Adaptive Engagement of Older Adults’ Fitness through Gamification

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Abstract
Many older adults lead sedentary lifestyles, as the challenges of aging can complicate efforts to maintain a healthy level of physical activity. These challenges can include decreasing strength, reduced mental capacity, social isolation, and the development of chronic health conditions. My PhD research attempts to analyze the needs and challenges of older adults and review their attitudes and motivations towards physical activity (PA). Furthermore, I aim to investigate various approaches in the development of socially interactive fitness activity programs, with the goal of increasing positive lifestyle motivations and quality of life (QoL). This research defines a taxonomy of motivational and personality characteristics of older adults to engage in PA. Lastly, this dissertation proposes the development of an adaptive application that addresses fitness gamification from the motivational perspective of an older adult. This application will empower older adults to engage in PA as a means to gain freedom, mobility and social interdependence within their public spheres.

Author Keywords
interaction design; gamification; game design; elderly; older adults; social interaction; entertainment technology; human factors; usability

ACM Classification Keywords

Research Situation
I am a PhD student in Computer Science supervised by Dr. Lennart E. Nacke, at the University Of Ontario Institute Of Technology, Oshawa, Ontario, Canada. As a 3rd year doctoral student, I anticipate that I will complete my degree in 2016. With an industrial design background and a design educator perspective, I have always been keen on researching and developing interaction modalities for the older demographic. This demographic, though growing in size is often neglected in the development of new technology. To combat this problem, we can encourage the integration of technology for gamified fitness and entertainment applications aimed at providing humanized experiences for an aging population. My work on social interaction
in public spaces and learning has resulted in a full paper publication at CHI PLAY 2014 [7], and short paper publications at CHI [5] [12] and Gamification [8] [6].

**Context and Motivation**

Cognitive and physical challenges of older adults define both limitations [2] and opportunities for them to participate in leisurely, recreational, and fitness activities. Research emphasizes the positive aspects of gaming and technological devices for older adults [2]. Most usability studies have been conducted with younger adults, and a study of the limitations and abilities of older adults would help develop usability criteria for designing fitness games for this demographic. It is important to challenge the current fitness activity paradigms for older adults, with the goal of increasing mobility, freedom, and social interdependence among the population[4]. This PhD research analyzes various methods that have been used in designing digital games that leverage the motivational characteristics of older adults. This dissertation examines the breadth of research conducted in the areas of social interaction of older adults through digital games. Following this analysis, it investigates the challenges and opportunities that would define a paradigm shift in the lifestyle enhancement of older adults through fitness gamification. The dissertation presents research into the area of motivational play through gamification, and identifies a summation of needs and challenges faced by older adults to engage in fitness activity. Furthermore, this dissertation proposes a taxonomy of personality characteristics of older adults who would engage in the exploration of fitness gamification. The application of this taxonomy within a research context will enable designers to customize fitness applications to specific older adult personality characteristics. With the identification of older adults’ motivational characteristics, I intend to develop an adaptive gamified website which addresses the needs, barriers, motivations and amotivational attributes of engaging in fitness gamification.

**Background and Related Work**

A great deal of research has been conducted on the topic of positive aspects of gaming and technology devices for older adults. This research has been focused predominantly on the relevance of gaming and its applicability in the areas of: rehabilitation, physical and cognitive training, leisure and entertainment, and adult learning. Whitcomb (1983) [13] presented pioneering research in the area of computer games for the elderly, discussing the benefits of engaging with digital games, ranging from improvements in perceptual-motor speed to social and educational enrichment. Nap et al. (2009) [10] indicated that seniors preferred to play games with realistic graphics or scenarios that conferred health benefits in the form of reflex tests or brain training. Many researchers have explored the Self Determination Theory (SDT) [11] construct, which propounds the value of intrinsic and extrinsic motivations. Facilitating internalization posits introspections and integrations [3] in relation to social contexts and SDT. While the core construct of gamification relies on the intrinsic and extrinsic motivations [11] provided by a gamified application, Larsen (2013) studied that users’ external motivation could increase their internal motivation over time [9]. The Kaleidoscope of Effective Gamification (KEG) [8] relies on influencing human behavior using game design principles in decision-making applications and services.
**Statement of Thesis or Problem Definition**
People within the age group of 50-70 years are often interested in the pursuit of healthy lifestyles; however, the aforementioned challenges of aging present hindrances to free and able fitness activity. Oftentimes, these adults require assistance and support in sustaining their intrinsic motivations to maintain a healthy and fit lifestyle. Older adults feel amotivated, confused, and unsure of the complex fitness offerings available in the marketplace and the adaptability of these programs to suit their specific needs. To develop more effective strategies for the facilitation of (PA) programs, I am interested in identifying the fitness motivations of older adults who lead an active lifestyle. An active lifestyle [14] was defined as the ability to engage in activity equivalent to walking more than 3 miles per day in addition to the independent completion of normal daily activities. The thesis statement involves researching the needs and motivations of older adults engaging in fitness activities, identifying personality characteristics of older adults related to motivations underlying fitness and play, and developing a needs-based, personalized, and adaptive gamified online fitness application. This development of motivationally aware playful technologies would help to sustain and improve the ability of older adults to create and achieve health and wellness goals.

**Research Goals and Methods**
From the intersection of motivations posited by SDT [11] and effective gamification (KEG) [8], I intend to analyze fitness activity data from multi-method studies including interviews and focus group sessions. In doing so, I will establish influencers for intrinsic and extrinsic motivation that help older adults to engage with online technology. This analysis will help to define the personality traits and motivational characteristics of older adults related to fitness activities, which can then be used to customize and personalize digital games for this specific population. I intend to evaluate motivational differences between people who are already active and those who lead more sedentary lifestyles. This evaluation will also examine different attitudes towards engagement with a gamified technology. Systematic collection and comparison of data pertaining to physiological activity and online performance will help us to establish a scientific framework correlating motivated (PA) and online presence. I plan to evaluate the use of and PA interaction with new online technology using the KEG [8] model. This would serve as a foundation for social computing and technologies that enable attention [1], engagement, and retention in a successful fitness service for older adults. Furthermore, this dissertation proposes the development of online fitness games for older adults through the deployment of adaptive technologies that recognize the importance of older adults’ motivational characteristics towards PA.

**Dissertation Status**
Deductive analysis of rich qualitative data from initial interviews and focus group sessions conducted with active older adults has been completed. I have identified preliminary fitness motivations of older adults using SDT [3] and KEG [8]. Currently, I am in the process of defining a fitness gamification strategy for motivating older adults to engage in (PA). I intend to conduct a pilot study of the developed application with this demographic, followed by a detailed qualitative study involving interviews to evaluate usability and the effectiveness of fitness gamification. At the consortium, I would like to receive feedback regarding my method.
of identifying and evaluating the fitness motivations of older adults, and inquiring into new areas to develop motivated play through these fitness applications for older adults.

**Expected Contributions**
Providing an aging population with an engaging fitness community and online service that is focused on their needs will allow older adults to continue to live healthily and minimize deterioration of their cognitive and physical abilities. Within the scientific and design communities, the development of this gamified online service and technology provides new insights in the understanding of fitness motivations in older adults. This research would help to pioneer gamification development for older adults, creating opportunities to engage in fitness activities and productive social interaction. My work surveys a wide range of older adults with different perspectives on fitness motivation and shows some of the common ground when they are struggling to motivate themselves to exercise. Through my research, I provide a complementary view of exercise motivation frameworks, demonstrating that certain motivational factors have superior relevance to older adults. The adaptive gamification application developed by this research would provide a method for customizing and personalizing fitness activities tailored to the needs of the older adults to improve their QoL.

**References**