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Investigating gameplay intention of the elderly using an Extended Technology Acceptance Model (ETAM)

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ABSTRACT

With the increase in an aging population, there is an urgent need for innovative solutions to help the elderly to improve their lives. Digital games have already been suggested as valuable tools for enriching the lives of old people, however, older users are less familiar with technology and are not likely to be early adopters of digital games. This paper investigates the gameplay intentions of older people based on data collected from 534 elderly respondents. An Extended Technology Acceptance Model (TAM) was constructed to tailor to the characteristics of elderly users to explore and examine the impact of potential factors on the gameplay intentions of the elderly. The results revealed the predicting power of game narrative, the social interaction and physical condition of the elderly, and the moderating effects of age, gender and previous experience on older people's gameplay intention. Implications were derived for the design of novel digital games that could foster physical activity, social interaction and entertainment for older people, especially for those who live alone.

1. Introduction

Cathy is 69 years old. Her husband died a couple of years ago. She is now living by herself in a quiet residential area in Leicester. She spends most of her time alone at home. Often, after finishing some routine housework, Cathy switches on her television and plays a digital game we called 'Active Senior Explorers' (ASE). The game enables her to travel around the world virtually. Today, she adopts the role of a travel reporter in the game and chooses to explore the Great Wall of China. By moving her body physically, she is able to 'climb' the Great Wall in the game. As Cathy has minor visual impairment, the game adapts the interface to her vision by adjusting the font size of the text and the resolution of graphical objects. While climbing, she meets virtually a group of elderly people and joins them to relive how the Chinese people built the Great Wall. Together, they enjoy the beautiful scenery and engage in some interesting conversations. Cathy feels very satisfied with the stimulating experience. In the evening, she falls asleep happily.

In 2008, in the UK alone there were >1.2 million elderly people leading isolated and lonely lives (Gary, 2008) with specific social and physical demands needing to be met to help them remain active and in good health. The world's most populous country, China, is expected to become home to the highest number of elderly people. China's sixth national census (China Sixth National Census, 2011), organized in 2010, reported that its population in the age group of 60 and above stood at approximately 178 million, accounting for 13.26% of the total Chinese population. The economic and social structures in China are still experiencing a phase of reform and, consequently, they cannot keep pace with the growing number of elderly people. With this increase in the aging population and the decline in the number of those of a working age, the age dependency ratio in China currently stands at 0.36, but this will reach an ultra-high level of 0.8 in 2070, based on United Nation predictions (United Nation, World Population Prospects, 2013), which suggests that four working-age people will have to support at least two senior citizens and one child. China's one child policy has further exacerbated the situation. It is not only China, but the whole world, which is urgently in need of innovative solutions to solve the particular health care problems that have come as a result of an aging population. Of all the problems older people may encounter at home, those related to leisure time are most intractable (IJsselsteijn et al., 2007). Consequently, we have developed a digital game concept which was inspired by these facts. The game aims to encourage physical activity, social interaction and entertainment among elderly people, especially those who live alone.

Digital technologies have become an indispensable part of our lives, and while technology in general can be employed to improve the lives of the elderly, this group has long been regarded as being uninterested in new technology or less capable of learning to use new devices or services (McKenzie, 2011). In general, the elderly tend to use less new technology than younger generations. This tendency has been observed in the use of personal computers at home and at work (Czaja and Moen, 2004), the Internet or the World Wide Web (Morrell et al., 2002), and

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other everyday technology such as dishwashers, microwave ovens, and videocassette recorders (Wahl and Mollenkopf, 2003). However, it is not necessarily the case that the elderly wish to ignore new technology. On the contrary, it is evident that many elderly people are expressing their interest in learning to use new technology (Morrell et al., 2000).

Digital games have been shown to be a valuable tool for helping people across their typical lifespans to improve lifestyles, healthy behavior and manage disease (Hannah and Stuart, 2012). The benefits of cognitive functioning to be gained from playing digital games, such as executive control, processing speed, attention control and spatial ability are clearly in evidence (Green and Bavelier, 2003; Sarah et al., 2013). However, most studies on digital games have focused on finding any potential adverse effects associated with playing such games (Gentilea et al., 2004). Most of the attention of these studies has centered on children and adolescents where the interests lie mainly in whether or not playing digital games, and violent games in particular, can have an impact on the development of negative behavior, such as aggression (Bushman and Anderson, 2002).

There have already been efforts to use technology to support old people's daily lives, such as applications for personal care and housekeeping (Wahl and Mollenkopf, 2003). However, these types of solutions are typically not of any interest to old people because they are not for leisure activity (IJsselsteijn et al., 2007). New opportunities, such as using digital games to entertain old people, become feasible along with the latest technological advances. Overall, the frequency with which we make use of certain technologies depends on how well these technologies can serve our needs, and this is especially true for the elderly (Schutter and Abeele, 2010). Older adults are not likely to be early adopters of new technologies, as defined in diffusion of innovation research(Rogers, 2003); however, they are not opposed to using new technology (Morrell et al., 2000).

Digital games are no longer the preserve of teenagers or youngsters. In a study conducted in 1999, the Entertainment Software Association (EESA, 2013) estimated that only 9% of the digital gamers in North America were over 50 years old, however, by the year 2005 their estimate had increased to 19%. Other studies (Morrell et al., 2002) have validated that the players of digital games have extended beyond children, teenagers and young adults.

Inspired by these and other findings, the overall aim of this research is to construct a research model to help with the designing of effective digital games which aim to improve the quality of life for older people.

Understanding users' gameplay intention is the first step towards developing successful digital games (Law and Sun, 2012). On one hand, the Technology Acceptance Model (TAM) is one of the leading models widely used to bring about the understanding of factors impacting the intention to use new technology. TAM has been employed for various game technologies studies (Ryua et al., 2009) and elderly-specific technology acceptance studies (Mallenius et al., 2007). These studies may indicate that TAM-based approaches can be effectively used to analyze the elderly's adoption of advanced and innovative technology and systems. On the other hand, Chen and Chan (2011) concluded "TAM is a useful model, but to better understand technology acceptance behavior of older people, additional variables are to be included, related to biophysical and psychosocial characteristics, abilities and problems experienced by older people". Therefore, we consider to include the elderly-specific variables in the study of elderly's gameplay intention in addition to the conventional TAM constructs (i.e. perceived ease of use and perceived). An inductive research approach has been employed to: 1) first explore elderly-specific factors which may have impacts on the gameplay intentions of the elderly based on the existing literature; 2) then construct and test an extended TAM model specifically tailored to elderly users. We further improve our conceptual model by examining the moderating effects of demographics variables on the relationship between extended TAM constructs and intention to play digital games as literature (e.g. Hussaina et al., 2015) recognized individual difference factors (e.g. gender, age) as moderators in the acceptance of digital games.

In our study, "elderly" has been defined as an individual with a chronological age of 60 years and above. Chinese Association of Senior Citizens estimated in 2001 that by 2005 the percentage of the elderly living on their own was expected to reach 50% (Zhang, 2001). With growing aging population in China and growing number of elderly living on their own, we believe the implications of this study are important for both researchers and practitioners.

2. Research on the gameplay intentions of the elderly

The critical importance of intention as a predictor of usage or acceptance has long been established in the relevant literature (Sheppard et al., 1988; Taylor and Todd, 1995). Most previous technology acceptance studies have been derived from models such as the Technology Acceptance model (Davis, 1989) and Diffusion of Innovation models (Rogers, 2003). Both focus on user acceptance of technology by using intention or usage as the dependant variable (Compeau and Higgins, 1995; Davis, 1989). These models have been applied in the study of game technologies (Sun and Law, 2012). TAM has also been used to study acceptance by the elderly of robotic agents (Heerink et al., 2006), and their acceptance of residential technology (Ahn, 2004). However, there is still very limited research with an emphasis on older people's perceptions and play intentions of digital games (Pearce, 2008). Recent studies concerning the elderly and digital games are in the field of interaction design, which focuses on designing interactive digital products and environments for people's use (Khoo et al., 2006), but these studies have neglected to examine the relationship between game narrative and player characteristics (i.e. social interaction and physical condition of the elderly) with the gameplay intention, which is suggested explicitly or implicitly in game studies (Sun and Law, 2012)and in cognitive, psychological and behavioral literature (Yee et al., 2010; Schutter and Abeele, 2010; Smith et al., 2009). Most previous studies have also neglected to investigate the moderating effect of experience and demographic variables, such as gender and age, between gameplay intention and its determinants (Venkatesh and Morris, 2000; Venkatesh et al., 2003; Levy, 1988). This paper is one of the first studies to investigate the relationship between variables, such as narrative, social interaction, health condition and elderly people's intentions to play digital games.

3. Extended Technology Acceptance Model for the Elderly (ETAME)

Davis (1989) has shown how valid scaled and defined perceived ease of use and perceived usefulness are the two fundamental determinants of attitude towards using, and how attitude towards playing predicts intention. According to (Davis, 1993), perceived ease of use is found to have a direct effect on perceived usefulness, while perceived usefulness is not found to have an impact on perceived ease of use. The easier it is to use a system, the more useful the system should be. However, the reverse does not hold. According to Fishbein and Ajzen's attitude theory (Fishbein and Ajzen, 1975), perceived ease of use and perceived usefulness have indirect effects on intention mediated by attitude towards use. Perceived usefulness was not only shown to have an indirect effect on intention but it also exerts more than twice as much direct influence on intention than does attitude towards playing, which underlines the critical importance of perceived usefulness (Davis, 1993). The direct effect of attitude towards playing on intention was further validated in the Theory of Reasoned Action setting (Sheppard et al., 1988). The original TAM is shown in Fig. 1.

The attention of previous studies which employed the TAM was largely centered on children and adolescents (Bushman and Anderson, 2002), so it is possible that the TAM may not be suitable for studies of the elderly. Consequently, we have extended the TAM to accommodate this particular user group - namely, elderly users. We have included a