# Computer Games and Health: A Proof of Concept

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## Abstract

Government and other surveys highlight the problem of youth inactivity and obesity. A contributory factor to this problem is the enticement of computer games which have been believed to displace healthy physical exercise. There is some evidence that the intrinsic appeal of computer games lures individuals into sedentary game playing as an alternative to other activities of a more physical nature e.g. sport. An alternate view is that the infrastructure of computer games technology presents the individual game player with a wider range of opportunities than those afforded by traditional sports (e.g. control, participation, social constructs etc).

An earlier study by the authors highlighted the possible contribution of computer games as physical activity specialists. In order to substantiate this possible avenue of research a series of ad hoc experiments have been carried out utilising fitness metrics such as heart rate and blood pressure in a variety of scenarios. Although the sample tested was small and in no way indicates a rigorous medical field trial, the results indicate that this approach could yield a new paradigm in the battle to combat such diseases as obesity and coronary heart fitness.

*Key-Words* : Computer Games, Games for Health, Serious Games, Augmented Gaming

## 1 Introduction

Government and other surveys [1][2][3][4][5][6][7][8][9][10][11] highlight the problem of youth inactivity and obesity, prompting a search for initiatives that promote health to the general public, and more specifically children and teenagers [3]. A contributory factor to this problem is the enticement of computer games which displace healthy physical exercise[12], and there is a popular perception that the entire blame can be laid on computers displacing traditional activities such as sport.

Is this fair? Is it the case that there is something intrinsic about computer games that makes individuals want to shun sport, or is it the case that there is something innately attractive about computer games that engage the imagination in a way that sport or other activities do not offer?

An earlier paper[13] examined the possibilities afforded by the technology in the overall improvement of health. This paper seeks to further that approach and to identify practical implications by use of an augmented reality game set up, GameTrak©, and relevant fitness metrics on a random sample of male students. The intention was to provide a proof of concept for the notion that video games and more specifically augmented reality games could form the basis of a new approach to teenage inactivity and provide a weapon or tool in the fight against obesity precursors.

## 2 Computer Games versus Sport

*Inactivity and poor diet are responsible for roughtly four-hundred thousand annual deaths and may soon become the leading causes of death in the United States[14].*

These alarming figures form a part of a picture of decline of participation in sport in the USA. This trend extends beyond America and many studies from around the world show a rise in levels of inactivity amongst the younger generation [15][12][14][16][17][18]. There is also evidence that this trend is noticeable in the Far East (eg Ho highlighted the problem of boys playing computer games being comparatively less active than boys who used the computer for other reasons [19]). From within the UK statistics regarding the proliferation of numerous chronic conditions such as diabetes and high blood pressure [1][2] illustrate the consequences of this inactivity. Such is the concern within the UK, that the government is claiming to be in the process of launching a "War on Obesity"[3][11].

One important factor in the prevalence of sedentary behaviour is the growth in passive entertainment media such as computer games, the internet and television[15][17] [16][14][12] [20]. Computer games are proving to be a considerable displacement activity for other forms of social interaction[21][17].

Accepting that there is a problem, what are the solutions? Apart from making sport more attractive, another approach would be to combine physical activity with computer games and this is a possibility that has venerable antecedents.

## 3 Potential Models of Interaction

Over more recent years a goal of the games industry is to encourage players to have more involvement and by consequence more physical activity by the use of interactive devices in the form of augmented reality.

### 3.1 Augmented Reality Gaming

The traditional input and output devices for playing computer games (keyboards, mice, joysticks and games pads) have not been conducive to the promotion of physical activity since their patterns of usage have been envisioned as sedentary, and the needs for cables and wires for connection with the processing unit restricts movement in any case.

Wireless technology for many of these devices is becoming more readily available, and while this will not make keyboard users any more active, wireless joysticks and games handsets represent a significant step forward. Newer interaction devices however are providing means of getting games players out of their chairs.

Recent, mass-produced and widely available peripheral devices include such items as the Eyetoy©, the dancepad and the GameTrak©. Much research is being undertaken in other more physical input devices [22][23]. All of these developments suggest that the technology with which to perform physical exercise is now widely available, and likely to improve in reliability and availability in the coming years.

This is a move more towards the integration with real life activity and game playing. A 2003 study by Plante et al[24] explores the issues of whether VR simulations can be used in improving the mood benefits of exercise. Their study involved an experiment in subjects were exercised on an exercise bicycle, played a virtual reality bicycle game, or rode an exercise bicycle in a VR setting. It was found that subjects tired less when in the VR setting, than when they were playing on the bicycle. They conclude that there is some evidence that VR can promote the mood benefits of exercise.

Users argue that in some instances they feel more involved with the game, however currently this approach to games interactivity is in it's infancy. The fact that the game players have now to move from the sedentary style of game play bodes well for involvement in physical activity within gaming. Indeed the advent of such interactions as the Dance-Mat from both Sony's Playstation©and Microsoft's Xbox©has led to a raft of dance style exercises, although these are actually aimed more at either the wannabe dance stars of the future or the additional form of exercise.

More recently there has been a move towards exercise style gaming, however this has incorporated the use of a personal trainer style avatar guiding and cajoling the "player" through the relatively active exercises[25]. This is a move towards a "virtual gymnasium" and in our opinion will suffer from some of the same preclusive and elitist goals as in a real gymnasium. Current arguments in press releases have implied that this is the game players' version of the exercise video. The benefit of this approach is the ac-

cess is in the user's own home, but the disadvantage is that it is a game version of gymnasium exercise, and the design has not considered the specific circumstances in which the game is deployed.

## 3.2   Interaction Models

The US Army uses a multimedia games for recruitment purposes to show the range of situations in which a soldier may expect to find himself during the course of his duties. The interest in this particular approach to games and game play has over recent years been developing and increasing as illustrated by the Serious Games Consortium, which is now a regular feature at the Game Developer's Conference (GDC [26][27]).

In December 2003 after a visit to Dave and Buster's Midway Amusements in Chicago observing users, and after ad hoc discussion the following day on how they enjoyed the experience and the effects on their physical wellbeing, the notion of using augmented reality gaming to promote engagement in healthy activity and exercise was conceived. This was progressed with ad hoc discussions from games producers, vendors at GDC in San Jose during April of 2004.

Since that time a research project has been initiated which seeks to address the issues of obesity holistically by using computer technology as part of the measurement, motivation and implementation of physical exercise. The relevance of this line of research has been highlighted in recent times by the advent of the Serious Games Initiative for Health [28] and a number of recent publications [29][30] and is currently the subject of a number of papers by the authors and potential grant applications.

## 4   Ad Hoc Experiments

In order to identify any possible improvements which could be made by use of this approach, several scenarios were conceived, using a small number of students as subjects. The intention was to provide a proof of concept approach rather than a full field trial. The intent of the authors was to provide "toe in the water" evidence utilising known and accepted fitness measurements to gauge any influence of an augmented

reality game on adolescent exercise levels. The scenarios used are presented below.

**Scenario One.** The students were subjected to a measurement of heart rate and blood pressure readings utilising a wrist monitor. Wrist monitor measurement is acknowledged as an indicator although there are reservations by doctors as to its accuracy over the more traditional arm monitors [31][32].

This measurement forms a base-line for comparison with the active scenarios. Students were asked to sit and relax for 5 Minutes before a series of three measurements were taken - each proved to be within 0.1% of an initial reading.

**Scenario Two.** In order to get a base figure of activity the students were asked to run up and down 5 flights of stairs. Their blood pressure and heart rate were measured at the end of the exercise. Both the heart rate and blood pressure had increased, as would be expected when carrying out this form of exercise.

**Scenario Three.** Students were subjected to a game playing situation in a passive environment ie. the game employed in this scenario was an Xbox version of the "Rocky" boxing game. Each student played three fights on the rocky game with increasing difficulty in order to subject them to an increase in engagement. The final fight was against a superior fighter and in all cases resulted in a defeat. Immediately after the final fight blood pressure and heart rate measurements were taken. It was clear that as the game increased in difficulty the players became more involved and competitive, taunting the game verbally and becoming more agitated and animated. The resultant blood pressure and heart rate showed a slight increase from the base rate.

**Scenario Four.** In order to clarify this rise as catalysed by the game play rather than the specific genre of the game ie. a competitive fight game, students were asked to complete 5 minutes on the Doom 3 demo. This game has been highlighted for its engagement and "adrenalin / scary / stimulation" during game play. At the end of the 5 minutes blood pressure and heart rate measurements were again taken. In 2 out of 3 cases there was in fact a rise in both the blood pressure and heart rate in Student 3's case there in fact was a slight reduction. This

anomaly may well be due to the student preference for FPS games.

**Scenario Five.** The heart of our experimental approach was to provide an indicator of any positive effect on health provided by the use of augmented gaming. The final scenario involved the use of a PlayStation game "DarkWind" - again this was a boxing game with futuristic opponents in a round by round fight. However, the difference in this scenario was that the game utilises an augmented reality approach to the game known as GameTrak©. This device involves the player donning neoprene gloves which are connected to the games' unit via wires. The player (after suitable calibration of the device) boxes the virtual opponent with the physical movements being displayed as virtual punches. On occasions the player is also expected to utilise their feet by pressing a "mouse mat" on the floor. The play continues and the player is expected to throw combination punches, use their feet and turn etc. At the end of each fight the program yields statistics on the power of the punch, the time taken to win the fight and the number of calories burned by the player.

Each student was again subjected to three fights (in this situation however there was no control over the difficulty of the opponent, this was in fact part of the game that each successive opponent was more skilled and harder to defeat than the last). At the end of the three fights (not all of which ended in defeat) blood pressure and heart rate measurements were taken. In this scenario the heart rate and blood pressure were both raised to the levels indicated by running up and down the flight of stairs.

## 5   Discussion

Although the experimentation was not rigorous, and the scenarios were not formalised in any way, they do indicate that this approach has merit. The fact that Scenario 5 yielded raised levels of both blood pressure and heart rate to the extent that they were at the same level as in physically running up and down stairs clearly indicates that this approach can yield some form of exercise. However one factor should not be overlooked which overbalances the scales in favour of this augmented gaming approach. The students were far more engaged in the DarkWinds game than they were running up and down the stairs, consistent with the findings of Plante et al[24].

This is one of the cornerstones of our approach, as we have discussed in a previous paper. The very fact that games are played so widely and provide high levels of both attraction and engagement indicates that this engagement can be harnessed to provide subliminal (or even camouflage) health benefits, the players are actually encouraged to exercise whilst carrying out a favourite pastime, namely playing computer games. It should be made clear our contention is that this approach is designed to involve inactive participants in a form of physical exercise, rather than as a direct substitute for active involvement with sports.

Discussions with the student participants after each of the scenarios also tend to support this fact. All of the students preferred the augmented game approach to the sedentary fighting game. A member of the sample group is a regular participant in exercise, visiting a gymnasium up to six times a week performing circuit training. His comments on use of the GameTrack© were that (in his opinion) a 5 minute game of "Darkwind" was equivalent to a twenty minute gymnasium workout.

This comment is also supported by work carried out in parallel by a research group in Scandinavia [29], where an augmented reality boxing "game" was developed in human interface research where the authors made the observation that such an approach could be used to train professional boxers.

## 6   Conclusion

All of these comments, although from a bias sample indicate that this approach is worthy of further investigation. It is currently the topic of a proposal to the Medical Research Council and we are actively seeking funding to expand the work in a more rigorous clinically based research activity.

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