

# Exergames For Elderly

## Social exergames to persuade seniors to increase physical activity

Ellen Brox  
Luis Fernandez Luque  
Gunn Judith Evertsen  
Northern Research Institute  
Tromsø, Norway

Juan Emilio González Hernández  
Department of computer architecture and technology  
University of Seville  
Seville, Spain

**Abstract**—Games with remote controls and motion sensors that require the players to move, so-called exergames, have become very popular. Many of these games are also being played by the senior population. Participating in regular training sessions outside their homes can be challenging for elderly, and it is hard to motivate oneself to exercise regularly alone at home. Regular physical activity is important both for the physical and psychological health and it is an integral part of many rehabilitation therapies. In addition, many elderly suffer from loneliness, making social interaction within exergames very important. In this paper we provide a narrative review of how exergames can help to motivate elderly to exercise more, focusing in possible social interactions in online exergaming and persuasive technologies. Finally, we discuss how social exergaming can be used both to prevent loneliness and encourage physical activity.

**Keywords**—exergames; seniors; social gaming; persuasion; remote controllers

### I. INTRODUCTION

Games are gaining popularity as a tool for health prevention and education. Video games are not just for teenagers or game enthusiasts anymore, they are designed for a wide range of ages. Recent innovations in game controllers and motion sensors are being incorporated into games where body movements are used to control the game.

The lack of physical activity is becoming one of the main challenges for public health. Lack of physical activity is related with obesity, cardiac problems, cancer, etc [1]. It is affecting all age groups, including the elderly.

Many games are being designed to promote physical activity, and can be a good supplement for elderly. However, as we explain later, to design for that target population is not an easy task.

Exergames are games where the users have to perform physical exercises to control the game. Another sub-type of games is not just using physical movements as game-controllers, but they are also designed to persuade users to exercise more based on different psychological theories. These games are using persuasive technology, which means the deliberate use of communication to change attitudes and behavior of people [11, 12].

In this position paper we provide an overview of how

exergames are being used in the elderly population and the specific challenges related to this age group (section II). In addition, we provide an overview of persuasive games to promote physical activity (section III). Finally we provide a discussion on how exergames can be adapted to the elderly population and we outline future areas of research.

#### A. Exergames for elderly: challenges and oportunities

Billis, Konstantinidis, Mouzakidis, Tsolaki, Pappas and Bamidis [2] point out that old seniors commonly lack physical fitness and often suffer from severe mobility problems in their upper and lower extremities. They also state that elders often lack motivation for physical activities and stay at home instead of visiting day care centers and organized training activities.

In addition elderly face several other changes concerning senses and motor skills [2]. Elderly also face several cognitive challenges, such as slower information processing and learning [3]. Falls are the most common reason for medical intervention amongst the elderly [4], and prevention is important. Physical exercise is both important in prevention and in rehabilitation.

Also the mental health is of importance. Rosenberg et al have found that exergames also can be used as intervention for subsyndromal depression [5], a condition often seen in elderly.

#### B. Exergames and persuasion

The hypothesis is that exergames can be used to motivate and persuade seniors to exercise more, simply because it is fun. Adding a social factor should increase the effect, and we have been looking into different persuasive technology used in games to see if we can find support for our hypothesis.



Figure 1. Avatars for players of Wii Bowling

## II. EXERGAMES AND SENIORS

For games to be motivational and persuasive, they must be accepted by the target group, and research on persuasive technology has not been focusing on seniors. This section describes some research on exergames and the target group both regarding acceptance and a health benefit. We particularly look at experiences with Nintendo Wii games for elderly, since most research on seniors and exergames is on these technologies. Also research on social experience is mentioned.

### A. Experiences with Wii games

The Nintendo Wii comes with a range of games like the Wii fit balance board and the Wii sports games with handheld “Wii mote”. Several studies have been conducted with elderly playing different kind of Wii games [2, 6, 7, 8], and particularly bowling has been considered suitable since the game is self paced; i.e. players can take the time they need when it is their turn. However [7] let the senior female players choose between a range of Wii games, and found that the individual choices comprised games like tennis, boxing and sword fighting. They also found that playing Wii sports was difficult, but that said the players responded that it had a positive social effect between those participating, and they also liked the fact that the games forced them to be physically active and to do new things. Shubert [9] also found that many seniors were interested in playing Wii if it could benefit their health. A study in Singapore [8] tells that Wii had a high acceptance among elderly, but it does not tell which Wii games were played.

Jung, Koay, Ng, Wong and Kwan [6] concludes that playing Wii has a positive impact on the social well-being of the elderly compared with a group that only played traditional board games.

Reference [2] states that balance and strength training are a suitable kind of physical exercises for elderly, and they have tried out Wii balance board.



Figure 2. A player using Wii balance board and with a Wii mote (remote control) in hand



Figure 3. A dance pad used in Dance Dance Revolution – the player gets instruction on the screen about where to step

As [8] points out, Wii is not designed for elderly, and many games are found to be too fast or give a too negative feedback. There is also a certain risk of falling off the rather narrow balance board in Wii fit.

### B. Other exergames

Touchtown's Dancetown Fitness System® is a game specifically designed for elderly using a dance mat, and [8] thinks that both this and the Eyetoy games using cameras to track movement maybe are better choices for elderly both because of functionality and ease of use.

De Bruin, Schoene, Pichierri and Smith [4] studied the use of virtual reality techniques for the training of motor control in the elderly, and their theory is that “By creating a strong presence in a virtual, interactive environment, distraction can be taken to greater levels while maintaining the benefits of indoor exercises which may result in a shift from negative to positive thoughts about exercise.” They have been using dance pad games to train stepping.

Video camera controllers have also been tested with elderly users. For example, Eyetoy has been tried for elderly stroke patients, as referred to in [8].

### C. The social factor

Several studies conclude that playing Wii or exergames together is perceived as fun and social [6, 7, 8], but we have no studies of playing exergames together via the internet. We do however have some evidence that the senior population does not find co-playing quit as rewarding as the young. For instance [10] tried out woodpong both co-located and remotely, and found that online co-play was deemed less rewarding than physical co-playing or when they thought they were playing against a computer.

We think however that the social factor is very important, and that a combination of social gaming with exergaming will give better persuasive exergames than those without a social part, but that it is important that the players are confident with the technology.

## III. PERSUASION IN EXERGAMES

Persuasion is the deliberate use of communication to change attitudes and behavior of people [11, 12]. Persuasion can be used for positive purposes, but in some cases, as with some types of advertising, it can be understood as a way to change the point of view of individuals from a false promise or an element that is not such.

### A. Persuasive technology

Persuasive technology can be defined as a set of technologies that attempts to change attitudes and behavior of people through persuasion and social influence, but without making use of coercion and deception [11]. Those changes should be voluntary accepted by subjects.

Persuasive technology has a great potential to motivate and encourage old-aged people to change his sedentary lifestyle and become more physically active. Nevertheless, to make them change is a complex process. Appropriate persuasive methods should be used at the right time to persuade them to adopt healthier behaviors.

### B. Persuasive strategies

In the following, we expose some persuasive strategies [13] to motivate elderly individuals to change.

#### *Display information to encourage people to be more active.*

Do not show detailed information about users collected from sensors such as lung capacity or the number of steps they did. They may not understand it at all. In the project *Fish 'n' Steps* [14], the size of the virtual fishes represents user's progression. As users walk, fishes become larger and healthier to indicate that they are exercising instead of displaying only the number of steps they did.

*Record and display the user's past behavior.* Showing historical information related to their physical activity can help to establish new changes and attitudes. It can also be used to set new personal goals. In the project *Flowie, a virtual coach* [15], the system stores the number of steps the user did to show him/her a chart with his/her progression. In this manner, users can know if they are exercising enough a particular week or they can try to get better step accounts.

Use positive reinforcements to improve behaviors. Feedback should be immediately delivered as players achieve their goals. Do not punish them for not performing an activity nor accomplish a goal. In the project *UbiFit Garden* [16], if the user exercises, the garden will become more beautiful and pleasant with different flowers and butterflies appearing. But, if he/she does not exercise, nothing will happen. He/she will only see the green grass and blue sky of the garden. This way the users never get negative feedback.

*Make an attractive and friendly user interface.* This helps to motivate users to spend more time performing an activity. In addition, it will be easier to engage them in the game if it is easy to play. In the project *Flowie, a virtual coach* [15], the system registers the walking distance of the users by using a pedometer and sending the information via wireless networks to the application automatically so the players do not have to register their activities manually. Thus, users can focus only on exercising.

*Provide information at opportune moments.* Do not disturb users with annoying messages at inappropriate times. In the project *UP Health (Ubiquitously Persuasive Health Promotion)* [17], the authors designed a notification system focused on minimizing the possibility of interrupting users.

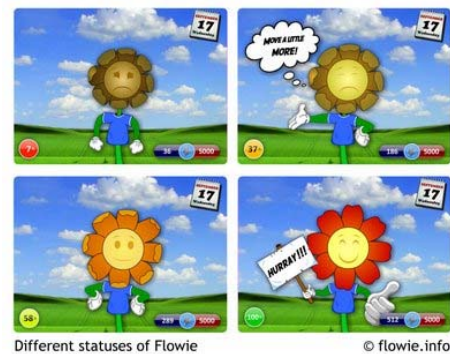


Figure 4. Different statuses of “Flowie” [15] depending on the activity of the player

*Use social influence.* There are several types of social influence that can promote behavior changes.

Social facilitation suggests that people get more involved while performing an activity when other people are participating too or if they are being observed [18]. For example, some studies show that people exercise more effectively when they do it with others [19]. In the project *Jogging over a distance* [20], jogging partners who are not in the same location use an audio system to be in contact in order to socialize and to motivate each other. Social Comparison is a theory that explains how individuals evaluate their own opinions and behaviors by comparing themselves to other people [21]. In the project *Chick Clique* [22], girls can use their mobile phones to see the number of steps given by their friends, and this motivates them to walk more and have similar count of steps as their friends. This also introduces a certain level of competition between the girls that can motivate them to exercise more.

*Houston* [23] is a project designed to increase physical activity of people in which users can communicate each other. The project's authors conducted an experiment in which a group of people could not communicate. Results showed that groups that could communicate were more likely to achieve their goals making it clear that social influence is a factor to consider.

## IV. DISCUSSION

Exergames have the potential to motivate elderly to be more physically active, since it is perceived as fun to play. However, the social factor is important. Seniors that we have talked to are worried that they will be offered games in stead of physical meetings and training sessions, so exergames should be used in addition for those who do get to regular training sessions. Exergames can be used as a supplement in training sessions, since there is evidence that playing Wii enhances the social interaction between the players.

Many elderly suffer from subsyndromal depression, a condition that is not as severe as full-blown depression. Loneliness is considered a risk factor that can be alleviated by multiplayer Wii games[5]. Maybe online exergames could mimic the real life situation and allow for (oral) chat.

In studies where elderly play games, they are often unfamiliar with the technology, and maybe even the co-players are strangers, and thus the players do not feel comfortable in an online situation. If the co-players are familiar, for instance those they also have met in training sessions, the situation may be different.

We think that the social factor is very important, and we want to combine social interactions with exergaming as we think that this will give better persuasive exergames than those without a social part. We want to investigate if exergames can help to motivate elderly to exercise more. We are involved in two European projects from the Ambient Assisted Living program where we will try out several persuasion techniques when developing exergaming for elderly, including social playing over the Internet.

#### V. CONCLUDING REMARKS

We think that both exercise and enjoying oneself are positive factors in therapies. Elderly tend to be more homebound, and many are both suffering from loneliness and a lack of physical activity. We think that persuasive online social exergames should be investigated further for this group both to be social and to get exercise. An extra bonus it that they hopefully also will have fun.

#### AKNOWLEDGMENT

This work is partly funded by the AAL projects IsActive and Join-In. We would also like to thank our project colleagues in Tromsø Lars K. Vognild, Norut and Tatjana Burkow and Elin Johnsen at the Norwegian Centre for Integrated Care and Telemedicine for interesting discussions.

#### REFERENCES

[1] C. Foster, M. Hillsdon, M Thorogood. "Interventions for promoting physical activity". *Cochrane Database of Systematic Reviews* 2005, Issue 1. Art. No.: CD003180. DOI: 10.1002/14651858.CD003180.pub2

[2] A.S.Billis, E.I. Konstantinidis, C. Mouzakidis, M.N. Tsolaki, C. Pappas, P.D. Bamidis, "A game-like interface for training eniors' dynamic balance and coordination" in *IFMBE Proceedings*, 2010, Volume 29, Part 4, 691-694, DOI: 10.1007/978-3-642-13039-7\_174

[3] O.K. Burmeister, "Websites for Seniors: Cognitive Accessibility" in *International Journal of Emerging Technologies and Society* Vol. 8, No. 2, 2010, pp: 99 – 113

[4] E.D. de Bruin, D. Schoene, G. Pichierri, S.T. Smith, "Use of virtual reality technique for the training of motor control of the elderly, *Z Gerontol Geriat* 2010, 43:229–23, DOI 10.1007/s00391-010-0124-7, Springer Verlag 2010

[5] D. Rosenberg, C.a. Depp, I. V. Vahia, J. Reichstadt, B. W. Palmer, J. Kerr, G. Norman, D. V. Jeste, "Exergames for subsyndromal depression in older adults: a pilot study of a novel interaction," *American Journal of geriatric psychiatry*, 18:3, March 2010

[6] Y. Jung, J. L. Koay, J.S. Ng, G. L. C. Wong, M. L. Kwan, "Games for a better life: Effects of playing Wii games on the well-being of seniors in a long-term care", *IE '09 Proceedings of the Sixth Australasian Conference on Interactive Entertainment*, doi>10.1145/1746050.1746055

[7] D. Wollersheim, M. Merkes, N. Shields, P. Liamputtong, L. Wallis, F. Reynolds, L. Koh, "Physical and Psychosocial effects of Wii Video game use among older women.

[8] Y.Theng, A.B. Dahlan, M. L. Akmal, T. Z. Myint,, "An exploratory study on senior citizens perceptions of the Nintendo Wii: the case of

Singapore", *i-CREAtE '09 Proceedings of the 3rd International Convention on Rehabilitation Engineering & Assistive Technology*, ACM New York, NY, USA ©2009, doi>10.1145/1592700.1592712

[9] T. E. Shubert, "The use of commercial health video games to promote physical activity in older adults", *Annals of long-term care*, 20.05.2010, p 27-32

[10] B. J. Gajadhar, H.H. Nap, Y. A. W. de Kort, W A Ijselsteijn, "Out of sight out of mind: co-player effects on seniors' player experience", *Proceedings of the 3rd International Conference on Fun and Games 2010*, doi>10.1145/1823818.1823826

[11] B.J. Fogg. "Persuasive Technology. Using Computers to Change What We Think and Do", *Magazine Ubiquity*, Volume 2002 Issue December, December 1 - December 31, 2002, doi>10.1145/763955.763957

[12] S. Chatterjee, A. Price. "Healthy Living with Persuasive Technologies: Framework, Issues, and Challenges". *JAMIA* 2009;16:171-178 doi:10.1197/jamia.M2859

[13] S. Consolvo, D. W. McDonald, J. A. Landay. "Theory-Driven Design Strategies for Technologies that Support Behavior Change in Everyday Life.", *CHI '09 Proceedings of the 27th international conference on Human factors in computing systems*, doi>10.1145/1518701.1518766

[14] J.J. Lin, L . Mamykina, S. Lindtner, G. Delajoux, H.B. Strub. "Fish'n'steps: Encouraging physical activity with an interactive computer game. *Proceedings 8th International Conference: UbiComp 2006*, Orange County, CA, USA, September 17-21, 2006, Springer, pp. 261-278. DOI: 10.1007/11853565\_16\_xxx

[15] I. M. Albaina, T. Visser, Charles A.P.G. van der Mast, Martijn H. Vastenburgh. "Flowie: A Persuasive Virtual Coach to Motivate Elderly Individuals to Walk", *Pervasive Computing Technologies for Healthcare*, 2009, p 1-7, DOI: 10.4108/ICST.PERVASIVEHEALTH2009.5949

[16] S. Consolvo, D. W. McDonald, T. Toscos, M. Y. Chen, J. Froehlich, B. Harrison, P. Klasnja, A. LaMarca, L. LeGrand, R. Libby, I. Smith, J. A. Landay. "Activity Sensing in the Wild: A Field Trial of UbiFit Garden.2, *Proceeding of the twenty-sixth annual SIGCHI conference on Human factors in computing systems 2008*, doi>10.1145/1357054.1357335\_M. Sohn, J. Lee. "UP Health: Ubiquitously Persuasive Health Promotion with an Instant Messaging System.", *Proceeding CHI EA '07*, doi>10.1145/1240866.1241059

[17] B.J. Fogg, D. Eckles. *Mobile persuasion. 20 perspectives on the Future of Behavior Change*, Persuasive Technology Lab, Stanford University, 2007, Stanford Captology Media. ISBN-10: 78097950251, ISBN-13: 978-0-9795025-2-1

[18] G. Roberts, K. Spink, C. L. Pemberton. *Learning Experiences in Sport Psychology*, 2<sup>nd</sup> edition, 1999, ISBN: 0-88011-932-2

[19] F. Mueller, S. O'Brien, A. Thorogood. "Jogging over a distance: supporting a "jogging together" experience although being apart.", *CHI 2007*. Publisher: Stanford Captology Media ISBN-10: 78097950251 and ISBN-13: 978-0-9795025-2-1

[20] L. Festinger. "A theory of social comparison processes.", *Sage social science collection*, doi: 10.1177/001872675400700202 *Human Relations* May 1954 vol. 7 no. 2 117-140

[21] T. Toscos, A. Faber, K. Connelly, and A. Mutsuddi Upoma. "Encouraging Physical Activity in Teens. Can technology help reduce barriers to physical activity in adolescent girls?" *Pervasive Computing Technologies for Healthcare*, 2008. p 218-221, DOI: 10.1109/PCTHEALTH.2008.4571073

[22] Consolvo, S. K. Everitt, I. Smith, J.A. Landay, "Design requirements for technologies that encourage physical activity", in *Proceedings of the SIGCHI conference on Human Factors in computing systems 2006*. *CHI 2006 Proceedings • Designing for Tangible Interactions* April 22-27, 2006 • Montréal, Québec, Canada

[23] S. Consolvo, P. Klasnja, D . McDonald, J. Landay. "Goal-setting Considerations for Persuasive Technologies that Encourage Physical Activity", In *proceedings of the 4th International Conference on Persuasive Technology 2009*. *ACM International Conference Proceeding Series*; Vol. 350, DOI: http://doi.acm.org/10.1145/1541948.1541960