Strategies to develop dual attention skills through video game training

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Abstract

The objectives of the current study were to investigate the utility of video games to enhance dual attention skills and compare these skills based on individuals' levels of expertise in video game playing. Twenty-four female participants aged between 17-25 years categorized as experts or novices, were divided into experimental and control groups. All participants completed the pre-test of divided attention wherein they read a story at the same time as they copied down irrelevant words dictated by the experimenter. Later, only the experimental group received video game training. Subsequently, all participants completed the posttest of divided attention. Results indicate that participants who received video game practice achieved an increase in their dual-attention skills compared to those who did not receive any training, with novices displaying a greater enhancement in performance. Implications of video game training to enhance dual-task efficiency are discussed.

Ability to develop dual attention skills via video game training

Individuals are able to best process information while carrying out a single task. Nevertheless, they are required to attend to and execute several tasks simultaneously in everyday life. The level of skill characterizes the efficiency with which people can alternate between more than one task. When attention was divided, Reinitz, Morrissey and Demb (1994) found that their participants failed to perceive stimuli accurately. However, other researchers have shown that the skill to cope with many demanding tasks at the same time can be enhanced through developing a better strategy of dividing one's attention proficiently. Hirst (1986) confirms that the limits of attentional capacity can be altered through practice. Further research has also revealed that performance on concurrent tasks improves significantly if subjects are allowed to practice the tasks (Spelke, Hirst, & Neisser, 1976; Stoffregen & Becklen, 1989).

Allport (1986) confirms that human beings do not have a built-in, fixed limit to the number of tasks they can perform simultaneously. But the ability to divide attention is constrained primarily by the individual's level of skill (Hirst, Spelke, Reaves, Caharack, & Neisser, 1980). Brown and Poulton (1961) showed that as people become better drivers, they can perform increasingly difficult mental calculations driving. It is therefore possible to capitalize on the human capacity for dual attention to execute complex cognitive functions in order to increase task efficiency.

One medium that could assist in the development of dual attention skills is the popular video game. Greenfield (1984), and Schribner and Cole (1981) explain that cognitive processes most often depend on interacting with either people or cultural artifacts. In fact, interactive video games have been described as "cultural artifacts that require and develop a particular set of cognitive skills; they are a cultural instrument of cognitive socialization" (Greenfield, 1994, p. 5). It is thus important to measure the extent to which video game practice develops cognitive skills.

Braun and Giroux (1989) indicate that when playing video games, players are required to constantly and simultaneously process multimodal perceptual information and respond to it with coordinated motor sequences on the basis of cognitive modelling, executive planning, and evaluation of ongoing feedback. Observations reveal that video game players are constantly monitoring several targets appearing simultaneously at several locations on the video screen, as well as pressing the different buttons on the controller *and* moving the joystick in the appropriate directions (Gagnon, 1985; Greenfield, 1984). Apart from these actions, the players must also carry out executive control process to oversee complex actions, and logical decision making process. In addition, there is anecdotal evidence that a child can attend to instructions given while he or she is playing video games. Such reports suggest that video games are surreptitiously allowing players to develop strategies to attend to several tasks simultaneously.

In light of these observations, Greenfield, DeWinstanley, Kilpatrick and Kaye (1994) found that training individuals for five hours with a video game could alter the strategies of attentional deployment. Their study showed that practice on a video game requiring visual monitoring of more than one location "could develop strategies for reducing the relative attentional cost of monitoring the location of a low-probability target" (p. 119). Clark, Lanphear and Riddick (1987) also observed that participants improved performance on an attentional task as a result of playing 14 hours of 'Pac-Man' and 'Donkey Kong' over a seven-week period. The largest effect of this practice appeared in the strategic response selection task in which players' right hand had to respond to a stimulus on the left while the left hand had to respond to a stimulus on the right.

Improvement in attentional skills could aid the provision of informal education for occupations that demand skills in divided attention (Greenfield, DeWinstanley et al., 1994) including instrument flying, military activities, and air traffic control. Gopher, Weil and Bareket (1994) emphasised that skills acquired through computer game practice could transfer to flight performance. They argue that attention control is an essential component in the acquisition of flight skills and can be enhanced through training using video games. In fact, high attention demands are a major apprehension in several features of human factors work in aviation, including design, training, operational procedures, and safety regulations (O'Hare & Roscoe, 1990; Wiener & Nagel, 1988). The theory of transfer of skills could also be applied to performance in

sports such as basketball, or life safety skills such as driving a car, or operating heavy equipment where skilled performance requires the monitoring of multiple stimuli (Greenfield, DeWinstanley et al., 1994).

The effects of practice on performance have been well established. Many studies have investigated the relation between the level of expertise in video game playing and performance on cognitive tests. While the study by Greenfield, Brannon and Lohr (1994) indicates that skilled or expert video game players have better skills for monitoring two locations on a visual attention task, Gagnon (1985) emphasises that a substantial effect of experimental practice on attentional skills will be witnessed in the less experienced group only. The more experienced players will not significantly improve their attentional skills beyond the large amounts of practice they would have already received in the real world (Greenfield, DeWinstanley et al., 1994). Therefore, it would be expected that the effects of the experimental treatment would be observed to a greater extent in the 'novices' group, as compared to the 'experts' group in their performance on the divided attention task.

Previous studies have not shown a clear-cut effect of video game practice on dual attention skills in relation to the role of expertise as distinguished not only by video game performance, but also other relevant factors, such as the age at which players started playing video games, their perception of their level of expertise and their ability to play well on a *new* video game. Most of the research into the effects of video games has also

employed only male participants or a larger proportion of males, owing to the availability of participants. However, the current study endeavoured to investigate the effects of the games among female players. It can be argued that if any increase in performance is witnessed amongst females, the results could also apply to males, as the latter have been consistently shown to be better at the games (Durkin, 1995; Greenfield, Camaioni, Ercolani, Lauber, & Perucchini, 1994). Also, the literature does not reveal differences in the ability to divide attention between males and females.

The main objectives of the current study were to establish the influence of video game playing on divided attention skills and assess any differences in these skills between experts and novices as a result of video game practice. It was hypothesised that those who receive video game training will perform better on the dual attention task than those who do not receive any training. It was also proposed that low skilled players would show a greater proportion of increase in dual attention skills compared to their high skilled counterparts.

Method

Participants

Twenty-four female participants with a mean age of 19.79 years took part in the study. All of them had some video game playing experience. They were categorised as experts (n = 10) or novices (n = 14) based on their score on Pac-Man and their level of experience with video games. Later, through random assignment, six experts and eight novices were asked to be a part of

the experimental group, while four experts and six novices were deployed to the control group. They were paid a nominal amount for their participation.

Apparatus

Level of expertise. Players' level of expertise in video game playing was assessed through their scores on a game of 'Pac-Man' and their responses on the 'Level of Experience in Video Game Playing' questionnaire.

Attention task. The faculty of divided attention was assessed by a measure similar to that utilized by Hirst et al. (1980) and Spelke et al. (1976) in their effort to determine the effect of practice on divided attention skills. Stories written by female authors were selected and they vary from 800-1200 words in length. The dictated words were randomly selected from the norms of Kucera and Francis (1967).

Video game training. A 'Nintendo-64' console with a controller was utilized to provide training. The game 'Banjo-Kazooie' was used as it is similar to 'Mario Brothers' which has been cited as the most preferred game by females in a survey conducted by the Australian Broadcasting Authority and the Office of Film and Literature Classification (Cupitt & Stockbridge, 1996). A 34cm television monitor was used to screen the game.

Procedure

Initially, participants were asked to play a game of 'Pac-Man' installed on an IBM computer and then complete the 'Level of Experience in Video Game Playing' questionnaire. Individuals scoring 5,000 points and above on 'Pac-Man' were classified as 'experts', while those scored anything below that

figure were designated as ‘novices’. It was found that individual’ ‘Pac-Man’ scores significantly correlated with the other determinants of video game expertise, which were evaluated through the questionnaire. Some of these include the age at which they started playing video games ($r(24) = .41$, $p = .022$), i.e., those who started playing at a younger age achieved a higher score; players’ ability to play well compared to the average video game player ($r\ (24) = .40$, $p = .023$); and, time spent playing video games more than other leisure activities ($r\ (24) = .50$, $p = .004$).

To assess dual-attention skill, participants read stories at the same time as they copied down irrelevant words dictated by the experimenter, after receiving a practice trial with a shorter story. The subjects’ ability to recall dictated words, answer comprehension questions (related to the story), dictation rate (words written per minute) and reading speed (words read per minute) were measured. All participants were required to complete this assessment in the pre- and post-training conditions.

To determine the influence of video game playing on divided attention skills, the experimental group were asked to play the game for either one hour or six hours: participants played the game individually over one session or six separate sessions respectively. Before the training sessions commenced, players were provided with 15 minutes of practice to acquaint themselves with the game and the use of the control buttons for the different manoeuvres. The experimenter observed their performance and monitored their improvement, the strategies they used to tackle the obstacles, and noted the scores they

achieved. The control group did not receive any practice. Any differences between participants who received different amounts of practice will not be compared as it is beyond the scope of the current paper.

Results

Using an alpha level of .05, independent t-tests show a substantial increase in comprehension scores ($t(22) = 2.63$, $p = .015$) and dictation rate (words written per minute) ($t(22) = 2.54$, $p = .019$) amongst the experimental group after video game training, while the control group did not exhibit any significant change. The means of dual attention tasks are presented in Table 1. Although the means for recall ability, and reading speed were not significantly different, an increasing trend was observed for those who received video game training compared to those who did not.

Insert Table 1 here

Dependent t-tests reveal that novices who received video game practice showed a significant increase in the average number of words recalled ($t(7) = -2.41$, $p = .047$), the number of words they wrote per minute (dictation rate) while reading the story ($t(7) = -31$, $p = .018$), and their reading speed (number of words read per minute) with $t(7) = -2.42$, $p = .046$, between the pre- and posttest conditions as compared to novices who received no training.

With regard to the experts' post-training performance, there was a significant increase in their comprehension scores ($t(5) = -3.80$, $p = .013$) and

a slight increase in their ability to recall dictated words ($t(5) = -2.31$, $p = .069$) compared to experts in the control group who showed no significant differences on any task between pre- and post-training measures. An overall comparison of scores between experts and novices who received video game training did not reveal any significant differences on the tasks, which could be due to the limited number of participants and differences in the number of hours of practice they received.

Discussion

The proposition that practice with video games will enhance divided attention skills was supported. Individuals who received training showed a significant increase in two components of the assessment task, namely, their comprehension scores and dictation rate. This indicates that they were not only able to understand the story well and remember events in the story, but were also able to perform the secondary task of writing dictated words at no cost. The findings thus show support for Braun and Giroux's (1989) explanation that video game players are capable of simultaneously processing several stimuli and responding to each in a coordinated manner. The current results are also consistent with Clark et al.'s (1987) and Greenfield, DeWinstanley et al.'s (1994) studies that found an increase in dual attention skills after video game practice.

The results also support the second hypothesis that video game training would result in a greater improvement in divided attention skills amongst novices compared to experts. This premise was supported to the extent that

novices who received practice exhibited a significant increase in several components of the dual attention assessment compared to their control group counterparts. This extent of improvement is similar to Gagnon's (1985) view that a substantial effect of experimental practice will be witnessed in the less experienced group only. There were some differences between experts who received training and their control group counterparts, with the former enhancing their comprehension and recall ability. This suggests that highly skilled players are also able to enhance their dual attention skills with video game practice, but, the extent of improvement made by novices was far greater compared to that observed amongst experts. Greenfield, DeWinstanley et al. (1994) also found that the experienced video game players do not show a significant increase in attentional skills after the video game training since they already achieved a higher level of dual attention skills by having received substantial amounts of practice from prior game playing experience.

Conclusions and Implications

In conclusion, it can be inferred from the present findings that the ability to enhance dual attention skills can be developed through video game training. The current study also showed that novices make a greater degree of improvement in attentional skills after training compared to experts, although the role of differential practice effects on dual attention skills were not considered. The above findings are applicable to both sexes, as the literature does not reveal differences in divided attention skills between males and females. Future studies should compare the role of receiving different

amounts of video game practice. Implications of the current findings include the possibility of constructing specially designed games for the purpose of divided attention skill testing, for example, a driving simulator to test, compare, or enhance driving skills; or, flight simulation games designed to assess pilot skills, or provide training to pilots (Gopher et al., 1994). The games could then serve the dual function of accurately testing individual performance and acting as performance enhancers. Research in this area is relatively young and further investigations are required to determine the role of video game playing in developing several cognitive skills.

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Table 1

Post training dual attention task performance between experimental and control groups

	Experimental group		Control group	
Measures	*M*	*SD*	*M*	*SD*
Comprehension score	8.14	1.03	6.90	1.29
Dictation Rate (words written per minute)	12.45	3.40	9.35	2.11

Note. Range of comprehension scores was 0-10.