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VIDEO GAMES AND THE ELDERLY

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We studied the effects of playing video games (Super Tetris) on the reaction time, cognitive/perceptual adaptability, and emotional well-being of 22 non-institutionalized elderly people aged 69 to 90. Volunteers in an elderly community in the Netherlands were randomly assigned to a videogame-playing experimental group or a non-playing control group. The televisions of the 10 videogame players were provided with Nintendo SuperNes systems. Participants played Super Tetris 5 hours a week for 5 weeks, and maintained a log of their play. Before and after this play period, measures of reaction time (Sternberg Test), cognitive/perceptual adaptability (Stroop Color Word Test), and emotional well-being (self-report questionnaire) were administered. Playing video games was related to a significant improvement in the Sternberg reaction time task, and to a relative increase in self-reported well-being. On the Stroop Color Word Test, both the experimental and control groups improved significantly, but the difference between groups was not statistically significant. The videogame-playing group had faster reaction times and felt a more positive sense of well-being compared to their nonplaying counterparts. Consistent with previous research on video games and the elderly, the present study finds the strongest effects on measures of reaction time, and the weakest effects on cognitive performance measures. Explanations and alternative interpretations of these findings are discussed.

Playing video games requires concentration, memory, coordination, and quick reactions. To the extent that they strengthen these skills, video games have potential benefits for the elderly (Hollander & Plummer, 1986; Schueren, 1986; Weisman, 1983). They may affect attention, hand-eye coordination, fine motor

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skills, short-term memory, problem-solving, and speed reactions to novel situations. Furthermore, by engaging people in play, they may also contribute to emotional well-being (Banse, et al., 1996; Goldstein, 1994; 1996). To the extent that game playing produces positive affect, this is associated with improvements in mental health (Dustman et al., 1992).

There is evidence from studies of the non-institutionalized elderly that videogame play can speed reaction time. Dustman and colleagues (1992) found faster reaction times among male and female 60- to 79-year-olds who played video games three hours per week for 11 weeks. Clark, Lanphear and Riddick (1987) report faster reaction times among men and women with a median age of 70 following seven weeks of videogame play.

Cognitive effects of video games have not been consistently obtained in studies of elderly players. Improved knowledge acquisition and retention among videogame-playing adults was reported by Ricci, Salas and Cannon-Bowers (1996), while Drew and Waters (1986) found higher WAIS IQs among the elderly after they played video games for 8-9 hours over a two-month period. However, Dustman, et al. (1992) found no effects of play on any of six tests of free recall, cued recall, and recognition memory for word lists. As in other research, Dustman, et al. report a significant improvement in reaction time, but no effects of videogame play on any of their cognitive measures.

Although only a few studies have been published on the effects of videogame play by the elderly, they suggest the possibility of behavioral, cognitive, and emotional effects. Our study is designed to examine behavioral, cognitive, and emotional responses to videogame play among the non-institutionalized elderly in the Netherlands. Based on the sparse literature on video games and the elderly, it was hypothesized that playing video games would be associated with faster reaction times, better cognitive/perceptual performance as measured by the Stroop Color Word Test, and an enhanced sense of emotional well-being.

METHODS

In the present study, a sample of non-institutionalized elderly people played video games for five or more hours a week for a period of five weeks. To recruit participants for the study, a lecture-demonstration about the research was held, and the relevant video games were demonstrated, in an apartment complex for the elderly. Volunteer residents agreed to play video games for a period of five weeks (in the summer of 1995). Reaction time, perceptual/cognitive adaptability, and emotional well-being were measured before and after this period.

Subjects

Subjects resided in a small town (population +12,000) in The Netherlands, in apartments for the elderly built around a central building containing administration, recreational, nursing, and dining facilities. An announcement in the housing newsletter asked anyone interested in a study of video games to attend an information lecture at which the purposes and general procedures of the experiment were described. Volunteers were solicited from the nearly 50 people in attendance. Participants had to be over 60 years of age, mentally competent, with good vision and no motor impairments.

Twenty-two volunteers were randomly assigned to an experimental and control group. This resulted in 10 experimental and 12 control subjects, all women with the exception of 1 man in each group. Their ages ranged from 69 to 90 years. The mean age of the experimental group was 76.5 years (sd = 3.8) and for the control group 78.7 years (sd = 6.4 years). This difference is not statistically significant.

The apartments of those in the experimental group were provided with a Nintendo SuperNes videogame console connected to their television sets. They were given a cartridge containing the game SuperTetris (hereafter Tetris). Tetris consists of seven different shaped blocks which descend on the screen and must be rotated rapidly to form a solid wall. Those in the experimental group were instructed to play Tetris for a minimum of five hours a week for a five week period. Each of them kept a log of their playing schedule, highest score and highest level attained. Playing time varied from 25.5 to 36.5 hours, but two women played 63 and 111 hours. The control group completed the same pre- and post-test measures but did not play video games. At the beginning and end of the study, all participants in the experimental and control groups were tested for reaction time, cognitive performance, and emotional well-being. Testing was done in a common room of the administration building.

Dependent Measures

Reaction time

Reaction time was measured with procedures described by Sternberg (1969) and used in prior research on video games and reaction time by Dustman et al. (1992). The Sternberg test measures reaction time to a display of figures on a computer screen. Memory loads of 1, 3, and 5 digits were shown on a computer screen for 1 second. A fixation point then appears on the screen, followed by a single digit. If the single digit was part of the previous display, the person presses a 'yes' key; otherwise, the 'no' key. After getting at least 8 of 10 practice trials correct, 180 experimental trials followed. Time to respond is measured in milliseconds. The three forms of the Sternberg test (1, 3, and 5 characters) were highly intercorrelated, and a composite score was derived [A+B+C/3]. The reliability of the measure we used was .90 (Spearman-Brown coefficient).

Cognitive adaptability

A Dutch version of the Stroop Color Word Test (1935) was used to measure cognitive performance. Stroop Test reflects the ability to shift perceptual set and meet changing response demands. The test requires the person to read through 3 cards. Card A is a list of 100 color names (blue, green...). The respondent states the word as quickly as possible, keeping errors to a minimum. Card B consists of 100 colored squares (blue, green...), which the respondent names as quickly as possible. Card C consists of 100 colour names printed in a different color (for example, the word 'green' printed in blue). The respondent states the color in which the word is printed, rather than the printed word itself. Time (in secs.) and number of errors for each card are recorded. An 'interference score' is obtained by subtracting the time time required for Card B from that required for Card C. The Spearman-Brown reliability coefficient for the Stroop Test was .89.

Taken together, the Stroop Color Word Test and the Sternberg reaction time measure reflect abilities in the areas of response speed, attention, visual scanning and tracking, and the capacity to quickly shift perceptual set (Dustman, et al., 1990).

Emotional well-being

Emotional well-being is regarded as the relative proportion of positive to negative feelings experienced by an individual. Positive and negative feelings are treated as independent of each other, according to the model of Bradburn and Caplovitz (1965). Following this view, Hermans and Tak-van de Ven (1973) developed a 36-item questionnaire [in Dutch] to quantify well-being. Individuals indicate their agreement or disagreement with positive and negative statements. The number of negative statements endorsed is subtracted from the number of positive statements endorsed, to yield a single score indicating positive well-being. The reliability of the original scale is greater than .75. For this study we selected selected five positive (e.g., 'I have a lot of energy.' 'I am satisfied with my life.') and five negative items (e,g., 'I am often bored.' 'I often feel "under the weather."').

RESULTS

The three dependent measures were not significantly intercorrelated (r's from -.39 to .16), suggesting that they tap different aspects of behavior, as intended. There were no significant pretest differences between the experimental and control group on any of the dependent measures (see Table 1).

A multivariate analysis of variance (MANOVA) was performed on the difference scores (posttest minus pretest) of the three dependent measures. There was a significant difference between the playing and non-playing groups, F (3, 16) = 6.03, p<.01. Univariate tests show that the dominant contribution to this significant finding is from the Sternberg Test, F (1, 18) 16.63, p <.01, and the least from the Stroop Color Word Test, F (1, 18) <1, with a moderate contribution from the emotional well-being measure, F (1, 18) 2.29, p = .14.

TABLE 1
EFFECTS OF PLAYING VIDEO GAMES ON MAIN DEPENDENT MEASURES

	EXPERIMENTAL GROUP Mean	sd	CONTROL GROUP Mean	sd
Reaction time (msecs)				
Before	1287.5	257.3	1269.1	206.7
After	940.5	202.5	1158.1	149.5
Change	347.0	149.9	111.0	121.4
Stroop Color Word Test (interference score, in secs)				
Before	52.20	17.1	47.67	26.4
After	38.40	15.3	41.50	18.0
Change	13.80	20.7	6.17	11.6
Emotional Well-Being (Possible range -5 to +5. The higher the score, the more positive the sense of well-being.)				
Before	2.11	1.80	2.18	2.90
After	1.89	1.54	0.63	1.40
Change	0.22	1.30	1.55	2.33

For each of the three dependent measures, an analysis of covariance was performed, with pretest scores as the covariate. Reaction time as measured by the Sternberg Test was significantly faster among the videogame-playing group than the non-playing control group, F (1, 19) = 26.03, p<.001. There was no significant difference between players and non-players on the Stroop Color Word Test, F <1.

Regarding emotional well-being, both the experimental and control groups felt less positive at the end than at the beginning of the study. However, in comparison to the control group, those who played video games felt more positive than their non-playing counterparts, F (1,17) = 5.76, p=.03.

DISCUSSION

In general, our results suggest that playing video games for 25 hours is related to improved reaction time and, relative to a non-playing control group, a more positive sense of well-being. Videogame play was not associated with improved cognitive/perceptual agility as measured by the Stroop Color Word Test.

As in previous research (Clark, Lanphear & Riddick, 1987; Dustman et al., 1992), video games were associated with faster reaction time among noninstitutionalized elderly players. This has proven to be a robust finding, even though each of these studies used a different measure of reaction time.

Why should playing video games affect reaction time? Clark et al. (1987) attribute the reaction time improvements in their study with the elderly to different information processing strategies used by those who played video games. For example, one strategy that improves response selection is to store stimuli in a short-term memory buffer, where retrieval time is quicker. Birren (1995) also attributes reaction time findings to enhanced information retrieval, rather than quicker reflexes.

Dustman et al. (1992) suggest that faster reaction times are due to improved efficiency in cell assemblies stimulated by visuomotor activities common to both videogame playing and reaction time tasks. They conclude that 'positive changes can occur in the central nervous system of elderly people over a relatively short time through the practice of activities that most find enjoyable' (p. 171).

Regarding our cognitive/perceptual and affective measures, Dustman et al. (1992) report a similar pattern of results. In their research, video game play among healthy older people was associated with speeded reaction time but not with changes in cognition or affect. Our strongest effects were on the reaction time measure, and the weakest effects on cognitive performance.

Relative to the control group, those who played video games felt more positive. However, both groups felt less positive at the end, than at the beginning, of the study. Neither we nor our research subjects have an adequate explanation for the overall deterioration in feelings of well-being. It may reflect the fact that the researchers made weekly visits to each participant in the study, and the end of the study meant the end of these often pleasant visits.

There are several alternative explanations for our findings. The first is that any activity that requires concentration, memory and quick reactions — not just playing video games, but playing board games or building model airplanes, for example — results in improvement in physical and emotional responses. Perhaps the unique characteristics of playing SuperTetris, whatever they may be, are not the key factors underlying change. Instead, the key may be those characteristics that video games share with other leisure activities (Kerr & Apter, 1991).

One of our dependent measures, the Sternberg reaction time task, requires facility with a computer keyboard, a skill that videogame playing may heighten. The Sternberg reaction time test is computerized. There may be transfer of training from videogame playing to computer-based testing. Arguing against a transfer of training interpretation is the fact that Tetris was played not with a computer keyboard, but with a separate joystick apparatus. Nevertheless, playing video games may have lowered anxiety about computerized testing, resulting in improved test performance.

The Sternberg reaction time test may be regarded as an 'endogenous task,' following the scheme developed by Lepper and Gertner (1989). Reaction time is required of *Tetris*, and therefore a reaction time measure has direct connection to the video game. On the other hand, our other dependent measures are 'exogenous' to the task. Color/name recognition is not a feature of *Tetris* and is therefore exogenous to the game. Emotional reactions, of course, are by-products of play and are not per se part of the game.

The participants in this study, although randomly assigned to the experimental or control group, were volunteers, and thus perhaps primed to benefit from their participation in the study.

We observed informally that, like youngsters who play video games, the elderly players in our study used them as a topic of conversation in an effort to make and maintain friendships. They frequently discussed their play with other players in the cafeteria and commons rooms. During our debriefing period, some two months after the play phase of the study had ended, they were still enthusiastic about their play experience.

Video games are not a panacea for the physical, cognitive or social changes that tend to accompany aging, but they reliably improve some physical and emotional responses. The length of play in the previous studies of video games and the elderly varied from two months to 11 weeks. Our study obtained effects within five weeks (mean number of hours played was 34.6). Individuals unable to engage in aerobic exercise may derive some of the same benefits through play.

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