

# Video and Computer Games: Effect on Children and Implications for Health Education

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**ABSTRACT:** Video and computer-based games have assumed a prominent role in the culture of American children and adolescents. Given the pervasiveness of their influence, it is likely that these games may affect the health and well-being of children. This paper examines the health effects of these games on children, suggests criteria upon which parents and teachers may evaluate the games, and notes some implications for health educators. (J Sch Health. 1997;67(4):133-138)

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Video games represent a \$7 billion business in the United States, exceeding the \$5 billion annual box office sales of the Hollywood movie industry.<sup>1</sup> Nintendo, which launches 8-12 new games yearly, sold 2.2 million copies of its best seller *Donkey Kong Country* game in the 1994 Christmas season and has sold 7.4 million copies of this game worldwide.<sup>2</sup> More than 40% of all television households had a video game console unit in 1995.<sup>1</sup> Furthermore, computer software makers have discovered the value of incorporating gaming strategies in their educational packages. With personal computers in more than 30 million homes and 125,000 schools nationwide, educational software packages that are entertaining have a huge market potential.<sup>3</sup> A 1993 survey<sup>4</sup> assessing frequency and location of play and game preference completed by 357 students in grades seven-eight found the average time spent playing games at 4.2 hours per week. Two-thirds of girls surveyed played video games at least one-two hours per week at home, but only 20% played in arcades, while 90% of boys played at home and about 50% in arcades. Almost half of preferred games were violent in nature, while only 2% of preferred games were educational. An independent analysis of the 47 most popular video games found violence as the theme in 40 of the games.

These facts suggest this pastime has a major influence in the lives of American children. Because of the pervasiveness of video and computer-based games in homes, and due to the nature and content of these games, an examination of their affect on the health and education of children is warranted.

## POTENTIAL NEGATIVE CONSEQUENCES

**Cardiovascular implications.** American children are more overweight, slower, and weaker than their counterparts in other developed nations. In addition, U.S. children adopt sedentary lifestyles at earlier ages. Video games and television viewing may contribute to a sedentary lifestyle by displacing involvement in sport and other physical activity.<sup>5</sup>

However, video game playing is not a passive activity, and it may not have the same effects as television on the prevalence of obesity. Segal and Dietz<sup>6</sup> assessed the meta-

bolic and cardiovascular responses of 32 males and females ages 16-25 to video game playing. Heart rate, blood pressure, and oxygen consumption were measured serially over a 30-minute duration of playing *Ms. Pac-Man* video game under laboratory conditions, then compared with measurements made in a standing, inactive position. Playing the video game significantly increased heart rate, systolic and diastolic blood pressure, and oxygen consumption in males and females. While the energy cost of playing a video game is similar to that of mild intensity exercise, video games should not be seen as an alternate to exercise. The level of cardiorespiratory stress from playing the video game is not sufficient to improve cardiorespiratory fitness. Playing an arcade-type video game may increase energy expenditure by roughly 80%, but it fails to provide sufficient cardiorespiratory stress to improve physical fitness in youth.

In a study<sup>7</sup> which examined the cardiovascular reactivity patterns in 213 healthy, Black and White, male and female children ages 6-18, children were exposed to the psychological stress of a video game challenge played under three levels of increasing stress. Results indicated video games provoked significant cardiovascular reactivity as measured by an increase in heart rate, and diastolic and systolic blood pressure.

Effects of video game playing on 23 college-age men on blood pressure and heart rate also were examined.<sup>8</sup> Mean systolic blood pressure for the group was considerably higher during play than before and after play. Mean heart rate also was higher during play. However, cardiovascular effects were higher in the novice player than the skilled player, suggesting anxiety abates as greater skill is acquired.

**Video game induced seizures.** Video game induced seizure, also called "Dark Warrior epilepsy," has been noted in a few children.<sup>9,10</sup> According to Kasteleijn-Nolst Trenite,<sup>11</sup> 50 documented cases of video game induced seizures have been reported worldwide. However, one-third of these children experienced previous seizures not related to video games. Most children experiencing seizure have documented photosensitivity to flashing images,<sup>12,13</sup> while only 5% of all epileptic patients prove sensitive to photic stimulation.<sup>10</sup> Video games may provoke a seizure response more easily than television because video games usually consist of geometric figures and they are played with the participant sitting closer to the screen.<sup>14</sup> Treatment of video game induced seizure consists of avoidance of games or administration of anticonvulsant drugs.<sup>14,15</sup>

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**Nintendinitis.** Brasington<sup>16</sup> reported a sport injury attributable to excessive playing of video games. The injury, called nintendinitis, caused severe pain in the extensor tendon of the right thumb, which had been used to press repeatedly a button on a video game. The patient was treated with ibuprofen and abstinence from the video game for several days with successful resolution of the problem.

**Pathological preoccupation with video games.** Keepers<sup>17</sup> reported a case study of a pathological preoccupation with video games in a preadolescent. The child, who had stolen and forged checks, and skipped school to use the video game, was experiencing distress in a family situation and appeared to be immersing himself in the game to suppress family problems. The child was placed in a residential treatment center with marital and family therapy which resulted in resolution of pathological use of video games.

**Aggression and prosocial behavior.** The role of video games in promoting aggression has been the focus of much controversy. However, studies which examined the relationship have been inconclusive and inconsistent in their findings. The relationship of aggression and video game play has been explained using several theoretical frameworks.<sup>18</sup> General arousal theory implies that children when aroused most likely will behave in a manner most recently observed. Hence, the arousing nature of video games may increase aggressiveness regardless of the game content. Social learning theory suggests children behave in a manner reinforced by a significant other. Accordingly, playing a video game allows children to practice aggression and be rewarded for successful aggression. Catharsis theory holds that experiencing a specific emotional drive reduces the likelihood of behavior related to that emotional drive. Video games, then, offer children opportunity to act out their aggressive behavior on the game or fantasy, resulting in lower levels of actual aggressive behavior.

Cooper and Mackie<sup>19</sup> examined the effects of playing an aggressive and a nonaggressive video game on the free play of fifth grade children. While girls experienced more general activity and aggressive free play after playing the aggressive video game, the games did not affect boys' free play. Additionally, neither boys nor girls exhibited differences in levels of interpersonal aggression.

Kestenbaum and Weinstein<sup>20</sup> studied video game use in 447 junior high school students in an urban middle class neighborhood. Students were divided into high and low video game users, then asked to complete several personality and developmental scales. Findings show that heavy video game use neither results nor relates to global psychopathology or social introversion. For the most part, high video game users were healthy adolescents upon whom video games had a calming rather than an excitatory effect in terms of aggressive energies. The researchers further state that video game use may assist adolescents in the important mastery of competitive and aggressive feelings that seek expression during adolescence. Adolescents who doubt their adequacy and competence in other areas may find a release from this frustration in video games which may be mastered by continual play and improvement over time. In addition, the study found students in an enriched class actually spent less time playing video games.

Violent video games may arouse children in the same way as violent television cartoons. Silvern et al<sup>18</sup> examined

28 children, ages four-six, in a free play setting at baseline, after watching a violent cartoon and after playing a video game. Results indicated significant differences in aggressive behavior, relative to baseline behaviors, after watching television and after playing video games. No difference existed between the television and video game conditions. However, the researcher reported that prosocial behaviors also increase when compared with the baseline but not to the same extent. Further study is needed to examine which elements of the video game (difficulty, number of players, type of fantasy) might contribute to any post-game aggression.

Schutte et al<sup>21</sup> examined the effects of video game play on 31 children, ages five-seven, who were matched according to gender and randomly assigned to play either a nonviolent game (jungle vine swinging) or a violent video game (karate). Researchers observed the children during free play immediately following video game experience. Children who had played the jungle swing game played more with a jungle swing toy later, whereas children who played the karate video game showed more aggressive behavior. Playing a video game seems to lead children to exhibit behaviors similar to those portrayed in the game, including aggressive behaviors. This study reinforces implications that children tend to model what they experience in video games.

The affect of video games on aggression and social adjustment is not without controversy. Several studies have not reinforced the commonly held belief that computer games increase aggression on the part of the player. For example, in a study of university students in Scotland, Scott<sup>22</sup> exposed students to varying levels of violence in three different video games. No linear pattern occurred of aggressive affect change as indicated by a hostility inventory, across the games played. Results indicate a lack of support for the generally held view that playing aggressive computer games causes an individual to feel more aggressive.

Studies with Japanese children support the notion that frequency of video game use is not related significantly to a child's social maladjustment. For example, Sakamoto<sup>23</sup> studied 307 girls and boys in a Tokyo elementary school and found no relationship between video game use and social adjustment. The author states the results "raise doubts about the popular belief that children will become socially maladjusted if they play video games." In a study of Japanese kindergarten children and their parents, Shimai et al<sup>24</sup> found kindergarten video game players showed superior development in several areas of social skills compared to nonplayers. Specifically, the video game players were reported as "having more friends" and "speaking more willingly" than nonplayers.

## IMPLICATIONS FOR EDUCATION

Video game technology has had and will continue to have profound impact on childhood education. A common complaint leveled at video games is that they displace time that could be spent reading or pursuing other educational activities. Because video games provide stiff competition for the attention of children and adolescents, some parents worry that owning a home video game will hurt their child's study habits. However, that fear has not been shown by research.

Creasey and Myers<sup>25</sup> examined three groups of male and female children ages 9-16. The three groups — new owners, nonowners and those who had owned a video game for some time — were surveyed over time as to their leisure time activities, grades and school performance, and peer interactions. Results showed that an initial high involvement with video games soon disappeared. New game users averaged 15 hours per week in the first few weeks of ownership of the video game. By three months, this rate had dropped by more than half. In the few weeks immediately following purchase of the video game, alternate leisure activities declined, but the effect was temporary. School activities and peer involvement were not affected at any time. None of the children with video games showed a decline in mathematics or English grades. It was concluded that owning a video game does not alter a child's activities.

A more subtle impact of video game technology on education is the expectation by children that all learning must take a gaming approach and be "fun." Classroom teachers find they must compete with numerous video game "personalities" when determining the lesson plans for the day. The demand for entertaining education has given rise to "edutainment" media. Software developers and distributors realize that the 37 million children ages 4-12 prefer this approach to learning.<sup>3</sup>

Some evidence suggests that important skills may be built or reinforced by video games. For example, spatial visualization scores improve with video game playing. Spatial visualization is the ability to rotate mentally, manipulate and twist two and three dimensional objects. Students with a high degree of spatial visualization are high achievers in mathematics and science. Improving spatial visualization may have a corresponding affect on student mathematics.<sup>26,27</sup>

Occupations which require mechanical tasks or machinery operation also demand excellence in spatial skills. In a study of 61 fifth grade boys and girls, Subrahmanyam and Greenfield<sup>28</sup> found video game practice significantly more effective than a word game in improving spatial performance, and that video games were more effective for children who started out with relatively poor skills. They suggest that video games may be useful in equalizing individual differences in spatial skill performance.

## VIDEO GAMES AND HEALTH PROMOTION

Video games can be used in a positive way to promote health and provide information to children and adolescents, which captures and keeps their attention and allows them to interact with the information in a meaningful way. Games and simulations have potential to help adolescents personalize information, forcing them to assess risks and consequences and make decisions in a hypothetical yet realistic situation.

An example of this application is the Body Awareness Resource Network (BARN).<sup>29</sup> Computer-based games and simulations are used to attract adolescents to a health promotion program. Quiz games challenge students to test their knowledge on a topic, and simulations challenge students to apply health information in a nonjudgmental, hypothetical situation.

Yet another example of a health promoting video game is Health Works, a state of the art interactive computer-based video game with animated graphics. A study<sup>30</sup> of 3,829 New York City youth in grades five-eight found this video game took students beyond cognitive learning to experiential involvement in the subject matter. Researchers report that the learning experience is enhanced and recommended health behaviors are encouraged.

The Vicksburg Mississippi Medical Center uses video games to introduce its services to shoppers at a retail mall.<sup>31</sup> The games help consumers to assess their risk of heart disease or the need for a checkup, then provide information about specific hospital programs. Thirty percent of people who played the game during the first year requested additional information from the hospital.

SMACK<sup>32</sup> is a video game developed as an attempt to illustrate for teens the negative consequences associated with drug use. SMACK uses simulations which require teens to make decisions regarding drug use and respond to the consequences of such decisions. The program provides reinforcement for those not inclined toward drug abuse while providing a forum for simulated "experimentation," with the likely outcomes, for those tempted to use drugs.

Video-based games also have been used as a correlate in the therapeutic regimen. For example, video games have been used in behavior modification therapy<sup>33</sup> and as a pain aversion technique for children with cancer.<sup>34</sup> One study<sup>35</sup> used a simple video game for a five-week regimen of respiratory muscle training in young patients with Duchenne Muscular Dystrophy (DMD). The games were operated and driven by the respiratory efforts of the patients. Researchers concluded that computerized respiratory games which make application of breathing exercises may improve respiratory performance in children with DMD.

## EVALUATING COMPUTER-BASED VIDEO GAMES

In general, parents support use of video games that help children learn about school subjects while they play, according to *The Wall Street Journal* ("PC games could capture Sega, Nintendo customers," April 27, 1994, page B1). With this in mind, there are several elements which the teacher, parent, or facilitator should evaluate when choosing a health promoting/educational or helping computer game (Figure 1).<sup>36</sup>

**Educational or therapeutic objective.** The objective of the game should be clear. Professional helpers and developers should have a known goal in mind for the players of the game. The outcomes they are seeking should be clear to the teacher and to the player.

**Type of game.** There are seven basic types of activity content: games, puzzles, mazes, play, fantasy/adventure, simulations, and simulation games. Some games require physical skill and strategy, while others are games of chance. Some video games are board or adventure game, while others involve simulation involving real events or fantasy. No evidence supports a greater therapeutic or educational effect in either situation.

Figure 1  
**Health Education Computer/Video Game Evaluation Form**

Game Title: \_\_\_\_\_

Publisher: \_\_\_\_\_ Version \_\_\_\_\_ Copyright \_\_\_\_\_

Format: CD-ROM \_\_\_\_\_ Disk \_\_\_\_\_ Other \_\_\_\_\_

Cost: \_\_\_\_\_ Serial Number or Site License Agreement Number \_\_\_\_\_

**Hardware/Software Required:**

Computer :  IBM Compatible  Macintosh  Other \_\_\_\_\_

Software Platform:  DOS  Windows 95  Windows 3.x  Other \_\_\_\_\_

Video game platform:  Sega  Nintendo  Other \_\_\_\_\_

Other requirements:  Monitor  Joystick  Speakers  Microphone  Graphic Cards

Laser Disk Player  CD-Player \_\_\_\_\_ (speed)

**Intended Audience:**

- Elementary  Secondary  
 Middle  Adult  
 High School

**Skill Level Required:**

- Beginner  
 Intermediate  
 Advanced

**Content Areas Covered:**

- Aging  Exercise/fitness  
 AIDS/HIV  Mental health  
 Community health  Nutrition  
 Consumer health  Personal health  
 Disease prevention  Sexuality  
 Environmental health  Substance abuse

**Type of Game:**

- Board game  
 Puzzles  
 Mazes  
 Simulation games  
 Fantasy/adventure  
 Simulations

**Role of Luck:**

- Physical skill required  
 Player strategy required  
 Chance and luck

**Information and rules:**

- Help screen always available during play  
 Help and game instructions can be printed  
 Information withheld for game excitement  
 Documentation included  
 Technical help provided

**Duration:**

- Average time of one game \_\_\_\_\_  
 Game can be played several times without boredom  
 Uses personal challenges to keep player interest  
 Uses color, sound, graphics to maintain interest

**Difficulty:**

- Difficulty levels can be adjusted  
 Player chooses difficulty based on game progression  
 Computer automatically assigns difficulty  
 Game becomes increasingly more challenging

**Competition:**

- Game has built in competitive features  
 Game is not competitive  
 Players have opposed interests  
 Each player may gain

Level of involvement required by player:

- passive  active

Number of players:  individual

- pairs  multiple players \_\_\_\_\_

Teacher role:  observer

- participant  facilitator

Educational /therapeutic objective:

Evaluated by: \_\_\_\_\_ Date: \_\_\_\_\_

**Required level and nature of involvement.** The evaluator should assess whether the video game player is passive or active. In some games, the computer plays the game while the participant watches the results. In computer-moderated games, the computer provides the environment for the game to occur and presents decisions or questions to the player at key points during the game. The computer then reveals the consequences of the decisions made by the player.

**Information and rules.** Some games allow the player to have a range of knowledge and information about past experiences with the game. Others provide minimal amounts of information to the player. Part of the strategy may involve the player's response to this lack of information. Rules and player participation in setting rules may vary among games.

**The role of luck.** Some games are driven by chance. Presumably the greater the influence of chance in the working of the game, the less educational and therapeutic in nature. However, some players prefer games of chance over games of strategy.

**Difficulty.** Some games allow the player to choose the difficulty level. Others adjust difficulty level based on the progression of the player. This approach allows the game to become progressively more interesting as it becomes more challenging.

**Competition.** Many games build in competition. Some players are attracted by competition. Classroom teachers may wish to examine if the competition is presented in such a way that all can win and that one does not win at the expense of all others.

**Duration.** Some games have very short duration, while others may go on at length. Making of use rewards, personal challenges, or changes in color or graphical surroundings to maintain interest some games can hold player interest for long periods of time.

**Participant age and characteristics.** Computerized games have been developed for a range of ages. It assumes that the participant can understand the rules of the game and has the skill level to accomplish the motor aspects of playing the game. Some games allow for modification of text to meet the needs of poorly sighted players.

**Number of players.** Some are solitary in nature. Others pit players against each other or the computer. Solitary games may meet the needs of those who find group work difficult.

**Facilitator's role.** In some games, the teacher or facilitator merely observes. In others, the facilitator may be an important part of the game format.

**Setting.** Fully prepare staff to integrate these games into the curriculum or program. Without proper acceptance, the games may be used primarily as a game or toy rather than as a therapeutic or educational tool.

**Hardware.** This idea includes computer, storage capacity, type of disk drive needed, the monitor, and printer needs.

• Although empirical studies have been inconsistent in their findings regarding the impact of violent games on player post-game aggression, it is wise for teachers and parents to examine games for violent (and other unhealthy)

effect and avoid overexposure to these types of games.

• If games have an effect on behavior, then perhaps they could be used to promote prosocial behavior. Health educators should continue to explore use of computer-based games as a means to promote health among children of the computer generation.

• Video games are not a benign force in the lives of American children. In some instances, physical conditions arise as a result of video game use such as nintendinitis. Video game technology also brings new challenges to the education arena.

• Video games represent one technique which may be available to the classroom teacher. Care should be taken that enthusiastic use of this technique does not displace other more effective techniques of a comprehensive health education program.

• Video and computer-based games may possess advantages not present in other learning strategies. For example, the ability to choose different solutions to a difficult problem and then see the affect those decisions on a fictional game allows students to experiment with problem-solving in a relative safe environment.

• Development of effective health-promoting video and computer games will require health educators to collaborate with other professionals (software designers and engineers) to produce a product that is therapeutic and educational, yet fun to play. This approach may require health educators to leave the comfort zones of the classroom and interact with those in the computer laboratory and in industry.

• The cost of development of these products is great, but their appeal to children equally is great.

• Educational video games and simulations which are developed should represent an outgrowth of educational and health behavior change theory. Research is needed to develop a better understanding of how video and computer game technology fits within current theory and how current theory should influence the development of more effective video games.

## CONCLUSION

Video and computer-based games represent forces in American culture that are not likely to fade. In fact, the role of technology in the every day life of Americans is increasing dramatically. However, attention should to be given to the potential detrimental effects this technology may have on health, education, and society. Of particular importance is the affect of violent games on children's behavior. Just as violent television and movies affect viewer behavior, so do violent video games. It also is important for health promoters to understand how this technology can be harnessed to improve health. Use of technology such as video and computer-based games may provide an important way to improve the health of many children and adults of an increasing technologically based society. ■

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