Game Controllers for Older Adults: Experimental Study on Gameplay Experiences and Preferences

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ABSTRACT
With the world population ageing, studies had shown that gameplay influence to older adults' lives. However, there were few user studies to investigate older adults' experiences and preferences with different types of game controllers. The goal of our experimental study was to compare older adults' evaluation of three popular game controllers: (i) Button Controller, (ii) Gesture Controller and (iii) Mixed Button and Gesture Controller. Our findings showed that the older participants performed best with the Mixed Controller in *Nintendo Wii*. However, further analysis showed Gesture Controller in *Xbox Kinect* was most preferred controller type, despite some older participants having problems using body movements to complete the running game.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces and Presentation**]: User Interface – *input devices and strategies.*

General Terms
Design, Experimentation and Human Factors.

Keywords
Older Adults, Usability, Multimodality, Game, Controllers.

1. INTRODUCTION
With the world's population ageing, many health care centers and care facilities have been set up to cater to the needs of older adults. Other than health screening and regular exercise, they include gaming activities. Recent research also shows that playing games, such as the *Nintendo Wii*, can bring a positive influence to the older adults' lives [6]. However, the responses from older adults to various game controllers are still unknown.

There are a growing number of games for older adults in the market; manufacturers are bringing more modalities into gameplay such as 3D acceleration (e.g. Nintendo Wii), image and speech (e.g. Microsoft Kinect). In recent years, we see the introduction of three popular game controllers: *Button Controller:* (e.g. *Xbox 360* controller, *PlayStation 3* controller), *Gesture Controller: (Microsoft Xbox Kinect)* and *Mixed Button and Gesture Controller: (Nintendo Wii remote).*

These new game controllers employing new technologies have brought more variance into gameplay. However, there are few user studies investigating the efficacy and appropriateness of game controllers for older users. We believe that such studies are important, as older adults experience decline in their motor skills and response times as they age, and game developers should consider older adults-related issues in the design of game controllers so they are easy to use for older adults.

Hence, we propose an experimental study to investigate and compare older adults' feedback on performance, experiences and preferences of three popular game controllers: (i) only *button controller*; (ii) *only gesture controller*; and (iii) *mixed button and gesture controller*.

2. THE STUDY
We employed a within-subject design. Older participants were assigned to evaluate three different test conditions (three different types of controllers as independent variable). The dependent variables selected were performance data (task completion time), subjective rating of intuitive use, usability and experiences.

2.1 Participants
A total of twenty-four older adults, 17 females and 7 males, were recruited for the study. The participants (mean age = 74, SD = 6.4) were regular members of a Senior Activities Center. Except for one, all twenty-three recruited older participants had no prior experiences playing digital games. Majority of the participants were reported to be healthy, and had fine muscle movements and could move around on their own. At the end of the study, the participants received a $5 shopping voucher as a token of appreciation for their participation.

2.2 Selection of Gameplay
Inclusion of gameplay in our study was determined by classifying gameplay content into two categories: (i) game requiring gamers to hold the controller; and (ii) game not requiring gamers to hold the controllers, that is, hands-free.

2.3 Game Consoles and Titles
Three game consoles were used for our study including Xbox 360 with classical controller (*button controller*), Xbox with Kinect (*gesture controller*) and Nintendo Wii with Wii Remote (*mixed button and gesture controller*). Three set of game titles were used for the study including: (i) Beijing 2008 – 100m Sprint and AMF Bowling 2004 (button controller - Xbox 360); (ii) Kinect Sport 100m Sprint and Bowling (*gesture controller* – Xbox Kinect); and (iii) Mario and Sonic at the Olympic Games – 100m Sprint and Wii Sport Bowling (*mixed button and gesture controller* - Nintendo Wii).

2.4 Tasks
All older participants were required to complete two tasks for each controller type. **Running Task:** comprised of two stages: (i) Game Initiation; and (ii) Action Run. The participants were asked to start the game (Game Initiation) follow by players use the

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different controllers to make the game character run (Action Run). **Bowling Task:** comprised of three stages: (i) Direction Adjustment; (ii) Action Selection; and (iii) Actual Play. First players were asked to make adjustments of the direction that the bowling ball would go (Direction Adjustment). In the Action Selection stage, players indicate the strengths to throw the bowling ball (via button/gesture) and follow by player rolls the bowling ball start the game (Actual Play).

2.5 Measurement Items

Measurements for performance, gameplay experiences and preferences of different controller types include: (i) subjective rating of intuitive use; (ii) usability; and (iii) qualitative comments.

2.5.1 Intuitive use

To measure subjective consequences of intuitive use, we defined intuitive use as 'the subconscious application of prior knowledge that leads to effective interaction". Five subscales were used to capture intuitive use as described in [5]: (i) *Perceived Cognitive Load (PCL)* – (e.g. "Playing game using button controller was not complicated to me."); (ii) *Perceived Achievement of Goals (PAG)* (e.g. "I played the way that I wanted to play."); (iii) *Perceived Error Rate (PER)* (e.g. "No problem occurred when I play game using button controller."); (iv) *Perceived Effort of Learning* (PEL) (e.g. "The way of playing game using button controller was immediately clear to me."); and (v) *Familiarity (FA)* (e.g. "I could play the game without thinking about how to play."). The questionnaire items were answered on a five-point Likert scale (1=Strongly Disagree, 5=Strongly Agree).

2.5.2 Usability and Experience

To access subjective rating of usability and experience, the revised version of AttrakDiff's survey instrument [2] was used. The measurements of usability and experience have four product-related subscales [1,3,4] as: (i) *Pragmatic Quality (PQ)*. (e.g. "Playing games using button/gesture/mixed controller is straightforward."); (ii)*Hedonic Quality – Stimulation (HQS)* (e.g. "Playing games using button/gesture/mixed controller is challenging."); (iii)*Hedonic Quality – Identification (HQI)* (e.g. "Playing games using button/gesture/mixed controller is bringing me closer to the gameplay.");and (iv) *Attractiveness (ATT)* (e.g. "Playing games using button/gesture/mixed controller is inviting.").

2.5.3 Qualitative comments

Participants were also asked open-ended questions to elaborate on likes and dislikes of each controller type. In the last part, participant indicated their preferred game controller.

2.6 Procedure

Three game stations with different controller style were setup for the study. Participants were divided into groups of three people. One group took part in the evaluation at a time. Every member of group was randomly assigned to one station and started their evaluation. At each station, the participant began with a short introduction to the game console and how to play two games: Running and Bowling. Participants then completed the two tasks by playing the two games with the assigned console. The completion times for running task were recorded by the student assistants. When participants finished the tasks for one controller, they then completed the questionnaire giving feedback on the game controller.

The procedure was repeated for the other two stations until the participants completed evaluation of the three game controllers. Upon completion, participants then completed the last section of the questionnaire, which included self-reported information on preferences on the game consoles as well as their demographics.

3. FINDINGS AND IMPLICATION

The results of our study showed that older players could perform better with the *Mixed Button and Gesture Controllers* (Nintendo Wii Remote) in terms of completion times, compared to the standalone *Button Controller* or *Gesture Controller (*Wilks' Lambda = .16, $F(2,22) = 54.98$, $p<0.05$). The *Mixed Controller* also required less learning effort for the older players because they needed to learn to use the controller with less control buttons (only 1 button), and simpler body gesture (e.g. swinging the arm). However, when asked about the overall intuitiveness, usefulness and efficacy of each type of controllers, no significant differences were found.

In terms of preferences, even though the performance (completion times) with the *Gesture Controller* was not as good, the older participants still indicated the *Gesture Controller* as most preferred (42%) compared to the *Mixed Controller (25%)* and *Button Controller (8%). 21%* of the participants who did not prefer any type of controller, and *4%* liked all 3 types of controllers

Three main findings relevant to game design emerged from our study. First, the older participants preferred to play games with less or no controlling devices. Devices that require more hand manipulations seemed cumbersome to the older participants. Second, the *Gesture Controller* (Kinect), which reported to require a lot of physical movement, scored the highest in the overall attractiveness, while participants gave negative feedback to *Button controller,* which required fewer body movements. Perhaps the older adults were aware of the importance of physical activities, and the benefits of playing games for exercise. Finally, from the Hedonic Quality results (Stimulation and Identification), the older adults showed that they perceived the need to develop their knowledge and skill further for the new technology, i.e. *Gesture controller.*

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