The Effects of Familiarity Design on the Adoption of Wellness Games by the Elderly

Zhengxiang Pan[†], Chunyan Miao[*†], Han Yu[†], Cyril Leung[†‡] and Jing Jih Chin[§]
[*]*School of Computer Engineering, Nanyang Technological University (NTU), Singapore*
[†]*Joint NTU-UBC Research Centre of Excellence in Active Living for the Elderly (LILY), NTU, Singapore*
[‡]*Department of Electrical and Computer Engineering, the University of British Columbia, Vancouver, BC, Canada*
[§]*Tan Tock Seng Hospital (TTSH) and Lee Kong Chian School of Medicine (LKCMedicine), NTU, Singapore*
{panz0012, ascymiao, han.yu}@ntu.edu.sg, cleung@ece.ubc.ca, jing_jih_chin@ttsh.com.sg

***Abstract*—The elderly often struggle when interacting with technologies. This is because the software and hardware components of the technologies are not familiar to the elderly's mental model. This is a lack of empirical studies about how the concept of familiarity can be infused into the design of interactive technology systems to bridge the digital divide preventing today's elderly people from actively engaging with such technologies. In this paper, we investigate the impact of familiarity in design on the adoption of wellness games for the elderly. We propose a familiarity design framework with three familiarity design elements: 1) *symbolic* familiarity; 2) *cultural* familiarity; and 3) *actionable* familiarity. We then conduct a focused group study involving 10 people over 65 years old to experience two wellnesses games - one with familiarity based design considerations and one without. The results shows that familiarity in design improves the perceived satisfaction and adoption likelihood significantly among the elderly users. These results can potentially benefit intelligent interface agent designed to interact with elderly users.**

***Keywords*-Symbolic familiarity; cultural familiarity; actionable familiarity; elderly; human-agent interaction;**

I. Introduction

The gradual ageing of Singapore's population has enormous economic and social consequences that will need to be addressed urgently in order to soften their impact on society in the next few decades. Despite the utmost importance of aging, there is a significant dearth of technologies available at the moment to deal with serving the elderly. The elderly have a hard time interacting with technology [1] and there is a need to address this "technophobia". One important reason for the lack of participation in the use of technology by seniors has to do with the lack of age-friendliness of technological hardware, software and interfaces [2].

This research and the efforts towards inclusion of the elderly under the umbrella of technological use by the population has important ramifications for society. A greater embrace of technology by the elderly would lead to provision of greater support to them, their physical independence, their greater social and psychological activity which would lead to an enhanced feeling of emotional well-being. This would improve their feelings of self-worth, their dignity and their quality of life. As the elderly form a significant proportion of Singapore's population, this would mean, an enhancement of the quality of life and the level of satisfaction of a significant percentage of the Singapore population.

In this paper, we investigate the impact of familiarity in design on the adoption of wellness games for the elderly. We propose a familiarity design framework with three dimensions of familiarity design: 1) *symbolic* familiarity; 2) *cultural* familiarity; and 3) *actionable* familiarity. We then conduct a focused group study involving 10 people over 65 years old to experience two wellnesses games containing different sets of with familiarity design elements. The results shows that familiarity in design improves the perceived satisfaction and adoption likelihood significantly among the elderly users. With these results, we discuss how the study can benefit intelligent interface agent [3], [4] design when these agents need to interact with elderly users.

II. Related Work

Research into familiarity has occurred within several different fields, such as consumer behaviour [5], [6] (especially consumer trust [7], [8], [9], [10], [11], [12], [13]), collaboration [14], recognition memory [15], human computer interaction (HCI) [16], [17], [18] and intuitiveness [19], [20]. In order for the adoption of technology in general and wellness games in particular several researchers have suggested the importance of various factors. These include, but are not limited to accountability [21], usability [22], accessibility [23], [24] and acceptability [25]. So while keeping all of these factors in mind, the research shall focus on the effects of familiarity in design on the adoption of wellness games for the elderly. Herein, the wellness games are defined as those games that necessitate body movements in order to control on screen activity and those that can supplement or complement traditional exercise [26].

Upon utilization of the related work, the definition of familiarity was developed for this research. According to this definition, familiarity refers to recognition and understanding as a result of previous knowledge and that familiarity is a gauge of the extent of recognition and understanding pertaining to a specific context as a result of previous knowledge [27]. Something is familiar when it is recognized and in some way understood as a result of prior knowledge [28].

III. A Framework of Familiarity Design

The effect of familiarity on the interaction between a user and a technological product can be summarized in three stages. The first stage relates to the works of Fitts and Posner [29], Taatgen et al [30], and Ericsson [31], and can be referred to as the "Cognitive stage". It revolves around the basic knowledge required for task execution. The second stage is referred to as the "Associative stage" in which the persons move from their declared understanding of the action to a process based performance of the action. The stronger the association with something the person is already familiar with, the higher the speed of execution and the lower the amount of effort needed to carry out the action [30]. The third stage is called the "Autonomous stage" in which the actions follow a smooth procedure and actions are quick and involve negligible effort.

Based on this three-stage model of the effect of familiarity, we propose a framework of familiarity design for human-computer interactions. It consists of three dimensions of familiarity design elements:

1) *Symbolic Familiarity*: objects, activities or processes commonly occurring in the target users' daily life are infused into the design of a system.
2) *Cultural Familiarity*: concepts, artifacts, patterns, traditions, or rituals commonly appearing in the target users' culture are infused into the design of a system.
3) *Actionable Familiarity*: the acts of interacting with the symbolic familiarity elements and cultural familiarity elements in a system are similar to the acts of interacting with these elements in real life.

Depending on the degree of fidelity in replicating the symbolic and cultural familiarity objects in a system, and the similarity between interacting with these elements in the system compared to interacting with them in real life, a given computing system can be quantitatively evaluated based on these three dimensions of familiarity design.

IV. The Focus Group Study

A. Study Design

The familiarity research was carried out at Joint NTU-UBC Research Centre of Excellence in Active Living for Elderly (LILY).For the purpose of carrying out research on familiarity, two similar interactive game systems are selected. They are the Personal wellness and rehabilitation suite (PWRS) (Figures 1 and King Ping Pong (Figure 2).

Both games are virtual table tennis games. As playing table tennis is a familiar activity in the participants' daily life, both games are considered to contain symbolic familiarity. PWRS contains culturally familiar elements (e.g., the dragons in the background) to the study participants who are Singaporeans, while King Ping Pong does not contain such elements. Thus, PWRS is considered to contain cultural familiarity while King Ping Pong is not. In PWRS, players

Figure 1. Observation of elderly's table tennis play involving camera with depth sensors (virtual reality).

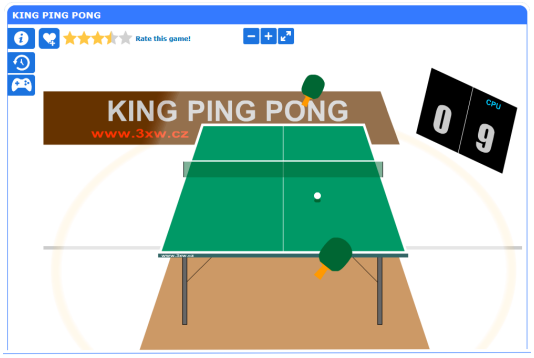


Figure 2. The King Ping Pong game screen.

can use body gestures similar to playing table tennis to control the virtual paddle, whereas King Ping Pong requires the player to use a mouse to control the paddle. Therefore, PWRS is considered to contain actionable familiarity while King Ping Pong is not.

B. Study Participants

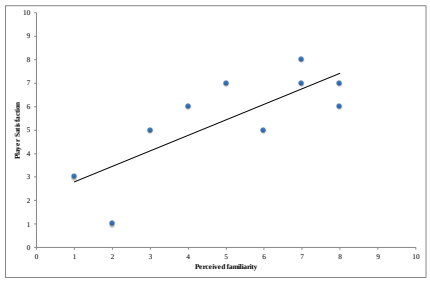
The study was carried out with the help of a focus group of 10 senior citizens with ages between 65 and 85 years with a mean age of 74.6 and a standard deviation of 6.80. They were asked to play both the PWRS game and King Ping Pong game. Each participant played both games uninterrupted for about 2 minutes each. They were observed during their game play sessions and interviewed at the end of each session. A survey form was filled up by each participant as part of the evaluation process.

V. Results and Analysis

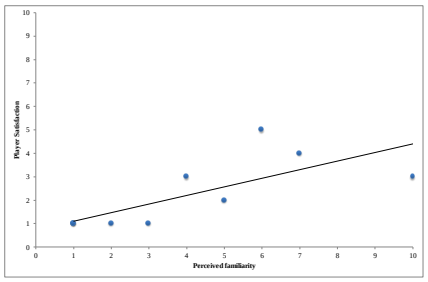
In this section, we discuss the results obtained from analyzing the study participants' responses to the interviews and the survey questionnaire.

As can be seen from Figure 3(a), there is a strong positive correlation between the elderly participants' satisfaction and the perceived familiarity for PWRS (with a product moment correlation coefficient value of 0.78). Hence, it can be seen that the higher the perceived familiarity of a game, the greater the elderly user satisfaction is with the game.

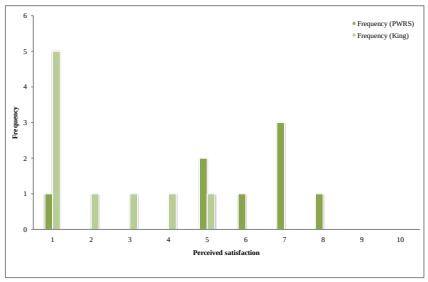
As can be seen from Figure 3(b), there is a strong positive correlation between the elderly participants' satisfaction and



(a) The relationship between satisfaction and perceived familiarity for PWRS

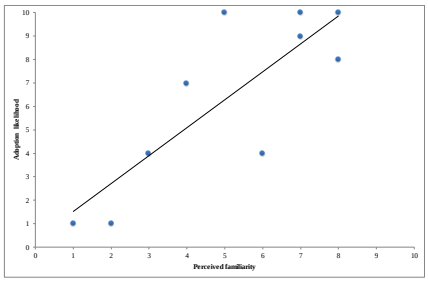


(b) The relationship between satisfaction and perceived familiarity for King Ping Pong

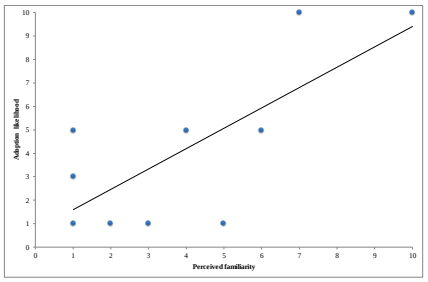


(c) The PWRS and King Ping Pong satisfaction

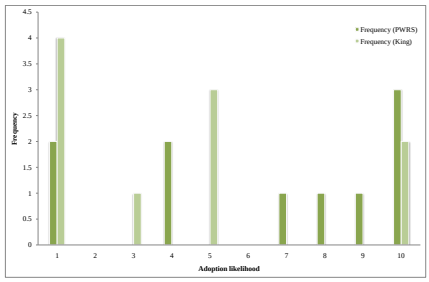
Figure 3. Analysis of user satisfaction.



(a) The relationship between adoption likelihood and perceived familiarity for PWRS



(b) The relationship between adoption likelihood and perceived familiarity for King Ping Pong



(c) The adoption likelihood for PWRS and King Ping Pong

Figure 4. Analysis of adoption likelihood.

the perceived familiarity for King Ping Pong (with a product moment correlation coefficient value of 0.75). Hence, the results obtained from Figure 3(a) are upheld. By Comparing Figure 3(a) with Figure 3(b), it is clear that player satisfaction for PWRS, which contains two more dimensions of familiarity design than King Ping Pong, is significantly higher than that for King Ping Pong.

It can be seen from the analysis of PWRS and King Ping Pong games (Figure 3(c)), the PWRS game is more popular among the participants and that the participants are more satisfied with it. The reason could again be linked to what is shown in Figures 3(a) and 3(b), that a greater perceived familiarity leads to a greater satisfaction with use.

From Figure 4(a), it can be seen from the analysis that there is a strong positive correlation between the likelihood of the adoption of a wellness game and the perceived familiarity with the wellness game (with a product moment correlation coefficient value of 0.82).

It can be seen from the analysis of King Ping Pong as well (Figure 4(b)), that there is a strong positive correlation between the likelihood of the adoption of wellness games and the perceived familiarity with the wellness game (product moment correlation coefficient value of 0.74). Hence the greater the perceived familiarity, higher shall be the likelihood of adoption of the wellness game.

It can be seen from Figure 4(c), the PWRS game is more popular and that the participants are more likely to adopt it than King Ping Pong. The reason can again be linked to what is shown in Figures 4(a) and 4(b), that a greater perceived familiarity leads to a greater likelihood of adoption.

VI. Discussions and Future Work

This research has yielded novel results that a greater perceived familiarity with respect to a wellness game is likely to lead to a better performance in terms of the ability to do well in the game, a greater satisfaction with its use, and a higher likelihood of adoption by elderly users. This has important implications for the adoption of other technological platforms in the context of gerontechnology. With the proposed framework, researchers who need to design intelligent interface agents which interact with the elderly can have a method to analyze which dimension of familiarity design the agents require.

In future research, we will focus on two main areas. Firstly, we will conduct larger scale studies involving senior citizens from more diverse backgrounds to improve the generalizability of our results. We plan to achieve this objective through a crowdsourcing [32] based experimentation platform. Secondly, we will study the relative importance of the three dimensions of familiarity design to provide more detailed guidelines for innovators serving the elderly.

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