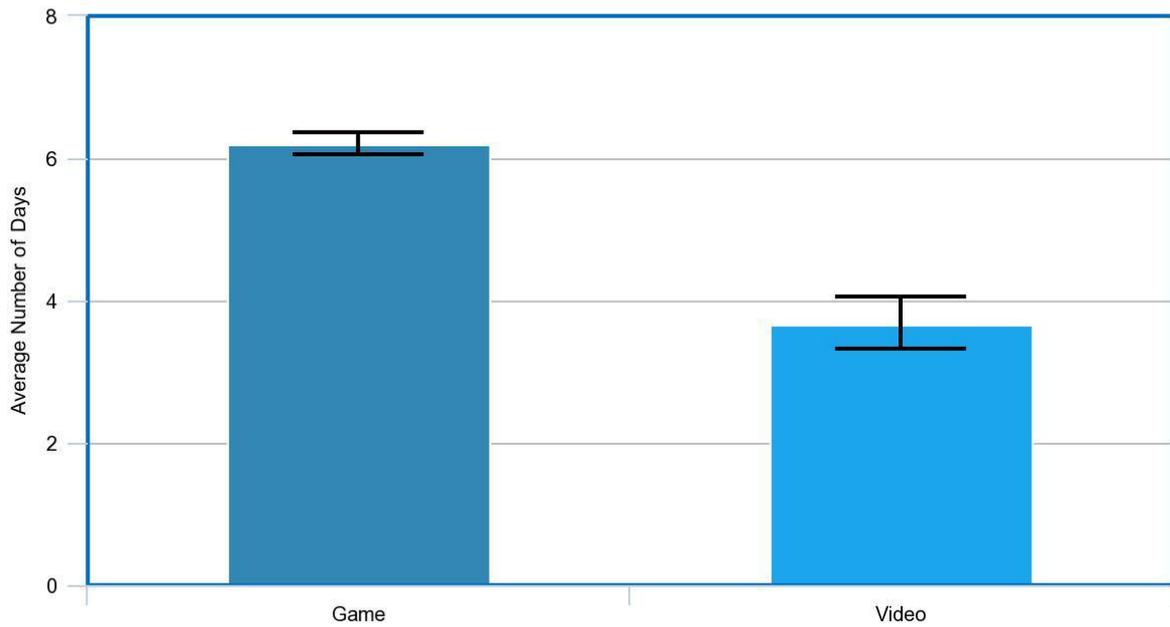


Figure 2 Bars showing the mean number of days completed during each condition with error bars

Of the day's participants completed their designated exercised, they were required to select the hour in which they exercised. Most participants completed their exercise in the morning (before 12pm) or in the evening (after 5pm) totalling 182 (86%) occurrences throughout the course of the study. During these busy periods, an almost bell-shaped curve appeared indicating the data could be normally distributed, with 10am and 6pm seemingly the peak of each curve. These peak times totalled 32 and 34 occurrences respectively throughout the study. Figure 3 presents the data visually.

Figure 3



As this study was carried out remotely, participants were also able to leave comments each day about their exercise medium or anything they believed to be relevant. Table 5 shows some an exhaustive list of all comments made from each condition.

Table 5

Exercise Video	Exercise Game
"It assumed a level of balance/flexibility and coordination I don't have"	"It was Easter"
"Expects a lot of flexibility"	"It was Easter Day, ate chocolate instead!"
"Completed 2 rounds of 3"	"Had to sort out wii fit-hadn't been used in a while and needed new batteries"
"Very fast pace!"	"31 minutes banked but took far longer to go through exercises"
"Rested during two exercises but did the rest."	"Connected to TV- harder to find time to do this"
"I went for a run instead as the weather was nice"	"Getting in early today as covid vaccination later"
"Went for a run instead"	"Arm sore after covid jab and tired- hopefully tomorrow"
"Too hard, too fast"	"Saw the family for Easter"
"Body not flexible enough to feel that I'm benefiting from some of the exercises. Need a beginners course."	"Ate lots of chocolate with the family"
"Again expects a certain flexibility that I don't have"	"My body was in so much pain from the day before, however I did complete some skipping"
"And this is supposed to be fun?!"	
"Only did about 20 minutes"	
"Better session today"	
"You over estimate my flexibility"	
"Didn't complete because of muscle fatigue from working out over the weekend"	
"In preparation for chocolate"	

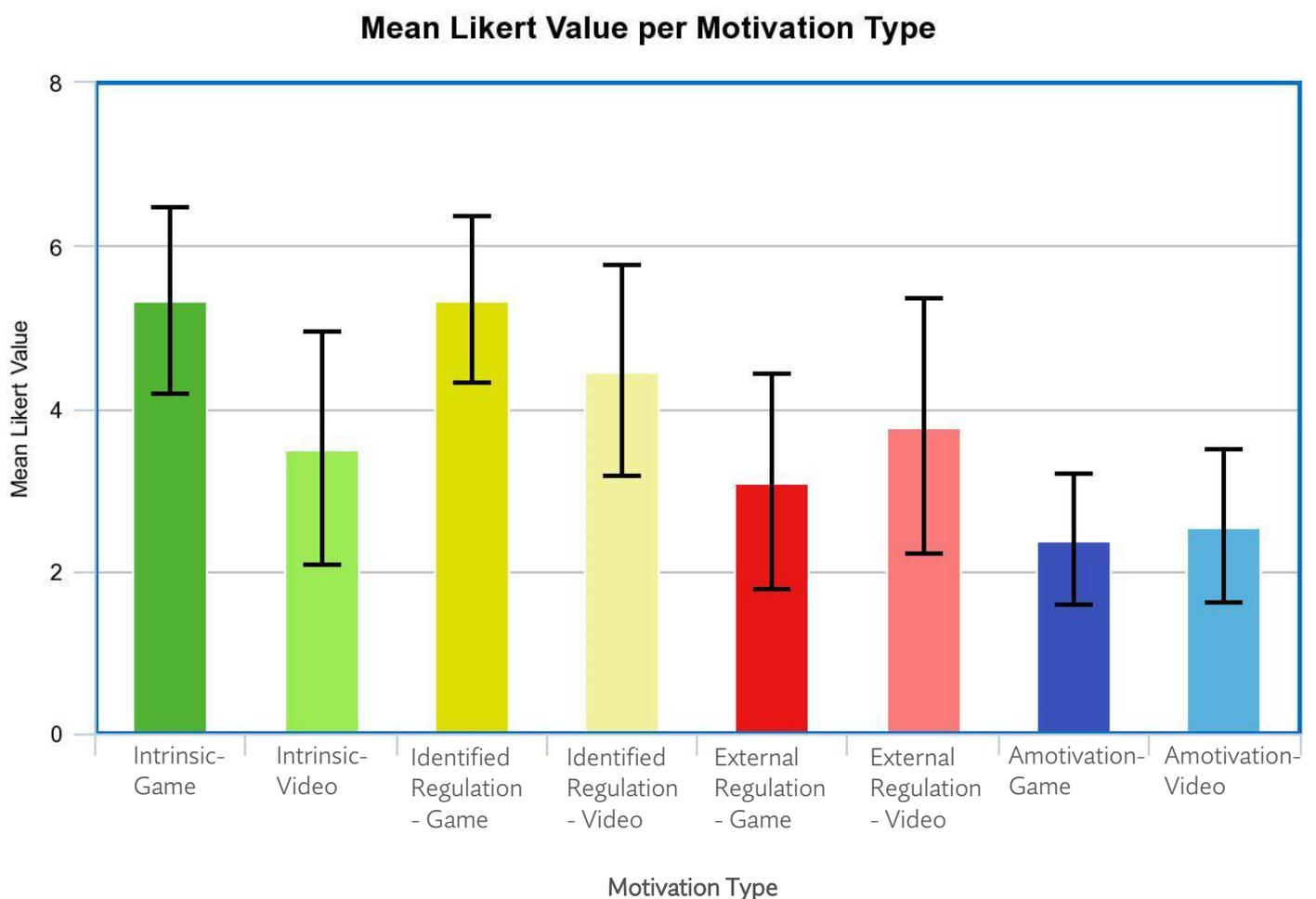
### 5.5 Situational Motivation Scale (SIMS)

The Situational Motivation Scale was used to show there was a significant increase in internal (intrinsic and identified regulation) motivations from the exercise video series to the exergame condition. It was also found that exergames have a moderate effect size on these internal motivations.

To calculate these values, the SIMS questionnaire was completed twice by each participant; once at the end of their first week and once at the end of their second. This questionnaire assessed which type of motivation kept participants exercising throughout each condition by considering four forms of motivation: intrinsic- the act of doing something without any obvious external rewards. It is done because it is enjoyable and interesting rather than because of an outside incentive or pressure to do it; identified

regulation- internal motivation based on conscious values personally important to an individual; external regulation- external motivation driven by self-control efforts to protect ego. Motivated by rewards and punishments; amotivation- external regulation exclusively regulated by compliance, conformity, external rewards, and punishments. The motivation type's totals were calculated to find the mean Likert score (M), and standard deviation (SD) for the sample throughout the entire study during both the exergame and exercise video weeks. Exergame motivation statistics: intrinsic motivation M= 5.32, SD= 1.54; identified regulation motivation M= 5.33, SD= 1.30; external regulation motivation M= 3.08, SD= 1.88; amotivation M= 2.37, SD= 1.40. Exercise video series motivation statistics: intrinsic motivation M= 3.49, SD= 1.76; identified regulation motivation M= 4.45, SD= 1.69; external regulation motivation M= 3.77, SD= 2.07; amotivation M= 2.54, SD= 1.36. Figure 4 shows the mean Likert value for each motivation type and their corresponding error bars.

Figure 4



Intrinsic motivation and identified regulation had almost the same impact (according to the mean values) on participants' motivation towards exercising when using the exergame however, these values both decreased when using the video. The biggest difference in mean was the intrinsic motivation from the exergame to the exercise video, decreasing by

almost 2 points on the Likert scale. The mean values for external regulation and amotivation, on the other hand, both increased from the exergame to the exercise video series.

A paired *t*-test (*df*=20) was computed for each condition across each motivation type; intrinsic motivation (*t*= 4.81, *p*= .0001, mean difference= 1.83) the Likert score for each type of intrinsic motivation question was on average 1.83 times higher when considering the exergame condition as opposed to the exercise video series condition; identified regulation (*t*= 3.17, *p*= .0048, mean difference= 0.88) the Likert score for each type of identified regulation motivation question was on average 0.88 times higher when considering the exergame condition as opposed to the exercise video series condition; external regulation (*t*= 1.58, *p*= .1307, mean difference= 0.69) the Likert score for each type of external regulation motivation question was on average 0.69 times lower when considering the exergame condition as opposed to the exercise video series condition; amotivation (*t*= 0.50, *p*= .4993, mean difference= 0.17) the Likert score for each type of amotivation question was on average 0.17 times lower when considering the exergame condition as opposed to the exercise video series condition.

Cohen's *d* values were calculated with the correction for sample sizes under 50 applied. The effect that exergames have on intrinsic motivation is large (*d*= 1.15) and a medium effect size can be found from exergames on identified regulation motivation (*d*= 0.62). On the contrary, the effect size that exergames had on the motivation types external regulation and amotivation, is small to negligible (*d*= 0.31 and *d*= 0.19 respectively).

For those participants that did not wish to take part in the focus group, an option to leave any comments about the exergame or the exercise video series conditions they believed to be of significance to them was available at the end of each SIMS questionnaire. The general feedback from the comments included remarks such as Participant 20- "Felt more in control of the pace I went [during the exergame] and was generally more engaged"; Participant 12- "Great incentive to exercise... adjustable difficulty makes coming back to the [exergame] easier"; Participant 4 "I most like how I felt when [the exercise video] was over!". An extensive list of all comments can be found in the appendix section 12.5 SIMS Responses.

## 5.6 Focus Group

The focus group consisted of a series of 5 questions aimed at understanding what the participants enjoyed or did not enjoy about the different exercise conditions. The key point that was raised during the focus group mentioned the physical size of the games consoles as being an issue effecting usability. A thematic analysis was conducted by the researcher by first obtaining the transcript from the focus group. The app Taguette was used to edit the transcript by creating different tags to represent different thoughts, feelings, or topics. Once the transcript had been successfully tagged, these tags were then analysed for their underlying theme. Common themes were collated to form the final set of 7 themes: visibly/feeling a benefit from exercise- being able to feel muscle fatigue or visibly seeing a game score improve; competition; collaboration; technology age and evolution- how technology has changed over time; enjoyment; suitability; feedback- from the exercise medium; control.

Visibly/feeling a benefit from exercise was the most commonly mentioned theme by 5 of the 7 participants throughout the focus group. Over 10 separate comments were made about this theme with the verdict from the participants being that the exercise video series made their muscles more fatigued the following day, they became more out of breath, and produced a more considerable amount of sweat as opposed to the exergame. Participant 9 stated “[after completing the exercise video] I felt like I'd actually like had a proper workout.” This was common among both the Wii Fit and Ring Fit Adventure participants. However, the participants did not see this benefit as a positive one as they believed a benefit must include some element of enjoyment which was not found whilst exercising using the video series. Furthermore, participants felt they gained no visible benefits from the exercise video series whereas they were inundated with visual benefits whilst using their exergame. Again, Participant 9 said, “[the exergame] gives you that tangible evidence that you've done something good.” They believed they gained a sense of achievement from receiving a virtual reward from their exergame and clear growth could be seen from their improved score. Despite this sense of achievement, participants felt that the lack of muscle fatigue and sweat meant that there may be more exercise or health benefits from the exercise video series.

Another commonly mentioned theme was feedback. The participants all stated that they received no feedback at all from the exercise video series as it was not a live session whereas they all received many different types of feedback from their exergame. Participant 1 simply stated, “There was no like feedback from the video, because it's just a video!”. The various types of feedback in the exergame condition included the participant's score, the time taken to complete a section or activity, as well as verbal praise or encouragement containing phrases such as “Well Done!”, “Good Job!”, and “Keep Going”. The participants felt they were able to understand how they had performed when given feedback from their exergame which they stated meant they felt good about themselves and therefore encouraged them to continue. They also mentioned that their feedback also gave them hints or tips on how to improve which enabled the participants to focus on their weaker areas. However, some participants raised an issue with the Wii Fit exergame, stating despite their continued play on a specific mini game, the same feedback would be given meaning it felt repetitive and redundant. Moreover, Participant 10 felt that there was sometimes too much feedback given from the Wii Fit exergame and believed they would benefit more from having slightly less. “[I] found it annoying at times, the fact that [the exergame] had to give me feedback every time before I could sort of move on.”. On the other hand, participants were disheartened by the exercise videos as they were uncertain about their performance due to the lack of feedback. Participant 4 mentioned, “I had no idea if I was doing the exercises correctly.” whilst talking about the exercise video series. They believed this discouraged them from participating on some days as they did not know if they were completing the exercises correctly or know what or how to improve on them.

Suitability was found to have a large impact on the participants as they would regularly circle back to this theme bringing the total number of comments in excess of 12. The focus group contained the same age range as the study including both the youngest and oldest participants and they all agreed that the exercise video series was not suitable for all ages or abilities. It was mentioned that there were no options to select an easier

exercise if the one shown wasn't achievable, meaning the participants became demotivated when they were not able to complete the exercise. Participant 5 commented "At my age, no way am I able to do that sort of physical exercise... I'm not going to get any better so I'm going to stop" talking about the exercise video series and was later supported by Participant 17 when he stated, "You were in pain from day one, so then on day two, you were less motivated." again in reference to the exercise video series. The high level of flexibility required for the exercise video was also mentioned throughout, even by participants, who believed themselves to be quite flexible, struggled with some of the exercises. Participant 4 stated, "I used to be into yoga, so I found I was surprised that I found it so difficult.". The exercise videos also required a level of coordination that the older participants considered to be more of an issue than the younger participants. Despite this, one older participant (Participant 10) in particular thought they would not engage with the exercise video series, however found themselves surprisingly connected to them. She stated, "I did engage with doing an online session, which I wasn't sure I could.". Overall, the participants felt the Wii Fit exergame was more suitable for all ages and abilities as there were different game options to choose from meaning the experience could be tailored to the user.

Another theme which emerged from the focus group was the enjoyment levels participants claimed to have whilst participating within the different exercise conditions. When exercising using the exercise video series, most participants stated that they did not enjoy it, in fact, it not only felt like a tedious task, but it also brought them physical pain (muscle fatigue) discouraging them from partaking. Participant 4 exclaimed, "There was no benefit apart from the pain!". On the contrary, when participants were using their specific exergame, each individual claimed to enjoy exercising each day. However, one participant gave an example of one of the games incorporated within Wii Fit being a running game that they did not enjoy. This involved free jogging around a simulated park or outdoor area for a set amount of time. Participant 1 commented "I might as well just actually to go outside and do it a normal run.". Participant 9 verified this belief by saying "I like to be able to actually feel like I'm playing a game as opposed to doing "real" exercise."

Control appeared to be a theme each participant had something to comment on. Most participants liked the fact they could control the level or intensity of their exergame as well as how fast or slowly each exercise was completed. They believed this enabled them to have more control over their exercise routine and it could therefore become their own territory. Participant 12 remarked, "I felt like I was much more in my own kind of territory." whilst playing the exergame. On the other hand, participants felt completely out of control with the exercise video series as they could not control the speed of the exercises, the level or intensity. This meant participants wanted to give up on the video regardless of whether they had just started it or were nearing the end each day. However, the participants also stated that they enjoyed not having to travel to exercise, for example, by going to an exercise class, as each exercise condition could be completed from home. In this way, they also felt more freedom over when they completed their exercise and felt safe that there was no judgement from others. Participant 5 mentioned, "The beauty of the two different forms of exercise, is that they can both be done in your own home at your own time and there was no cost.". These feelings were applicable to both exercise conditions.

The competition and collaboration themes were commonly mentioned together as participants wanting increased competition also wanted to be able to collaborate with friends to increase their own scores or rankings. Participant 17 mentioned, "If there was some way of opening it up to your friends as well, then you could, maybe see your friends scores and then you could try and beat them. And that adds an element of competition to the game or, the video that way so you're competing against people you actually know instead of the avatar on the game." Participants felt that they were motivated by their own personal best scores as part of the Wii Fit exergame and would continue playing the games to increase their ranking or score to reach the top of the leader board. Participant 5 stated, "You can see whether you have improved, or you have not improved and [the exergame] makes you want to beat that score." They were also able to view others within the same house's scores and those gave the participants encouragement to score higher than their families or housemates. There was also a competitive element with the Wii Fit age, as participants were working towards bringing this age down to their current age or below. The participants exercising with the Ring Fit Adventure exergame enjoyed the competitive nature of the game in which they had to beat the next boss or level. Participants stated that they would specifically play well past the designated 30 minutes to complete this. Participant 12 stated, "I actually spent a lot more time [exercising] just because of the fact that it was a game." However, there was no competitive element included within the exercise video series which participants generally found less enticing. The collaboration was strongly sought after with both exergames however, some participants, would call their friends (non-participants) in order to complete their exercise together, bringing in an element of cooperation. Participants that did this stated they were more likely to exercise when collaborating with others to not let anyone down.

Finally, the last theme mentioned was the age of the technology. The Wii Fit exergame is over 10 years old which means that its technology and features are highly outdated and therefore displays a lower quality of graphics than those expected to be seen today. The participants commented on how accurate features such as the Wii Fit Age could be, as they are based on the research and data available in the past. They also mentioned how there were certain aspects of the Wii Fit that would most probably not be approved if the exergame were made today such as the minimal choice of trainers (male or female) and the fact that both are slim white characters. Participant 10 mentioned, "I do remember thinking at the time [of selecting a trainer] that these days you wouldn't get away with just the fact there were two white trainers." However, those that knew of Ring Fit Adventure commented that the exergame is more up to date and therefore has a higher quality display. One other comment participants had about the age of technology was its size. They stated that the Wii Fit is a sturdy device and is therefore not portable, however in comparison to the latest games console on the market, the PS5, it is still regarded as slim and petit. They commented on the Nintendo Switch, required for Ring Fit Adventure, being smaller still, requiring only a small handheld device. However, the participants made a point that despite the physical size of the games consoles, neither Ring Fit Adventure nor Wii Fit can be played anywhere at any time, whereas if the user has a screen and an internet connection, the exercise video series can be completed anywhere. Participant 9 stated, "I think that the fact you can't just take [the exergame] anywhere is slightly off putting because it means I can't just do it when and where I want to, like at my friends or something. It has to be plugged in and that can take longer to do."

## 6.0 Recommendations

By conducting this investigation, a set of 7 recommendations has been formed based on both the quantitative and qualitative data collected from participants. These recommendations should be consulted when designing a new exergame to encourage the highest number of people to engage with the game both initially and after a prolonged use due to an increased intrinsic motivation. There are also some considerations named at the end of this section that do not form a part of the recommendations, however, these should be consulted during the design process for new exergames focusing on external regulation motivation.

### 6.1 Competition

Competition is a type of social motivation and should always be considered as an integrated feature when developing an exergame. Whether this comes from competing against one's own score (as in Wii Fit), against a computer 'villain' (as in Ring Fit Adventure), against friends and family, or on a global leader board (both as suggested by participants with knowledge from other games they have enjoyed). Participants regularly spoke about the enjoyment and motivation they received from competing against others whilst mentioning they found the more people they could compete against, the more motivated they became. These beliefs are supported by previous research in which competitive sporting and musical participants showed increased levels of intrinsic motivation when exposed to competition (Frederick-Recascino, 2003, Eisenberg, 2011).

### 6.2 Collaboration

Similarly, collaboration is another type of social motivation meaning participants believed they were more motivated when connected with others. This could be via a chat functionality, having players compete together to achieve a common goal, or simply the ability to play the same game at the same time. One study proved that working as a team increases the effort levels individuals pour into an activity, corroborating the participants beliefs (Le Bouc, 2013). When individuals feel like they are not alone and are working together as part of a team, motivation increases, and they are 64% more likely to persist with a task or activity (Gaskell, 2014). By incorporating collaboration into exergames, it should therefore be more likely that players will not only increase their motivation to exercise in the short term, but also in the long term.

### 6.3 Feedback

Feedback is known to increase intrinsic motivation as it satisfies competence and autonomy needs (Burgers, 2015). Negative feedback motivates individuals to repair poor short-term performances while positive feedback is more powerful in fostering long-term motivation and play. Participants were aware of their own motivations increasing when receiving feedback regardless of whether they are being congratulated, encouraged, or given suggested improvements during their exercise. However, the participants did mention that sometimes too much feedback was given which was both irritating and demerited the other feedback they had been given. This can be called feedback fatigue and occurs when an individual receives an overload of negative feedback (Lipkin, 2017). This can cause them to feel emotionally depleted, disengaged and most alarmingly,

immune to positive feedback. Feedback fatigue needs to be highly considered when implementing feedback within an exergame as too much can cause the opposite effect to the one intended and result in amotivation from the player.

Moreover, too much positive feedback can also cause the player to become confused, slow down the pace of their work and again, lead to amotivation (Anon, 2020). It is therefore recommended that future developers use a reduced amount of negative feedback to maintain enthusiasm, however, still incorporate a small amount to ensure an unrealistic view is not assumed as well as increasing individuals immediate play (Burgers, 2015). Positive feedback should be given in a ratio of at least three positive comments to one negative comment in order to achieve high levels of intrinsic motivation and feelings of competence (Reh, 2018, Vallerand, 1988). It should also be noted that future exergames should incorporate different areas to present feedback in. Exergames should not only focus on, for example, performance feedback or posture feedback, but rather a combination in order to better inform the player of their strengths and weaknesses and therefore foster long-term motivation (Jones, 2018).

#### **6.4 Enjoyment**

Enjoyment is a crucial element in the design for any game as consumers need to have fun playing the game to encourage them to continue playing. In previous research it has been found that different types of exergame are more enjoyable than others (Lyons, 2012). It was proved that balance games were rated as more enjoyable than aerobic games. Furthermore, it was found that games presenting themselves simply as games (game-themed games), are more likely to produce higher levels of intrinsic motivation as opposed to simulating a form of “real” exercise (exercise-themed games). This was corroborated within the focus group conducted as part of this study as Participant 5 explicitly stated, “I prefer my [exercise] games to be themed like a game instead of simply simulating exercise.” It is therefore strongly recommended to future exergame developers that they do not focus on making a ‘real feel’ exergame and instead focus more on incorporating exercise into a game situation.

#### **6.5 Control**

The general public often feel a loss of control at some point during their daily lives which is why ensuring environments experienced whilst gaming allowing the user to feel a sense of control and therefore safety are crucial (Toprac, 2013). This feeling of control is one of the most important psychological needs which is why it is a requirement for future exergames to fulfil players subconscious needs. The participants vocalised their thoughts surrounding control or, occasionally, having a lack of, when enduring each exercise condition during the study. Some of the comments they made were in reference to the intensity, speed, flexibility, and suitability of the games and how this made them feel. Flexibility was mentioned across the focus group and throughout the daily log and SIMS comment sections therefore continually highlighting the need for control. They believed that to further encourage them to participate in exergames, they would need to be able to set these different aspects of the game allowing them to tailor their experience. They made suggestions such as being able to set the intensity level, not only when beginning the game for the first time but having the option to change it easily within the settings at

any time without losing current progress. Other suggestions included being able to change the speed in which exercises are presented to them and by whom; the option to personalise their own character, for instance with different skins; the option to choose which (mini) game to play, at what time during the main game and for how long. Moreover, it was mentioned by participants that they would like a fully comprehensive tutorial, especially when the technology is new, or the participant is older, so they feel control over the game rather than being uncertain leading to the feeling of control lost to the game or console.

## **6.6 Exercise Intensity**

The metabolic equivalent units (MET) for physical training are as follows: activities in the 1-4 METs range are of low intensity and therefore are not suitable for cardiorespiratory fitness; 5-8 METs indicates a more moderate intensity, the ideal intensity for elderly or sedentary individuals; activities requiring an energy expenditure of more than 8 METs are considered to be of a high intensity and therefore the best for exercise (Jette, 1990). The common problem with current exergames is that it is rare for them to induce a high intensity MET value. This means that, despite the fitness intentions, users are not expending the ideal amount of energy for exercise. This is likely due to a lack of space available indoors for majority of players to move around in and therefore a lack of movement is required in order to compensate for this. This results in a decreased heart rate for players in comparison to traditional exercise. For example, playing tennis outdoors on a court requires players to continually run across the court, using full body motions to ensure the ball returns to the other side of the court. However, when playing tennis via an exergame, players are simply required to move their wrist, therefore not requiring full body movements, resulting in a decreased heartrate. This was highlighted within the focus group as participants mentioned feeling as though they were not getting the intended exercise benefits from their exergame, especially when compared to other forms of exercise, and the exercise video series. They noted a significant decrease in the amount of sweat produced when using the exergames. However, Ring Fit Adventure participants claimed to have experienced muscle fatigue from their exergame indicating there were some exercise benefits. Wii Fit has been found to have an average MET value between 1.90 and 4.45 depending on the mini game completed (Lyons, 2012). These values show that the maximum energy expenditure is still considered to be of a low intensity and therefore have minimal fitness benefits. It is therefore imperative for future exergame developers to ensure the MET values for the players will be at least above 5, with an ideal MET value above 8.

## **6.7 Music**

The final recommendation for future development of exergames is to incorporate music. Music has been found to increase the motivation of individuals as they are able to engage better and therefore enjoy exercise more (Wininger, 2003). Furthermore, music has been proved to have more of an impact on exercise motivation than instructor satisfaction and exercise role-identity. It is important to note that upbeat music significantly decreases feelings of anger, fatigue and depression as well as leading to a higher positive mood state, in comparison to slower music (Edworthy, 2007, Lee, 1987). Participants within the focus group stated that "On some days, the music she used [in the exercise video] was the

only thing that kept me going!”. This supports the previous research that music does effect motivation towards exercise. It would therefore be advantageous to incorporate upbeat, high tempo music to create a successful exergame.

## 6.8 Considerations

Other elements and features that would be highly beneficial to incorporate into the creation of a new exergame, however, are not included within the 7 key recommendations, encompass external regulation motivation. These were not included within the recommendations due to the type of motivation they encourage. By taking away enjoyment to replace it with something material, players may begin to lose interest in the game over an extended period of time. Previous research has suggested that intrinsic motivation is most critical to gaming behaviour, even with regards to non-entertainment games (Burgers, 2015). Moreover, they found no significant effect of extrinsic motivations on desire to play the game presented in their study immediately or in the future. This was further supported by researchers reporting that when intrinsic motivation is high, extrinsic rewards either do not affect or enhance intrinsic motivation (Arnold, 1976).

However, participants during the focus group mentioned they would potentially like to see an exergame with virtual, physical or financial rewards or incentives. With regards to virtual rewards, these could be in the form of skins for avatars, an extended time limit or trophies that can be shared externally. One study found that incentivising players with extra time to defeat a boss character in an exercise game increased the amount of time they were performing physical activity (Berkovsky, 2010).

Physical rewards extend beyond the gaming world and have an impact on the world around us. Suggestions surrounding physical rewards from the focus group participants included after playing a set series or after playing for a specific length of time, a physical reward would be granted such as a tree being planted, materials for a homeless shelter being sourced or a meal being given to someone in need. Participant 9 stated, “If there was some way of creating an ecological reward... if you complete 15 minutes or so it plants a tree for you.”. There are many psychological reasons behind why people want to give and offer help to others less fortunate than themselves, however research has shown that a strong motivation comes from accruing a social benefit (Rolland, 2019). By building these features into an exergame, players may be more motivated not only to improve themselves but to also assist others.

Lastly, financial rewards were suggested by the participants as a means of encouraging those with lower incomes to participate in exercise. The type of financial rewards proposed were vouchers for discounts at certain stores or for specific products. Not only would this create sponsoring for the exergame to be produced from companies due to advertising, it would also be an opportunity to encourage players to consider their nutrition, especially if the vouchers were aimed at healthy food or drinks. One study concluded that financial rewards were ranked as the top influential factor in creating motivation as opposed to many different non-financial rewards (Yousaf, 2014). It has also been found that in the UK the lower the socio-economic position of an individual, the more their inactivity increases (Anon, 2014). Therefore, this means that this group of

individuals are more likely to be overweight or obese as they cannot afford to do physical activities such as joining a sports club or the gym. If a new exergame was offering financial rewards, this group of people may be able to access exercise in a way that was not possible before, encouraging them to participate in exercise and therefore resulting in weight loss. In turn, this would reduce the total number of overweight and obese individuals and consequently, the strain on the NHS achieving one of the long-term goals of this study.

## 7.0 Discussion

This study investigated the difference in exercise motivation levels whilst exercising using an exergame and an exercise video series. A significant increase in intrinsic and identified regulation motivations was found when participants exercised using their exergame as opposed to the exercise video series. On the contrary, it was found that there was very little difference in external motivation or amotivation across both conditions. On the whole, participants exercised more during their week using their exergame whether this was the number of days exercised or exercising for longer than the required amount of time when compared to their week using the exercise video series.

The levels of intrinsic and identified regulation motivations reported in this study are contrary to predictions and those found in previous work (Osorio, 2012). It was assumed that participants would increase their external motivations whilst using the exergame due to the rewards and punishments, however the internal motivations showed the largest increase. This implies that the hypothesis is correct, exercise games do increase motivation to exercise, however, participants became more motivated due to the enjoyment of playing the game rather than to simply receive a reward.

A previous exploration into exercise motivations considering the use of exergames reported median intrinsic values of 5.33 and 5.67, when using an exergame and exercising without, respectively (Osorio, 2012). This contradicts the median intrinsic values found in this sample of 5.50 and 3.50 for the exergame and exercise video conditions respectively. These results may differ due to methodology. In this study, participants were able to experience both exercise conditions whereas the previous research took current users from each condition and analysed them separately. Furthermore, the participants in this study all showed high levels of fitness motivation prior to the exercise conditions being experienced indicating they already possessed a strong intrinsic motivation towards exercise. This begins to explain the high intrinsic values found for the exergame; however, it is unclear whether this had an effect on the exercise video series. During the focus group, participants mentioned that despite the obvious physical benefits they were gaining from the exercise video series, they believed this benefit did not outweigh the lack of enjoyment (intrinsic motivation) they were experiencing due to the difficulty and flexibility issues. This may also explain the difference in the median intrinsic values found both within the study and compared to the previous study. Moreover, it has been found that overweight women's intrinsic motivation decreases as exercise intensity increases (Ekkekakis, 2005). Neither study considered the weight class of the participants which therefore may be another contributing factor in the intrinsic motivation value difference.

Focus group participants stated that to visibly see or feel a benefit from exercise they must not only have their heart rate raised or become out of breath, but they must also have to encounter some form of enjoyment. Past research has shown that playing exergames increases positive emotions more than traditional exercise after completing a workout meaning individuals are more likely to experience both types of benefit mentioned by the participants within this study (Li, 2017). Physical activity stimulates the release of endorphins, boosting individual's mood after completion, however, sometimes when pushed too far during exercise, this neurotransmitter becomes lost amongst others (Legg, 2017, Klosowski, 2013). These findings were corroborated within this study.

Participants were able to feel and see the difference in the way their body reacted physically to each of the conditions experienced, clearly showing more exertion from the exercise video series. With this evident exercise benefit being presented to participants, and considering the endorphins post exercise, in theory, they should have scored higher levels of intrinsic motivation for the exercise video series. However, individuals often push past their intrinsic range when beginning new activities which can lead to amotivation and therefore result in the termination of exercise (Wang, 2013). This research supports the findings in this study and offers an explanation for the low intrinsic motivation scores gathered and smaller number of days of exercise completed during the exercise video series condition. Consequently, it is critical to ensure future exergames allow the user to modify the intensity of the exercise they are experiencing in order to keep individuals within their intrinsic range. This will therefore result in the element of enjoyment alongside the exercise benefits, keeping individuals motivated towards exercise.

Interestingly, the mean Likert scores for external regulation motivation were lower than expected. This is likely due to the lack of feedback received from each condition and it was mentioned by participants during the focus group. Previous research has found that receiving feedback increased the mood and performance of participants as well as their motivation towards exercise (Wilson, 2017). There was very little feedback available to participants during the exercise video series condition as the videos were pre-recorded and not interactive thus explaining the low mean score during this condition. However, the mean external regulation motivation score for the exergame condition (3.08) was lower than that of the exercise video series (3.77) despite feedback being provided. This contradicts the aforementioned research and suggests that feedback is less important than previously thought. That being said, the lower external motivation score may have been on account of the lack of rewards given by the exergame. Wii Fit does not provide typical game rewards such as character outfits or trophies, rather presents fitcoins for each minute of exercise completed and unlocks harder modes for certain activities based on performance. These may have been viewed as features of the game as opposed to rewards by the participants therefore explaining the low score. To combat this lack of external regulation motivation, participants suggested adding special rewards in future exergames.

One of the suggested rewards mentioned in the focus group to increase external regulation motivation was to include financial benefits. Participant 1 stated “If you could incorporate a feature that means the more exercise you do, the more you build your currency, that’s always going to motivate people.” This opinion aligned with other participants in the focus group with additional ideas encompassing food vouchers and exclusive offers. Past research has shown that financial rewards increase external regulation motivation more than non-financial rewards, however, another study presented results that show participant’s intrinsic motivation decreased when receiving financial benefits (Yousaf, 2014, Pritchard, 1977). This is crucial to analyse when developing a new exergame as external regulation motivation, although useful in the short term, can become exhausting in the long term if it is the only motivating factor (MasterClass, 2021). On the contrary, creating an exergame that inspires intrinsic motivation towards exercise is more likely to produce long lasting use of the game and therefore produce visible exercise benefits to the player. This study has shown that

individual's motivations towards exercise are already changing as participants displayed high levels of intrinsic motivation before experiencing the exercise conditions and their SIMS scores post exercise conditions support this. Therefore, it is imperative to consider the aims of the exergame before deciding whether to incorporate financial rewards.

Accessibility was briefly mentioned during the focus group, however, has a large impact on the future of exergames. The exergames used within this study were not designed to be portable whereas the exercise video series could be completed anywhere as long as the participant had access to a screen and the internet. Participant's 10 and 12 raised this issue separately and mentioned that "[the exergame] has to be plugged in and that can take longer to do." "... However, the time it takes to set up is probably the most annoying part of the game.". Previous research has found that the most common barrier towards exercise has been identified as having no time (Ebben, 2008, Canadian Fitness and Lifestyle Research Institute, 1996). Although participants reported high Likert scores for intrinsic motivation whilst participating in the exergame condition, the practicalities of using this medium to complete their exercise for an extended period of time may cause this value to decrease. It should therefore be considered by future developers to create a more highly accessible exergame that can be easily transported like Pokémon Go. This exergame was found to significantly increase physical activity over a short period of time and may be used as a design aid to create a longer term exergame solution for the future (Althoff, 2016).

## 8.0 Limitations

The experiment conducted within this study does not come without its potential limitations. This study began during the COVID-19 pandemic meaning many special measures had to be taken to ensure the safety of both the participants and the researcher. The main measure taken, was to carry out the entire study remotely meaning it heavily relied on participants self-reporting. Participants were therefore able to state any number of untruths in their questionnaires without the researcher being aware. However, due to the lack of presence from the researcher, participants may have felt more comfortable to present their true feelings as they would feel no sense of social or researcher desirability's. Further impacts due to the pandemic include the small sample size, thus increasing the likelihood of a type II error, and participants mainly being White individuals from Dorset and South Wales indicating generalisation to other locations may not be accurate.

Vast amounts of previous research into exergames and their ability to aid physical health, have been completed using the overweight or obese population. In this study, the weight class of the participants is unknown and therefore knowledge about BMI or health of the participants cannot be assumed. The motivations for the overweight or obese weight class may differ from those found within this study and therefore no direct recommendations or conclusions can be drawn in order to aid them.

Due to the time and funding constraints, this study collectively analysed the three exergames used by participants as a whole. This means that it is unknown whether participants preferred one game over another. The generalisation of these exergames limits the potential implications towards other exergames as there may be specific features used in one game that are not captured in others. However, due to the repeated measured design, each participant was exposed to both the exergame and exercise video series conditions, therefore individual differences were eliminated thus increasing the internal validity.

Another factor affected by the time and funding restraints, that may have influenced the results, is that participants had all been previously exposed to the exergames and one participant exposed to the exercise video series. Due to the participants having already played their exergames, they may have been bias towards presenting a higher motivation towards the exergame.

Despite these limitations, it is expected that further research will be able to address these potential issues.

## 9.0 Future Work

This study has shown that more research is required into both exercise motivations and exergames as well as their impact on each other. Future research should focus on presenting a previously unseen exergame, created based on the recommendations set out in this study, to a large sample size with a wide spread of geographical locations, ethnicity, and weight categories. Other metrics such as age, gender and current exercise levels should also be considered. This will allow for comparisons to be made in support or to contradict results presented within this study. It would also enable a greater understanding into how different groups of people interact with exergames and how their experiences can be tailored to motivate the greatest number of people to exercise.

This study only considered the exercise and gaming elements of exergames to promote weight loss. However, it would be interesting for future developers to incorporate an element of nutritional information into their exergames to discover whether this impacts on individual's exercise motivation. This would add to the previous research carried out with US children using the nutritional exergame "Alien Health" (Johnson-Genberg, 2014). Future research would enable further knowledge into the effects of receiving nutritional information or recommendations alongside exercise on different participant groups and their resultant exercise motivations.

Future researchers should also consider creating a longitudinal study, thus allowing the recommendations set out in this study to be tested over an extended period of time. Moreover, it is suggested that this research should be carried out into the effects of intrinsic vs external regulation motivations towards exercise. A series of exergame prototypes based on the recommendations should be created that are identical in all aspects, apart from rewards and punishments. These rewards and punishments should be different in each prototype in order to analyse the effect they have on participant's exercise motivations in the short and long term. This should help to illuminate the difference in motivation types and the corresponding length of time spent completing exercise.

Furthermore, it would be interesting to create a series of exergames that each focus specifically on one of the recommendations presented as part of this study. By emphasising simply on one functionality or feature future, researchers would be able to decipher which of these recommendations had the largest, or smallest, impact on the participants motivation towards exercise. These findings could then be used to adjust the recommendations in order to produce a certified ranking, with the feature or functionality having the largest effect on exercise motivation prioritised at the top. Moreover, this ranking would allow future developers to implement these recommendations in order to motivate the greatest number of people to exercise.

This study forms the basis for future research into the aforementioned areas and provides key insights on the aspects to focus on. One final critical issue that needs considerable further research, is the MET value of activities included within exergames. The current exergames on the market have not been fully analysed for their MET value and therefore it cannot be assumed that the players incur an exercise benefit whilst playing them. Future developers will need to strongly assess this metric in their newly

created exergames to ensure they reach the required exercise standards before presenting them to the general public as an exercise aid. It is highly important that these new exergames meet or exceed the minimum criteria for exercise before assumptions can be made into their effectiveness. It is only then, that the target audience will be able to achieve weight loss by using the exergame thus reducing the total number of overweight or obese individuals and therefore reducing the strain on the NHS.

## 10.0 Conclusion

In conclusion, the data from this study has provided evidence that exercise games increase intrinsic motivation towards exercise therefore indicating that they are enjoyable and fun to participant in. It was also found that participants spent a longer time playing their exergames as opposed to exercising using an exercise video series generating the hope that exergames will be able to tackle the ever-growing issue of overweight and obesity within the UK in the future.

A set of 7 recommendations was produced based on both qualitative and quantitative data analysed throughout the study to provide a comprehensive list of features and functionalities for future exergame developers to use as guidelines when producing new exergames. Considerations were also produced for future developers to utilise based on the aims of the exergame being produced. It is uncertain that the exergames used within this study provide any meaningful exercise benefits. Subsequently, it is imperative that new exergames induce a high MET value in the participant in order for them to incur any sort of exercise benefit.

However, the question remains, was it the exercise games that increased individual's motivation towards exercise, or did the intervention itself have an impact? For the time being, it is proposed that individuals should participate in both exergames and traditional exercise for the purpose of achieving the government recommended guidelines whilst also maintaining a high intrinsic motivation towards exercise.

## 11.0 Personal Reflection

During this study I was able to successfully conduct a two-week experiment, plus a focus group in which 21, and 7 participants took part in, respectively. The aim of this study was to gain a further understanding into the motivations towards exercise and whether these could be impacted based on the medium used to present exercise. I believe this was achieved and the set of recommendations fully represents the findings presented by the participants within this study as well as helping future exergame developers to design their products. However, the weight class or BMI of the participants was not requested and therefore the results cannot be applied to any particular group of people. This means if given the opportunity to repeat the study, I would need to encompass this metric before any implications could be made.

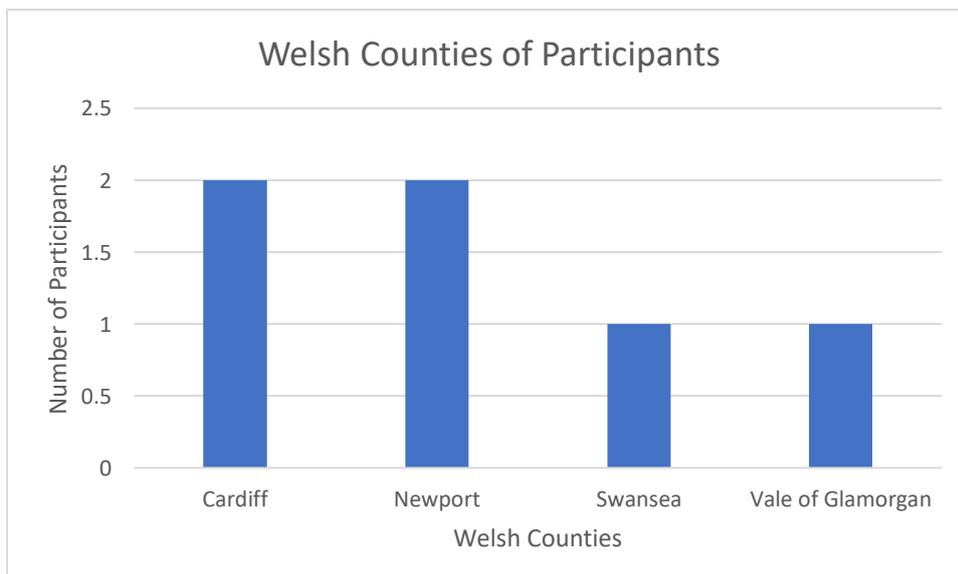
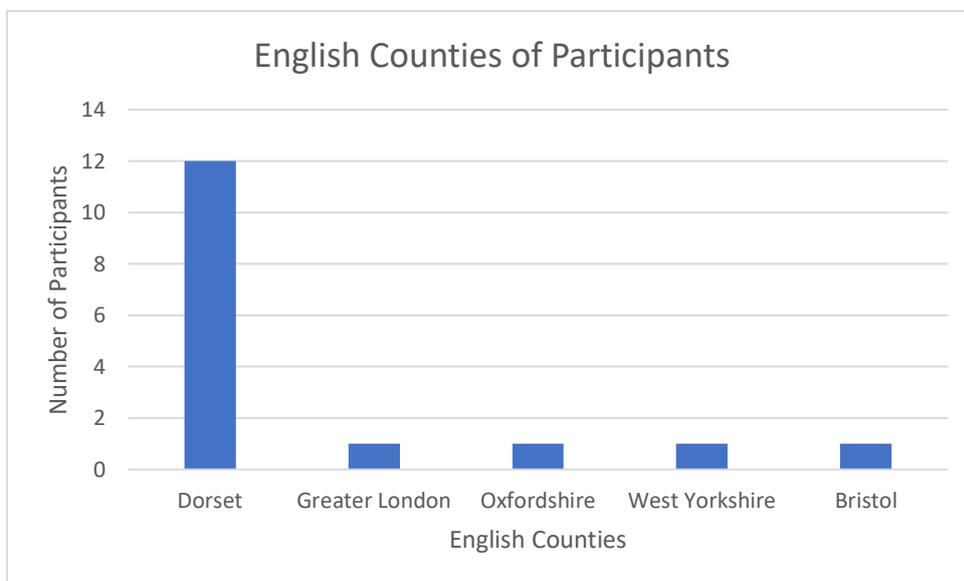
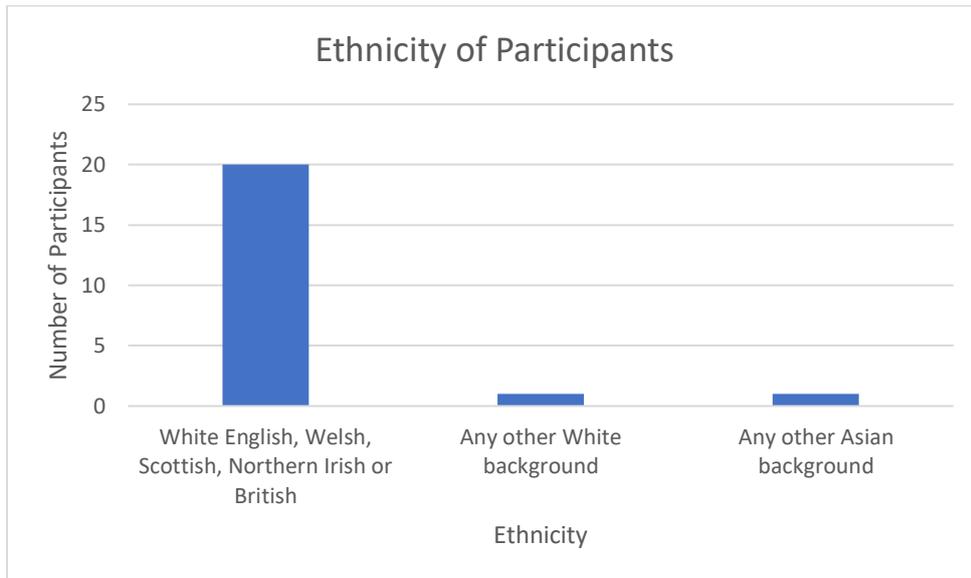
Throughout the study, modifications were required in order to ensure the project would succeed. For instance, it was initially hoped that the same one exergame would be used by all participants. However, due to a lack of responses, I made the difficult decision to incorporate other exergames into this condition to enable a larger number of participants. Other researchers may have continued with a smaller sample size; however, this was the conclusion I came to. This therefore had implications on the findings as the exergame condition had become broader meaning statistical significance may hold less meaning. If this study were to be carried out again, I would attempt to gain a larger number of participants to ensure the same exergame was used by all participants.

It once seemed obvious to only take the participant's MPAM-R scores at the beginning of the study. However, considering the results presented by the SIMS questionnaires, it is now more tempting to ask for a repeat of the MPAM-R after the study also. This would allow direct comparisons to be made about exercise motivations in general; not only after the two conditions. Therefore, it may be more accurate to suggest this if I were to complete the study again.

Overall, I believe this study was carried out to a high standard which will enable future researchers to build upon these findings. I trust that the decisions made throughout the course of this project were correct based upon the evidence provided at the time and were each evaluated appropriately. If the aforementioned modification were rectified when repeating this experiment, a more comprehensive understanding could have been made within these areas and I would advise them to be strongly considered when performing future research.

## 12.0 Appendices

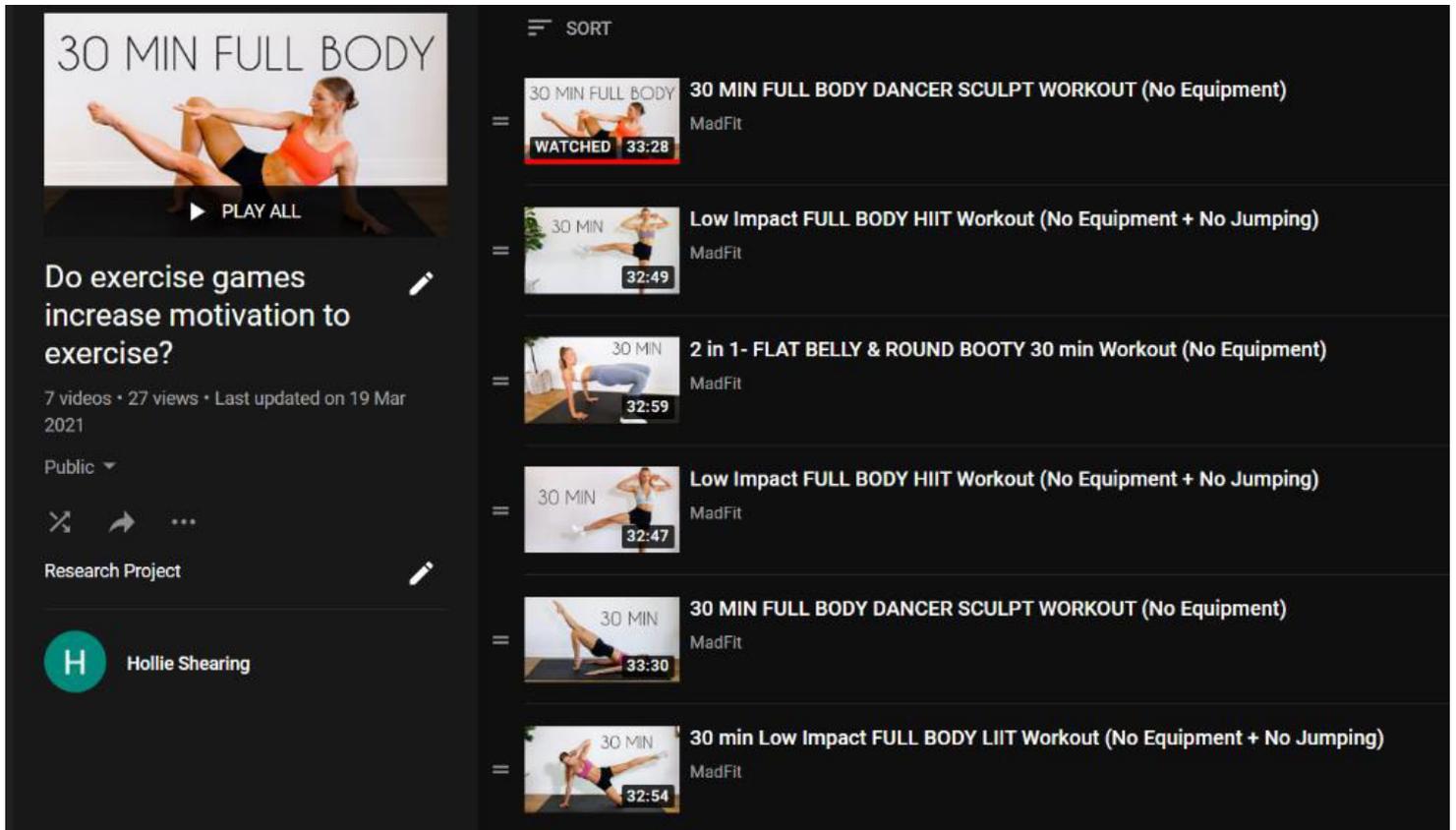
### 12.1 Personal Data Responses



## 12.2 Exercise Videos

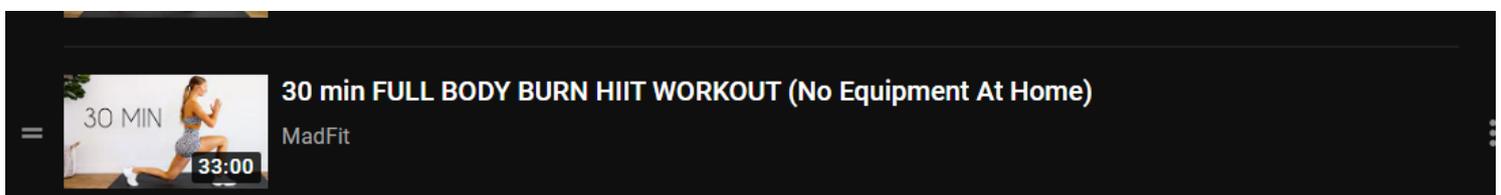
The following link will present a playlist titled 'Do exercise games increase motivation to exercise?'. The playlist can be found on youtube and consists of 7 videos. The video titles and thumbnails can be seen in the following images.

<https://www.youtube.com/playlist?list=PLRjfj5GZvafGPctLdMg9b3kj7X6nQDPDZ>



The screenshot shows a YouTube playlist interface. On the left, there is a large video thumbnail titled '30 MIN FULL BODY' with a woman in a red top and black leggings performing a side plank. Below the thumbnail is the text 'Do exercise games increase motivation to exercise?' and '7 videos • 27 views • Last updated on 19 Mar 2021'. The channel name 'Hollie Shearing' is visible at the bottom left. On the right, a list of six videos is shown, each with a thumbnail, title, and duration. The first video is marked as 'WATCHED'.

Video Title	Duration
30 MIN FULL BODY DANCER SCULPT WORKOUT (No Equipment)	33:28
Low Impact FULL BODY HIIT Workout (No Equipment + No Jumping)	32:49
2 in 1- FLAT BELLY & ROUND BOOTY 30 min Workout (No Equipment)	32:59
Low Impact FULL BODY HIIT Workout (No Equipment + No Jumping)	32:47
30 MIN FULL BODY DANCER SCULPT WORKOUT (No Equipment)	33:30
30 min Low Impact FULL BODY LIIT Workout (No Equipment + No Jumping)	32:54



This screenshot shows a single video thumbnail from the playlist. The thumbnail features a woman in a blue top and black leggings performing a side plank. The text on the thumbnail includes '30 MIN' and '33:00'. The video title is '30 min FULL BODY BURN HIIT WORKOUT (No Equipment At Home)' and the channel name 'MadFit' is visible below the title.

## 12.3 Questionnaires

### Screening Questionnaire

\*Required

1. Do you own any of the following exercise games?

*Tick all that apply.*

- Ring Fit Adventure (Nintendo Switch)
- Zumba Burn It Up! (Nintendo Switch)
- Just Dance 2021 (Nintendo Switch)
- Fitness Boxing 2 (Nintendo Switch)
- Beat Saber (PS VR)
- Wii Fit (Nintendo Wii)



3. If you own Zumba Burn It Up!, which option best suits when you started playing the game? \*\*Select N/A if you do not own the game.\*\*

*Mark only one oval.*

- Never played
- Since February 2021
- Since January 2021
- Since December 2020
- Since September 2020
- Since March 2020
- Before March 2020
- N/A

6. If you own Beat Saber, which option best suits when you started playing the game? \*\*Select N/A if you do not own the game.\*\*

*Mark only one oval.*

- Never played
- Since February 2021
- Since January 2021
- Since December 2020
- Since September 2020
- Since March 2020
- Before March 2020
- N/A

7. If you own Wii Fit, which option best suits the last time you played this game? \*\*Select N/A if you do not own the game.\*\*

*Mark only one oval.*

- Never played
- Within the past year
- Over 2 years ago
- Over 5 years ago
- Over 10 years ago
- N/A

2. If you own Ring Fit Adventure, which option best suits when you started playing the game? \*\*Select N/A if you do not own the game.\*\*

*Mark only one oval.*

- Never played
- Since February 2021
- Since January 2021
- Since December 2020
- Since September 2020
- Since March 2020
- Before March 2020
- N/A

4. If you own Just Dance 2021, which option best suits when you started playing the game? \*\*Select N/A if you do not own the game.\*\*

*Mark only one oval.*

- Never played
- Since February 2021
- Since January 2021
- Since December 2020
- Since November 2020
- N/A

5. If you own Fitness Boxing 2, which option best suits when you started playing the game? \*\*Select N/A if you do not own the game.\*\*

*Mark only one oval.*

- Never played
- Since February 2021
- Since January 2021
- Since December 2020
- N/A

Contact  
Details

Please leave your name AND email address here if you are willing to be contacted to participate further in the 2 week study.

8. NAME

\_\_\_\_\_

9. EMAIL ADDRESS

\_\_\_\_\_

## Personal Data

Participants Voluntary Personal Data

\*Required

Participant Number \*

Choose ▾

Are you willing to share your personal data in this study? \*

- Yes  
 No

Next

Gender \*

- Female  
 Male  
 Prefer not to say  
 Other: .....

Age (in years) \*

Choose ▾

Email address \*

Your answer \_\_\_\_\_

Ethnicity \*

- White English, Welsh, Scottish, Northern Irish or British  
 White Irish  
 White Gypsy or Irish Traveller  
 Any other White background  
 White and Black Caribbean  
 White and Black African  
 White and Asian  
 Any other Mixed or Multiple ethnic background  
 Indian  
 Pakistani  
 Bangladeshi  
 Chinese  
 Any other Asian background  
 African  
 Caribbean  
 Any other Black, African or Caribbean background  
 Arab  
 Any other ethnic group  
 Prefer not to say

Do you live in the UK? \*

- Yes  
 No

Where do you live within the UK? \*

- England  
 Northern Ireland  
 Scotland  
 Wales

Which county in Wales do you live in? \*

- Blaenau Gwent  
 Bridgend  
 Caerphilly  
 Cardiff  
 Carmarthenshire  
 Ceredigion  
 Conwy  
 Denbighshire  
 Flintshire  
 Gwynedd  
 Isle of Anglesey  
 Merthyr Tydfil  
 Monmouthshire  
 Neath Port Talbot  
 Newport  
 Pembrokeshire  
 Powys  
 Rhondda Cynon Taff  
 Swansea  
 Torfaen  
 Vale of Glamorgan  
 Wrexham



# Daily Log

Participant's daily log

\*Required

Participant number: \*

Choose ▾

What is today's date? \*

Date

dd/mm/yyyy

Did you complete your exercise today? \*

Yes

No

Within which hour did you complete your exercise today? \*

Choose ▾

# The Situational Motivation Scale (SIMS)

Exercise Game

\*Required

Participant Number \*

Choose ▼

Using the scale below, please circle the number that best describes the reason why you are currently engaged in this activity. Answer each item according to the following scale: 1: corresponds not at all; 2: corresponds a very little; 3: corresponds a little; 4: corresponds moderately; 5: corresponds enough; 6: corresponds a lot; 7: corresponds exactly.

1	2	3	4	5	6	7
Not at all	Very little	A little	Moderately	Enough	A lot	Exactly

Because I think that this activity is interesting

Because I am doing it for my own good

Because I am supposed to do it

There may be good reasons to do this activity, but personally I don't see any

Because I think that this activity is pleasant

Because I think that this activity is good for me

Because it is something that I have to do

I do this activity but I am not sure if it is worth it

Because this activity is fun

By personal decision

Because I don't have any choice

I don't know; I don't see what this activity brings me

Because I feel good when doing this activity

Because I believe that this activity is important for me

Because I feel that I have to do it

I do this activity, but I am not sure it is a good thing to pursue it

3. During the past week, did you continue to exercise past the required time (30 mins)? \*

Mark only one oval.

Yes  
 No Skip to question 5

4. On which day(s) did you exercise longer than the required time? \*

Tick all that apply.

- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday
- Sunday

5. Would you like to be considered to participate in a focus group to further express your opinions? \*

Mark only one oval.

Yes  
 No

6. Any other comments you'd like to make? e.g. what did you like most/least about "Wii Fit" or why you exercised more/less using "Wii Fit"

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## 12.4 Participant Instructions

Hi Everyone,

Thank you for already completing my screening questionnaire. I am contacting you now as you own the exercise game Beat Saber and have volunteered to participate further. I have attached a participant briefing and consent form to this email to inform you of the next steps of my project.

In brief, the next steps are to complete a set of exercises daily for two weeks (22/03-05/04) completing a daily log (3 short questions) and 3 marginally longer questionnaires about your exercise habits. There will also be an opportunity to take part in a focus group to discuss your thoughts and feelings around the exercise you have completed.

If you would still like to be considered and participate, please **fill in the consent form and return it to this email address by Sunday 21st.**

Thank you again,  
Hollie

---

Hi

**YOUR PARTICIPANT NUMBER IS** | Please make a note of this as you will need it in every questionnaire from now on.

The next steps in this experiment are to complete 2 longer questionnaires (should take you 5-10 mins). The first questionnaire is all about you and your personal data. The questions within this questionnaire are completely voluntary and therefore have the option to select you would rather not disclose any personal information.

The second questionnaire is all about your thoughts and feelings towards exercise in general. When completing this questionnaire please keep in mind your primary physical activity/sport BEFORE using Wii Fit.

The links to these questionnaires are below.

Personal Data:

<https://forms.gle/TLLV3PP5cUpygsif9>

Motives to Exercise:

<https://forms.gle/ybatbj3YQe44xKrYA>

**Please complete these as soon as you can!**

Many thanks,  
Hollie

Hi Everyone,

So **tomorrow (22/03/21)** you will start exercising using your exercise game **Ring Fit Adventure**. For your exercise you will need to complete 30 minutes worth of gameplay.

**You are only required to complete 30 minutes of exercise in total each day.**

Each day you are required to fill in a small questionnaire (2-3 mins) called the daily log, stating whether you did or did not complete your exercise that day and your participant number. You should already be aware of your participant number, (it should have been in my previous email) however if not, please ask!

If you do miss a day of exercise, do not worry, just make sure to record that in your daily log.

Daily Log:

<https://forms.gle/aNUUSgtYmzTWASAB7>

If you have any questions, please do not hesitate to ask!

Good luck!

Hollie

Hi Everyone,

So **tomorrow (22/03/21)** you will start exercising using your **exercise game Wii Fit**. For your exercise you will first need to complete the daily exercises presented by the game. Time how long these take you and after completion, use the rest of your 30 minutes to choose any of the other games to play.

**You are only required to complete 30 minutes of exercise in total each day.**

Each day you are required to fill in a small questionnaire (2-3 mins) called the daily log, stating whether you did or did not complete your exercise that day and your participant number. You should already be aware of your participant number, (it should have been in my previous email) however if not, please ask!

If you do miss a day of exercise, do not worry, just make sure to record that in your daily log.

Daily Log:

<https://forms.gle/aNUUSgtYmzTWASAB7>

If you have any questions, please do not hesitate to ask!

Good luck!

Hollie

Hi Everyone,

So **tomorrow (22/03/21)** you will start exercising using the **exercise videos**. I will provide a link further down this email that will take you to a playlist with 7 videos on youtube. Each video is roughly 30minutes long and they are in order for the days of the week. For example, video number 1 should be completed on Monday, video 6 should be completed on Saturday etc.

Each day you are required to fill in a small questionnaire (2-3 mins) called the daily log, stating whether you did or did not complete your exercise that day and your participant number. You should already be aware of your participant number, (it should have been in my previous email) however if not, please ask!

If you do miss a day of exercise, do not worry, just skip ahead to the current day's video, and make sure to record that in your daily log.

Video Playlist:

<https://www.youtube.com/playlist?list=PLrJfJ5GZvafGPctLdMg9b3kj7X6nQDPDZ>

Daily Log:

<https://forms.gle/aNUUSgtYmzTWASAB7>

If you have any questions, please do not hesitate to ask!

Good luck!

Hollie

Hi Everyone,

So **tomorrow (22/03/21)** you will start exercising using your exercise game **Beat Saber**. For your exercise you will need to complete 30 minutes worth of gameplay. You must set the intensity level to medium however, you are free to choose any song you would like.

**You are only required to complete 30 minutes of exercise in total each day.**

Each day you are required to fill in a small questionnaire (2-3 mins) called the daily log, stating whether you did or did not complete your exercise that day and your participant number. You should already be aware of your participant number, however if not, please ask!

**If you do miss a day, do not worry, just make sure to record that in your daily log.**

Daily Log:

<https://forms.gle/aNUUSgtYmzTWASAB7>

If you have any questions, please do not hesitate to ask!

Good luck!

Hollie

Hi Everyone,

Well done for completing your first week (by the end of today)! Please make sure all your daily log entries are completed for the past week whether you completed your exercise or not. Also, the clocks went forwards today so bare that in mind when filling out your time today!

As promised, here is the link to the daily log:

<https://forms.gle/WMAkfcJs9H7NNcKt6>

Thank you to everyone that's already completed their personal data and motives to exercise questionnaires. If you haven't already done so please complete those as soon as you can-I'll leave the links below.

Personal Data:

<https://forms.gle/z99VJUKrZEY1ZbAh6>

Motives to Exercise:

<https://forms.gle/5QXCGBQzJ5YM46d8A>

Finally, I shall be sending a personalised email shortly containing a reminder of your participant number, a slightly longer questionnaire (5-7 mins) and details on how to proceed with your exercise next week.

As always, if you have any questions, please ask!

Keep up the good work 😊

Hollie

Hi \_\_\_\_\_,

**YOUR PARTICIPANT NUMBER IS \_\_\_\_.** Please make a note of this as you will need it in every questionnaire from now on.

The next step in this experiment is to complete a longer questionnaire (should take you 5-7 mins). This questionnaire is about why you are currently engaged with the exercise game Wii Fit. There is also an option to select if you would like to be considered to participate in a focus group to further express your thoughts and feelings about the exercise you have undertaken.

The link to this questionnaire is below, please fill this out as soon as you can!

<https://forms.gle/K26xsoCGYGe2gt748>

Next week you will begin exercising using the exercise videos. I will provide a link further down this email that will take you to a playlist with 7 videos on youtube. Each video is 30minutes long and they are in order for the days of the week. For example, video number 1 should be completed on Monday, video 6 should be completed on Saturday etc.

Each day you are required to fill in a small questionnaire (2-3 mins) called the daily log, stating whether you did or did not complete your exercise that day and your participant number. You should already be aware of your participant number, however if not, please ask!

If you do miss a day, do not worry, just skip ahead to that day's video, and make sure to record that in your daily log.

Video Playlist:

<https://www.youtube.com/playlist?list=PLrJfJ5GZvafGPctLdMg9b3kj7X6nQDPDZ>

Daily Log:

<https://forms.gle/aNUUSgtYmzTWASAB7>

If you have any questions, please do not hesitate to ask!

Good luck!

Hollie

Hi \_\_\_\_\_,

**YOUR PARTICIPANT NUMBER IS \_\_\_**. Please make a note of this as you will need it in every questionnaire from now on.

**The last step** in this experiment is to complete a longer questionnaire (5-7 mins). This questionnaire is about why you are currently engaged with the exercise game \_\_\_\_\_.

The link to this questionnaire is below, **please fill this out before 07/04/21!**

<https://forms.gle/DgQe5YbU5p5H2eSo8>

If you are still yet to fill out your personal data, motives to exercise or your previous weeks questionnaire **please also fill these out before 07/04/21**. The following links show the personal data and motives questionnaires. **If you would like the link to your previous questionnaire, please ask!**

Personal Data:

<https://forms.gle/TLLV3PP5cUpygsif9>

Motives to Exercise:

<https://forms.gle/ybatbj3YQe44xKrYA>

Thank you for participating, this means a lot to me!

Thanks again,

Hollie

Hi Everyone,

In your first week's questionnaire you all selected the option that you'd be willing to participate in a focus group. I have attached an availability schedule for you to select the times you would be available to participate in this. Please select all times and days you are available, and I will get back to you shortly 😊

Focus Group Availability ([View/vote in browser](#))

Thank you all so much, you've done a great job so far!

Hollie

Hi Everyone,

The general consensus is that Friday 9th would be best. I have scheduled a zoom meeting for midday on Friday- the details should be below.

Topic: Focus Group

Time: Apr 9, 2021 12:00 PM London

Join Zoom Meeting

<https://us05web.zoom.us/j/81355598204?pwd=SFlyVmJlaml1ZGFNNjVFNjJuTzZCUT09>

Meeting ID: 813 5559 8204

Passcode: Ms7CpQ

This meeting will consist of a couple of questions from myself and any following discussion about your experiences throughout the past two weeks. It should take approximately 20-30 minutes.

I hope to see you all there!

Hollie

Hi Everyone,

Thank you all so much for participating in my study, it really has meant a lot to me. You'll be pleased to know that you have completed the final steps! I have attached the debrief forms to inform you of your participation and the aims of this study. If you have any questions or would like to know anything else about this study, please do not hesitate to email me.

Thanks again,

Hollie

## 12.5 SIMS Responses

Exercise Video	Exercise Game
"I least like the speed and intensity I most like how I felt when it was over!"	"It is fun!"
"I'm not as flexible so many exercises having to reduce level at which I did; my coordination is not great when she's doing both arms/legs and introducing different moves within one exercise. She was encouraging through the exercises. I may look for other online exercise routines to follow as first time I've really tried online routines."	"Exercised more because it didn't feel like you had to put in a lot of effort compared to the Youtube exercise"
"I like the way she structured the videos - it kept them engaging"	"Having to go through the same steps before each exercise was annoying but feedback undecided about - was good, but also annoying in terms of time wasted."
"Required too much flexibility, which is something I don't have so often I would come away discouraged as I didn't really feel like I accomplished a lot."	"It's more engaging to have a game to play whilst exercising, it's the reason I prefer playing sport rather than just doing workouts but with the pandemic sport is hard to play so the Wii fit is a great substitute"
"Couldn't follow it and felt useless after watching someone do it all better than I can for 30 mins"	"it was enjoyable and the competitive aspect doing it with friends made me want to do it more"
"Really like the music she uses!"	"The idea of it is pretty cool, I just wish it incorporated things better. To have a balance board is cool but if they just made the exercises like if you're playing a real sport rather than just workout which you can do fine without the Wii fit. Also the UI is really old."
	"There is a wide and varied selection of activities that can be undertaken. Although this particular exercise course was for myself there was always a challenge to improve your score and try a little bit harder to improve. Very competitive."
	"The game appears quite dated in comparison to new ones."

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