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Older adults' engagement with a video game training program

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Abstract

Objectives—The current study investigated older adults' level of engagement with a video game training program. Engagement was measured using the concept of Flow (Csikszentmihalyi, 1975).

Methods—Forty-five older adults were randomized to receive practice with an action game (*Medal of Honor*), a puzzle-like game (*Tetris*), or a gold-standard Useful Field of View (UFOV) training program.

Results—Both Medal of Honor and Tetris participants reported significantly higher Flow ratings at the conclusion, relative to the onset of training.

Discussion—Participants are more engaged in games that can be adjusted to their skill levels and that provide incremental levels of difficulty. This finding was consistent with the Flow theory (Csikszentmihalyi, 1975)

Keywords

aging; flow; engagement; videogames; older adults

Introduction

Video games have become a popular form of entertainment in the United States, and the average age of video game players has been increasing. While the younger generation still dominates the gaming market, older adult gamers tend to play more frequently than their younger counterparts (Lenhart, Jones & Macgill, 2008). Several studies have investigated the effects of video games on the brain and behavior particularly of younger adults (Green & Bavelier, 2003; Castel, Pratt & Drummond, 2005; Boot, Kramer, Simons, Fabiani, &

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Graton, 2008; Dye, Green & Bavelier, 2009) but very few studies have focused on their benefits for the older population (Clark, Lanphear, & Riddick, 1987; Bazak, Boot, Voss & Kramer, 2008). Furthermore, there is a growing body of work on engagement in video game play (Vorderer, Hartman, Klimmt, 2003; Sweetser & Wyeth, 2005; Hefner, Klimmt & Vorderer, 2007; Nacke & Lindley, 2008; Klimmt, Rizzo, Vorderer, Kock & Fischer, 2009; Nacke, Stellmach & Lindley, 2010). Few of these studies have examined the engagement of older gamers. We have conducted an intervention study in which we investigated the efficacy of using video games to improve visual attention skills in older adults (Belchior et al., manuscript submitted for publication). While the main intervention outcomes have been detailed by Belchior and colleagues, the present study focused on the engagement of older adults in this type of entertainment. One rationale for using video games to train elders' visual attention was the assumption that games are more interesting and engaging, and as such would facilitate enjoyment and compliance.

To measure engagement in this study, we the researchers employed the concept of flow (Csikszentmihalyi, 1975). Flow is an optimal psychological state said to occur when people are able to meet the challenges of a given task or activity with appropriate skills and accordingly feel a sense of well-being, mastery, and heightened self-esteem (Csikszentmihalyi, 1990). Flow is also characterized by a deep sense of enjoyment that is not simply the result of satisfying a need, but is a deeper sense of having achieved something novel and unexpected (Csikszentmihalyi, 1990).

A key element of flow is a match between challenges and skills. According to flow theory research, when a person perceives a challenge (an intrinsic demand experienced when engaged in an activity) as being greater than his or her perceived skills (the individual's perception of his or her capacity to meet the demands of the activity), the person experiences anxiety. On the other hand, if the person perceives his or her skills as being greater than the challenge at hand, he or she will experience boredom and apathy (Massimini, Csikszentmihalyi & Massimo, 1987). Activities that are most likely to foster flow are those that have concrete goals and rules (Mannell & Bradley, 1986), provide clear feedback regarding performance, induce concentration, and allow the individual to meet challenges with adequate capabilities (Csikszentmihalyi, 1975, 1990, 1993; Keller & Bless, 2008).

Sherry (2004) posited that video games lend themselves well to the facilitation of flow. That is, most video games are rule-bound puzzles, supplying both concrete goals and novel challenges. Furthermore, games can be adjusted to the player's skill-level, and are designed to be adaptive thereby increasing in difficulty as the player advances. Finally, video games provide the player with control over the experience, provide concrete, consistent feedback regarding performance and create an immersive experience in a virtual environment (Sherry, 2004). Weber and colleagues (2009) augmented this conceptualization by postulating neuropsychological underpinnings for the flow experience, namely the synchronization of attentional and reward networks that occurs under the conditions of a balance between challenge and skill.

To date, very few studies have examined flow in the older-adult cohort. Exceptions include the work of Farrow and Reid (2004) who investigated stroke survivor's engagement in a virtual reality intervention program. Study findings suggested that older adults are not only comfortable using this new technology but were also engaged in the experience. Nacke, Nacke & Lindley (2009) found that digital games heighten the sense of flow not only in young adults but also in the older population.

The aim of this study was to investigate older adults' engagement, or perceived flow during the course of video game, relative to Useful Field of View (UFOV) training. We

hypothesized that participants who received video game training (i.e., Medal of Honor or Tetris) would report higher Flow scores as compared to participants who received UFOV training, which is a laboratory-based visual attention training protocol. The video games used in this study were selected on theoretical and empirical grounds in part due to prior evidence supporting the association of action games with visual attention improvements (Green & Bavelier, 2003; 2006).

Methods

Overall Procedure

Participants were recruited by phone calls, by mail and through flyers that were distributed in the community. Participants were then randomized to one of three training groups (Medal of Honor-Tetris-UFOV). Training consisted of 6 training sessions of 90 minutes each, which was completed in 2–3 weeks. After each training session, participants completed a flow questionnaire to measure their engagement with the training.

Sample

Forty-five participants (mean age = 74.7 years, $SD = 7.0$; 24 women) who were mostly college-educated (mean education = 16 years, $SD = 2.4$, high school to doctorate) took part in this study. Participants were randomized to one of three groups: (1) *Medal of Honor* training, $n = 14$; (2) *Tetris* training, $n = 15$; or (3) *Useful Field of View* training, $n = 16$.

Measures

The Flow State Scale (FSS) was used. This scale was developed by Jackson & Marsh (1996) using the Csikszentmihalyi, (1990) concept of flow. The FSS conceptualizes Flow in nine dimensions: Challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on task at hand, sense of control, loss of self-consciousness, transformation of time and autotelic experience. These dimensions were described previously by Csikszentmihalyi (Csikszentmihalyi, 1990) and they are also related to use of games and flow. Confirmatory factor analysis demonstrated a satisfactory fit for both the nine factor model and a single order model (flow), the internal consistency for the nine FSS scale was satisfactory (alpha $M = .83$), suggesting a good reliability and validity for this scale.

Participants in the two video game groups and in the UFOV training group answered the Flow State Questionnaire at the end of each of the six training sessions, after they had played games with a coach for about 90 minutes. Thus, each participant had a total of six Flow scores. The questionnaire used a Likert scale in which participants need to rate their level of agreement (strongly agree through strongly disagree) with statements like: “I was very challenged but I believed my skill would allow me to meet the challenge”, “My attention was focused entirely on what I was doing”, “I loved the feeling of that performance and want to capture again”, “At times, it almost seemed like things were happening in slow motion”. Scores (for each session) could range from 30–180, higher scores were indicative of greater Flow.

Training

For the three training conditions, training consisted of six one-on-one 90-minute sessions administered over 2–3 weeks. Trainers were undergraduate student assistants who had extensive self-reported experience with action video games. All trainers received instruction in the implementation of the study’s interventions, which are manualized. All undergrad students who worked in this project were trained by the principal investigator. The training was standardized and all students used the same procedures with all participants. Training details are described below.

The two video game training conditions (MOH and Tetris) employed a Sony PlayStation 2, console model 97060 and dual shock 2 analog controller, model 97026. The games were presented on a 19" TV monitor. The UFOV training was administered via a computer; a CPU was connected to a 21" ELO touch screen.

In order for training to be standardized, trainers were required to follow the manual training guide developed to the study. A manual guide with step by step instructions on game play were developed for both video game conditions and a training manual guide previously used in the ACTIVE (Ball et al., 2002) study was used for the UFOV condition. In the first training session, the trainers introduced the training to participants. Trainings were provided individually or in groups of 2. Feedback by the trainers was provided as needed.

Medal of Honor—In this training, participants were asked to play the "first person shooter" video game *Medal of Honor – Rising Sun*, first with a tutor and then more independently. In this first person action game, the participant assumed the role of a US Marine at Pearl Harbor. The player engaged in a variety of combat-related missions (e.g., navigating to the top deck of a battleship while extinguishing fires, assisting crew members, and fighting off enemy combatants).

Step by step instructions were presented through power point slides on a computer that was placed next to the participants. When participants have had successfully made it through the mission, they were asked to repeat the mission on their own, drawing on their tutor's help if needed. Once they had mastered a mission on their own, they moved on to the next mission with increased level of complexity.

Tetris—In this game, participants were asked to play the video game *Tetris* (Tetris worlds for PS2, arcade mode), with a tutor. In the game, which is a classic 1980s arcade game, seven randomly rendered tetrominoes or tetrads - shapes composed of four blocks each - fall down the playing field. The object of the game is to manipulate these tetrominoes with the aim of creating a horizontal line of blocks without gaps. When such a line is created, it disappears, and the blocks above (if any) fall. As the game progresses, the tetrominoes fall faster, and the game ends when the stack of Tetrominoes reaches the top of the playing field.

In this condition, there were no step by-step instructions on a computer screen, because there is no story line in this game. Unlike MOH, the game scenario did not change over the course of the following sessions. The participants had to repeat the same task over and over again. As game play improved, the speed of tetramino dropping increased.

Useful Field of View (UFOV)—The Useful Field of View training was administered via a computer. A CPU was connected to a 21" ELO touch screen. This training was adapted from the UFOV training guide from previous studies (Ball et al., 2002). In the initial assessment, participants received a preliminary score on the Useful Field of View (UFOV) test. In general, training was started at participants' current skill level. The complexity of the UFOV subtests is modified by holding the duration of the display constant and by gradually increasing the complexity of the central task, the peripheral task or both. These modifications allow individuals to practice the task at customized levels of difficulty until mastery is achieved.

Results

The present analyses were aimed at determining whether there were differences in participants' task engagement by intervention group, and whether levels of engagement changed over the course of training. One rationale for using video games to train elders'

visual attention was the assumption that games are more interesting and engaging, and as such would facilitate enjoyment and compliance. Thus, Flow scores were assessed from all intervention groups after each of their six intervention sessions. The resulting mixed between-within ANOVA included one within-persons factor, Occasion (6, Training Sessions 1 – 6), and one between-persons factor, Group (3, MOH, UFOV, Tetris). The dependent measure was the Flow score obtained at the end of each of the six intervention sessions. Results revealed a significant Occasion X Group interaction, $F(10, 185) = 2.0, p < .05, \eta^2 = .10$. Table 1 shows the means and standard deviations for each training group at each session. Figure 1 illustrates reported Flow experience across the six training session, by intervention group.

A post hoc t-test analysis using Bonferroni correction was conducted. However, given the number of comparisons (45), the resulting corrected p-value (.05/45) was so low as to not shed any light on the reason for the significant interaction. Thus, a Least Squares Difference post-hoc analysis was conducted to provide a preliminary, exploratory insight into the interaction, acknowledging that family-wise error was probably inflated in these comparisons. Here, the six training sessions were compared to one another, separately by training group. The LSD results revealed different temporal trends for the three intervention groups. For the MOH group, there was a significant increase in Flow after the first sessions (Sessions 2 and 3 were significantly greater than Session 1) and this persisted through the end (Session 5 was also significantly higher than Session 1). This suggests that participants experienced more Flow right after beginning the training sequence, and maintained these gains over time. A congruent pattern was found for the Tetris group. Although the visual pattern of Flow improvement for this group was one of monotonic linear increase over the six sessions, concretely Session 6 was significantly higher than Sessions 1 and 2. Thus, as with MOH, participants reported greater Flow experience as training progressed. A very different pattern was observed for the UFOV training condition. Here, there was little change in Flow over the six sessions, with the exception of one “outlier” session, Session 4. Session 4 was significantly lower in Flow than Sessions 1 and 5. Overall the results suggested that participants in the two video game conditions experienced increased Flow over time, which was not observed in the UFOV training.

Discussion

The aim of this study was to assess whether there were any group differences in the pattern of change in Flow over the six training session. The analyses revealed an interesting dissociation in pattern between the two video game groups and the UFOV group. Although the exact pattern differed slightly between the two video game groups, both MOH and Tetris participants reported significantly higher Flow ratings at the conclusion, relative to the onset of training. This suggested that there was growing enjoyment of and engagement with the games over the course of training (sudden and lasting for MOH, gradually incremental for Tetris). In contrast, the overall trend in Flow for the more mechanistic UFOV training was flat.

The pattern of Flow experience may have reflected differences in the training experience by group. For example, the UFOV training is highly repetitive. While training conditions change incrementally from trial to trial, the root task remains unchanged over the six sessions. Moreover, the UFOV visual interface is dichromatic and visually restricted to text and two dimensional icons. Thus, the task and the interface were not very “game like”, compared to the two video game conditions.

For MOH, the significant difference between the first session and later sessions (which had significantly higher Flow) may have reflected the initial difficulty of learning the complex

game. For Tetris, Flow gains were more gradual and incremental, and may have reflected participants' growing sense of mastery of the game. The patterns of findings observed are consistent with Csikszentmihalyi's (1990) Flow theory. Participants in the MOH initially experienced less Flow, which might have resulted from frustration experienced while skills were not adequate to meet the demands of the game. On the other hand, the mechanics and game strategy of Tetris were likely learned faster, which was reflected in the incremental trend in Flow reported by Tetris players. Thus, in the course of the brief game-based training utilized in this study, Tetris appeared to be most likely to promote the sense of mastery associated with Flow.

The literature supports this finding (Mannell and colleagues, 1986; Csikszentmihalyi, 1975, 1990, 1993; Keller and colleagues, 2008). Tetris had more clear goals and rules than MOH and participants received immediate feedback on their performance. As soon as they've mastered one level, the game became more challenging, demanding improved skills which according to the literature are characteristics of activities most likely to foster flow.

Game play in this study was limited to six laboratory-based sessions. Future studies would augment the literature on older adults' engagement with digital media by: 1) exploring these processes in the context of more prolonged experiences with games, and in naturalistic environments, such as participant's homes and 2) by investigating if engagement in the training would serve as an indicator of compliance with the training.

The use of video games in rehabilitation settings and community centers has been increasing in the past years, however, to date few studies have addressed older adults' engagement with this type of technology. This study will contribute to the literature by demonstrating that older adults' experience flow by playing video games. In addition, higher levels of engagement are experienced with games that provide clear goals in immediate feedback to players.

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Figure 1.
Flow experience across the six training sessions, by intervention group.

Table 1
Mean Standardized Scores and Standard Deviations of Flow Scores for the Six Training Sessions, by Intervention Group

	Total	MOH	UFOV	Tetris
Training				
Session 1				
M	115.78	106.5	123.5	116.0
SD	18.96	23.43	11.13	18.62
Training				
Session 2				
M	118.68	118.0	120.57	117.36
SD	20.93	23.97	17.6	22.63
Training				
Session 3				
M	117.35	115.58	119.36	116.86
SD	22.06	25.0	12.62	27.66
Training				
Session 4				
M	115.18	113.5	110.14	121.64
SD	26.23	24.51	29.92	24.19
Training				
Session 5				
M	120.68	118.25	119.5	123.93
SD	24.11	26.95	17.29	28.49
Training				
Session 6				
M	120.43	117.08	115.57	128.14
SD	27.67	28.28	23.99	30.73

Note. MOH = Medal of Honor; UFOV = Useful Field of View