CHAPTER 4

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New Forms of Electronic Media

The Impact of Interactive Games and the Internet on Cognition, Socialization, and Behavior

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Over the past few years, U.S. households have added home computers, electronic games, and the Internet to the other technologies—the telephone, radio, TV, and stereo system—that consume children's time. In 1998, 43% of adult Americans owned a personal computer (PC), up from 36% in 1995 (Pew Research Center for People and the Press, 1998). Moreover, PC ownership is higher among households with children than those without, and this rate too is growing. For example, in 1994, 39% of American

households with children had personal computers; by 1999, this had jumped to more than 60% for married couples with children (Roberts, Foehr, Rideout, & Brodie, 1999; Turow, 1999; see Figure 4.1). Indeed, computers have replaced television as the favorite medium of children and adolescents (both boys and girls) from 8 to 18 years of age (Roberts et al., 1999).

What, then, is the impact of computer use outside of school on child and adolescent development? During the early 1990s, game playing was the dominant use of computers among children 3 to 17 years of age (U.S. Census Bureau, 1993). The introduction of the Internet, however, has dramatically changed the picture. Recent data suggest that 75% of households with computers currently have Internet access, and the dominant use of the Internet is for electronic mail (Shih & Venkatesh, 1999). Recent surveys (Turow, 1999) suggest that, although games are the most frequent on-line activity among 8- to 12-year-olds, schoolwork has surpassed games as the most frequent on-line activity for teens ages 13 to 17.

But electronic games are not limited to personal computers. Games are also played on other popular computerized platforms such as Nintendo or Sega game systems. In 1999, it was reported that 67% of households with children had such a computer game system (Stanger & Gridina, 1999). For the first time in 1999, video games are even expected to outperform the domestic box office of movies ("Vita Stats," 1999). Electronic games seem to have an especially important place in the lives of boys. In a study of the self-reported leisure-time activities of 2,200 third- and fourth-grade children, the activities most often reported by boys were computer game playing on any platform (33%); in contrast, the activity most often reported by girls was doing homework (39%), with only 9.7% reporting computer game playing (Harrell, Gansky, Bradley, & McMurray, 1997). Although games were clearly the most frequent computerized activity for children, the Internet is the most rapidly growing one; 36.6% of all households with children had Internet services in 1999 (Turow, 1999).

In this chapter, we focus on the impact of the most frequent use of computers—games—and the most rapidly growing and recent use of computers—the Internet (not even mentioned in the 1990 census). Note that games are a category of content and the Internet is a delivery system or medium of communication. An important quality of modern information technology, however, is the complex relationship between content, delivery system, and platform. Thus, electronic games can be played through many different computerized platforms and delivery systems, including stand-alone game sets, arcade consoles, and personal computers, while the Internet can basically deliver anything. Even within the personal computer, games can be delivered through stand-alone pieces of software or through the Internet. Not only can games be downloaded from the Internet, but they can also be played interactively with other live players over the Internet.

Demographics

The presence of a home computer is closely related to the income and ethnicity of families. By the end of 1998, 88% of American adults with family incomes greater than $75,000 reported owning a personal computer, compared with 47% of those with incomes between $30,000 and $50,000, and only 19% with family incomes less than $20,000. In homes with children from 2 to 18, 78% of white respondents reported a family computer, whereas only 55% of African American and 48% of Hispanic respondents did so (Roberts et al., 1999). On-line access is also strongly correlated with income: 12% of families with annual incomes under $30,000 subscribe to the Internet, compared with 61.1% of families with annual incomes over $75,000 (Stanger, 1998). In addition to replicating this economic gradient of Internet access, Roberts et al. (1999) also found that the

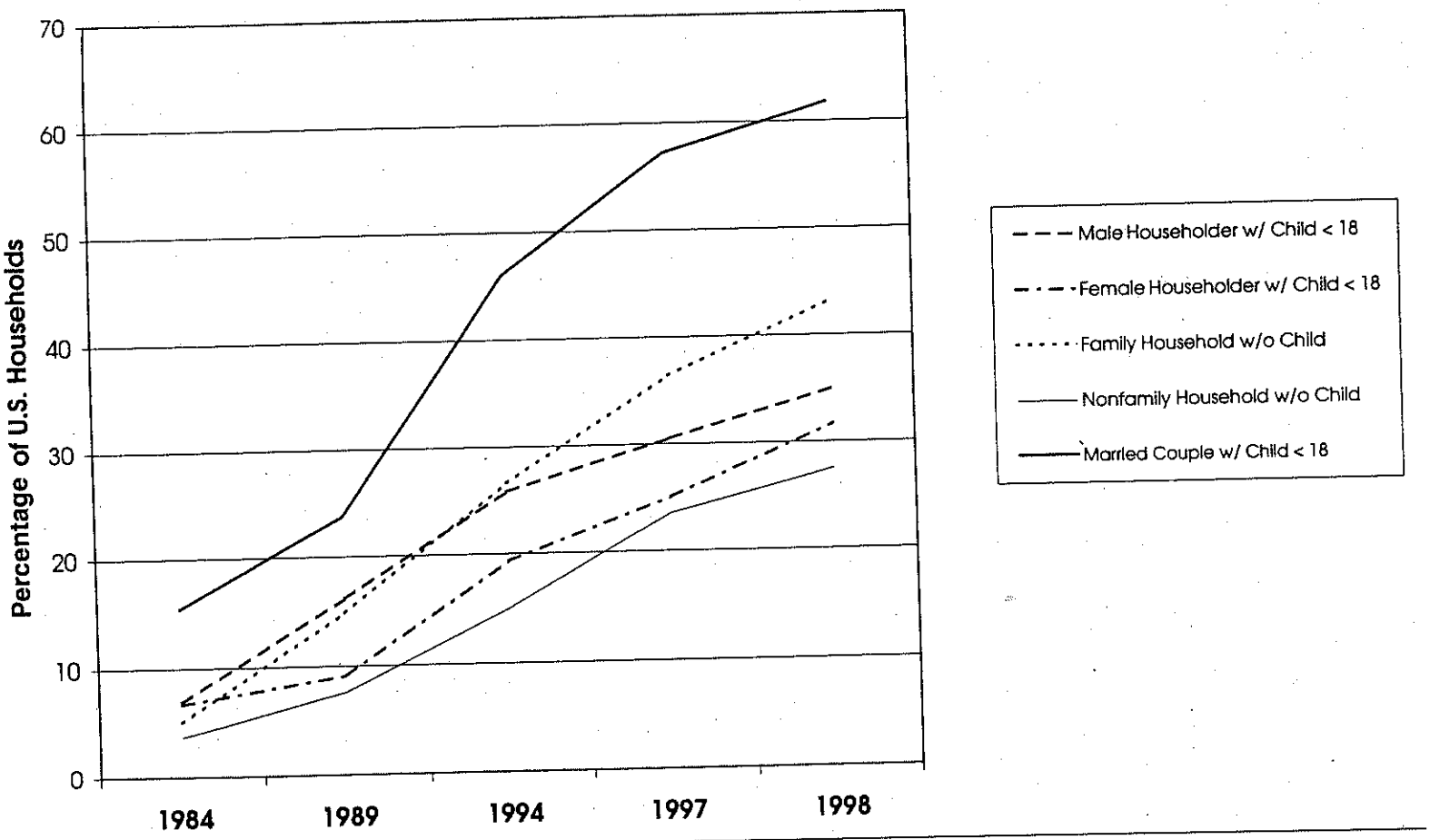

Figure 4.1. Percentage of U.S. Households With Personal Computers

SOURCE: Data from the National Telecommunications and Information Administration, *Falling Through the Net: Defining the Digital Divide* (U.S. Department of Commerce, July 1999).

average daily computer use among children and adolescents increased as a function of parental education. Interestingly, stand-alone video game platforms do not vary systematically with income and race (Roberts et al., 1999), supporting the notion that they may be the most democratic means for diffusing computer literacy (Greenfield, 1994).

Time on Computers

We start by examining research on the amount of time children spend on computers and the time such computer use takes from other activities. Parents report that children (2-17 years) in homes with computers spend approximately 1 hour and 37 minutes a day on computers, including video games (Stanger & Gridina, 1999). In contrast, using an analysis of PC meter data[1] from 10,076 households with computers in September 1996—including who was using the computer, which applications were used, and which websites or web pages were viewed—Coffey and Stipp (1997) reported that half of the 2- to 11-year-olds in these households did not use the computer at all, and less than 10% actually accessed the Internet. Children in this age group who did access the Internet spent on average only half an hour a month Web surfing. Although the Coffey and Stipp results reflect earlier trends, they do raise questions about the accuracy of self-report data (e.g., Stanger & Gridina, 1999) and suggest the need for more accurate estimates of computer use by children.

The picture is very different for children and adolescents from 10 to 19.[2] The data on this age group come from the HomeNet project, a field trial at Carnegie Mellon University whose purpose was to understand household use of the Internet (Kraut, Scherlis, Mukhopadhyay, Manning, & Kiesler, 1996). The trial included 107 families and 302 individuals, including 113 children between the ages of 10 and 19.[3] Table 4.1 shows averages for various measures of Internet use, broken down by generation and gender. In these data, respondents logged onto the Internet personally, and metrics were collected from machine records.

First, and most important, teenagers are much heavier users of the Internet and all its services than their parents are. Among teenagers, boys are substantially heavier users than girls, even though they had equal access to the technology at home. Figure 4.2 shows the distribution of weekly use across the teens in the study, averaged across approximately 2 years of data. Teens who were using the Internet at all (100% of the boys and 81.6% of the girls) during a week used it about 3 hours a week on average, and more than 10% were using it more than 16 hours per week.

Figure 4.3 shows the distribution of Internet use over the hours of the day. The school day strongly structures how teens use the Internet. During school days, their use starts to rise in the middle of the afternoon, when they are dismissed from school, and increases steadily, reaching a peak in the prime-time television viewing hours of 8:00 to 10:00 P.M. Use on the weekends is lower overall because more activities compete with it; it starts later in the day, because many of the students sleep late, and peaks closer to midnight or 1:00 A.M.

We also have data on Internet use and experience from a sample of adolescent America Online (AOL) users who responded to a questionnaire in February 1997. The questionnaire was put out by the creators of Plug In! (an on-line teen community on AOL) to recruit adolescent leaders and "cast members" for the forum.[4] The questionnaire sample included 290 respondents (mean age = 14.89 years; range = 10-19 years), of which 184 were girls and 106 were boys.[5] Note that this is not simply a larger sample of young respondents compared with the Pittsburgh sample (i.e., the HomeNet study); it is also a different kind of sample. Whereas the Pittsburgh sample consisted of first-time Internet users, the Plug In! sample was a national sample of children and adolescents who not only had com-

TABLE 4.1 Metrics of Internet Use, by Generation and Gender

Weekly Usage Measure	*Teenage Boys*	*Teenage Girls*	*Adult Men*	*Adult Women*
Percentage active per week	58.00	44.00	37.00	35.00
Number of Internet sessions	5.30	2.93	1.41	1.45
Hours on-line	4.00	1.51	0.82	0.57
Session length in minutes	37.98	30.83	33.54	28.13
Hours on e-mail	1.70	0.84	0.25	0.22
Unique websites visited	11.17	3.89	4.34	1.93
Mail messages sent	3.79	2.51	0.32	0.49
Mail messages received	3.40	1.95	0.22	0.28
Newsgroup messages sent	0.36	0.14	0.01	0.00
Newsgroup messages read	4.55	2.59	0.39	0.17
Listserv subscribed to	0.20	0.28	0.08	0.06
Listserv messages sent	0.03	0.01	0.00	0.00
Percentage using a MUD or IRC	38.00	25.00	0.00	0.00
N (windsorized)	31.00	44.00	67.00	88.00
N (all)	43.00	67.00	92.00	116.00

puters and Internet access at home but were sufficiently "plugged in" to want to become site leaders. (Although this study uses self-report data, we focus on age and gender comparisons within the data set; therefore, any self-report biases should be similar across the comparison groups.)

An analysis of variance on the mean weekly use of Plug In! as a function of gender revealed that there was greater use among boys (mean = 18.9 hours) compared with girls (mean = 13.9 hours) [$F(1, 251) = 6.71$, $p = .01$]. However, when age (preteens = 10-12; teens = 13-15; and older teens = 16-19) was taken into account, there were no reliable differences in mean weekly use [$F(2, 285) = .642$, $p > .05$]. Figure 4.4 shows the distribution of the mean weekly use among preteen, teen, and older teen boys and girls. Although not significant, the means present an interesting trend: Among the boys, the greatest use was by the older teens (mean = 19.84 hours), whereas, among the girls, the greatest use was by the preteens (mean = 20.85 hours).

Prior experience with the Internet (in months) was similarly analyzed by an analysis of variance with age and gender as between subjects factors; again, no reliable effects were obtained. Figure 4.5 shows the distribution of prior experience as a function of age and gender. Examination of means suggests that, although boys had more prior experience with the Internet than girls among the older teens (mean = 13.05 months and 9.68 months, respectively), the gender gap was not present among the teens (mean = 11.92 months for the boys and 11.23 months for the girls) and, in fact, showed a reversal among the preteens, with the girls (mean = 6.29) having more prior experience than the boys (mean = 3.60 months). It is possible that this trend reflects a historical change, with girls now getting socialized with the Internet at an earlier age, compared with earlier times. We

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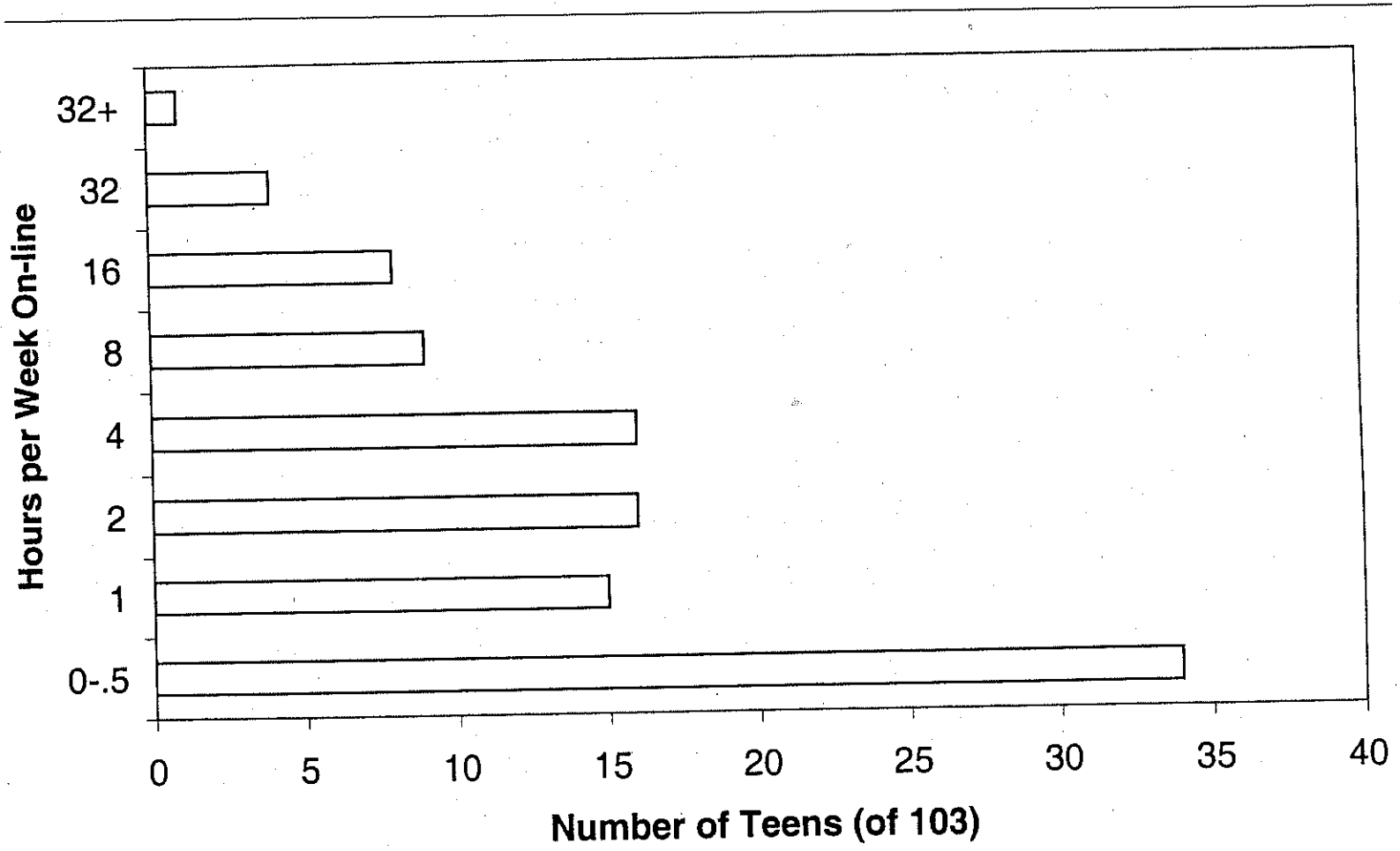

Figure 4.2. Distribution of Weekly Internet Use Among Teens
SOURCE: HomeNet Study (1996).

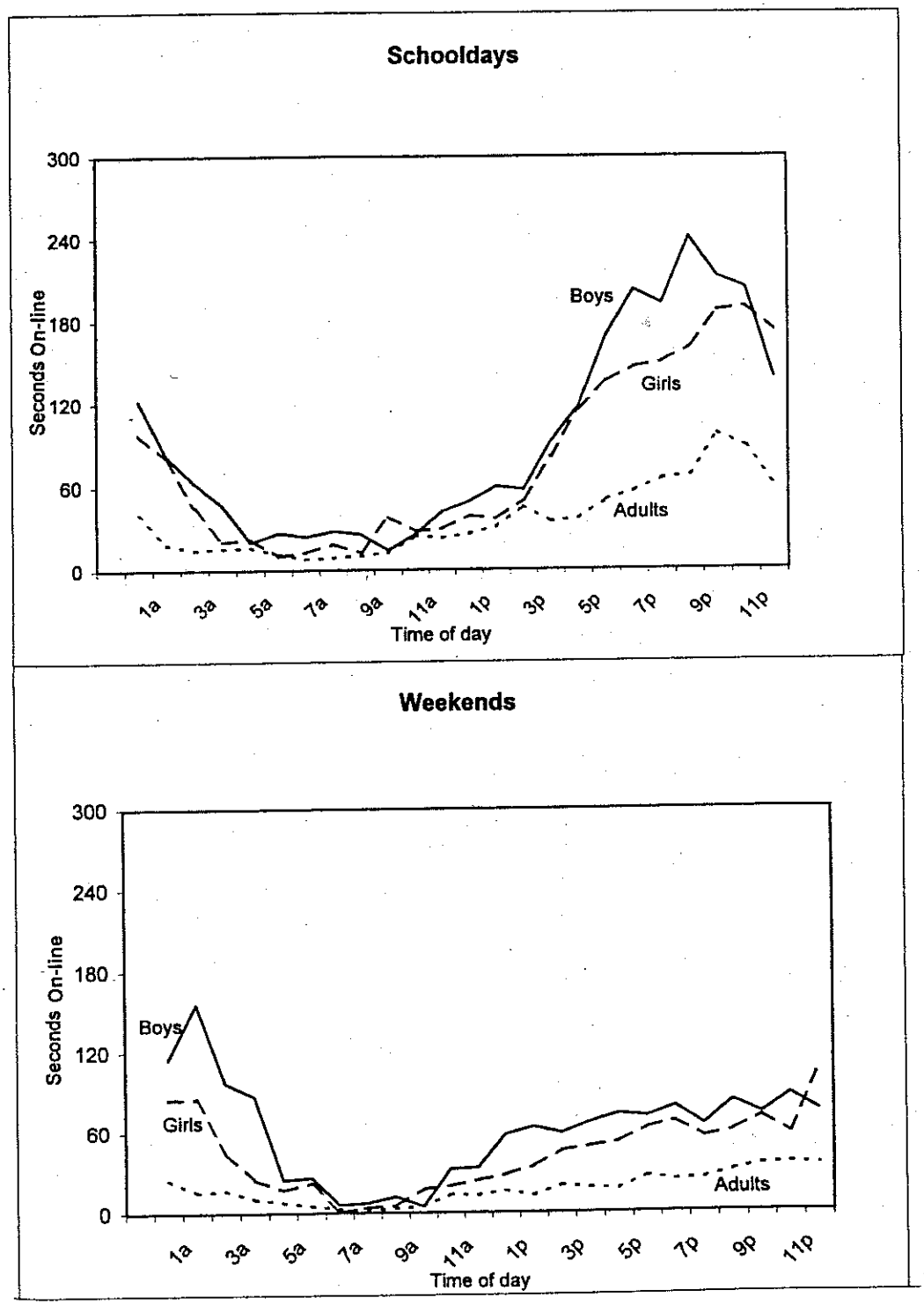

Figure 4.3. Distribution of Internet Use, by Time of Day and Type of Day
SOURCE: HomeNet Study (1996).

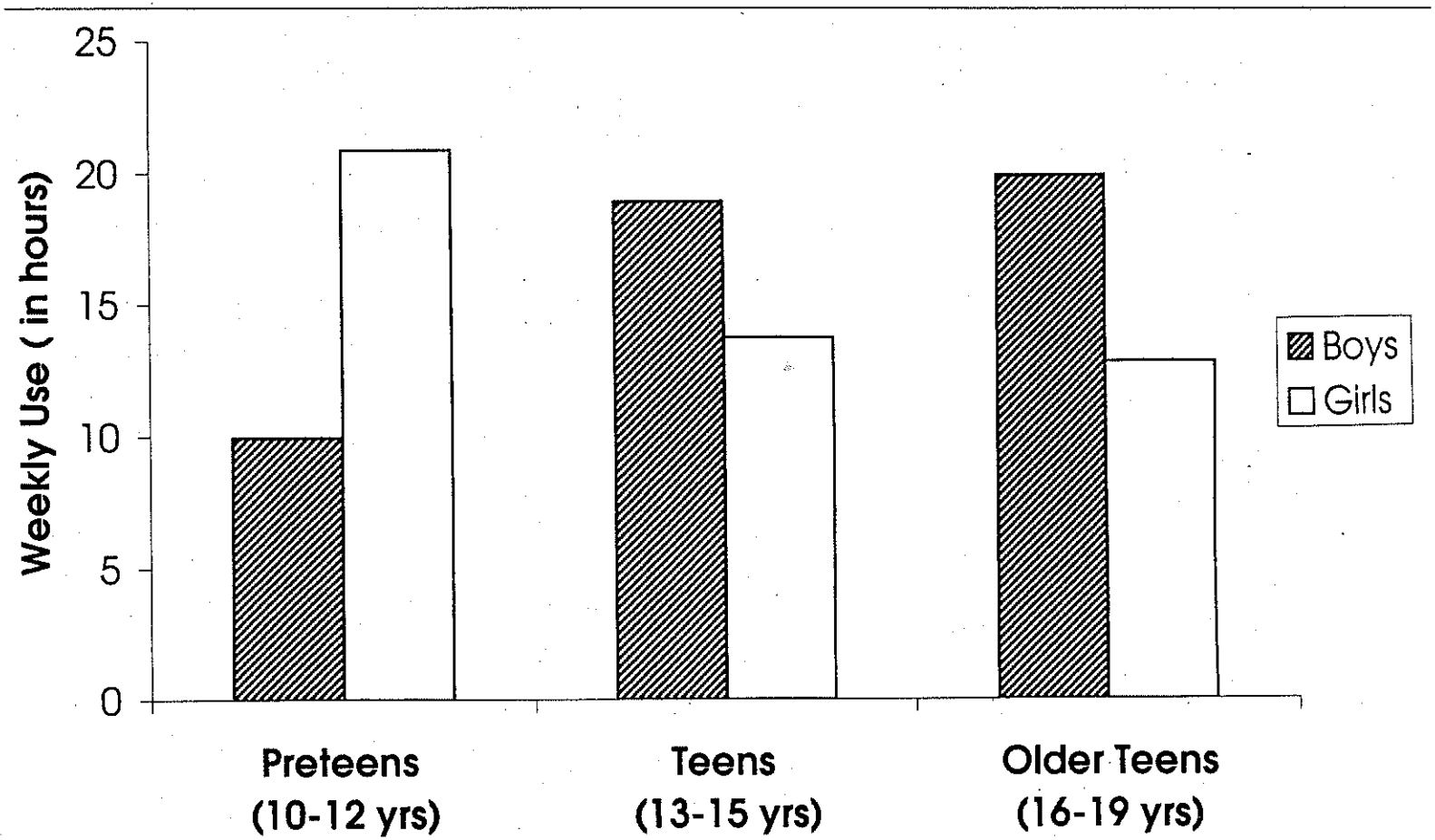

Figure 4.4. Distribution of Mean Weekly AOL Use Among Teens
SOURCE: AOL Study (1997).

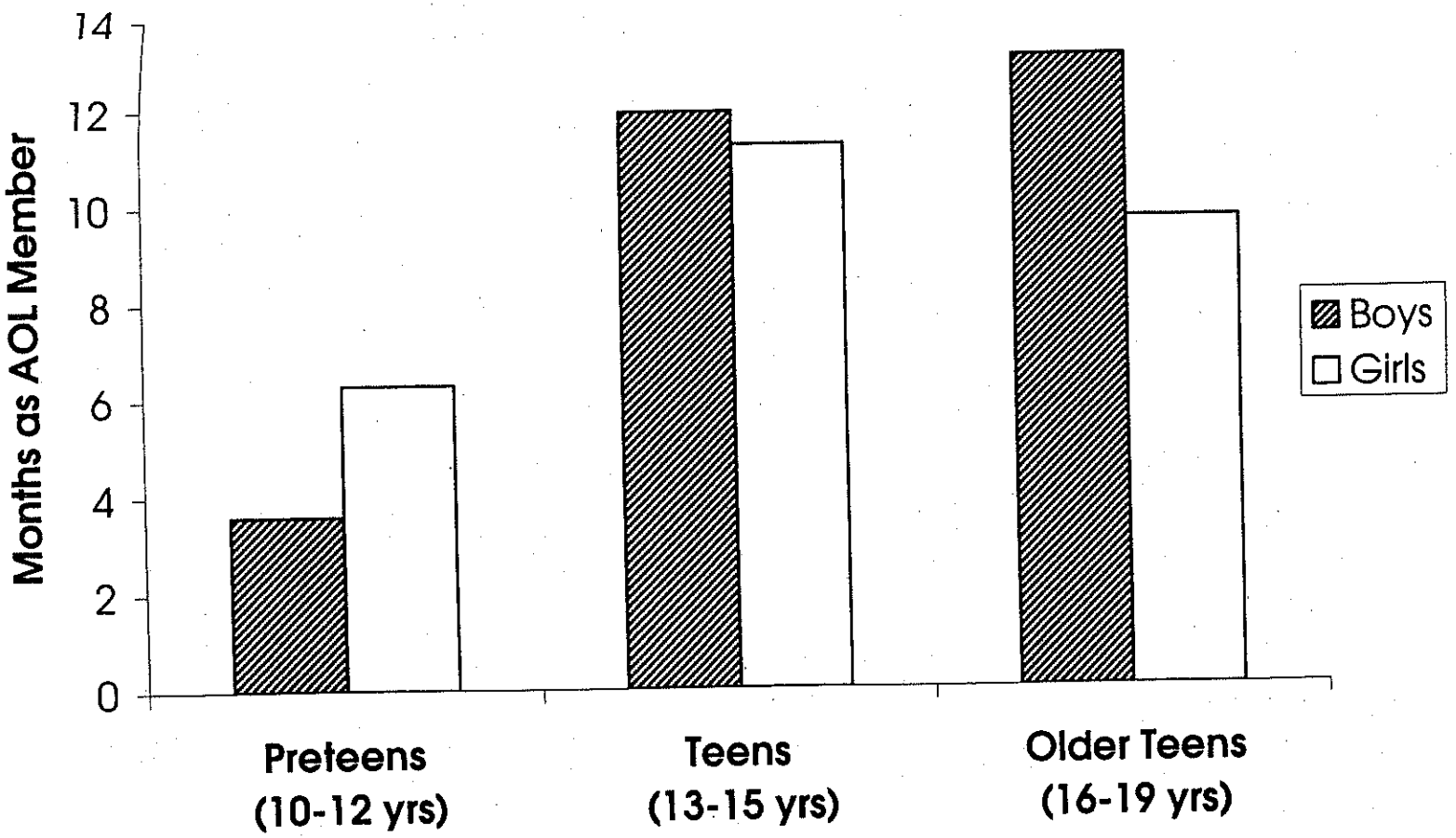

Figure 4.5. Distribution of Prior Experience With AOL
SOURCE: AOL Study (1997).

also speculate that the highly social nature of AOL appeals to preteen girls more than to preteen boys, who lag behind their female peers in social development. In addition, girls are generally more social than boys (Grusec & Lytton, 1988).

On the basis of a national survey, Roberts et al. (1999) present a developmental picture of various Internet activities among children and adolescents. Dividing their sample into three age groups—2-7, 8-13, and 14-18—they found a steadily increasing amount of time spent in each succeeding age group on websites and e-mail. Chat rooms were not used at all in the youngest age group but were used equally (and about as much as e-mail) in the two older age groups.

Activities That Get Displaced by Computers

The evidence is mixed as to whether time spent by children on computers displaces other activities that they engage in such as television viewing, sports, and social activities. There is some evidence that personal computer users might watch less television than nonusers do (Stanger, 1998; Suzuki, Hashimoto, & Ishii, 1997). For instance, the Annenberg report of the 1998 Television in the Home Survey found that children in households with computers watched television an average of 2.3 hours per day, compared with the children in homes without computers, who watched an average of 2.9 hours a day (Stanger, 1998). However, this finding might be confounded with the income and education level of parents because higher income level is associated with both higher ownership of a PC and lower television watching. Others have reported that PC use does not compete with adults' television viewing. For example, Nielsen Media Research (1998), in a prospective study, found little change in household television viewing after the household gained Internet access. Most of the differences in television viewing between households using the Internet and those not using it existed before the households went on-line.

The impact of computers on other activities is varied. According to the Annenberg report (Stanger, 1998), children from homes with computers spend less time watching videotapes and more time doing schoolwork and reading magazines or newspapers compared with children in homes without computers. Interestingly, having a home computer did not affect the time spent playing console-based video games and reading books. Again, these results are difficult to interpret because of the unreliability of self-report data and because of the preexisting differences between families who have computers and those who do not.

A complicating factor in assessing the relationship between computer use and other activities is the increasing systemic relationship between the content of various media (Kinder, 1991). This is exemplified by the trend in the children's software market for tie-ins between games and television characters and shows (e.g., the show *Sabrina, the Teenage Witch* and the computer game *Sabrina, the Teenage Witch*). Coffey and Stipp (1997) even suggest that cross-listings might actually increase television watching among samples of PC users. The concern is that eventually the time spent on electronic media (television, PCs, and the Internet) will negatively affect the time spent on organized sports and other social activities.

Interactive Games

Interactive games are played on two types of platforms: stand-alone video game and PC platforms. Video games include arcade games, games for game systems such as Sega or Nintendo, and stand-alone games or interactive toys; PC games include those downloaded from or played on a PC. Following Roberts et al. (1999), we will call the former *video games* and the latter *computer games;* we will use the term *interactive games* to

cover both types of platforms. We will also consider stand-alone interactive toys as a genre of video games. Incidentally, the stand-alone video game platforms are more popular with children and adolescents than are games played on a computer (Roberts et al., 1999).

Although games are, as we have seen, the most popular use of the computer in most age groups, the actual time spent playing video games may be less than what people have feared. For example, among the heaviest users (boys from 8 to 18 years of age), only 21% of a national sample reported playing games more than 1 hour per day on a stand-alone platform, and only 6% reported playing more than 1 hour per day on the computer (Roberts et al., 1999). These researchers, however, did find a significant negative correlation between video game playing and feelings of contentment and adjustment: The lowest average adjustment scores were received by children and adolescents who reported spending the most time on video games. We cannot know to what extent game playing was a constructive outlet for relatively maladjusted young people versus to what extent it was a causal factor in the maladjustment.

In terms of content, Roberts et al. (1999) found the action adventure genre to dominate accounts of the prior day's video game play in all age groups (2-18 years) and across ethnic groups (white, black, Hispanic). African American youngsters were more than three times as likely as white and Hispanic respondents to report playing classic, gambling, and puzzle-logic games. Again, these researchers confirmed the well-known gender differences. They found almost no girls between ages 2 and 7 playing video games but a substantial number of boys. Between 8 and 18 years of age, boys were more than three times as likely to report playing video games than girls were, and this difference was even bigger for simulation games.

The content situation is quite different for computer games because of two additional important genres found in computer but not video games: education and arts and crafts. In their report for the Kaiser Family Foundation, Roberts et al. (1999) summarize their findings in this way:

> In general, computer game selection looks quite different from video game selection. Among those children who play computer games, educational games dominate the early years; classic and gambling games moving to the fore in the later years, at least in part because of their greater availability—these are the games that come preloaded on most new computers. Action and sports games are highly popular among older kids, but never dominate computer game selections the way they do video game selections. (p. 51)

Interactive Games and the Development of Cognitive Skills

The most popular interactive games, the action games, have design features (they are spatial, iconic, dynamic, and have things going on simultaneously in different locations) that may lead to the development of particular information-processing skills. Because the features are common to computer applications of all kinds, the suite of skills that the games develop constitutes a foundational computer literacy. We now summarize the experimental evidence for the role of interactive games in developing cognitive skills.

Subrahmanyam and Greenfield (1994) found that practice on a computer game (*Marble Madness*) reliably improved spatial performance (e.g., anticipating targets, extrapolating spatial paths) compared with practice on a computerized word game. Similarly, Okagaki and Frensch (1994) reported that practice on the computer game *Tetris* (a game that requires the rapid rotation and placement of seven different-shaped blocks, shown in Figure 4.6) significantly improved undergraduate students' mental rotation time and spatial visualization time on computerized spatial performance tests such as those shown in Figure 4.7.

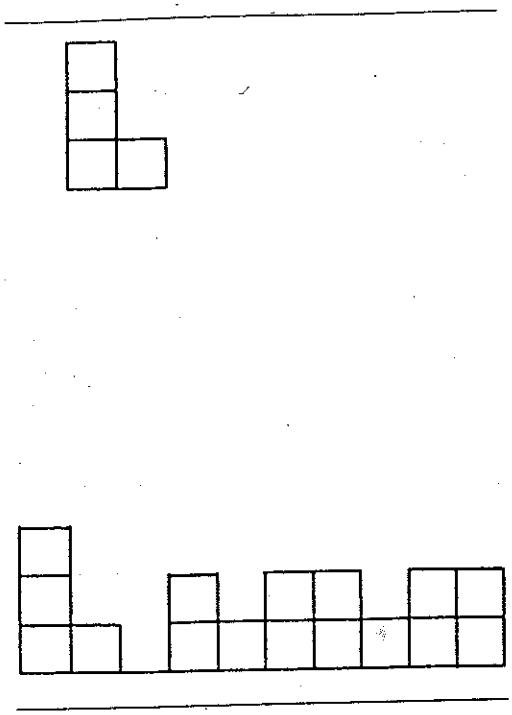

Figure 4.6. Example of a Tetris Shape and the Wall Opening Into Which It Has to Be Placed
SOURCE: Okagaki and Frensch (1994).

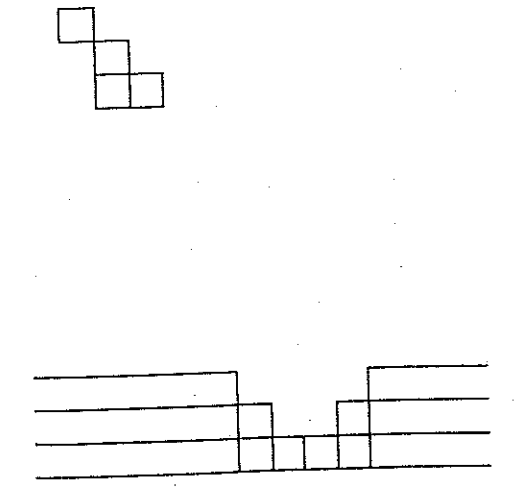

Figure 4.7. Example of the Computerized Spatial Visualization Task in Which Subjects Had to Decide Whether or Not a Non-Tetris Shape Would Fit in the Wall Opening at the Bottom of the Screen
SOURCE: Okagaki & Frensch (1994).

Another skill embodied in interactive games is that of iconic or analog representation—in other words, games privilege images over words. In a cross-cultural study carried out in Rome and Los Angeles, Greenfield, Camaioni, and others (1994) found that participants who played *Concentration* on the computer became more iconic and less symbolic in their communication about the animated computer simulation in software called *Rocky's Boot* compared with those who played the same game on a board.

Another study explored the role of interactive games in developing strategies for keeping track of events at multiple locations on a screen. In a task where an icon could appear at either of two locations (but with unequal probabilities), the researchers found that expert video game players had faster response times than novices at both high- and low-probability positions of the icon. Furthermore, they found that 5 hours of playing an action arcade video game, *Robotron,* improved strategies for keeping track of events at multiple locations, but only for the low-probability target position (Greenfield, deWinstanley, Kilpatrick, & Kaye, 1994).

Most of the research on the impact of interactive games on cognitive processing has assessed short-term transfer effects, and little is known about the cumulative impact of electronic games. Recently, Greenfield (1998) suggested that the proliferation of computer games and the corresponding development of iconic representational skills may have a causal role in the recent dramatic increases in nonverbal or performance IQ scores that have occurred in the period of years when modern computer technology was developing and becoming widespread (Flynn, 1994).

Most of the published research on the cognitive impact of game playing has been done with the older generation of arcade games and game systems. Despite advances in interactive technology and the capabilities of current computer games, we believe that the fundamental nature of computer games has remained unchanged. The need for divided

attention, spatial imagery, and iconic representation continue to be features of the current generation of games. On the basis of previous research, we would predict no changes in the nature of the effects of computer game playing that stem from structural features of the medium, although the strength of visual effects could change with increasing sophistication of the graphics. Regardless, we need research on the effects of the newer generation of software (both games and nongames such as coloring, creative writing, etc.) and on the effects of multiparty games that are now possible on the Internet.

Computer Games and Social Development

Aggression in Computer Games and Its Impact on Children

Next we address issues surrounding the aggressive content of computer games and their impact on children's behavior. These questions are especially relevant in the context of violent incidents such as the massacre at Columbine High School in Littleton, Colorado, on April 20, 1999, in which children killed children. The Columbine case has highlighted the role of video games because the shooters, Eric Harris and Dylan Klebold, were later described as being "obsessed with violent video games." Harris and Klebold's favorite game was *Doom,* and a customized version of *Doom* was even found on Harris's Internet site. He had gone as far as modifying the game to resemble the subsequent attack on Columbine High. Given such incidents, the violent content of computer games is a major concern among many parents, educators, and policy makers. In this section, we will review the limited research on the links between computer games, access to the Internet, and violent behavior.

Although home education games encourage prosocial behaviors (e.g., when players cooperate or share, they are often rewarded), most commercially available entertainment software involves aggression and competition. Violence is an integral part of computer games today (Provenzo, 1991), but this was not always the case. The first game, *Pong,* was nonaggressive. Aggression started in the second generation with *Breakout,* which involved destruction but no human aggression. *Pac-Man* started animate but nonhuman aggression. The next generation of games such as *The Empire Strikes Back* involved human aggression. Human aggression took on a more fantastic form with *Super Mario Brothers.* It became more personal, with hand-to-hand combat, in games such as *Mortal Kombat.* Violence continues to reign in the current generation of action games, which include titles such as *Doom, Duke Nukem, Mace, Hexen II,* and *Mortal Kombat 2.* Using a content analysis of popular Nintendo and Sega Genesis computer games, Dietz (1998) reports that nearly 80% of the games have aggression or violence as a game objective. Even more troubling is the finding that half of the favorite choices of children were games with violent themes (Funk, 1993). Given the amount of violence in the games, the amount of time children spend playing these games, and their liking for violent games, an important question is whether they have a deleterious impact on children.

One concern is that playing an aggressive or violent interactive game can increase children's aggressive behavior in other situations. Based on the evidence that watching violent TV shows increases children's aggression (Eron, Huesmann, Lefkowitz, & Walder, 1996; Friedrich-Cofer & Huston, 1986), it is possible to assume that the same holds true for interactive games. A review of experimental studies suggests that playing a violent game, even for brief periods of time, can generate short-term transfer effects such as increased aggression in children's free play (Cooper & Mackie, 1986; Irwin & Gross, 1995; Schutte, Malouff, Post-Gorden, & Rodasta, 1988; Silvern & Williamson, 1987), increased aggressive or hostile responses to ambiguous,

open-ended questions (Kirsh, 1998), and increased aggressive ideation (Graybill, Kirsch, & Esselman, 1985).

Research on the relationship between the amount of interactive game playing (as measured through self-reports) and aggressive behavior is more ambiguous. For instance, Fling et al. (1992) report that the amount of interactive game play (as measured by questionnaires) was positively correlated with self-reported aggression as well as teachers' ratings of aggression among sixth through twelfth graders. When van Schie and Wiegman (1997), however, had participants (10-14 years) record their out-of-school activities on a daily basis for a week, there was no relationship between the amount of interactive game playing and peer nominations of aggressive behavior. Furthermore, they suggest that the critical variable might be children's preference for aggressive interactive games; those who liked aggressive electronic games were rated as more aggressive by their peers (Wiegman & van Schie, 1998).

Another question is whether exposure to violence and aggression in interactive games will have an anesthetizing effect and desensitize children to violence. Although such desensitization effects have been shown with television (Rule & Ferguson, 1986), this issue needs to be explored with electronic games. One clear problem is the ignorance of parents. Although an electronic game rating system has been in place since September 1994, parents seem unaware of even the most popular violent titles. For example, in a survey of more than 500 parents, it was found that less than 5% of them had ever heard of *Duke Nukem,* a violent electronic game rated M (mature), whereas 80% of junior high students said they were familiar with it (Oldberg, 1998). Also of concern is the growing trend of marketing violence to children. *Duke Nukem* action figures are now found in toy stores, and a number of violent games are advertised through rebellious advertisements in game magazines popular among young boys (Oldberg, 1998).

Interactive Games and Their Impact on Prosocial Behavior and Friendships

Another area of interest is the impact of playing aggressive electronic games on children's prosocial behavior. The limited research on this question suggests that preference for and playing aggressive electronic games lead to less prosocial behavior, such as donating money or helping someone (Chambers & Ascione, 1987; Wiegman & van Schie, 1998).

Another concern is that, because of the solitary nature of most game playing, children will form "electronic friendships" with the machine instead of friendships with their peers. The research suggests that, for the average player, this might not be so, and "boys who play computer games often are more likely to see friends outside school" (Colwell, Grady, & Rhaiti, 1995, p. 201). In addition, no differences have been found in the sociability (Rutkowska & Carlton, 1994) and social interactions (Phillips, Rolls, Rouse, & Griffiths, 1995) of players versus nonplayers. Less is known about the long-term effect of excessive electronic game playing among the 7 to 9% of children who have been identified as playing interactive games for at least 30 hours a week (Griffiths & Hunt, 1995). We agree with Griffiths's (1997) speculation that any activity that is engaged in for a disproportionate amount of time at the expense of other leisure activities must have negative consequences on social and educational development.

The impact of interactive games on family dynamics is another area of interest. In an early study, Mitchell (1985) interviewed 20 families with new home game sets and found that interactive games brought together members of the family for shared play and interaction. We need more research on whether this is still the case given that computers and game sets have become more routine and numerous in U.S. homes, to making sharing less necessary.

A related issue is the fact that children and teens are often more sophisticated than their parents are in their knowledge and ability to navigate computers. In a CNN/USA Today/NSF poll of teenage children between 13 and 17 (*U.S. Teens and Technology,* 1997), 62% said that they could operate electronic equipment or computer software without any help, and 54% reported that they or a sibling were responsible for programming the VCR. Anecdotal observations confirm that children are often more knowledgeable than their parents about computers. Research is needed to assess the impact that such role reversals have on family dynamics and interactions.

Gender Issues in Interactive Games

One issue that has consistently stood out is the gender imbalance in the playing of electronic games. The core audience for game systems such as Nintendo or Sega has always been boys between the ages of 8 and 14; indeed, boys are five times more likely than girls to own a Genesis or Super Nintendo game system (Elmer-Dewitt, 1993). Boys have also been found to spend more time playing interactive games than girls have. In a recent survey of seventh- and eighth-grade students, Funk (1993) reported that 67% of the girls spent an average of 2 hours per week playing electronic games, whereas 90% of the boys spent an average of 4.2 hours per week. This trend continues with the new generation of home games. In a questionnaire study of 11- to 16-year-olds, boys reported playing more often than girls, and they also reported playing for significantly longer periods of time at a given sitting (Griffiths & Hunt, 1995). It is important to keep in mind that, although boys clearly spend more time playing compared with girls, research has found that females are just as likely to be players as males (*U.S. Teens and Technology,* 1997; van Schie & Wiegman, 1997). The gender difference in game playing also spills over to the schools; girls lag behind boys in the school use of computers, and computers are even perceived to belong more to boys than to girls (Cassell & Jenkins, 1998, p. 12).

It was initially believed that girls were turned off by electronic games because of the lack of female protagonists and the violent nature of the games (Malone, 1981). The early efforts of the software industry to create nonviolent games with female protagonists have largely been a failure (Subrahmanyam & Greenfield, 1998). Although one recent "girl software," *Barbie Fashion Designer,* has been very successful, other girl games such as *Let's Talk About Me, Rockett,* and *Barbie Print and Play* have not been as successful. The Barbie character certainly has importance in itself: A number of Barbie games have become best-sellers among girls.

We have recently suggested that the success of *Barbie Fashion Designer* did not stem from the mere presence of Barbie and the lack of aggression but stemmed instead from the fact that it contained features that fit in with girls' play and their tastes in reading and literature in general (Subrahmanyam & Greenfield, 1998; Tizard, Philips, & Plewis, 1976). We proposed that, by helping girls create outfits for Barbie, the computer became a creative tool for girls' pretend play, which tends to be based more on reality and real-life models than that of boys' pretend play. Unlike most games in which the electronic fantasy is primary, the electronic medium became a tool to design a product, which could then be used in play with Barbie dolls. Our analysis suggests that girls like nonaggressive tool software that allows them to enhance popular play themes with realistic familiar characters. One such theme, important in *Barbie Fashion Designer,* is nurturance.

Tamagotchi and Simlife: Issues of Gender, Mental Simulation, and Social Development

The theme of nurturance is taken to new levels with the *Tamagotchi,* a gender-neutral

game that is somewhat more popular with girls. Beyond gender issues, however, the *Tamagotchi* represents another important trend in child-computer interaction, the simulation of artificial life and the interaction between artificial characters and real children (Richard, 1998; Turkle, 1995). This type of electronic game represents a new level in the integration of computers into the social world of children.

The *Tamagotchi* is a small interactive game toy created in Japan that represents a virtual animal. Its game structure is as follows: Each *Tamagotchi*'s owner must take care of it in order to prevent it from "dying." The *Tamagotchi* communicates with its owner by beeps (to attract his or her attention) and by icons (to indicate its immediate needs for food, sleep, or play). The *Tamagotchi* is an artificial life simulation put within the reach of children (Richard, 1998). The goal of the player is to keep the *Tamagotchi* alive as long as possible; to avoid its death, children must take the *Tamagotchi* with them wherever they go. Apparently, *Tamagotchis* stimulate the same emotions as real, live animals and people do. Virtual Internet "cemeteries" for *Tamagotchis* cannot be distinguished from Internet "cemeteries" for real animals and people; the same language is used in both cases (Richard, 1998). Indeed, Richard observed a girl in a restaurant burst into tears; the reason for her sudden emotion turned out to be the death of her *Tamagotchi*. It seems, therefore, that these electronic toys can lead to attachment responses on the part of their owners.

The *Tamagotchi* phenomenon extends Turkle's (1984) observation that people attribute minds to computers. But the *Tamagotchi* leads to a further step; children treat *Tamagotchis* as if they were alive. The *Tamagotchi* phenomenon represents the first major popular success in artificial or virtual life at the child level. But there are other important small-scale successes as well. For example, the game of *Simlife* is an exploration of the emerging field of artificial life (Turkle, 1995, 1997); it is a simulation of evolutionary processes. Turkle's interviews make it clear that children and even adolescents have difficulty in understanding the boundaries between real and artificial life. This may be a factor in the kinds of reactions to *Tamagotchi* death described above.

This phenomenon of integrating simulated life into real life in the domain of electronic games is being reinforced on the Internet, where robot-like programs "run around" multi-user dungeons (MUDs) interacting with "real" characters operated by real people but sometimes indistinguishable from them (Turkle, 1995). *Tamagotchi* and *Simlife* phenomena, therefore, provide a link to important Internet issues that will be developed later in this chapter.

At the same time, *Tamagotchis,* like other interactive games and software, have specific cognitive requirements: The *Tamagotchi* screen presents an iconic code whose meanings and functions must be mastered by the child; thus, it contributes to cognitive socialization to the world of computers. The *Tamagotchi* beeps also socialize the child to respond to the types of messages "wired" adults handle, as with beepers, cell phones, and voice mail (Richard, 1998). Sometimes parents use *Tamagotchis* as training to take care of a real animal.

The actual psychological effects of *Tamagotchis* have not been studied in a systematic fashion. Nonetheless, the popularity of simulation or "virtual life" has continued with the advent of the very popular Furby, which is an electronic toy with fur, eyes, ears, a 200-word vocabulary, and a limited ability to interact with its environment. Clearly, systematic research regarding the child development impact of such robotic games is needed. What is certain at this point is that the *Tamagotchi* represented a new stage in the integration of electronic information in the daily life of children.

Closing the Gender Gap?

The success with girls of *Barbie Fashion Designer* and the *Tamagotchi* is an indication

that the gender gap in the out-of-school use of computers might be narrowing. In the *U.S. Teens and Technology* (1997) national survey of teenagers between 13 and 17 years, it was found that, despite differences in game playing, teenage boys and girls report equal levels of usage and express equal levels of confidence in their computer skills. Although boys were more likely than girls to report playing electronic games on a daily basis, this difference did not transfer to computer use, where the same number of boys and girls reported daily use of the computer. Overall, boys reported slightly more time on computers in the past week compared with girls (4.7 vs. 4.1 hours). This difference is due to a small number of boys who report using the computer for more than 20 hours per week. Despite these gains, girls still lag behind boys in the number of higher-level computer science courses they take in high school (AAUW, 1999). Overall, the research suggests that, although girls lag behind boys in some areas of computer use, there are other areas in which they are similar to boys and are even catching up. As we will see, the Internet provides certain activities that strongly contribute to a more equal gender balance in computer use.

Children, Adolescents, and the Internet

> "I really want to move to Antarctica—I'd want my cat and Internet access and I'd be happy." (16-year-old HomeNet participant, 1995)

Use of the Internet and Computers by Parents and Their Children

In this section, we describe how the Internet and computers were used by the HomeNet teenagers in Pittsburgh, Pennsylvania, from 1995 to 1998 and how their lives changed as a result of this use. Starting in 1995, Kraut and colleagues (1996) provided families with computers and connections and carefully documented how they used on-line services such as electronic mail, computerized bulletin boards, on-line chat groups, and the World Wide Web. Data from detailed auditing of their Internet use, quantitative surveys, and interviews with family members provide a rich picture of how this sample was using the Internet and its impact over time. The developmental analysis consisted of comparing the younger generation of children and adolescents (10-19 years) with their parents.

Figure 4.8 shows the purposes for which the sample reported using the Internet, averaged over three time periods between 1995 and 1998. In this figure, a "0" indicates that the Internet was never used for a particular purpose in the preceding 6 months, a "1" indicates that it was used occasionally for that purpose, and a "2" indicates that it was used frequently. The dominant use of the Internet was hedonic—for pleasure rather than for instrumental purposes. This finding was confirmed on a national level by Roberts et al. (1999), who found, for example, that the most frequently visited Internet sites fell in the entertainment category. In the Pittsburgh sample, teens were more likely than adults to report using the Internet for social purposes—communicating with friends, visiting MUDs and chat rooms, getting personal help, and joining groups.[6] In addition, they were more likely to use the Internet for listening to music, playing games, and downloading software and less likely than the adults (especially the men) to view sexual materials.

Like the adults, the teens used the Internet to some extent for instrumental purposes, which in their case meant doing schoolwork and finding educational material rather than using it as part of paid employment. Indeed, the largest single use of the computer in the 10- to 18-year-old group was for schoolwork.[7] Curiously, in contrast to their parents, young people in Pittsburgh were less likely to use the Internet to get product information and to purchase products, presumably because teens are lighter consumers overall than adults, and they were much less likely to have the credit cards necessary for on-line purchasing.

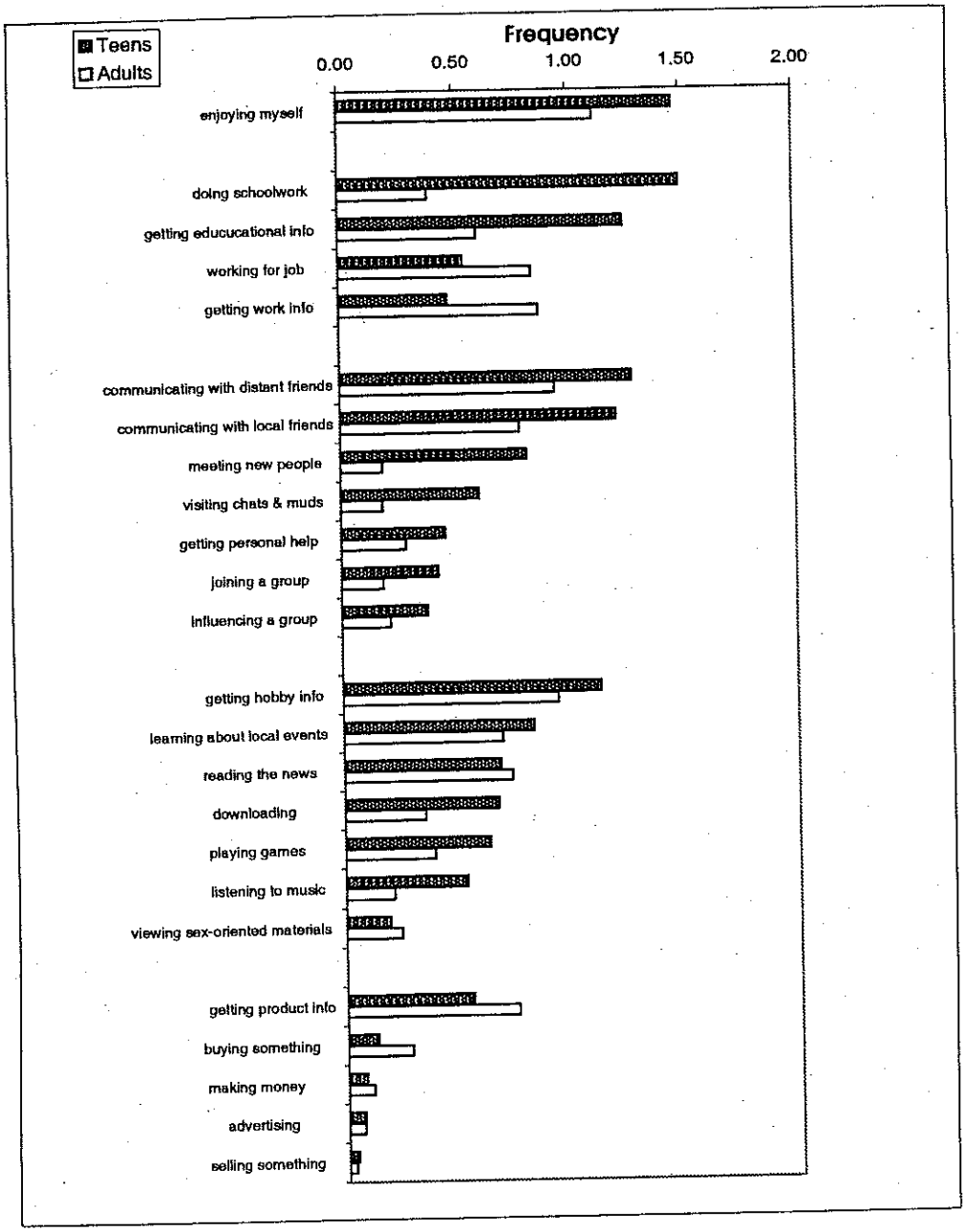

Figure 4.8. Teens' Self-Reported Purposes for Using the Internet
SOURCE: HomeNet Study (1996).

Educational Uses

Many parents buy home computers and subscribe to Internet access to provide educational opportunities for their children. This is consistent with the finding that, in 1994, 45% of U.S. households with children had computers compared with only 30% of households without children (Times Mirror Center for the People and the Press, 1994). According to the interviews, these parents often have a nonspecific goal of preparing their children for the information-age future. Although they anticipate that they are providing an educational resource, once they actually see how their children use computers, they start to see costs along with the benefits. For example, they see their children, as they describe it, "wasting time" on computer games, electronic communication, and browsing the Internet. In fact, a more recent national survey found no relationship between reported daily exposure to computers and school grades (Roberts et al., 1999). The researchers found a significant negative relationship between computer and print exposure; print exposure was the only medium that had a significant positive relationship to school grades.

Nevertheless, most of the HomeNet parents considered time wasted on the computer preferable to time wasted on TV. The interactive nature of on-line services, the possibilities for communication, the use for schoolwork, and, we suspect, the favorable treatment that the Internet gets in advertising and the popular press all contribute to this favorable attitude toward computing. One grandfather, for example, described the benefits that his live-in grandchildren get from computing:

> It's taking them away from TV actually, which they had a problem with. With TV, they would be glued to the screen, especially the seven year old, she was almost mesmerized. You couldn't even communicate with her, she would just sit there with that blank stare on her face and just watch, I still don't believe that she had a clue as to what was going on. It was just emotion. So now she's onto the computer and she stays away from the [TV]. So it's helped keeping them away from the TV.

Teens frequently used both their home computers and the Internet for their schoolwork. Among the teenagers in the HomeNet sample, stand-alone educational applications, such as *KidWorks* or *Thinkin' Things,* were used much less frequently than word processing software, stand-alone games, electronic mail software, and Internet browsers. The most common of the education uses was simple word processing for school assignments. At home, as in the office, the computer has replaced the typewriter. In addition, students use the World Wide Web to find information for various class reports. One student, for example, was able to find information on Pittsburgh's role in the Underground Railroad for a black history month assignment, and one seventh grader included a disputed photograph of the Loch Ness monster he found on-line to illustrate his report. Students in clubs (e.g., the school newspaper) sometimes used Internet communication to coordinate meetings or to distribute shared materials (e.g., assignments or stories), but this was far less common than using the computer for writing, printing, and research.

Parents in the HomeNet study appreciated the new educational resources that the Internet provided their children but, at the same time, worried about erosion of standards and about the credibility of on-line information. One mother marveled at the wealth of information that her middle school son was able to uncover but also worried that the sheer abundance of the information was devaluing research and critical thought. Others worried about the balanced nature of the information. Another mother was concerned about her 13-year-old son's use of the Internet as a research tool for a paper on the McCarthy era; she felt that it was important for him to read books from the library to get a more balanced set of views, less fraught with ideological problems (Kraut et al., 1996).

Interpersonal Communication Versus Information

For the teenagers in the HomeNet sample, communication with others was a major use of the Internet. Interpersonal communications via electronic mail were more important to them than information acquisition via the Web. When teens described why they used the computer and the Internet in the past 6 months, keeping up with both their local and distant friends was a very important reason, after their schoolwork (see Figure 4.8). It is important to note that, although communication was particularly appealing to girls, it was also the most important use of the Internet for boys.

In addition to being more popular, use of the Internet for interpersonal communication was also more sustaining. Both Web use and e-mail use dropped over the first 2 years that members of the sample were on-line, but the drop in Web use was steeper. In addition, in contrast to people for whom the World Wide Web was their dominant Internet application, people who used e-mail more heavily than they used the Web were more likely to still be using the Internet after their first year. All of these observations suggest that electronic mail was the Internet application that kept people coming back to the Internet. Although these conclusions were based on data from both the teenagers and adults in the sample, in this regard, teenagers and adults treated the Internet similarly.

A closer look at on-line communication shows that the majority of on-line social relationships had their roots outside of the Internet and, for this sample of Internet neophytes, existed prior to their access to the Internet. When keeping up with their close friends and family members, what sociologists term *strong ties* (Granovetter, 1973), electronic mail supplemented the telephone and face-to-face visits but rarely replaced these older communication modes.

Teens would hurry home from school to have e-mail conversations with the friends they had just left. Students frequently corresponded with their parents by e-mail when they went off to college, and one teenager created a distribution list so that all of his high school chums could easily keep in touch as they dispersed around the country. When another student went off to college, she kept up with at least some of her high school friends by electronic mail alone for up to a year. Many of these keep-in-touch communications were small talk—gossip and news of the day, with a here-and-now flavor. These communications existed for the pleasure they brought rather than for their instrumental benefits.

However, in contrast to earlier telecommunications technologies for interpersonal communication, the Internet contains several popular communications applications that encourage strangers to communicate with each other. These include *Usenet newsgroups,* which are topically oriented electronic bulletin boards; *listservs,* which are topically oriented distribution lists for electronic mail; *MUDs* and their variants, which are synchronous communication systems organized around role-playing games; and *chats,* which are more topically oriented, synchronous communication systems. The important similarity among these services is that they provide public spaces on the Internet where people gather, meet each other, communicate or observe others communicating, and occasionally form new relationships. When HomeNet participants were asked how they used the Internet in the prior 6 months, those who participated more in Usenet newsgroups, MUDs, and chats were more likely to report using the Internet for meeting new people.

Teenagers were disproportionately heavier users of MUDs and chats than adults, even after accounting for teenagers' greater use of the Internet overall. This may be because teenagers are in a stage of life when they are sampling personal relationships. Indeed, Roberts et al. (1999) found that, whereas 8- to 13-year-olds most often visited chat rooms that dealt with entertainment topics, 14- to 18-year-olds most frequently visited chat rooms devoted to discussion of relationships and lifestyles. Therefore, it is not surprising that

teenagers reported using the Internet to meet new people relatively more than adults did, again after accounting for teenagers' greater use of the Internet overall.

Using an extensive set of clinical interviews, Turkle (1995) discussed other kinds of identity issues brought about by MUDs. People create multiple characters as they role play in different or even the same MUD. Turkle writes about Doug, a Midwestern college junior who plays four different characters (e.g., a seductive woman, a macho cowboy, a rabbit, and a furry animal) distributed across three different MUDs. He talks about turning on different parts of his mind when moving from window to window (Turkle, 1995, p. 13). In addition to raising questions concerning a movement toward multiple identities as a function of participation in MUDs, Doug's experience also illustrates the increasing importance of simulated worlds, a notion introduced by the *Tamagotchi,* and the declining importance of the real world (Turkle, 1995, 1997). There is every indication that socialization by the Internet to form multiple identities and to relate more and more to a simulated social world is reaching an increasingly young audience. Turkle (1995), for example, reports that, although most MUD players are in their teens or 20s, "it is no longer unusual to find MUDs where 8- and 9-year-olds 'play' such grade-school icons as Barbie or the Mighty Morphin Power Rangers" (p. 11). We as yet know little about whether we should appreciate the adaptive value of alter egos or worry about the maladaptive nature of fragmented or multiple personalities.

The Pittsburgh study indicated that young people frequented MUDs and chat rooms for the express purpose of interacting with strangers. In contrast, adults made more of their new on-line relationships through Usenet groups and listservs; they often used these services to get information about hobbies or work and met people as a side effect of these more nonsocial motivations. Typically, the new relationships remain in the electronic domain. People who meet new partners on-line have conversations with them both in the original newsgroup or chat where they first met and by private electronic mail. Less frequently did people (in the Pittsburgh study) whose relationship started on-line meet in the flesh. Meetings occurred if the friend one met on-line lived locally.

It is important, however, to note that this use of the Internet can be a dangerous one. For example, two teenage girls told a journalist that they had invited males they knew only from the Internet to their homes when their parents were not there. In the case of one of the girls, a man appeared at the door who was much older than she expected (Lauren Greenfield, personal communication, May 1999). It is clear that parents generally do not monitor the type of Internet interactions that would lead to such incidents. In a national sample of seventh through twelfth graders, 61% reported that they were "mainly alone" when they visited chat rooms (Roberts et al., 1999).

Although the new relationships of the subjects in the Pittsburgh sample typically remained in the electronic domain, data from people who were independently on-line suggest slightly different trends (McKenna, 1999; McKenna & Bargh, 1998). McKenna (1999) surveyed a large nationwide sample of people (333 females and 234 males from 13 to 70 years old; mean age = 32) who were already on-line (respondents' experience on the Internet ranged from 1 month to 443 months, with a mean of 34 months) and had posted to one of 20 Usenet newsgroups randomly selected for the study. She reports that

> 63% of all respondents had spoken to someone they met via the Internet on the telephone, 56% had exchanged pictures of themselves, 54% had written a letter through the post, and 54% had met with their Internet friend in a face-to-face situation. (p. 3)

While on-line relationships do exist, are they typically "weaker" than comparable relationships people report having off-line? According to Parks and Roberts's (1997) data, people describe their on-line relationships as

existing for a shorter time, involving less time spent together, having less breadth, and being less likely to endure than their real-world relationships. However, the strength of relationships created on-line might be related to an individual's self-identity. On the basis of her study of the Usenet participants, McKenna (1999) suggests that "the socially anxious and lonely not only find new friends on the Internet, but they also integrate these friends into their 'real' world" (p. 4). Although McKenna's sample includes 13- to 19-year-olds, she does not report specifically on age-related differences. Even so, given the widely divergent implications of these data and the HomeNet findings, the differences and interactions between on- and off-line relationships demand further study.

Social and Psychological Effects of Internet Use

Despite these findings that the Internet is a social technology used for communication with individuals and groups, other analyses of the HomeNet data demonstrate that use of the Internet is associated with declines in social involvement and the psychological well-being that goes along with it. The data come from an analysis of 169 individuals from 93 households during their first 2 or 3 years on-line. (The 2-year results are reported in Kraut et al., 1996.) They measured the number of minutes that members of the panel reported talking to other household members; the number of people they reported keeping up with, both in Pittsburgh and nationally; and their levels of daily-life stress, depression, and social support. Results show that these variables measured before respondents got their Internet connections did not predict how much they subsequently used the Internet. On the other hand, the greater use of the Internet during their first 12 to 24 months with Internet access was associated with small but statistically significant declines in social involvement (as measured by communication within the family and the size of people's local social networks) and with increases in loneliness (the psychological state associated with lack of social involvement). Greater use of the Internet was also associated with increases in depression. Because initial social involvement and psychological well-being were generally not associated with subsequent use of the Internet, these findings imply that the direction of causation is more likely to run from use of the Internet to declines in social involvement and psychological well-being rather than the reverse.

The statistical interactions of Internet use with age showed that increases in Internet use were associated with larger increases in loneliness and larger declines in social support for teenagers than for adults. There were no statistical interactions between Internet use and age for family communication, depression, or size of social circle.

There are at least two plausible and theoretically interesting mechanisms for these changes, but we have little evidence from our current research to establish which, if either, is correct. The first is that the time people devote to using the Internet substitutes for the time that they had previously spent engaged in social activities. This interpretation is consistent with the finding that people who use the Internet more spend less time talking to other household members. The second explanation is that, by using the Internet, people are substituting a poorer quality social relationship for a better one—that is, substituting weak ties for strong ones (Granovetter, 1973; Krackhardt, 1994). We observed that many of the on-line relationships in our sample, and especially the new ones, represented relatively weak ties with strangers, acquaintances, or nonintimate kin. Research shows that these types of social contact typically provide less social support and less consequential social support than more intimate ties do (Krackhardt, 1994; Wellman et al., 1996).

During respondents' second or third year on-line, use of the Internet did not have the same effects that it had initially. That is, during respondents' first year or two, the more hours they were using the Internet per week,

the more their psychological and social well-being declined. During the next 12 months, further use of the Internet was associated with smaller declines in psychological and social well-being or even improvements. (These results are based on one sample that was tested before Internet access and after Years 2 and 3; a second sample was tested before Internet access and after Years 1 and 2.) Initially, hours on-line were associated with increases in loneliness but, subsequently, were associated with declines in loneliness.

There are three competing explanations for these diminished effects or even reversals. First, as with many learning processes, early exposure may have larger consequences than later exposure. Because the initial exposure is completely novel, it generates greater adaptation on the part of users than does later exposure. Second, as the novelty of the Internet wears off, people may be using it more wisely later in their experience than they did early on. Third, over time, the Internet as a technology and set of resources is also changing. To take but one example, during 1995-1996, when respondents were using the Internet for the first time, MUDs and Internet Relay Chat were the two most popular services that could be used to communicate with other people in real time. Because these services connected anyone who logged in to a common site, they increased the likelihood that users would communicate with a stranger. In 1997-1998, in contrast, America Online's Instant Messenger and ICQ were the popular real-time communication services. Both of these services allow users to identify a list of people and to be notified when these people go on-line. These "buddy lists," as they are known, increase the likelihood that people will communicate with known others. Similarly, the growth in the proportion of the population on-line between 1995 and 1998 means that people have more opportunities to communicate with people who are meaningful to them. Their close friends and relatives were more likely to have an Internet account in 1998 than in 1995. Distinguishing between these alternative explanations will require additional research.

Integrating Internet Use and Interactive Games: The Fifth Dimension

For about 15 years, Michael Cole has been experimenting with the use of electronic communication and games with children in both classroom and after-school settings (Cole, 1996). The after-school programs have been titled "the Fifth Dimension" and are described as follows:

> The Fifth Dimension is a distributed literacy consortium comprised of after-school programs located in Boys and Girls Clubs, YM & YWCAs, recreation centers, and public schools across America, Mexico, Australia, Denmark, and Russia. . . . To an outsider, the Fifth Dimension appears as if children actively engage in computer games and other playful activities. But much more is happening. The Fifth Dimension is an activity system that mixes the leading activities of play, education, peer interaction, and affiliation. . . . About 75% of the activities utilize educational software and computer games. Included are telecommunications activities for searching the Internet, tools for computer-mediated and video-mediated conferencing, and MUSE and MUD activities. The remaining activities are non-electronic and include board games and arts and crafts. The software represents the curricular content of the Fifth Dimension. Subject matter includes social development, communications, reading, writing, math, geography, social studies, health, technology, language, and problem solving. . . . According to the rules of the Fifth Dimension (enshrined in a constitution agreed upon by each child), children make progress . . . by mastering tasks set for them in each game or activity. (Blanton, Moorman, Hayes, & Warner, n.d.)

As can be seen in this description, the electronic games and Internet activities are based in a total social and cognitive environment that includes a ladder of challenges. The Fifth

Dimension programs are permanent; they are staffed by students (working as volunteers or for credit) at local colleges and universities. Elementary school children can participate in the program on a long-term basis. Effects of the total environment are impressive, although we cannot separate out effects of individual components such as particular Internet activities or games. The effects, in well-controlled studies, include advances in reading and mathematics (Blanton et al., n.d.), computer knowledge, following directions, grammar, and school achievement tests (*Summary of Cognitive Evaluation Studies,* n.d.). Perhaps the most important message of the Fifth Dimension, vis-à-vis interactive games and the Internet, is that the maximum positive impact of these computer activities and tools will come about when they are embedded in a total environment that is both constructive and socially mediated.

Conclusion

In conclusion, the proliferation of computers and on-line access in households with children has raised questions about the extent of computer use by children and the impact of such use on their activities and development. Examination of available research suggests a paucity of accurate estimates (those not based on self-report data) of the actual time spent on computers by children. It appears that children in homes with computers spend less time watching television and more time reading than children in homes without computers do. Because of the growing trend in tie-ins between different media, it is expected that eventually the time spent on all electronic media could negatively affect the time spent on reading, sports, socializing, and other activities.

Research suggests that computer use has changed the balance of cognitive skills from the verbal to the visual. Electronic games provide the training wheels for computer literacy. From the cognitive perspective, they prepare children and adolescents for the increasingly visual domains of science and technology. At the same time, electronic games, computers, and, more recently, the Internet have also changed the balance between real and simulated worlds, with the real world sometimes becoming merely a relatively boring window on the computer screen (Turkle, 1995).

One of the greatest concerns about computer games and the Internet is their increasingly violent content. The limited research on this topic has measured short-term effects and, in general, suggests that playing aggressive games increases and even provides dangerous tools for aggressive behavior in children. The recently instituted ratings system of software by the Entertainment Software Ratings Board is a step in the right direction. Increasing parental awareness of these ratings is critical to controlling children's access to such violent media; otherwise, they may just be used by children to find the most violent and sexually explicit games. In the domain of social development and social relationships, Internet use seems to have augmented trends toward multiple identities, as well as relationships with strangers and even robots. The Fifth Dimension holds promise that, when embedded in an environment that provides structure, guidance, and positive social affiliations, electronic games and the Internet can have important positive outcomes for child development.

Notes

1. Note that the PC meter data is collected automatically by the computer, which keeps track of usage information.

2. This picture of an increase with age on the Internet is supported by the developmental data of Roberts et al. (1999), who found that, in their national sample, the time on computers showed a many-fold increase between the 2- to 7-year-old group and the 8- to 18-year-old group.

3. The HomeNet study did not collect data from children younger than 10, even though they were in the trial.

4. One of us, Elisheva Gross, was a cocreator of Plug In!

5. A total of 440 questionnaires were submitted, but 157 were blank or had incomplete information. A great number of those incomplete or even blank questionnaires were a result of our young users' unfamiliarity with the technology. For example, it is all too easy to click "send" without pasting in your completed questionnaire. Also, respondents were required to copy and paste the questions into an e-mail; many found this difficult and simply wrote asking to be in the cast.

6. These comparisons control for the greater number of hours per week that teens are on-line compared with adults.

7. The national sample of Roberts et al. (1999) confirms this basic picture but also reveals a developmental trend: Schoolwork is second to gaming in the computer use of 8- to 13-year-olds but rises to the number-one activity in the 14- to 18-year-olds. (Note, though, that Roberts et al. include not only the Internet but all uses of the computer for schoolwork in this finding.)

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