

Games for a better life : effects of playing wii games on the well-being of seniors in a long-term care facility

Lee, Kwan Min; Jung, Younbo; Li, Koay Jing; Ng, Janissa Sihui; Wong, Gladys Li Chieh

2009

Jung, Y., Koay, J. L., Ng., J. S., Wong, G. L. C., & Lee, K. M. (2009). Games for a better life : effects of playing wii games on the well-being of seniors in a long-term care facility. Proceedings of the 6th Australasian Conference on Interactive Entertainment 2009 (IE 2009), Australia.

<https://hdl.handle.net/10356/101524>

<https://doi.org/10.1145/1746050.1746055>

© 2009 ACM. This is the author created version of a work that has been peer reviewed and accepted for publication by Proceedings of the Sixth Australasian Conference on Interactive Entertainment, ACM. It incorporates referee' s comments but changes resulting from the publishing process, such as copyediting, structural formatting, may not be reflected in this document. The published version is available at:
[DOI:<http://dx.doi.org/10.1145/1746050.1746055>].

Downloaded on 20 Mar 2024 16:32:05 SGT

Games for a Better Life: Effects of Playing Wii Games on the Well-Being of Seniors in a Long-Term Care Facility

Younbo Jung

Nanyang Technological University
31 Nanyang Link, WKWSCI Building
Singapore 637718
+65-6316-8968

ybjung@ntu.edu.sg

Koay Jing Li

Nanyang Technological University
31 Nanyang Link, WKWSCI Building
Singapore 637718
+65-6316-8968

KOAY0003@ntu.edu.sg

Ng Sihui Janissa

Nanyang Technological University
31 Nanyang Link, WKWSCI Building
Singapore 637718
+65-6316-8968

NGSI0006@ntu.edu.sg

Wong Li Chieh Gladys

Nanyang Technological University
31 Nanyang Link, WKWSCI Building
Singapore 637718
+65-6316-8968

WONG0276@ntu.edu.sg

Kwan Min Lee

University of Southern California
3503 Watt Way
Los Angeles, CA 90089
+1-213-743-2317

kwanminl@usc.edu

ABSTRACT

In the current study, we examined the impact of playing Nintendo Wii games on the psychological and physical well-being of seniors in a long-term care facility. A six week-long intervention was held in SASCO Senior Citizens' Home, a long-term care facility in Singapore. Forty five residents aged between 56 and 92 years old participated in the longitudinal field experiment. Results showed that playing Wii games had a positive impact on the overall well-being of the elderly, compared to a control group that played traditional board games. Implications for future applications of Wii in interventions for the elderly are discussed.

Categories and Subject Descriptors

J.4 [Social and Behavioral Sciences]: Psychology.

General Terms

Experimentation.

Keywords

Seniors, Well-being, Video Game, Social Game, Intervention.

1. INTRODUCTION

The United Nations projected that the number of seniors aged 60 years and above will increase from 629 million in 2002 to 2 billion by 2050, with 54% of the world's older population residing in Asia. In developed countries, the proportion of seniors has already surpassed that of children (19 percent versus 18 percent) in 2000 [1]. Singapore is one such country facing this problem. The number of residents aged 65 years or older will multiply threefold from the current 300,000 to 900,000 in 2030 [2]. These statistics point to future challenges for Singapore, as the government prepares to cope with what they term the 'silver tsunami.' In the anticipation of a population that will soon be skewed towards the older demographic, greater attention is increasingly paid to prepare the nation for a larger elderly population. Over the past decade, there was marked increase in

the number of health care centers and care facilities catering to the elderly [2]. Yet, providing good quality healthcare for the elderly population remains a challenge due to concerns over the affordability and availability of manpower to provide such care.

Therefore, it becomes essential to explore new ways of allowing seniors to maintain an active lifestyle and continue to be socially integrated with the community. This means not only adapting already existing tools to the needs of seniors, but also developing tools especially devoted to prevent or treat seniors' precise impairments and diseases [3]. One of the tools is the use of video games to address health issues. Ever since the inception of the video game, the benefits of these games have been recognized beyond their function as a source of entertainment. Previous research has consistently shown that playing video games has the ability to aid improvements in attention span, hand-eye coordination, motor skills, short-term memory, problem-solving and reaction time [3]. As such, video-game playing has been implemented in numerous healthcare interventions. Some examples of video-game based interventions include the use of video-game playing as a treatment or rehabilitative tool for specific health problems such as cerebral palsy and improving motor skills [4, 5]. The benefits of video games have also been explored in interventions that involve improving peoples' perceptual and cognitive abilities, as well as the training of visual attention for better driving skills [6, 7]. The incorporation of bodily movements in games such as "Dance Dance Revolution" has led to their use for health-related physical benefits [8].

Despite their numerous benefits, cutting edge video-game technology has seldom found a receptive audience among the elderly. However, Nintendo Wii, a home video game console, has not only achieved tremendous commercial success, it has also amassed a huge following among the elderly. Dispelling the stereotype that the elderly cannot keep up with technology, people in the above-65 age group have quickly picked up on Wii. Roughly 25 percent of today's gamers are above 60 years old, and Wii is their game of choice [9]. Although researchers are beginning to recognize the appeal of Wii and have begun to make inroads into understanding its benefits, there are a few empirical

studies in this area. Therefore, the purpose of our study is to examine the effects of playing Wii on the overall well-being of the elderly in a field setting.

2. LITERATURE REVIEW

2.1. Video Games and the Elderly

The therapeutic effects of video games for the elderly have caught the interest of researchers for some time now. The concentration, memory and reflexes required in the ‘first generation games’ inspired researchers who started using them as methods to enhance the perceptual abilities of the elderly. Clark, Lanphear and Riddick [10] explored the effects of the elderly playing with ‘Pac Man’ and ‘Donkey Kong’ twice a week over seven weeks, and observed a reduction of their reaction time. Another study required the elderly to play a video game called ‘Crystal Castle’ once a week over a period of two months. Results indicated that the game improved the elders’ manual dexterity, hand-eye coordination, and verbal and non-verbal intelligence [11]. The cognitive functions of video games have also been put to medical uses such as disease diagnosis. For example, ‘FreeCell,’ a solitaire game installed in many home computers, was used to diagnose Alzheimer’s [12]. Research that has been done on the therapeutic effects of video games on the elderly has also been applied in physiotherapy and occupational therapy [13, 14]. Video games can also act as educational tools for the elderly and are advocated by researchers in this area as a useful tool for enhancing short- to long-term memory functioning [15].

Research of video games on the elderly has also extended its scope to take into account the emotional and psychological aspects of gaming. As a result of physical and emotional involvement in video-game play, such games have demonstrated the ability to improve self-esteem among the elderly [16]. Besides enhancing information processing, reading, comprehension and memory abilities of the elderly, Whitcomb reported that gaming also had an impact on their self-image [17]. A longitudinal study conducted by McGuire examined the effectiveness of playing video games on self-esteem and affect of the elderly who were residents in a long-term care facility [16]. The elders improved significantly on both affect as emotional responses and self-esteem upon completion of the eight-week long study. This study demonstrated the use of video games as a non-instrumental activity to improve the quality of life for the elderly in long-term care facilities.

2.2. Wii as an Intervention

The characteristics and features of Wii have the potential to address the health and well-being concerns of the elderly. Firstly, its game interface provides a real-time visual representation of the players (i.e., avatars) involved in the game. This interactive aspect may foster social interactions between players. Secondly, a substantial amount of physical activity is required to play Wii. These two features of Wii differentiate it from other forms of video gaming and are likely to be significantly beneficial in health interventions.

The immense popularity of Wii among the elderly debunks the notion that video games are only for young children and teenagers and shows the tremendous potential of this market for gaming technology [18]. Besides being highly entertaining, Wii allows the elderly to socialize and exercise while playing the games. For

example, Wii bowling leagues have also been known to be organized around its bowling game [19]. Playing Wii also has benefits in improving functional abilities like hand-eye coordination and balance, which in turn reduce the incidence of falls among the elderly [20]. Hence, some nursing homes and care centers have adopted Wii and incorporated it into their daily activities [21].

2.3. Playing Wii and Psychological Well-being

According to Crisp, an individual’s well-being, in general, is what is ‘good for’ himself or herself and it amounts to the notion of how well an individual’s life is going for the individual [22]. Hence, overall well-being is an important reflection of how one regards his or her own life. The Social Production Function (SPF) Theory was applied as a structural framework to describe the satisfaction of the needs of the elderly, where both health-related and non-health related factors play a part in determining one’s quality of life. In this theory, quality of life is defined as psychological well-being, which is dependent on the realization of both social and physical needs [23]. Having a sense of well-being is related to basic psychological needs and these also include emotional issues such as pleasure, mood regulation and relaxation, as well as issues of identity, belonging, and agency [24]. Apart from having a sense of well-being, the other two most desirable conditions in order for the elderly to enjoy life is good physical health and social contacts [23]. Being in a good state of physical and psychological health is necessary for well-being [25]. Based on our discussion, we propose the following hypotheses about psychological well-being. In this study, overall subjective well-being constitutes of affect as emotional feelings, self-esteem, and loneliness.

H₁: The elderly who played Wii games will feel more positive affect, compared to those who did not play Wii in a long term care facility.

H₂: The elderly who played Wii games will feel more positive self-esteem, compared to those who did not play Wii in a long term care facility.

H₃: The elderly who played Wii games will feel less lonely, compared to those who did not play Wii in a long term care facility.

2.4. Playing Wii and Physical Activity

A unique aspect of Wii is the fact that it incorporates a substantial amount of physical movement and activity into the act of playing the Wii games. Empirical research has demonstrated the medical benefits of Wii for the therapeutic treatment of cerebral palsy, Parkinson’s disease and osteoporosis [26]. So far, Wii has already been implemented in physical rehabilitation programs to help improve mobility [27]. Using Wii as a therapeutic activity with elders allows the clinician to work towards goals such as increasing standing and activity tolerance, improving dynamic balance and reducing fear and anxiety.

In the example of Wii Sports, a basic game that comes with every Wii console package, the controllers are used in the simulation of actual sports such as bowling, tennis and golf. Wii incorporates an element of entertainment into the exercise process, which is important for the enjoyment of the game. Wii Sports require players to simulate the arm motions similar to playing the actual sport. Through the use of Wii as an ‘exergame’ or ‘exertainment’,

Wii can be an innovative way of reducing sedentary activity in the elderly and promote a more active and health lifestyle for them. It allows them to simulate the experience of playing a sport that they may not be physically capable of doing in real-life. In view of these beneficial qualities of the Wii, we propose the possibility of this interactive technology in positively influencing the physical well-being of the elderly population.

H₄: The elderly who played Wii games will engage in more physical activity, compared to those who did not play Wii in a long-term care facility.

3. Methodology

3.1. Overview

To explore the long-term psychological benefits of video games on the elderly, we collaborated with SASCO (Singapore Amalgamated Services Co-operative Organization) Senior Citizens' Home, a long-term care facility which has been providing shelter for needy elderly over 60 years of age in Singapore. Our goal was to implement a program involving Wii play that investigated whether playing Wii would be beneficial to the elderly, and how it may help to address the common needs faced by the elderly - and in specific, those residing in long-term care facilities like SASCO.

The intervention was a six-week long program, implemented in SASCO. Residents in SASCO include men and women of various ethnicities and dialects. The participating seniors were mostly semi-ambulant but were able to move around independently. They were qualified for the study if they had reasonable motor skills and vision and had functional cognitive abilities to play Wii games. In total, 45 residents took part in the study. The residents in the program were divided into two groups of 30 and 15 people respectively. In each group, quota sampling was employed to ensure that there was an equal mix of both males and females in the group. The participants were randomly assigned to one of the two conditions with gender balanced across conditions via the quota sampling method.

In the first condition, participants were given a Wii set with controllers. In total, four games from Wii Sports and Cooking Mama were introduced in the intervention. The Wii sports games were tennis, bowling, baseball and boxing. The second condition was a control group where participants played traditional games such as memory games, UNO and Jenga. To ensure comparability between this group and the Wii-playing groups, the games introduced were new to the participants.

The activity sessions, lasting 1.5 hours each, took place three times a week. During these sessions, the participants of each group gathered in separate activity rooms, where the various activities were facilitated by the researchers and volunteers from Fei Yue Community Services. Caregivers from SASCO were also present to assist the games. Taking into account the time taken for new technology to be adopted, three training sessions lasting 1.5 hours each were held one week before the actual intervention started. During the training, the participants were slowly introduced to Wii technology and taught how to use the controllers. A researcher was present to log in the amount of play time that each participant clocked in for that session. The amount of play time for each participant was tracked so that at the end of the week, everyone would have roughly spent equal amounts of time playing the games. On the average each week, participants in

the Wii group clocked an average of about 15 minutes playing Wii. Similarly, the elders in the control group who played traditional games instead of Wii, also clocked the same amount of playing time as the Wii-playing groups. Three training sessions, each lasting 1.5 hours a week, were also conducted in this group, one week before the actual commencement of the games.

3.2. Procedure

Face-to-face interviews were conducted on all 45 participants. Interviews were used instead of self-administered surveys as literacy was an issue with some of the participants. Another reason for conducting the interviews was the unique mix of languages and dialects that characterize first-generation Singaporeans. The participants were of various ethnicities and dialects and spoke a range of languages, such as English, Mandarin, Hokkien, Cantonese and Malay.

The questionnaire, originally in English, was translated into Mandarin by a professional translator. Interviewers who were proficient in the various languages were recruited to conduct the interviews. To ensure accurate translations, training sessions were held for the interviewers prior to the interviews. Apart from familiarizing them with the questionnaire and interviewing protocol, we also established a standard for translations in Hokkien, Cantonese and Malay to ensure that the translated words accurately reflected the intended meanings of the questions. All the interviewers were instructed to follow closely to the questionnaire to avoid any potential confounds that may arise because of the individual interviewers. For participants who were bilingual, interviews were conducted in the language that they were most comfortable with. Altogether, two sets of data were collected at the beginning and end of the intervention.

3.3. Measures

Loneliness was measured with the UCLA Loneliness Scale (Version 3). The scale has been tested in many studies and is regarded to be highly reliable in terms of internal consistency (coefficient α ranging from .89 to .94) and test-retest reliability over a 1-year period ($r = .73$) [28, p. 20]. The twenty items in the scale contain statements about participants' feelings on loneliness in a particular setting. Participants can choose between "Never", "Rarely", "Sometimes" and "Always" in response to the statements, with scores of '1', '2', '3' and '4' attached to them respectively. The scores on this index were averaged, with higher scores indicating a stronger sense of loneliness.

The *Rosenberg Self-Esteem Scale (SES)* was used as a measure of the participants' level of self-esteem [29]. This scale was initially designed by Rosenberg to measure adolescents' feelings of self-worth and acceptance, but has since been applied to many other contexts, including the elderly. This is a 10-item Likert-style questionnaire consisting of five positive and negative statements each. It is one of the well-used measures to assess self-esteem because of its proven validity [29]. The scores for all ten items were averaged ($\alpha = .89$), with higher scores indicating more positive self-esteem.

The *Bradburn Affect Balance Scale* was used to measure the level of positive or negative affect of the participants [30]. The ten statements in the scale are to be rated either "YES" or "NO", with five statements each reflecting positive and negative affect. Positive responses (reflecting positive affect) to the statements

were given a score of “1”, and negative responses (reflecting negative affect) were scored as “0”. The scores for all ten statements were totaled, with higher scores indicating a strong positive affect.

The *Physical Activity Questionnaire for Elderly Japanese* was adapted as a measure of physical activity [31]. It was developed as a recall questionnaire that explores the frequency and duration of involvement in each of seven categories of physical activity during a typical week in the preceding month. Hence, it acted as a valid reflection of any physical changes that would have taken place during the duration of the intervention. Four types of physical activity that were relevant to the lifestyles of the elderly at SASCO were chosen: these include Light Exercise, Moderate Exercise, Light Housework and Labor. For each category of physical activity, respondents were asked how often they performed this activity in a given week: never, seldom (1 or 2 days), sometimes (3 or 4 days), or often (5–7 days). Based on their answer, there were then asked about time taken to perform that activity, with options ranging from <1 hour, 1 to <2 hour, 2 to <4 hours, or ≥4 hours. The categorical data was subsequently converted to arbitrary scores, using midpoints for the stated frequency and duration of potential responses. The midpoints for frequency are never = 0, seldom = 1.5 days, sometimes = 3.5 days, and often = 6 days, and for the duration of effort, the corresponding midpoints are <1 hr = 0.5 hours, 1 to <2 hours = 1.5 hours, 2 to <4 hours = 3 hours, and ≥4 hours = 5 hours. To convert these arbitrary PAQ-EJ scores to MET hours per week, an intensity weight was assigned to each physical activity. The weightings used for this purpose were light exercise = 3.0 METs, moderate exercise = 4.3 METs, light housework = 2.0 METs, and labor = 2.8 METs. The final PAQ-EJ score was computed as the product of: the number of days, time taken, and the intensity weight of that activity.

4. RESULTS

An independent-samples *t* test was conducted to evaluate H1, H2, and H3 that seniors who played Wii are better off in their psychological well-being than seniors who engaged in traditional activities. The various aspects of well-being measured were the feelings of loneliness, affect and self-esteem.

Table 1. Results of independent-samples *t* test on Wii vs. Control Group: Post Intervention

Variables	Wii		Control		<i>t</i> (43)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Affect	4.35	1.52	2.93	1.64	2.85*
Self - Esteem	3.70	0.48	3.07	0.52	3.98**
Loneliness	2.07	0.57	2.99	0.46	5.34**
Physical Activity	30.08	16.98	9.91	6.23	4.30**

Note: * $p < .05$, ** $p < .01$ (2-tailed).

Consistent with H1, H2, and H3, the elderly in the Wii condition scored significantly higher on self-esteem and affect, and significantly lower on loneliness, compared to those in the control group. To investigate H4, the same test was conducted on the

variables of physical activity. Seniors in the Wii condition reported higher levels of physical activity, compared to seniors in the control group. Therefore, H4 was also supported. The means, standard deviations and *t* values of all the variables tested on these two groups are shown in Table 1.

In addition, the same independent-samples *t* test was conducted based on pre-test data. These post-hoc explanatory analyses were conducted to investigate whether there were changes in the Wii-playing group due to the intervention. Results indicated that there was not any significant difference between the Wii play group and the control group at the beginning. Table 2 summarizes the results.

Table 2. Results of independent-samples *t* test on Wii vs. Control Group: Pre Intervention

Variables	Wii		Control		<i>t</i> (43)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Affect	4.84	2.28	4.79	1.58	0.08
Self - Esteem	3.48	0.58	3.09	0.82	1.88
Loneliness	2.35	0.52	2.70	0.64	-1.93
Physical Activity	19.74	14.46	18.76	13.62	0.21

Note: * $p < .05$, ** $p < .01$ (2-tailed).

5. DISCUSSION

The major purpose of the current study was to assess the potential of Nintendo Wii in improving the quality of life of the elderly. The results showed that participants in SASCO who played Wii responded very well to the intervention. Compared to the control group exposed only to traditional games, the Wii group scored significantly higher on all the measures at the end of the intervention. This finding implies the positive effects of playing Wii on the overall well-being of the elderly. This was measured by their psychological well-being consists of self esteem, affect, and loneliness, as well as physical activity. The pre and post-test results indicated that the overall well-being of the Wii-playing group improved more significantly after the intervention.

To gain a deeper understanding into these differences, longitudinal comparisons were conducted for the Wii-playing group and the control group. This design allows us to eliminate an alternative explanation, the Hawthorne effect [32], for the improvement of well-being among the elderly. It is possible that the elderly may appreciate the increased amount of attention paid to them during the intervention, which could have resulted in their improved well-being. However, the lack of significant positive changes in the control group negates the Hawthorne effect as both groups received the same amount of attention during the intervention.

Taken together, the result provides empirical support for our hypotheses stating that playing Wii can improve the overall well-being of the elderly. In other word, the results demonstrated the potential of Wii to impact diverse aspects of the elders' lives, from psychological to physical well-being. Not only do the significant improvements in the Wii-playing group demonstrate how Wii can be effective in improving the overall well-being of the elderly, they also reflect the multi-functional nature of the Wii

and its unique ability to facilitate physical activity. While past research has generally proven the usefulness of technology and all its features on psychological well-being and interaction, there have been relatively a few studies that examined the multiple roles that a video game can have in the context of the elderly and healthcare. The confluence of psychological and physical aspects of playing Wii makes it a unique device that has the potential to be a source of entertainment, exercise, and interpersonal bonding.

As a final remark, we focused on the effects of the Wii gaming technology and its characteristics on the well-being of the elderly in the current study. However, it is important to note that there are human factors that are equally significant and essential in order for technology to have a positive impact on the elderly. In this aspect, the role of the caregivers and supervisors in long-term care facilities cannot be underestimated. Their support and enthusiasm towards the technology provides positive feedback and encouragement for the elderly as they pick up on the new skills. This is especially vital as the elderly tend to be more resistant towards technology [33].

6. ACKNOWLEDGMENTS

We thank staff and residents of SASCO Senior Citizens' Home, Evelyn, and volunteers from Fei Yue Community Services. This research was supported by WCU (World Class University) program through the National Research Foundation of Korea funded by the Ministry of Education, Science and Technology (Grant No. R31-2008-000-10062-0). Kwan Min Lee serves the corresponding author for this article.

7. REFERENCES

- [1] United Nations. 2002. State of world population 2002: People, poverty and possibilities. DOI=<http://www.unfpa.org/swp/2002/pdf/english/swp2002eng.pdf>
- [2] Ministry of Community Development, Youth and Sports. 2006. Report on aging population. DOI = <http://www.mcys.gov.sg>
- [3] Gamberini, L., Alcaniz, M., Barresi, G., Fabregat, M., Prontu, L., and Seraglia, B. 2008. Playing for a real bonus: Videogames to empower elderly people. *Journal of CyberTherapy & Rehabilitation*, 1(1).
- [4] Griffith, J., Voloschin, P., Gibb, G., and Bailey, J. 1983. Differences in eye-hand motor coordination of video-game users and non-users. *Perceptual and Motor Skills*, 57(1), 155-158.
- [5] Jannink, M., van der Wilden, G., Navis, D., Visser, G., Gussinklo, J., and Ijzerman, M. 2008. A low-cost video game applied for training of upper extremity function in children with cerebral palsy: A pilot study. *CyberPsychology & Behavior*, 11(1), 27-32.
- [6] Belchior, P. D. C. 2008. Cognitive training with video games to improve driving skills and driving safety among older adults. Dissertation Abstracts International: Section B: The Sciences and Engineering, 68(9-B).
- [7] Boot, W. R. 2007. The effects of video game playing on perceptual and cognitive abilities. Dissertation Abstracts International: Section B: The Sciences and Engineering, 68(6-B)
- [8] Olmsted, B. J. 2008. The effects of interactive video (DDR) on heart rate, perceived exertion, step count, self-efficacy, and enjoyment in elementary school children. Dissertation Abstracts International Section A: Humanities and Social Sciences, 68(8-A).
- [9] Howard, C. 2008. Teachings from the Trenches. *Computer Graphics World*, 31(4), 42-46.
- [10] Clark, J. E., Lanphear, A. K., and Riddick, C. C. 1987. The effects of videogame playing on the response selection processing of elderly adults. *Journals of Gerontology*, 42, 82-85.
- [11] Drew, D. and Waters, J. 1986. Video games: Utilization of a novel strategy to improve perceptual motor skills and cognitive functioning in the non-institutionalized elderly. *Cognitive Rehabilitation*, 4, 26-31.
- [12] Jimison, H.B., Pavel, M., McKanna, J. and Pavel, J. 2004. Unobtrusive monitoring of computer interactions to detect cognitive status in elders. *IEEE Transactions on Information Technology in Biomedicine*, 8(3), 248-252.
- [13] Sietsema, J. M., Nelson, D. L., Mulder, R. M., Mervau-Scheidel, D., and White, B. E. 1993. The use of a game to promote arm reach in persons with traumatic brain injury. *American Journal of Occupational Therapy*, 47, 19-24.
- [14] Krichevets, A. N., Sirotkina, E. B., Yevsevicheva, I. V., and Zeldin, L. M. 1994. Computer games as a means of movement rehabilitation. *Disability and Rehabilitation: An International Multidisciplinary Journal*, 17, 100-105.
- [15] Farris, M., Bates, R., Resnick, H., and Stabler, N. 1994. Evaluation of computer games' impact upon cognitively impaired frail elderly. *Computers in Human Services*, 11(1-2), 219-228.
- [16] McGuire, F.A. 1984. Improving the quality of life for residents of long term care facilities through video games. *Activities, Adaptation & Aging*, 6(1), 1-7.
- [17] Whitcomb, G.R. 1990. Computer games for the elderly. Proceedings of the conference on Computers and the quality of life (Washington, D.C., United States, Septemeber, 1990), 112 -115.
- [18] Petrecca, L. 2007. Tech giants target older buyers - and their cash. *USA Today* (November 30, 2007).
- [19] Baig, E. C. 2009. Older folks like tech toys, too. *USA Today* (January 8, 2009).
- [20] Kiefer, M. 2008. Local seniors get fit bowling with Wii. Pioneer Local. DOI = www.pioneerlocal.com/deerfield/news/1299345.de-wii-112708-s1.article
- [21] U.S. retirees bowled over by Wii. 2007. *USA Today* (March 23, 2007).
- [22] Crisp, R. 2008. Well-Being. The Stanford Encyclopedia of Philosophy.
- [23] Puts, M. T. E., Shekary, N., Widdershoven, G., Heldens, J., Lips, P., and Deeg, D. J. H. 2007. What does quality of life mean to older frail and non-frail community-dwelling adults in the Netherlands? *Quality of Life Research*, 16, 263-277.

- [24] Laukka, P. 2007. Uses of music and psychological well-being among the elderly. *Journal of Happiness Studies*, 8, 215-241.
- [25] Gracia, E. 1997. Social support in the community intervention. Barcelona: Paidós.
- [26] Deutsch, J., Borbely, M., Filler, J., Huhn, K., and Guarrera-Bowlby, P. 2008. Use of a low-cost, commercially available gaming console (Wii) for rehabilitation of an adolescent with cerebral palsy. *Physical Therapy*, 88(10), 1196-1207.
- [27] Wadsley, P. 2009. Wii! Coming to a rehab center near you? *Momentum*, 2(2), 47-47.
- [28] Russell, D. W. 1996. UCLA loneliness scale (version3): Reliability, validity, and factor structure. *Journal of Personality Assessment*, 66(1), 20-40.
- [29] Rosenberg, M. 1965. Society and the adolescent self image. Princeton, NJ: Princeton University Press.
- [30] Bradburn, N. M., and Caplovitz, D. 1965. Reports on Happiness. Chicago: Aldine.
- [31] Yasunaga, A., Park, H., Watanabe, E., Togo, F., Park, S., Shephard, R.J., et. al. 2007. Development and evaluation of the physical activity questionnaire for elderly Japanese: The Nakanojo study. *Journal of Aging and Physical Activity*, 15, 398-411.
- [32] Adair, G. 1984. The Hawthorne effect: A reconsideration of the methodological artifact. *Journal of Applied Psychology*, 69(2), 334-345.
- [33] Smither, J., and Braun, C. 1994. Technology and older adults: Factors affecting the adoption of automatic teller machines. *Journal of General Psychology*, 121(4), 381-389.