The Effect of Video Game Experience on Creative Problem Solving

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Abstract

The prevalence of video games in modern culture makes them a source of research interest; what effects do they have on the daily cognitive activities of their players? Previous research has focused on some of the negative aspects of video game usage, such as an increase in aggression and a proclivity towards imitating violence. However, some, including this study, aim to showcase the positive cognitive effects of playing video games. This particular study focuses on how different types of video games affect creativity in problem solving. Participants were recruited from the Georgia Tech community and provided with a desktop computer on which to play either a puzzle-solving video game or a first-person shooter game. The data showed that general video game play had a greater effect on levels of creativity than did game play in a game aimed at using a specific type of creative problem solving. Further research into the positive cognitive effects of video games, and the aspects of the games that bring about those effects, has the potential to greatly benefit educational video games.

Keywords: cognition, creativity, video games, cognitive ability, Torrance, remote associates task

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Video games have become an increasingly prevalent part of everyday entertainment for all age ranges (Gee, 2007). Although past research has delved into the effect of these games on levels of aggression, the effect of video games on general cognitive abilities has not been a main focus of many studies. However, there has been some proposed evidence for the positive effects of these games (Bartlett, Anderson, et al, 2009). While content is an important aspect of the video games, research involving video games and cognition should pay attention to the required strategies, rather than game mechanics or storyline, of the game and how those strategies affect cognitive abilities.

This research will focus on the effect of video games on creative problem solving. Gee (2007) established that elements of creativity must be utilized when a player is faced with a novel problem to which they are not given an obvious solution. Some of those elements are brain-storming, incubation, and illumination (Gleitmen, Reisberg, & Gross, 2007; Reisberg, 2007). The process of brain-storming consists of gathering information to prepare to solve an issue or come up with a new idea. Incubation is the process of letting the information gathered during brain-storming settle, without necessarily thinking out the problem at hand on a conscious level. Gleiman et al., (2007) and Smith & Blankenship (1991) present arguments that the process of incubation may not, in fact, be an aspect of the creative process, but no definitive evidence has been given for such a claim. Illumination is the point at which a conclusion to the problem at hand is reached.

Two ways of discriminating between types of creativity include divergent and convergent thinking. Divergent thinking involves exploring as many solutions to a problem through flexibility, fluency and originality. Convergent thinking, on the other hand, focuses on a single

idea or solution. (Jorlsen, 2013; Owens, n.d.). Brainstorming seems to be a very prominent feature of divergent thinking, as it is the process by which multiple new ideas are presented as solutions to the problem at hand (Jorlsen). Both divergent and convergent thinking can be used to solve a single problem, by generating multiple ideas and then focusing in on a single, "best-fit" solution (Owens).

Currently, no data regarding the relationship between the creative process and video game play has been gathered. However, there are multiple games on the market that exhibit the traditional characteristics of both types of thinking.

Previous studies have used the remote associates task (RAT), a convergent thinking task, during which participants are given two to three words and asked to determine a final word that fits thematically with the others (Mednick, 1962; Reisberg, 2007; Smith & Blankenship, 1991). In this study, participants who are assigned to play a puzzle-solving video game are expected to show a greater increase in pre- to post-experiment RAT scores than those who are assigned to play a neutral, non-strategic video game. Participants who were assigned a game that required solving puzzles by coming up with novel solutions through divergent thinking were expected to show a greater increase in pre-to post-experiment Torrance scores than those player a neutral video game.

Methods

Participants

This study drew participants from the Georgia Tech population. There were 64 total participants (ages 18-26; 47 male, 17 female). A pre-experimental questionnaire was used to gage how comfortable the participant was with video games and what types of games they

typically played. Thirty of these participants reported being proficient and familiar with many video games available on the market, while the other 34 reported having minimal experience.

Participants were matched for experience and assigned to play a non-strategic video game, a video game that requires divergent thinking, or a video game that requires convergent thinking.

Material and Stimuli

Participants were given two creativity tasks on paper, the Remote Associates Task (RAT) and the Torrance Task before and after the experiment, in order to gauge initial and final creativity scores. The RAT task was used to measure levels of convergent thinking in problem solving, while the Torrance Task was used to measure levels of divergent thinking in problem solving. They were provided with a pen to complete these tasks. A PC computer, loaded with the three video games, was provided for participants in the lab environment. The games were controlled using a standard QWERTY keyboard.

The stimuli on the RAT consisted of a series of 60 word pairs that share a common word that completes an idea (e.g. Falling-Dust share the common word Star to create Falling Star and Star Dust). The stimuli on the Torrance Task included three activities with different prompts. The first activity was a prompt of an ink splot on the page; participants were required to create meaning from the splot by adding details to the image. The second activity consisted of ten abstract figures, such as those in Figure 1, that the participant was asked to complete, as shown in Figure 2. The third prompt was a set of either circles or parallel lines that the participant was asked to add details to in order to create multiple pictures that may form a scene, such as that in Figure 3 The forms presented in the pre- and post-experimental sessions were equal in difficulty,

but presented different individual stimuli to the participant to avoid a practice effect for each task..

This experiment uses a 3-level between subjects design. One-third of the participants were assigned to play a neutral, non-strategic video game (New Super Mario Bros. for the DS), one-third were assigned to play a video game that requires divergent thinking to solve puzzles (Super Scribblenauts), and one-third were assigned to play a video game that requires convergent thinking to solve puzzles (Professor Layton and the Curious Village). The video games were played on the same platform by emulating the games onto a PC computer. Participants attended four sessions on four different days to complete the creativity tasks and play the game they were assigned.

Stimuli in the video games are determined by the video game that is assigned for play. No violent or disturbing images were presented to the participants.

Procedure

During their first session, participants completed the Remote Associates and Torrance tasks, taking 15 minutes for each task. After finishing these tasks, they began their assigned game. Participants completed thirty minutes of game play during this session.

The second and third sessions consisted entirely of one hour of game play with the assigned game.

The fourth session consisted of thirty minutes of game play with the assigned game. After the participants completed the game play, they were given new, equally difficult versions of the RAT and Torrance tasks.

Over the course of the experiment, participants were asked to refrain from playing video games in their leisure time. This was intended to control for any effects the participants' experiences with video games may have had on the study.

Results

The scores on the pre-and post-experimental scores on the creativity tasks were recorded and compared. Participants who played Super Mario Bros. scored an average of 17.18 (*SD* = 8.29) on the first RAT task, 15.36 (*SD* = 7.44) on the second, 30.59 *(SD* = 11.23) on the first Torrance task, and 33.05 (*SD* = 10.43) *on* the second Torrance task. Participants who played Professor Layton and the Curious Village scored an average of 19.35 (*SD* = 6.41) on the first RAT task, 21.09 (*SD* = 7.45) on the second RAT task, 41.83 (*SD* = 15.49) on the first Torrance task, and 38.04 (*SD* = 15.75) on the second Torrance task. Participants who played Super Scribblenauts scored an average of 19.84 (*SD* = 7.58) on the first RAT task, 18.74 (*SD* = 5.83) on the second RAT task, 41.95 (*SD* = 9.97) on the first Torrance task, and 43.05 (*SD* = 16.73) on the second Torrance task.

The scores on the pre- and post-experiment versions of the creativity tasks were examined to compare the effect on scores due to general video games play and play in a game that was aimed at using convergent or divergent thinking. In an ANOVA with all three video game groups (time x task x videogame), using z-transformed creativity scores as the dependent measure, I found no significant effect of time, $F(1,61) = 0.00$, $p = .989$, showing that participants did not score higher on the creativity tests after the gaming experience. There was no effect of task, $F(1,61) = 0.01$, $p = .944$, indicating that participants scored equally high on the RAT as the Torrance (an artifact of the z-transformation), and no time by task interaction, showing that the (lack of) change in creativity scores was identical across tasks, $F(1,61) = 0.02$,

p = .985. There was a significant effect of videogame, F (2,61) = 7.17, p = .002, indicating that performance differed between video game groups (post-hoc tests showed that the Super Mario group scored lower on all tests than the two other groups, which did not differ). This main effect was qualified by a time by task by videogame interaction, F (2,61) = 3.86, p = .026, indicating that progress after training differed depending on video game group and task. To unpack this finding, I ran three 2 x 2 ANOVAs (time by task), one for each video gaming group, to check which groups showed change that difference by task. The time by task interaction was significant only for the Professor Layton and the Curious Village group, which showed an increase in performance on the RAT and a decrease on the Torrance, F (1,22) = 4.46, p = .046; neither the Super Mario group, F (1,21) = 3.60, p = 0.072, nor the Super Scribblenauts group, F (1,21) = 0.28, p = 0.600 showed a significant interaction.

An alternative way to analyze the data would be to directly test for the hypothesis that the Professor Layton and the Curious Village game (as a game encouraging convergent thinking) should lead to larger positive changes in RAT performance and the Super Scribblenauts game (as a game encouraging divergent thinking) to larger positive changes in Torrance performance by looking at the time by task by video game interaction in this subsample alone. This interaction turned out to be only marginally significant, F (1,40) = 3.16, p = .083.

Discussion

This experiment aimed to determine the relationships between video game play and improvement in two aspects of creative thinking. Participants assigned to play video games that require problem solving abilities were expected to show a significantly greater increase in creativity levels than participants who play a non-strategic board game that relies on chance. This is due to the fact that puzzle-solving games, such as Scribblenauts, require players to think

about the obstacles put before them in a novel way. Players who practiced with a certain type of thinking, such as divergent or convergent, were expected to show a greater likelihood to use that form of thinking to solve problems because of a practice effect.

The results of this study supports the idea that some video game play leads to better performance on creativity tasks, specifically that playing a game that utilizes convergent thinking methods increases scores on the RAT task, a convergent thinking task.

Video games are a prevalent aspect of society now, and exist in many forms. Understanding the effects that video games have on creativity and problem solving can open up many future research opportunities, and various educational avenues. Understanding how video games affect cognitive abilities, and exactly what aspects of the games cause positive effects, could provide educators with alternative teaching methods. Future video games geared toward educational purposes can be precisely tailored to educate in an engaging and entertaining fashion. However, further research would be required to determine the exact components of the games that elicit positive cognitive development. Future studies may include insight into what aspects of video games require the different creative processes such as illumination. Once these aspects are uncovered, that knowledge can be put into use developing new games that encourage players to come up with a variety of different answers. This could potentially lead to an increase in children, adolescents, and young adults who are capable of coming up with novel and new solutions to old problems.

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Appendix

Examples of Torrance Tasks and Responses

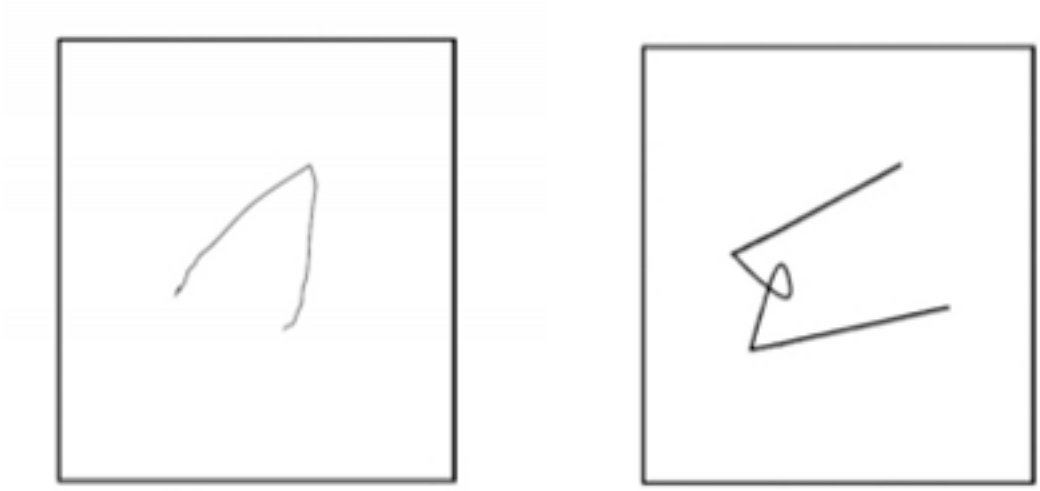

Figure 1. An example of the blank abstract images provided in the Torrance task.

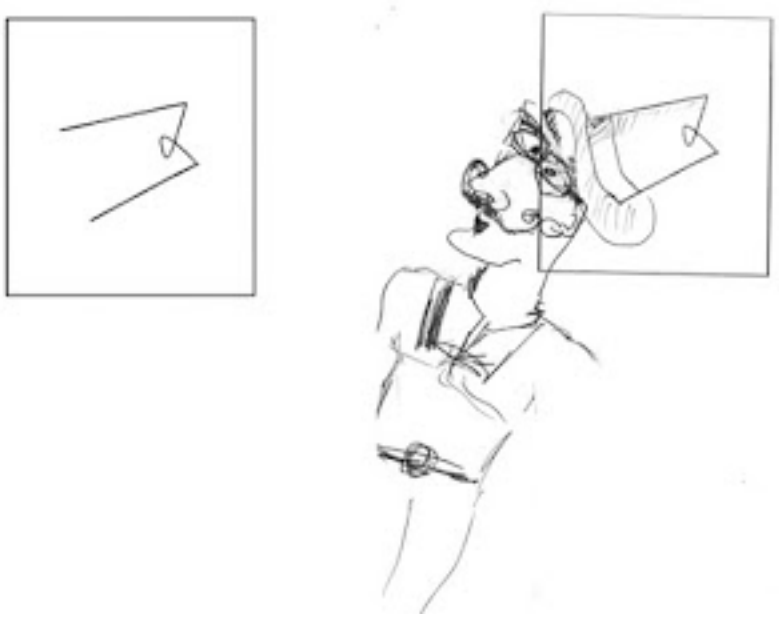

Figure 2. A completed, creatively complex example of one section of the Torrance task. Participants will receive points for creativity based on the originality of their creation (as determined by the grading guide provided with the Torrance tasks), the detail of their drawing, and the sophistication of the title they may give their drawing.

Figure 3. A completed example of the third prompt of the Torrance task. Participants will be given points for creativity for the originality of their drawing, the number of details they include in their drawing, and their ability to form a cohesive scene using the provided stimuli.