assessing well-being. Also of interest is that the relationship of functional ability, cognitive impairment, and depression is often mediated by psychological resources (e.g., mastery). This suggests that it may not merely be the presence of disabilities that lead to depression, but the ways in which they are interpreted.

CONCLUSION

Because the population of people older than 85 years is the fastest growing population in terms of age groups, research examining this age period is becoming more important. Although researchers have identified trends, the heterogeneity of this age group cannot be underemphasized, thus increasing the need for longitudinal studies examining intraindividual change. Caution should also be taken when interpreting the results from studies examining the oldest old because participants typically represent a very positive selection of the population and of their cohort. Finally, because of the relationships between the aspects of aging discussed (e.g., sensory ability and cognition, social relationships and emotion), there is a need for multidisciplinary research to further explicate when and how these interactions occur.

—Brian J. Ayotte

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VIDEO GAMES

ORIGIN AND GROWTH OF THE VIDEO GAME INDUSTRY

The first interactive computer game, *Spacewar*, was written in 1961 by an MIT student named Steve Russell on a Digital Equipment PDP-1 computer. The first consumer video game, *Pong*, was released a decade later in 1972. Throughout the 1970s and into the 1980s, most video games were played in arcades (in this chapter, we define video games to include arcade games, computer games, and home console games such as *PlayStation*). Several recurring themes began to emerge at this time: multiple companies vied for market dominance, displacing older systems with each new technological advance; the popularity and cultural impact consistently grew over time; and concerns arose regarding the effects games might have. Concerns about video game violence first became highly salient in 1976 with the game *Death Race*, in which the goal was to drive a car over stick figures called "gremlins."

Currently, video game images are created out of many polygons; therefore, the number of polygons processed per second (pg/s) is a common measure of graphics quality. The Sony *PlayStation*, released

in 1995, processed 350,000 pg/s. Sega's *Dreamcast*, released in 1999, leaped ahead to more than 3 million. A year later, Sony's *PlayStation 2* jumped to 66 million pg/s. One year after that, Microsoft's *Xbox* boasted 125 million pg/s. The stated goal for Sony's *PlayStation 3* is 1 billion. At the same time, this increased speed and graphic capacity allowed for games to become more realistic, including far more realistic and graphic violence. Returning to an old theme, the top-selling video games from 2001 to 2003 were the *Grand Theft Auto* series, which included running down pedestrians with cars, and killing police, prostitutes, and others with a variety of weapons. The video game industry is now bigger than Hollywood, raking in more than $10 billion annually in the United States in 2002 and 2003. As games have taken up more of children's time and become more realistic and engaging, researchers have begun to study children's uses of video games and the varied effects they may have.

CHILDREN'S USE OF VIDEO GAMES AND SEX-CORRELATED DIFFERENCES

The amount of time children spend playing video games has increased over the past three decades. Considering both home and arcade playing in the mid-1980s, children averaged about 4 hours/week. By the early 1990s, home playing had increased and arcade playing had decreased, and sex-correlated differences had begun to emerge. Girls played an average of about 2 hours/week, with boys playing an average of 4 hours/week. In the mid-1990s, home play had increased for fourth-grade girls to 4.5 hours/week and 7.1 hours/week for boys. In 1999, school-age children (boys and girls combined) averaged 7 hours/week. Most recently in elementary and middle-school populations, girls are playing about 5.5 hours/week and boys average 13 hours/week. Perhaps surprisingly, the average amount of television watched has not dropped as video game playing time has increased.

It is still unclear at what age video game playing begins, but it is likely to be younger with each passing year. In a nationally representative survey, parents reported that children aged 2 to 7 play an average of 43 minutes/day. In studies of preschool children, even preschoolers aged 2 to 5 play an average of 28 minutes/day. It is also unclear when play peaks, if it does, and when it declines, if it does. Regardless of when children start playing, and whether there is a normative

peak time, it is clear that gamers do not stop playing once they turn 18. The average age of a video game player has risen steadily, and is currently 29. It is important not to let this average mask the fact that video games have become ubiquitous in youth culture, with 92% of 2- to 17-year-olds playing.

Three sex-correlated differences have been found consistently across studies. First, males are more likely to play video games than females. Second, males are more likely to spend more time playing video games. Third, males prefer more violence in their video games Most researchers define violence in games as when the player can intentionally harm other characters in the game. Content analyses show that most games contain some violent content, and about half of those include violence that would result in serious injuries or death. When asked, a majority of fourth- to eighth-grade children prefer violent games.

VIDEO GAME EFFECTS

Video games are natural teachers. Children find them highly motivating; by virtue of their interactive nature, children are actively engaged with them; they provide repeated practice; and they include rewards for skillful play. These facts make it likely that video games could have large effects, some of which are intended by game designers, and some of which may not be intended. We review several of these intended and unintended effects below, grouped into what could be considered "positive" and "negative" effects.

Positive Effects

The educational value of educational software and video games (known as *discrete educational software*) has been so widely accepted that such software is second only to word processing software in its availability and use in school classrooms. Although the quality of research in this domain varies widely, meta-analyses of recent high-quality studies of the efficacy of discrete educational software show an effect size of 0.38. That is, the average correlation between student use of educational software and student achievement is 0.38. The average correlation is 0.35 for educational games teaching reading skills and 0.45 for games teaching math skills. The efficacy for teaching prereading skills may be even greater than for teaching reading skills. The average correlation between educational software/games and reading skills is

0.44 for prekindergarten and kindergarten children.

Video games with other specific types of content have also shown positive effects. Video games have been used to teach children healthy skills for the self-care of asthma and diabetes and have been successful in imparting the attitudes, skills, and behaviors that they were designed to teach. In a study of college students, playing a golf video game improved students' actual control of force when putting, even though the video game gave no proprioceptive feedback on actual putting movement or force.

Some researchers have argued that video games are the "training wheels" for computer literacy. Computer literacy includes skills beyond traditional literacy skills, specifically iconic skills (image representation and manipulation). Research suggests that people can learn iconic, spatial, and visual attention skills from video games. For example, a study with college students to determine relative ability to keep track of several different things on a computer screen at the same time (a skill similar to those needed by flight controllers) concluded that expert video game players were better at maintaining divided visual attention than novices. In a second study, 5 hours of playing a video game led to increased response speed in the visual attention task, regardless of previous video game experience. Other studies have documented relations between video game play and visual selective attention, spatial visualization, mental rotation, and reaction times. Video games can also provide opportunities for practice in following directions and in the use of fine motor skills. There have even been studies with adults showing that experience with video games is related to better surgical skills.

Negative Effects of Violent Video Games

Of several negative effects that have been studied, the one that has received the most attention is aggressive behavior. Dozens of studies have been conducted on the relation between playing violent video games
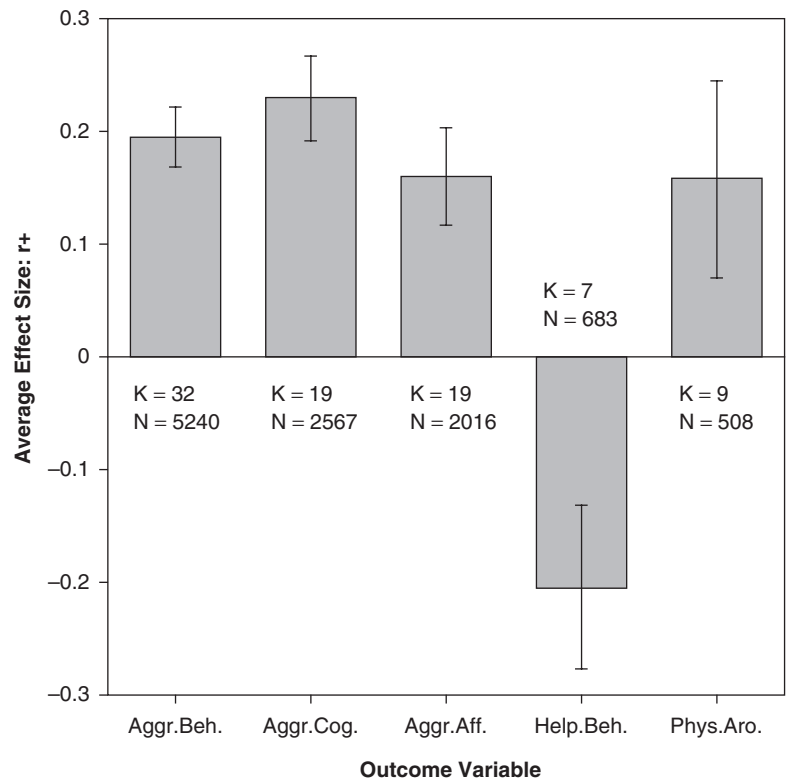
Figure 1   Effects of Violent Video Games on Aggressive Behavior, Aggressive Cognition, Aggressive Affect, Helping Behavior, and Physiological Arousal, All Samples.

SOURCE: Anderson, C. A. (2004). An update on the effects of violent video games. *Journal of Adolescence, 27*, 133–122. Copyright by Craig A. Anderson and Academic Press. Reprinted by permission.

NOTES: K = number of independent samples. N = total number of participants. Vertical capped bars are the upper and lower 95% confidence intervals

and aggression-related variables. When analyzed using modern meta-analytic techniques, these studies show remarkably consistent results that are in line with theoretical predictions and with the much larger research literature on violent television and film effects. As can be seen in Figure 1, there are five major effects of playing violent video games.

1. *Violent video games increase physiological arousal*. Experimental studies show short-term increases in physiological arousal, such as heart rate and blood pressure.

2. *Violent video games increase aggressive cognitions*. Experimental and correlational studies show short-term and long-term increases in aggressive cognitions. Measures have included reaction times to

aggression-related and unrelated words, aggressive content of story completions, hostile attributions to ambiguous provocations, and aggressive completions of word fragments, among others.

3. *Violent video games increase aggressive feelings*. Experimental and correlational studies show short-term and long-term increases in aggressive affect, sometimes labeled *anger* or *state hostility*.

4. *Violent video games increase aggressive behaviors*. Experimental and correlational studies show short-term and long-term increases in aggressive affect. Aggressive behaviors have been measured in several ways, ranging from highly ecologically valid approaches such as physical fights at school to highly controlled (and internally valid) laboratory approaches such as attempts to deliver highly noxious noise blasts to a game opponent. These effects have been found in children and adults, and in males and females, in nonaggressive and highly aggressive individuals. In a recent longitudinal study of third to fifth graders, violent video game play was related to increases in verbally and physically aggressive behaviors even after controlling for sex, hostile attribution bias, amount of screen time, parental involvement, and prior aggression levels.

5. *Violent video games decrease prosocial behaviors*. Experimental and correlational studies show short-term and long-term decreases in positive or prosocial behaviors.

As may be seen from this meta-analysis, violent video games appear to be every bit as good at teaching aggressive skills as educational video games are at teaching reading skills.

Incidental Negative Effects

Several studies have documented relations between video game play and a wide array of other negative effects, most notably academic performance. This appears to be related to the amount of play more than the content of the games, in that students who spend a lot of time playing video games tend to get poorer grades.

There are also a number of concerns about the potential effects of heavy video game play on children's physical health, including obesity, video-induced seizures, and postural, muscular, and skeletal disorders, such as tendinitis, nerve compression, and carpal tunnel syndrome. The causes for these types of disorders vary from posture at the computer to the repetitive nature of movements used with input devices (e.g., keyboards, mice, and joysticks). Most of the information on these types of disorders has been collected on adults. However, some have been documented in pediatric populations. In March 2000, Nintendo of America, a major video game manufacturer, acknowledged the problem by agreeing to provide protective gloves to about 1.2 million children because of numerous reports of hand injuries caused by the control stick of a particular game. Excessive video game playing has also led to documented cases of a form of tendinitis dubbed "Nintendinitis," caused by repeatedly pressing buttons with the thumb during game play.

Finally, some studies are beginning to document the existence of what appears to be video game "addiction." Studies suggest that perhaps as many as 15% to 20% of video game players could be considered "addicted" by criteria similar to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* criteria for gambling addiction. Although the correlates of video game addiction are only recently being investigated, it appears that this may be a growing problem.

SUMMARY

Children are becoming more engaged with video games as the technology advances, bringing more realistic and exciting games into millions of homes. Partly because so many children play games for increasing amounts of time, researchers have begun to ask what the consequences of play may be. In short, video games appear to be excellent teachers. Many of the things they teach are intended (e.g., reading or math skills), but many are not (e.g., aggressive attitudes and behaviors, visual attention skills). Furthermore, the amount of time spent with video games may also have a negative impact on school performance and physical health for many children.

The question of whether video games are "good" or "bad" for children is oversimplified. Playing a first-person shooter game for hours every day could have a negative effect on school performance, a negative effect on aggressive behaviors, and a positive effect on visual attention skills. We prefer to recognize that video games can have powerful effects on children, for good or ill.

—*Douglas A. Gentile and Craig A. Anderson*

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VIOLENCE

Violence is an act of physical force or threat of force that causes damage or is intended to produce harm. The damage inflicted by violence may be physical, psychological, or both. Violence may be distinguished from aggression, a more general type of hostile behavior that may be physical, verbal, or passive in nature.

TYPES OF VIOLENCE

Violence can be categorized in a number of ways. Violent crimes are typically divided into four main categories, based on the nature of the behavior: homicide (intentionally ending the life of another person), assault (attacking another person with the intent to cause harm), robbery (forcibly taking something from another person), and rape (forcing someone to engage in sexual activity). Other forms of violence overlap with these categories, such as child sexual abuse (engaging in sexual acts with a child) and domestic violence (violent behavior between relatives, usually spouses).

Violence can also be categorized according to the motivation for it. Reactive, or emotional, violence typically involves the expression of "hot-blooded" anger—a hostile desire to hurt someone—that arises in response to perceived provocation. Proactive, or instrumental, violence is more "cold blooded" and calculated, done in anticipation of a reward. Psychologist Kenneth Dodge found that these two types of violence involve distinct physiological states: a person engaging in reactive violence experiences increased autonomic nervous system arousal (i.e., increased heart rate and breathing, sweating), whereas a person committing an act of proactive aggression experiences low autonomic arousal.

Another method of categorizing violent behavior involves distinguishing between predatory and affective violence. Predatory violence involves planned acts of hostile force. Affective violence is more impulsive and unplanned. Other types of violence have been suggested, including irritable (motivated by frustration), territorial (motivated by intrusion into one's perceived territory or space), fear-induced (motivated by fear), and maternal (motivated by a threat to one's child) violence.

FREQUENCY OF VIOLENT BEHAVIORS

Since the time of early civilizations, violence has occurred throughout the world, in forms ranging from war between countries to individuals behaving violently toward other individuals. In recent decades, rates of violent crimes committed by individuals have been documented by the United Nations. Although every country experiences violence, rates of violence (calculated as the number of crimes per 100,000 people) vary considerably across countries. For example, in 2000, the reported homicide rate was relatively low in countries such as Greece (0.76), Japan (0.50), Pakistan (0.05), and Switzerland (0.96). Much higher homicide rates were reported that year in Colombia (62.74), Jamaica (33.69), Russia (19.80), and South Africa (51.39). In 2000, the homicide rate in the United States was 5.5 per 100,000 people. In the United States, 1,426,325 violent crimes were reported to the police in 2002; the violent crime rate that year was 494.6 per 100,000. Assaults accounted for the largest proportion (62.7%) of reported violent crimes in the United States, followed by robbery (29.5%), rape (6.7%), and homicide (1.1%). These rates do not account for all violence that occurs in the United