

REVIEW PAPERS

Is Mr Pac Man Eating Our Children? A Review of the Effect of Video Games on Children

Craig E Emes, MD, CCFP¹

Objective: To provide mental health professionals with an up-to-date review of the literature regarding the effects of playing video games on the well-being of children.

Method: A computerized literature search of MEDLINE and PSYCHINFO of all articles written in English from 1966 to 1996 was performed. The various studies are organized into different sections.

Results: Playing video games is associated with a variety of physical effects including increased metabolic and heart rate, seizures, and tendinitis. Aggressive behaviour may result from playing video games, especially among younger children. There is no direct relationship between psychopathology or academic performance and playing video games.

Conclusions: Video games have some adverse effects, but they are also valuable learning tools. Research about the role of video games is inadequate. The data are also limited by the lack of long-term studies and inconsistent findings.

(Can J Psychiatry 1997;42:409-414)

Key Words: video games, children, aggression, seizures, psychopathology, academic performance, physiologic response

Parents and other adults are very concerned that violence on television and in video games may be harmful to children (1). Video games were first introduced in the 1970s, and now they are present in arcade halls and living rooms all over the world. Is there any danger to our youth playing these games? In 1982, the Surgeon General of the United States (US), CE Koop, stated that there is "nothing constructive in the games . . . everything is eliminated, killed, or destroyed" (2). In response to the growing concerns about video games, city councils in several states actually prohibited or limited the availability of video games (3). The interest in playing video games decreased in the late 1970s, but by the late 1980s, the Japanese Nintendo system prompted a resurgence in video game sales. Interest in this new format resulted in an increase

in annual sales from \$100 million in 1985 to \$4 billion in 1990 (4). Video games remain very popular.

To examine the frequency of playing video games, Funk surveyed 357 seventh and eighth-grade students (5). The study found that playing video games was very popular and that boys spent much more time playing them than girls did. Two-thirds of girls spent an estimated average of 2 hours per week at this activity, whereas 90% of boys spent an average of 4.2 hours per week. The location of play was also different between genders, with 50% of the boys spending some time in arcades compared with only 20% of girls. The type of video games that children are playing was also addressed in this study. The results demonstrated that half of the "favourite choices" were games with violent themes and that educational games accounted for only 2% of preferred choices.

As psychiatrists we are asked both by parents and institutions: "Are video games harmful to our children?" It is important that our advice is based on empirical evidence rather than our personal opinion. The goal of this paper is to provide an up-to-date review of the literature about the effects of playing video games. This paper is divided into discussions

Manuscript received July 1996, revised November 1996.

¹Psychiatry Resident, McGill University, Montreal, Quebec.

Address for correspondence: Dr CE Emes, 339 Victoria Avenue, Suite 11, Westmount, QC H3Z 2N1

about 5 aspects of playing video games: physiologic responses, physical illness, aggression, psychopathology, and academic performance. The concluding remarks are intended to guide readers in their attempts to offer advice to concerned families.

Physiologic Responses

Playing video games is very exciting and involves players directly as they operate various levers and buttons. The physiologic response of playing video games was investigated by Segal and Dietz in 1991 (6). They monitored the metabolic and cardiovascular responses in 32 subjects playing a well-known video game. The investigators found the subjects had significantly increased heart rate, systolic and diastolic blood pressure, and oxygen consumption while they played the game compared with their resting measurements. The amount of increase in metabolic rate and cardiovascular stimulation was similar in magnitude to mild-intensity exercise, such as walking at 2 miles per hour. The study concluded that playing video games does not provide sufficient cardiorespiratory stress to improve physical fitness in youth.

Video Game-Related Seizures

In addition to stimulating the metabolic rate and the cardiovascular system, video games are visually exciting with their high-intensity, multicoloured flashes. The excitatory nature of video games is postulated as one of the possible causes of video game-related seizures (7). In 1994, Graf and others published a review of the 35 reported cases of video game-related seizures (8). The subjects who experienced seizures resembled the average video game player, with a mean age of 13.2 years. Seventy-four percent of video game players are male, and a similar proportion of subjects who experience seizures were male. The most common types of seizures were generalized tonic-clonic seizures (63%), simple partial seizures (19%), complex partial seizures (11%), and absence seizures (6%). Neurologic examinations, computerized tomography scans, and magnetic resonance imaging scans were all normal. A large proportion of the cases (29%) had a prior history of nonfebrile seizures. Graf and others postulated that a convulsive susceptibility in striate, peristriate, infratemporal, and posterior parietal cortices to particular visual stimuli was responsible for the seizures. They noted that 73% of the cases were successfully treated with abstinence alone, and they recommended valproic acid for those subjects who could not refrain from playing. Other adverse effects, for example, tendinitis, have also been associated with excessive playing of video games (9).

Video Games and Aggression

An important question that is often asked of health care professionals is whether playing video games will make children more aggressive. The answer is complex because it is difficult to isolate the role of playing video games from

other contributing factors. The research about video games and aggression is minimal, hence conclusions from research on the effects of television are often applied.

Research about television viewing and violence is plentiful (10–17). A recent survey discovered that children spend more time watching television than they do in school, that is, 25 hours per week (10). This amount of viewing translates to a conservative estimate of over 12 000 violent acts per year witnessed on television (11). The violence is frequent, inconsequential, effective, and rewarding. On TV a gun is seen in use an average of 2.5 scenes per hour (12). The effect of viewing such a high degree of violence on the television has been assessed with many different research designs. In a metaanalytic review of 28 naturalistic field studies, Wood and others concluded that exposure to media violence significantly enhanced the aggression of children or adolescents in unstructured social settings (13). One limitation of this review is that the data did not examine the long-lasting effects of exposure.

A longitudinal study attempted to demonstrate the temporal relationship of television viewing to violence or aggressive behaviour over an extended time period (14,15). Huesmann, in 1986, reported on a 22-year prospective study of 800 eight-year-old children. Criminal justice and health records were collected for just over 600 of the original subjects. This study found that criminal acts at age 30 correlated with both the total amount of television watched at age 8 and a preference, among boys, for violent television. The long-lasting effects of exposure are supported by this study, but it does have some important limitations. The authors also reported that the children's aggressive behaviour was related to the quality of the parent-child relationship. It may be that aggressive behaviour is directly related to inadequate parenting, while television viewing is only a secondary variable. The cohort is not representative of the general population because of the high dropout rate (approximately 25%) and the relatively small number of subjects.

Television viewing and violence are such a concern to our society that even population-based studies have been attempted in order to establish a causal relationship (16,17). Centerwall examined homicide rate trends in 3 countries before and after the introduction of television. The study looked at Canada, the US, and South Africa. In these 3 countries, television was introduced at different times, which allowed the 2 other countries to act as controls for Centerwall's study. After the introduction of television in each country, homicide rates increased more than twofold. Interestingly, the first groups of people affected were the urban and the affluent. The author hypothesized that these groups were affected first because they owned televisions before rural and poor populations. In a sample literally the size of a country, there are more possible confounding variables than even longitudinal studies. For example, the US was very active in the Vietnam War, and South Africa was coping with

Table 1. Summary of published studies on video games and aggression in children

Researchers ^a	Year	Sample size	Age	Method	Finding
Dominick (18)	1984	250	Grades 10 to 11	Questionnaire	Aggressive effect
Kestenbaum and Weinstein (33)	1984	208	11 to 14 years	Questionnaire	Calming effect
Graybill and others (27)	1985	116	Grades 2 to 6	Projective test	Assertive fantasies
Cooper and Mackie (21)	1986	84	Grades 4 to 5	Observation	Aggression in girls
Anderson and Ford (25)	1986	60	Undergraduates	Questionnaire	Hostility with games
Silvern and Williamson (22)	1987	28	4 to 6 years	Observation	Increased aggression
Graybill and others (28)	1987	126	Grades 2 to 6	Push-button test	No increase
Winkel and others (29)	1987	56	Grade 8	Role play	No increase
Schutte and others (20)	1988	31	5 to 7 years	Observation	Increased aggression
Fling and others (24)	1992	153	Grades 6 to 12	Questionnaire	Increased aggression
Calvert and Tan (26)	1994	36	Young adults	Questionnaire	Aggressive thoughts
Irwin and Gross (19)	1995	60	7 to 8 years	Observation	Increased aggression
Scott (23)	1995	117	Undergraduates	Questionnaire	No increase

^aReferences given in parentheses.

an ongoing struggle of apartheid during the times that television was introduced in each country.

Although the research about television viewing and violence has major limitations, the consensus from many different research designs supports a causal relationship. To conclude that television viewing and playing video games have the same effects, however, may be misleading. There are some important differences between watching television and playing video games. Television viewing is a passive experience; the viewer participates only as an observer. Playing video games, by contrast, is active, requiring more concentration and physical action. Video games involve the abstract simulation of aggression, whereas the violence depicted on television often imitates reality.

Nevertheless, most video games are violent and feature death and destruction (18). The association between violence in video games and aggression in children has been investigated in at least 13 published studies between 1984 and 1996 (Table 1). These studies examined aggression using different measures.

A number of studies have examined subsequent aggression after children played video games by observing the children in a free-play or structured setting. Irwin and Gross found that individual 7- and 8-year-old boys who played a video game with violent content exhibited significantly more object and interpersonal aggression than youngsters who played nonaggressive video games (19). They also reported that aggressive behaviour was no different between children categorized as either reflective or impulsive according to their responses on the Matching Familiar Figures Test. Schutte and others observed the free play of 5- to 7-year-old children after they played aggressive or nonaggressive video games (20). The result was that playing a video game led to behaviour similar to the theme of the video game. In this study, children who played the karate video game tended to be more aggressive compared with children who played the jungle video

game. They postulated that video games, as well as having the power to induce violent or neutral behaviour, may have the potential to induce prosocial behaviour. Cooper and Mackie also observed the effects of playing aggressive or nonaggressive video games on free play (21). This study looked at fourth and fifth graders randomly assigned to 3 cells: aggressive game, nonaggressive game, and control game. They found that girls' aggressive activity significantly increased after playing the aggressive game, although boys' aggressive behaviour remained unaffected. Finally, another study using a free-play design also demonstrated an increase in aggression after the children played the video games (22). The major limiting factor in all 4 of these studies is that they monitored aggression over a very short time period.

The presence of increased aggression has been measured using different types of questionnaires. Scott found that there was no increase in aggressiveness in students playing highly aggressive games compared with those playing nonaggressive games (23). In fact, there was no linear pattern in aggressive affect change in any of the games, which had varying levels of violence. This study also reported that the moderately aggressive game substantially decreased feelings of aggressiveness. In a survey of 153 high school students, Fling and others observed that the amount of video game play correlated with aggression but not with self-esteem (24). They also reported that boys both played video games more and were more aggressive than girls. The survey included items on video game play, self-esteem, and aggression scales. The teachers also rated the children on self-esteem and aggression. Teacher ratings found a positive correlation between self-esteem and aggression, unlike the self-rating scale, which demonstrated a negative correlation. In a questionnaire distributed to 250 teenagers, Dominick observed that video game play for boys correlated significantly with aggressive delinquency (18). This correlation became nonsignificant when the effects of other variables were taken into consideration. For example, the teenagers who reported frequent

television viewing also reported spending more time with video games. In contrast, Anderson and Ford reported that hostility and anxiety did increase after playing highly aggressive video games (25). This study measured hostility using the Multiple Affect Adjectives Checklist in 60 undergraduate students. Taken together, these 4 questionnaires illustrate some of the inconsistencies in the empirical research. Two studies concluded that aggression is increased, and 2 studies stated that there is no increase in aggression associated with playing video games.

In a study that attempted to measure aggressive thoughts, Calvert and Tan examined the effect on 36 young adults of participating in versus observing a virtual reality game (26). They concluded that physiological arousal and aggressive thoughts increased more for those who participated directly in the virtual reality game than for those who observed. Having aggressive thoughts after playing video games does not necessarily translate into aggressive behaviour. In the first of 2 studies with basically the same population, Graybill and others found that children (6 to 11 years old) exhibited more assertive fantasies after playing violent video games (27). In the second study, Graybill and others used a push-button apparatus to measure aggression after playing violent and nonviolent video games. No significant differences were detected (28). Another study using a behavioural design (role playing) also concluded that the aggressive content of the video game did not affect subsequent aggression (29). Those investigators also observed that there was no difference between males and females in levels of aggression after having played a video game.

The research on video games and aggression in children used a wide range of measures for postplay aggression including observation, questionnaires, projective tests, and behavioural designs. Unfortunately, these studies measured only short-term aggressive behaviour rather than long-term aggression. A majority of the studies showed that children, especially young children, become more aggressive after either playing or watching a violent video game. There are contradictory findings, however, and the reliability and validity of the procedures used to measure aggression levels are questionable. Research into the long-term effects of video game playing is lacking.

Psychopathology

The possibility that video game play may harm the emotional and psychological development of a child is another important concern. A number of studies have examined the psychological characteristics of video game players. Using the Bipolar Personality Inventory on 280 students, Gibb and others examined personality differences between frequent and infrequent video game users (30). They found no evidence that video games encourage social isolation, anger, antisocial behaviour, or compulsivity. There were also no significant differences between high- and low-frequency video game users along the personality dimensions of social

withdrawal, hostility, self-esteem, and social deviancy. The only significant difference between the groups was that for females, achievement motivation and length of experience in playing video games were positively correlated. McClure and Mears also found no significant psychopathology when they studied 290 students with differing frequencies of video game play (31). High-rate players were more extroverted but were no more conduct-disordered or likely to use drugs, alcohol, or cigarettes than low-rate players. The only significant difference was that high-rate players were sent to the school office for minor disciplinary offences more often than low-rate players. In an earlier study, McClure and Mears reported that frequent video game players tended to be young, male, and bright, whereas infrequent video game players were older, female, and not as bright (32). One hypothesis proposed by Kestenbaum and Weinstein was that heavy video game use has a role in resolving conflicts, expressing aggression, and managing competition (33). This hypothesis was tested on 208 adolescent males using self-report questionnaires and scales. The results divided the subjects into high-frequency and low-frequency video game players. Kestenbaum and Weinstein found many differences between the high- and low-frequency subjects. High-frequency subjects seemed to play video games more when they were tense, and they felt more relaxed after use than the low-frequency group. High-frequency subjects tended to play more competitively and felt that it was more important to win than to play fair. The high-frequency group also had more difficulty with frustration tolerance and delay of gratification compared with the low-frequency group. Despite these findings, the 2 groups did not differ on the neuroticism, extroversion, or daydreaming scales. The investigators concluded that heavy video game use did not result in global psychopathology or social introversion but that video game playing represents an arena for discharge of pent-up energies, particularly aggressive energies.

An interesting question is whether video game use can improve psychopathology or enhance personality development. Sherer tested this question in a study that attempted to raise the moral level of distressed youth by exposing them to a computerized simulation game (34). The study measured the level of moral development in 13 research subjects (mean age 15.3 years) and 14 control subjects (mean age 15.21 years) before and after exposure to the therapeutic game. On a scale with 5 indices of moral development, 2 of these—Moral Stage and Punishment—revealed a positive effect for the participants. From the limited evidence available, it appears that psychopathology is not associated with playing video games. There is some evidence that video games may even be useful in improving moral development of adolescents.

Academic Performance

One of the main concerns that is constantly raised against video games is that frequent playing negatively affects school

performance. The findings in this area are limited and mixed. For a sample of 234 fourth-, fifth-, and sixth-grade students, Lin and Lepper studied the relationship between academic performance and video game play (35). Teachers were given 7-point Likert-type scales to rate academic performance and various behaviour variables of the students. The study reported a small but statistically significant negative relationship between arcade game use and teachers' ratings of math ability and general academic competence in boys. There was no relationship between home game use and academic performance. Creasey and Myers examined the relationship between school performance and video games from an entirely different perspective (36). Using questionnaires with 64 adolescents, they assessed if new video game ownership influenced academic activities. As expected, children with a new video game initially spent a great deal of time playing, but their frequency and duration of play with the game diminished over time. Comparing the periods before and after ownership, they found that owning a video game system did not influence children's homework habits or grades in math or English. The group of children who did not own a video game, however, demonstrated higher math grades overall than did the game-owning group. To account for this difference, the authors surmised that families in which children are more serious students might also be predisposed against purchasing a video game system. The previously mentioned study by Dominick also concluded that school performance was not significantly related to video game playing (18).

Conclusions

In spite of the studies about the alleged negative effects, there are many people who support the use of video games. The US Army uses video games for the training of hand-eye coordination (37). Within the field of mental health, video games are useful for assessing and managing schizophrenia (38). Video games can equip children with computer-related skills for the future because they give children access to "state of the art" technology. In summary, although the research remains preliminary, it appears that video games influence players in the following ways:

1) The physiologic response of playing video games is similar to mild-intensity exercise but does not provide enough aerobic stress to improve physical fitness.

2) There are 35 case reports suggesting that playing video games can induce epileptic seizures in susceptible children. The most effective treatment is abstinence, though some children may need medication.

3) The majority of the studies show that children do become more aggressive after either playing or watching a violent video game. All of the studies used a short-term follow-up time period, however, and the reliability and validity of the procedures used to measure aggression are questionable. Research into the long-term effects of video game playing is needed.

4) Psychopathology is not associated with playing video games. There is no personality stereotype of a frequent video game player. Video game playing may be a useful means of coping with pent-up and aggressive energies. The research on this subtle topic is minimal.

5) There is no clear causal relationship between video game playing and academic performance. The research on this topic is sparse and contradictory.

6) Video games are useful for many different purposes including job training and management of mental illness. Additional research is needed to explore novel uses of this technology further.

Clinical Implications

- Playing video games is associated with seizures and short-term aggression.
- Playing video games is not associated with psychopathology or academic performance.
- Video games are used in many different fields such as job training and therapy for the mentally ill.

Limitations

- The number of well-conducted research studies in this field is small.
- The reliability and validity of the procedures used to measure aggression are questionable.
- Research into the long-term effects of playing video games is lacking.

References

1. Sneed C, Runco MA. The beliefs adults and children hold about television and video games. *J Psychol* 1992;126:273-84.
2. Koop CE. Surgeon General sees danger in video games. *The New York Times* 1982 Nov; Sect A16.
3. Klein MH. The bite of Pac-Man. *Journal of Psychohistory* 1984;11:395-401.
4. Provenzo EF. *Video kids: making sense of Nintendo*. Cambridge (MA): Harvard University Press; 1991.
5. Funk J. Reevaluating the impact of video games. *Clin Pediatr (Phila)* 1993;2:86-90.
6. Segal K, Dietz WH. Physiologic responses to playing a video game. *Am J Dis Child* 1991;145:1034-6.
7. Glista GG, Frank HG, Tracy WF. Video games and seizures. *Arch Neurol* 1983;40:588.
8. Graf W, Chatrian G, Glass ST, Knauss TA. Video game-related seizures: a report on 10 patients and a review of the literature. *Pediatrics* 1994;93:551-6.
9. Brasinbton R. Nintendinitis. *N Engl J Med* 1990;322:1473-4.
10. Dietz WH, Strasburger VC. Children, adolescents and television. *Curr Probl Pediatr* 1991;21:8-31.
11. Gerbner G, Signorielli N. Violence profile 1967 through 1988-89: enduring patterns. Philadelphia: Annenberg School for Communications; 1990.
12. Prince JH, Merrill EA, Claus ME. The depiction of guns on prime time television. *J Sch Health* 1992;62:15-8.
13. Wood W, Wong FY, Chachere JG. Effects of media violence on viewers' aggression in unconstrained social interaction. *Psychol Bull* 1991;109:371-83.
14. Huesmann LR. Psychological processes promoting the relation between exposure to media violence and aggressive behavior by the viewer. *Journal of Sociological Issues* 1986;42:125-39.
15. Huesmann LR, Eron LD. Cognitive processes and the persistence of aggressive behaviour. *Aggressive Behavior* 1984;10:243-51.
16. Centerwall BS. Exposure to television as a risk factor for violence. *Am J Epidemiol* 1989;129:643-52.

17. Centerwall BS. Television violence: the scale of the problem and where to go from here. *JAMA* 1992;267:3059–63.
18. Dominick JR. Video games, television violence, and aggression in teenagers. *Journal of Communication* 1984;34:136–47.
19. Irwin AR, Gross AM. Cognitive tempo, violent video games, and aggressive behavior in young boys. *Journal of Family Violence* 1995;10:337–50.
20. Schutte NS, Malouff JM, Post-Gorden JC, Rodasta AL. Effects of playing video games on children's aggressive and other behaviors. *Journal of Applied Social Psychology* 1988;18:454–60.
21. Cooper J, Mackie D. Video games and aggression in children. *Journal of Applied Social Psychology* 1986;16:726–44.
22. Silvern SB, Williamson PA. The effects of video game play on young children's aggression, fantasy, and prosocial behavior. *Journal of Applied Developmental Psychology* 1987;8:453–62.
23. Scott D. The effect of video games on feelings of aggression. *J Psychol* 1995;129:121–32.
24. Fling S, Smith L, Rodriguez T, Thornton D. Video games, aggression, and self-esteem: a survey. *Social Behaviour & Personality* 1992;20:39–45.
25. Anderson CA, Ford CM. Affect of the game player: short term effects of highly and mildly aggressive video games. *Personality and Social Psychology Bulletin* 1986;12:390–402.
26. Calvert SL, Tan S. Impact of virtual reality on young adults' physiological arousal and aggressive thoughts: interaction versus observation. In: Special Issue: effects of interactive entertainment technologies on development. *Journal of Applied Developmental Psychology* 1994;15:125–39.
27. Graybill D, Kirsch JR, Esselman ED. Effects of playing violent versus non-violent video games on the aggressive ideation of children. *Child Study Journal* 1985;15:199–205.
28. Graybill D, Strawniak M, Hunter T, O'Leary M. Effects of playing versus observing violent versus non-violent video games on children's aggression. *Psychology, Quarterly Journal of Human Behavior* 1987;24:1–7.
29. Winkel M, Novak DM, Hopson H. Personality factors, subject gender, and the effects of aggressive video games on aggression in adolescents. *Journal of Research in Personality* 1987;21:211–23.
30. Gibb GD, Bailey JR, Lambirth TT, Wilson WP. Personality differences between high and low electronic video game users. *J Psychol* 1983;114:159–65.
31. McClure RF, Mears FG. Video game playing and psychopathology. *Psychol Rep* 1986;59:59–62.
32. McClure RF, Mears FG. Video game players: personality characteristics and demographic variables. *Psychol Rep* 1984;55:271–6.
33. Kestenbaum GI, Weinstein L. Personality, psychopathology, and developmental issues in male adolescent video game use. *Am Acad Child Psychiatry* 1985;24:329–37.
34. Sherer M. The effect of computerized simulation games on the moral development of youth in distress. In: Theme Issue: electronic tools for social work practice and education, I: computers in Human Services 1994;11:81–95.
35. Lin S, Lepper MR. Correlates of children's usage of video games and computers. *Journal of Applied Social Psychology* 1987;17:72–93.
36. Creasey G, Myers BJ. Video games and children: effects on leisure activities, schoolwork, and peer involvement. *Merrill-Palmer Quarterly* 1986;32:251–62.
37. Trachtman P. A generation meets computers—and they are friendly. *Smithsonian* 1981;12:50–61.
38. Samoilovich S, Riccitelli C, Schiel A, Siedi A. Attitude of schizophrenics to computer video games. *Psychopathology* 1992;25:117–9.

Résumé

Objectif : Fournir aux professionnels de la santé mentale une analyse à jour de la littérature consacrée aux effets des jeux vidéo sur le bien-être des enfants.

Méthode : On a mené une recherche informatisée de la littérature, grâce à MEDLINE et PSYCHINFO, portant sur tous les articles rédigés en anglais de 1966 à 1996. Les diverses études sont réunies dans différentes sections.

Résultats : Les jeux vidéo sont liés à divers effets physiques, notamment une augmentation de la vitesse du métabolisme et de la fréquence cardiaque, des convulsions et des tendinites. Les jeux vidéo peuvent entraîner un comportement agressif, surtout chez les jeunes enfants. Aucune relation directe n'a été établie entre la psychopathologie ou le rendement scolaire et les jeux vidéo.

Conclusions : Les jeux vidéo provoquent certains effets indésirables, mais ils constituent aussi des outils d'apprentissage précieux. La recherche sur le rôle des jeux vidéo est insuffisante. Les données sont également limitées par l'absence d'étude à long terme et par des constatations incohérentes.