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Handbook of Children and the Media

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CHAPTER 4

Digital Media and Youth

Games, Internet, and Development

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Digital Media and Youth: Games, Internet, and Development

Digital media such as computers, interactive games, the Internet, cell phones, and other handheld devices have become an integral part of the media landscape surrounding young people. According to some estimates, 93% of U.S. children between 12 and 17 years of age are online (Jones & Fox, 2009); 87% of 8- to 18-year-olds in the United States

live in a home with at least one video game console (Rideout, Foehr, & Roberts, 2010); and 79% of 13- to 19-years old have a mobile device (Harris Interactive, 2008). This was not always the case. In 1994, 39% of American households with children had personal computers; by 1999, this had jumped to over 60% for married couples with children (Roberts, Foehr, Rideout, & Brodie, 1999; Turow & Nir, 2000). In 2004, 86% of 8- to 18-year-olds in the United States lived in a home with at least one computer. Time with these different entertainment media has similarly been increasing over the years. According to the 2010 Kaiser report, youth in the United States spend approximately 7 hours and 38 minutes daily using a variety of entertainment media. Because of the multi-tasking nature of their media use, in actuality, they consume 10 hours and 45 minutes of

media content during this time (Rideout et al., 2010). Apart from television and music/audio content, which are not the focus in this chapter, computers and video games are the two major media forms that young people access and interact with. In the results of the Kaiser report, respondents reported that outside of school work, they used the computer for 1 hour and 29 minutes per day to go online and access various applications and games; in addition, they reported spending an average of 1 hour and 13 minutes playing games on a variety of platforms (e.g., consoles, handheld systems, etc.). Online communication applications, such as email and instant messaging, and social networking sites, such as MySpace and Facebook, are popular among youth (Subrahmanyam & Greenfield, 2008a).

It is important to point out at the start that even more now than at previous times, distinctions between hardware and software are getting blurred as youth are able to use a range of hardware tools to access a variety of functions such as searching for information and entertainment, playing games, and importantly, interacting and communicating with each other. For instance, interactive games can be played on a variety of platforms, including consoles (such as the Nintendo Wii or the Xbox), stand-alone computers, handheld devices such as the PS2 or cell phones, and the Internet. Similarly, online applications such as email and instant messaging can be accessed on a desktop, laptop, or smart phone. As the lines between hardware and content are getting blurred, it is more meaningful to focus on the various digital applications rather than the particular hardware that supports them (Subrahmanyam & Smahel, 2010). Our goal here is to examine young people's informal, out of school use of these technologies and their implications for development. Accordingly, we focus here broadly on interactive games and the Internet, regardless of the particular platforms that may be used to access them.

Demographics and the Digital Divide

Although it has narrowed, there continues to be a digital divide based on parental education, family income, and race/ethnicity with regard to the presence of a home computer

and access to the Internet. By the end of 1998, 88% of American adults with family incomes greater than \$75,000 reported owning a personal computer, compared to 47% 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 European American respondents reported a family computer, whereas only 55% of African American and 48% of Hispanic respondents did so (Roberts et al., 1999). In 2010, according to the Pew Report, only 70% of youth in households with annual household incomes less than \$30,000 had a home computer, compared to 92% in households with higher incomes (Lenhart, Ling, Campbell, & Purcell, 2010). According to the 2010 Kaiser report, computer ownership ranged from 87% among youth whose parents had a high school education to 97% among those whose parents were college graduates (Rideout et al., 2010). Similarly, online access and time on computers tends to be strongly correlated with income and education (Roberts et al., 1999; Stanger, 1998); for instance, previously, 12% of families with annual incomes under \$30,000 subscribed to the Internet, compared to 61.1% of families with annual incomes over \$75,000 (Stanger, 1998). Although Internet access among youth has become relatively high across all ethnic groups, the 2010 Kaiser report reveals a range of 74% among Latinos, 78% among Blacks, and 88% among European Americans; furthermore it is 74% among those whose parents have a high school education and 91% among those with college educated parents (Rideout et al., 2010).

There are also other demographic differences in young people's use of technologies and consumption of media content that are deserving of attention. Previously, stand-alone video game platforms did not vary systematically with income and race (Roberts et al., 1999), leading us to speculate that they may be the most democratic means for spreading computer literacy (Greenfield, 1994; Subrahmanyam, Kraut, Greenfield, & Gross, 2001). Our speculation turned out to have some truth because in the 2010 Kaiser report, Latino (1 hour 35 minutes) and African American (1 hour 25 minutes) youth reported spending more time playing video games across all platforms compared to European

American youth (56 minutes). Equally important, African American and Latino youth consume almost 4 hours and 30 minutes more media per day than do European American youth, and the difference is greatest for television content.

Finally, there are interesting differences in how youth access the Internet and what sites they may access while online. Forty-one percent of teens from households with annual incomes less than \$30,000 report using their cell phones to access the Internet. Among teens from low-income households, 44% of African American, 35% of Latino, and 21% of European American youth use cell phones to access the Internet (Lenhart et al., 2010). Similarly, in the Kaiser report, African American (1 hour 28 minutes) and Latino (1 hour 4 minutes) youth report using cell phones to access media content (music, games, and television) at much higher rates than European American (26 minutes) youth. With regard to the kinds of sites accessed online, there are indications that, compared to European Americans, Latinos are more likely to use MySpace (Hargittai, 2007; Subrahmanyam, Reich, Waechter, & Espinoza, 2008).

Gender is another important demographic variable that is relevant to understanding young people's use of interactive media. In the early years, there was a big gender gap in video game playing—boys played video games more often and spent more time playing (Dominick, 1984; Linn & Lepper, 1987). Indeed, video arcades, which were the primary means of accessing this technology at the time, were well known to be male preserves (Kiesler, Sproull, & Eccles, 1985). With the advent of newer technologies, including handheld games, the Internet, and games for mobile phones, the gender gap has remained in some aspects of technology use, but it has been erased, and, at times, even reversed in other areas. One aspect that has remained the same is gaming: In the Kaiser report, boys were exposed to an hour more of media each day (11 hours 12 minutes vs. 10 hours 17 minutes), partly because they spend more time on computers, primarily playing games (25 minutes vs. 8 minutes) and watching videos on sites such as YouTube (17 minutes vs. 12 minutes). With regard to online use, there are no gender differences in time spent on email, instant messaging, visiting websites, graphics/photos, and reading

newspapers/magazines. However, girls spend more time on social networking sites (25 minutes vs. 19 minutes). Although both genders were equally likely (40%) to visit the sites, girls reported spending more time (1 hour 1 minute vs. 47 minutes); girls also spend more time—both texting and calling—with cell phones (Rideout et al., 2010). In our chapter in the first edition of this volume, we speculated that girls may be getting socialized with the Internet at an earlier age, and that the social nature of online applications might appeal more to preteen girls than to preteen boys (Subrahmanyam et al., 2001). While these data do not speak to whether girls are getting socialized with the Internet at earlier ages compared to boys, they certainly do indicate that the social applications of the Internet appeal to girls and have helped to erase the gender gap in at least one form of technology use.

Understanding the Influence of Digital Media on Development

To understand the influence of games on development, we start with Vygotsky's (1978) sociocultural theory, which posits that the context and, in particular, tools provided by the culture play a mediating role in development. Some cultural tools that Vygotsky considered to be important for the development of higher mental functions included the abacus, language, and mathematics. Drawing on Tikhomirov (1974) and Salomon (1979), we have extended this idea in prior work and posited that different cultural tools elicit and develop different sets of cognitive skills. Computers, digital games, and the Internet are the newest cultural tools in technological societies, and they will likely influence the development of thinking and learning (Greenfield, 1994; Maynard, Subrahmanyam, & Greenfield, 2005). Within this theoretical framework, there are at least three potential pathways through which digital media might influence development (Subrahmanyam, 2009).

The first pathway is based on the idea that time with digital media not only involves time spent on that particular activity, but presumably time away from other potentially more valuable activities—a proposal called the time displacement hypothesis (Nie & Hillygus, 2002). For children, time with computer games and the Internet could take away from book reading,

engaging in physical activities, and interacting face-to-face with friends and family members. The second and third pathways stem from the nature of interactive media themselves. In prior work, we proposed that in order to understand the influence of a particular media form on thinking and learning, we had to distinguish among the *physical platform or hardware* (i.e., television, computer, or video game system), *formal features* (i.e., audio visual production features that characterize a medium), and the *content* (i.e., the topic or focus of a game or online site) within it (Subrahmanyam & Greenfield, 2008b).

The second pathway of digital media influence is via its *formal features*, which are the symbolic and representational systems that it uses—for instance, enactive (action-based representations), iconic (image-based representations), or symbolic (symbol-based representations) (Bruner, Olver, & Greenfield, 1966)—and that the user has to decode to grasp the message. Consequently, repeated use of a media form will likely lead to internalization of the skills utilized by it and influence the development of those particular representational skills (Salomon, 1979).

The third pathway of influence involves *media content*, which consists of the message conveyed by the formal features. With regard to games, content could involve the particular topic area (math, history, science, or fantasy) or themes such as aggression. In online contexts, content could similarly include aggressive, prosocial, or academic themes. Just as we expect particular formal features of media to mediate development, message content in digital media may also influence development.

In addition to the preceding three pathways, a fourth pathway of influence involves the *communication environment* within online contexts such as social networking sites, games, and virtual worlds. Features of online contexts that may be relevant for development include the potential for anonymity; disembodied users; ease of interaction; lack of face-to-face cues, including eye contact and gestures; as well as the potential for contact with strangers (Subrahmanyam & Greenfield, 2008a). For instance, the potential for anonymity and the lack of readily available information about the body (e.g., age, gender, etc.) in contexts such as

games and virtual worlds may have implications for identity development and social interaction. In the next sections, we will take into account each of these pathways as we examine the implications of interactive games and the Internet for development.

Interactive Games

As we have already noted, interactive games can be played on a variety of platforms, including video game systems (e.g., Nintendo Wii, X Box), computers, the Internet, and handheld devices such as portable game systems (Nintendo DS, PS2) and mobile phones. Following Roberts et al. (1999), we will refer to games played on game systems as video games, games on the computer as computer games, and games played via the Internet as online games; the term *interactive games* will be used to refer to all three types of games. Video games were among the earliest forms of interactive media that were widely used by youth (Subrahmanyam & Greenfield, 1994). Interactive gaming has increased in popularity in the last five years; however, much of this increase has been because of the increased popularity of gaming via cell phones and handheld devices. On average, youth spend about 1 hour and 13 minutes playing interactive games; on a given day, 60% report playing games—47% on a handheld device and 39% on a console player. Those who do play on a given day report spending approximately 2 hours per day on interactive game playing across all platforms (Rideout et al., 2010). As with other digital media forms, interactive gaming varies as a function of age (11- to 14-year-olds spend the most amount of time), race/ethnicity (Latino and African American youth spend more time than European American youth), and gender (boys spend more time than girls, and among players, boys spend more time at the controller than girls).

Does Time Spent With Interactive Games Replace Other Activities?

Because of the difficulties involved in obtaining accurate estimates of young people's

media use, we can not say whether computer game playing replaces other activities such as television watching, reading, and physical activities. In recent years, concerns have been raised that sedentary activities such as game playing may be associated with well-documented increases in youth obesity. This is of particular concern among young children, whose first exposure to technology is via computer and video games (Rideout, Vandewater, & Wartella, 2003). A study of 922 Swiss elementary school children found a twofold increase in the risk of obesity for every hour spent playing electronic games (Stettler, Singer, & Sutter, 2004). However, another study, based on a national sample of 2,831 U.S. children younger than 12 years, did not find a linear relation between television viewing and obesity. Instead, they found a U-shaped relationship between obesity and time spent playing electronic games: Children with higher weights reported spending moderate amounts of time playing games, whereas children with lower weights played either a lot or very little (Vandewater, Shim, & Caplovitz, 2004). Thus, the relation between computer games and obesity is not entirely straightforward.

Another activity that may get replaced by interactive gaming is sleep, and there is evidence that children with a gaming computer in their room go to bed later on weekdays; those who spend more time playing computer games go to sleep later on weekdays and weekends and get up later on weekends (Van den Bulck, 2004). Van den Bulck (2004) suggests that the problem might stem from the fact that game playing is an unstructured activity with no firm start and end times and that setting time limits might help counteract the associated sleep loss. Especially as youth get older, and as they enter adolescence, reduced sleep may be associated with a variety of other problems, such as depression, school and academic problems, and even driving accidents (Subrahmanyam & Smahel, 2010).

Regardless of whether time spent playing interactive games replaces other activities, media use may be associated with school grades and psychological adjustment. The 1999 Kaiser report found 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 (Roberts et al., 1999). The 2010 Kaiser report found a negative relation between media use and grades and between media use and personal contentment (Rideout et al., 2010). Because media use was collapsed across all media forms, we do not know the particular role of video games in this relationship. More generally, because of the correlational nature of the data, we do not know to what extent game playing or media use in general is a constructive outlet for relatively maladjusted young people versus to what extent it was a causal factor in the maladjustment.

Excessive time spent playing computer and online games is also a concern. For a small minority of youth, such extreme game playing may even be considered a form of addiction. In one large survey of online gamers, the game playing of approximately 12% of respondents met the diagnostic criteria of an addiction (Grüsser, Thalemann, & Griffiths, 2006). We know that adolescents with addictive behavior on the Internet also have problems in other aspects of their lives, including academics (a drop in grades, avoiding school), family relations (conflicts and having to hide their excessive Internet use from parents), physical health (sleep deprivation), mental health (depression), financial (Internet expenses), substance abuse, and cyberbullying (Chou, Condron, & Belland, 2005; Griffiths, 2000; Ko et al., 2006; Kraut et al., 1998; Kubey, Lavin, & Barrows, 2001; Subrahmanyam & Smahel, 2010; Tsai & Lin, 2003; Young, 1998); we would expect similar consequences for excessive game playing.

Interactive Games and the Development of Cognitive Skills

The second pathway of media influence, described earlier, suggests that the formal features of media can influence thinking and learning (Subrahmanyam & Greenfield, 2008b). Video games are spatial, iconic, and dynamic, and they have things going on simultaneously in different locations on the screen; these features utilize and have been shown to develop a variety of attentional, spatial, and iconic 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. Next, we summarize the experimental evidence for the role of interactive games in developing the particular attentional, spatial, and iconic representational skills that they utilize.

Practice on a computer game (*Marble Madness*) reliably improved 10-year-olds' spatial performance (e.g., anticipating targets, extrapolating spatial paths) compared to practice on a computerized word game (Subrahmanyam & Greenfield, 1994). Similarly, practice on the computer game *Tetris* (a game which requires the rapid rotation and placement of 7 different-shaped blocks) significantly improved undergraduate students' mental rotation time and spatial visualization time on computerized spatial performance tests (Okagaki & Frensch, 1994). Playing *Tetris* improved mental rotation skills even among 3rd graders, and the effects were especially pronounced for girls (De Lisi & Wolford, 2002). The research to date suggests that video game playing enhances visual spatial skills and that the benefits may be greater for those who initially have weaker visual spatial skills. It is important to keep in mind that transfer effects from such use are most likely to accrue in the same or similar medium and on tasks that utilize the same suite of skills as the game.

Another skill embodied in interactive games is that of iconic or analog representation—in other words, games privilege image over word. In a cross-cultural study carried out in Rome and Los Angeles, 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 to those who played the same game on a board (Greenfield, Camaioni, et al., 1994). The study results also indicated that exposure to video games is related to both the comprehension and production of iconic representation.

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).

Recent research has provided further evidence that video game playing improves attentional skill, an effect that was found to transfer to very different attentional tasks (Green & Bavelier, 2003). In a correlational study, video game players (those who reported that they had consistently played in the 6 months prior to the study) had better attentional capacity compared to non-players (participants who had little video game usage in the 6 months prior to the study). These correlations were substantiated in a cross-sectional developmental study in which positive effects of video game play increased as players progressed in age from 7 to 17 years of age (Dye & Bavelier, 2010). In a training study comparing the action game *Medal of Honor* and the puzzle game *Tetris*, the action game led to greater improvements on all the attentional tests compared to *Tetris*. *Medal of Honor* is a battle game in which multiple entities are simultaneously engaged in various actions, whereas *Tetris* is a dynamic puzzle game in which only one event takes place at a time. These studies suggest that individuals who play interactive games may be better at monitoring two or more locations on a game screen and that repeated playing over time might improve strategies for monitoring low-probability targets. They show that video game training in the lab can have immediate short-term effects on the development of divided attention strategies and that expert game players have better-developed attention skills than novices.

Divided attention is the cognitive basis for screen-based multitasking, which that involves more than one window or application on a computer screen. We hypothesize that the divided attention required by most action games is the reason video game expertise has a positive effect on screen-based multitasking in a virtual real-world task. Kearney (2005) found that playing two hours of a shooting

game, *Counterstrike*, improved performance in a simulated multitask work environment (called *SynWork*); it comprised four simultaneous tasks that are useful in the military job of standing guard.

Most of the research on the impact of interactive games on cognitive processing has assessed short-term transfer effects; although some of the evidence presented earlier suggested relations between game playing expertise and cognitive or occupational skills, we know very little about the cumulative impact of electronic games. 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, 1999).

The best study of the long-term effects of video game play is a study of the effect of video game expertise on skill in laparoscopic surgery (Rosser et al., 2007). Laparoscopic surgery provides an example in which visual skills developed by video games have implications for training.

Surgeons recognize that laparoscopy has changed the required skill profile of surgeons and their training needs. In laparoscopic surgery, a small incision is made, and a viewing tube with a small camera on the eyepiece is inserted through it. The surgeon examines internal organs on a video monitor connected to the tube and can also use the viewing tube to guide actual surgical procedures. Navigating through and operating in a three-dimensional space represented on a two-dimensional screen with minimal tactile feedback constitute basic parallels between laparoscopy and action video games. A study of the relation between video game skill and success in training for laparoscopic surgery yielded positive results: Action video game skill (as demonstrated in the laboratory) and past video game experience (assessed through self-report) predicted laparoscopic skills; in contrast, neither laparoscopic experience in the operating room nor years of training significantly predicted laparoscopic skill. The best game players (the top third) made

47% fewer errors and performed 39% faster in the laparoscopy tasks than the worst players (the bottom third). These results indicate the value of video game play as informal educational background for specific training in laparoscopic surgery, a finding that is applicable to other lines of work (such as piloting a plane) whose skill profiles overlap with those required by action video games. (Greenfield, 2009, p. 70)

Much of the 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. Based on 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. For example, the newer generations of games such as EA Sports' Football and basketball games have very realistic images that appear to be almost three-dimensional. How will these games influence representational skill development? In fact, Green and Bavelier (2003) found more consistent effects of video game play on divided attention than had Greenfield, Camaioni, et al. (1994) almost a decade earlier. One possible reason for this difference is that young people are starting earlier and/or playing more than they were a decade before. Another possible reason is that the more sophisticated visual graphics are having a greater effect.

The Wii sports games and music video games such as the *Dance Dance Revolution* series utilize a whole new set of skills. For instance, in *Dance Dance Revolution*, a player uses his or her feet to press on a dance pad with four arrow panels (left, right, up, and down) that are connected to the computer. The player has to press the panels in response to visual information consisting of rapidly changing arrows (corresponding to those on the pad) on a screen that are synchronized to the beat of a song that is being played

simultaneously. Success on the game requires intermodal integration—the player has to see the arrows that have to be pressed and then press the correct ones with his or her feet. Additional research is needed to understand how these newer games, as well as multiparty games on the Internet, influence the cognitive skills of youth.

Content of Interactive Games and Development

The third pathway of influence occurs via the thematic content of digital media. Interactive games contain a wide array of themes such as fantasy, prosociality, and aggression, as well as topic domains such as history or math. The effects of prosocial and aggressive content on development are discussed in Chapter 12 and Chapter 13 of this volume. Here we focus on educational games; these have variously been called instructional games, entertainment games, edutainment, or serious games. They range from those that provide drill and practice (e.g., for spelling, multiplication) to those that present subject content (e.g., social studies, geography; e.g., *The Oregon Trail*). The premise behind these serious games is that students will be more engaged and presumably learn more when the information is presented in a game-like context. The effects of computers and video games on learning outcomes are in fact mixed.

A survey of the educational publications of 20 years revealed very little hardcore academic benefits of playing educational games (Kafai, 2006). Another recent review of 20 studies on this topic concluded that students can learn from computer games and that most appreciate the use of games in the classroom (Egenfeldt-Nielsen, 2009). However, Egenfeldt-Nielsen (2009) also pointed out that “we can certainly say that you learn from computer games but the support for saying something more valuable is weak” (p. 268); for instance, we do not know how educational software compares to other teaching methods, and more important, we do not know the particular game feature or sets of features that best promote learning. In addition, a recent well-designed longitudinal study commissioned by the U.S. Department of Education compared a national sample of 1st-, 4th-, and

6th-grade classrooms that used reading and mathematics software with classrooms that did not. No statistically significant differences were found between the test scores of students in the classrooms that used the software products and those in classrooms that did not (Dynarski et al., 2007). More research is needed to understand the motivating role of interactive games, particularly for drill-based activities that children may consider boring. It is very likely that for digital youth, the benefit of software/computer games to education may lie more in their motivational and social advantages.

In all of the research mentioned previously, the goal was to examine whether playing interactive games would lead to learning. However, Kafai has shown that allowing students to make games might help them develop new understandings of content knowledge. In one case study, students were asked to create their own games with their own worlds, characters, and storylines to teach fractions to a group of younger students in their school. The students enjoyed making games for learning, and they were able to develop their programming skills; after analyzing the games that the students designed, the authors hypothesized that the context of designing games helped them to develop more sophisticated and complex representations of fractions (Kafai, Franke, Ching, & Shih, 1998).

Games on the Internet: Role of the Communication Environment

The fourth pathway of influence—the communication environment—comes into play with multiplayer games on the Internet (Steen, Greenfield, Davies, & Tynes, 2006). A study of an online multiplayer game, *Sims Online*, revealed impacts of the structure of the game on social interaction (Steen et al., 2006). Each player has an avatar representing the self in the game. Avatars can interact with other avatars for online social interaction. However, several factors impeded social interaction in this game. First of all, the avatars were controlled robotically (through instructions concerning direction of movement) rather than directly (by moving a cursor). This made interaction slow and artificial and was one barrier to social

interaction. Second, the motivational structure of the game was economic, with economic gains made by leaving an avatar unattended in a money-making situation. In such a case, there was no one to interact with, making social interaction impossible.

These characteristics also weakened identification between avatar and player. If you can leave your avatar's body behind, there is clearly a psychological separation of player from avatar. The lack of realism of robotic control undoubtedly weakens identification with an avatar. We also found that players experimented with avatars, using them to express various identities, from fantastical to realistic, to ideal, to “off-the-wall.” As we will see, real and ideal selves are also constructed on social networking sites; however, fantastical and off-the-wall are probably specific to the more imaginative settings of a game world and may have been enhanced by the structural characteristics of *Sims Online* that caused the dissociation between player and avatar. In the development of a less game-like simulation, *Second Life*, there seems to be a much greater incidence of player-avatar identification. At its height, *Sims Online* had subscribers in the thousands, way below initial expectations and estimates. *World of Warcraft*, another massive multiplayer game with 6.5 million subscribers as of 2006, is at the other end of the spectrum, and is one of the best-selling online game in the United States. Its structure enhances various sorts of collaboration with offline friends and strangers as well as leads to scaffolded learning concerning the rules and opportunities in the game, not only from other players but from resources such as websites and forums (Nardi & Harris, 2006).

Gender Issues in Interactive Games

As we noted earlier, there remains a gender imbalance in the playing of electronic games, with boys continuing to spend more time playing them than girls (Rideout et al., 2010). It was initially believed that girls were turned off by electronic games by 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 were largely

a failure (Subrahmanyam & Greenfield, 1998). Although one “girl software,” *Barbie Fashion Designer*, was very successful, other girl games, such as *Lets Talk About Me*, *Rockett*, and *Barbie Print and Play*, were not. The Barbie character certainly has importance in itself: A number of Barbie games have become best sellers among girls. It has been suggested that the success of *Barbie Fashion Designer* did not stem from the mere presence of Barbie and the lack of aggression, but instead stemmed 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, 2006). 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 compared to boys' pretend play. Unlike most games where the electronic fantasy is primary, the electronic medium became a tool to design a product that could then be used in play with Barbie dolls. Our analysis suggests that girls like nonaggressive software that allows them to enhance popular play themes with realistic-familiar characters. Not much has changed since we proposed this. Based on their ethnographic work, Ito and Bittani (2009) suggest that although more girls are playing games, boys still play more games, and more boys are engaged in what they call recreational gaming; this involves more sophisticated, “geeked-out” gaming. Ito and Bittani suggest that there is more of a gender balance when it comes to playing games simply to hang out or to kill time. The gender imbalance in more sophisticated kinds of gaming is important because such informal activities might provide access to networks of technology expertise and learning.

Children, Adolescents, and The Internet

Since the previous edition of the *Handbook of Children and the Media* was published, there have been rapid and dramatic changes

in the Internet—not just in how it is accessed, but also in the various applications and activities that it affords. Dial-up access has given way to broadband and wireless networks, and the Internet can now be accessed via high-speed wired computers, wireless networks on laptops, as well as a variety of handheld devices, such as the iPhone, BlackBerry, and Sidekick. In addition, there are a variety of online applications with very diverse functions that are available—email, chat rooms, instant messaging, social networking sites (e.g., MySpace and Facebook), web blogs, microblogs (e.g., Twitter, mylifeisaverage.com), Formspring, and virtual worlds (e.g., Whyville, Teen Second Life); text messaging, while not strictly an online application, is nonetheless very popular among youth and so must be considered as part of the digital landscape.

Together with changes in the nature of the Internet itself, there has been its rapid diffusion, and as we noted earlier, more than 90% of U.S. youth are online. With most of their peers online, it is not surprising that the communication uses of the Internet remain popular among youth (Subrahmanyam & Greenfield, 2008a; Subrahmanyam & Smahel, 2010). Recent research has confirmed that most young people in the United States interact and communicate online with people from their offline worlds (Reich, Subrahmanyam, & Espinoza, 2009; Subrahmanyam & Smahel, 2010); this is in contrast to the earlier years of the Internet, when youth were more likely to interact with strangers (Subrahmanyam et al., 2001). Although there has been a decline in youth reports of unwanted sexual solicitation and harassment by predatory adults, probably because of better education and law enforcement (Mitchell, Wolak, & Finkelhor, 2007), there is an increased incidence of cyberbullying at the hands of peers (Hinduja & Patchin, 2008; Juvonen & Gross, 2008; Chapters 5 and 33 in this volume). At the same time, youth have come to depend on the Internet for information (e.g., for school work, for health information) as well as for entertainment (e.g., for downloading music, videos, and television shows). In the next sections, we utilize the pathways of influence framework that we described earlier as we

consider the implications of the Internet for child and adolescent development.

Implications of Online Time on Development

Consistent with the displacement hypothesis, an important question is whether time spent online displaces activities important for adolescent social development, such as face-to-face interactions with peers (Nie & Hillygus, 2002). On this line of reasoning, Internet use displaces adolescents' "real interactions" with peers and family, and so greater Internet use may be associated with weaker social ties as well as lowered well-being (e.g., greater depression). Early research revealed that greater use of the Internet was associated with declines in adolescents' well-being as well as weaker social ties (Kraut et al., 1998). Mesch (2003) also found that adolescents' perceptions about the quality of their family relationships were negatively related to their frequency of Internet use. Other studies have not found a reliable connection between adolescents' online time use and psychological well-being as measured by dispositional or daily well-being (Gross, Juvonen, & Gable, 2002; Subrahmanyam & Lin, 2007). Similarly, no relation was found between time online and aspects of social networks, such as size of local and distant social circles and amount of face-to-face communication (Kraut et al., 2002).

Furthermore, the research suggests that the developmental implications of online time use may be moderated by a variety of factors. When different types of online activity are considered, more time spent in chat rooms, online browsing, and games was related to higher levels of social anxiety among older adolescent and young adult males, but not females (Mazalin & Moore, 2004). Because the study was correlational, we do not know whether participants became more depressed because of their chat room use, whether they were drawn to chat rooms in the first place because they were depressed and were looking for support that they were not getting from their offline relationships, or both. Longitudinal research has shown that Internet use has differential effects based on user characteristics (e.g., Bessi re, Kiesler,

Kraut, & Boneva, 2008; Kraut et al., 2002; Steinfield, Ellison, & Lampe, 2008). Bessi re and colleagues (2008) found that using the Internet to meet new people and using it for entertainment lead to reduced depressive affect, but only for people with better social resources. For people with poor social resources, using the Internet to meet people was actually associated with reduced depressive affect. Steinfield et al. (2008) found that participants with lower self-esteem reported more gains in their social capital from their Facebook use. Neither of these studies focused exclusively on children and adolescents, but they are relevant to our discussion since 15% of the participants in Bessi re et al.'s (2008) study were younger than 19 years and Steinfield and colleagues' (2008) sample consisted of college students. Other variables that may mediate the relation between time use and well-being include young people's perceptions about their online relationships (Subrahmanyam & Lin, 2007) as well as the quality of their online interactions (Valkenburg, Peter, & Schouten, 2006).

Formal Feature of the Internet—Effects on Cognition and Learning

We have previously suggested that the Internet's formal or symbolic features are a combination of those found in all other previous media forms—"like books, the Internet contains text; like the radio, the Internet contains audio; like television, the Internet contains audiovisual representations; and like computer and video games, the Internet contains interactive audio and video" (Subrahmanyam & Greenfield, 2008b, p. 178). There is sparse literature with regard to whether formal features of the Internet have effects on cognitive skills. In previous work, we have speculated that because the information and communication uses of the Internet center around the production and comprehension of text, Internet use will likely have an impact on verbal, spatial, and other representational skills.

One important issue is that text-based online communication has features of both oral and written representation, and therefore, online text frequently consists of novel abbreviations (lol, brb) and short forms for

words (e.g., srsly for seriously), as well as incomplete and grammatically simple or even incorrect sentences (Greenfield & Subrahmanyam, 2003; Herring, 1996). Such text message abbreviations are called *textisms* (Plester, Wood, & Joshi, 2009; Rosen, Chang, Erwin, Carrier, & Cheever, 2010). Rosen and colleagues (2010) found that among young adults, the greater use of such textisms and more simultaneous instant messaging conversations was related to worse formal writing (e.g., a letter about a defective product); interestingly, there was a positive relationship between textisms and informal writing (Rosen et al., 2010). Among children 10- to 12-years of age, word reading, vocabulary, and phonological awareness measures were positively related to the ratio of textisms to total words used in a text message composing task (Plester et al., 2009). Textism use also predicted word reading ability over and above age, short-term memory, vocabulary, phonological awareness, and length of mobile phone ownership; furthermore, use of textisms was positively associated with word reading ability. Although preliminary, these results point to the need for more research to understand the relation between informal online writing and the more formal and informal reading and writing that occurs in offline contexts.

Spatial representation skills, particularly with regard to two-dimensional representations of three-dimensional space, may also be impacted by online activities. Unlike traditional books, which arrange pages in a linear fashion, the Internet utilizes a more complex set of links, linking content within a page and pages within and across sites. An example of this includes the personal home pages of adolescent cancer patients, which contained hyperlinks to a variety of other sites (Suzuki & Beale, 2006). Just as video games require players to create mental maps of game worlds, constructing and navigating websites might require users to create mental maps of the site organization and help them develop spatial visualization skills. Avatars, which serve as users' three-dimensional motion-enabled online identities, are also a part of the formal representational language of some contexts, such as online

games and virtual worlds; for instance, within some virtual worlds, an avatar with few accessories indicates a "newbie," and children inhabiting these worlds must learn this "language" in order to successfully navigate within them. Research is needed to evaluate avatars as symbol systems and to understand how use of these three-dimensional symbols might relate to young children's online and offline self-presentation and perception of others.

A final aspect of online symbol systems that we consider is multitasking. One type of multitasking involves utilizing multiple windows or multiple tabs within a window, each one representing a different activity. This type of multitasking is the phenomenon of using multiple computer applications (e.g., Internet and word processing applications) or multiple windows of the same application (e.g., multiple instant message windows) at the same time. A second type of multitasking is media-multitasking, "which is the practice of using different media at the same time such as the telephone, computer, and television" (Subrahmanyam & Greenfield, 2008b, p. 180). A third type of multitasking involves both a medium and a real-life interaction (e.g., texting while having a family dinner). Online multitasking (e.g., several concurrent conversations via instant messaging, or checking social networking profiles while also having an instant messaging conversation) has come to characterize young people's use of digital media (Carrier, Cheever, Rosen, Benitez, & Chang, 2009; Rideout et al., 2010). However, we do not have a very good understanding of the cognitive costs or benefits of engaging in online multitasking, especially while studying or doing homework.

Foerde, Knowlton, and Poldrack (2006) have examined the cognitive and neural effects of media multitasking in which one task was presented aurally and the other visually, on a computer screen. While this is not the Internet per se, there is no reason to believe that results would differ if someone were accessing a visual task on the Internet. Although dual task conditions (i.e., multitasking) did not affect performance on a weather-prediction task (the visual task) wherein participants had to learn the cues associated with weather outcomes

(being able to use cues to predict the weather), it did decrease the acquisition of metaknowledge about the task. In the dual task condition, participants could use the cues to predict the weather, but they could not say how they had done it. Neural processing also was affected by multitasking, and the neural processing of the task was shifted from the medial temporal lobe, which supports flexibly accessible knowledge and metaknowledge, to the striatum, which supports habit learning. In a study of the cognitive cost of the first kind of multitasking (multiple computer applications used simultaneously), college students who were heavy multitaskers took twice as long to write a critique (Calvert & Wells, 2007). There was no difference between heavy and light multitaskers with regard to the quality of the critiques.

A study of the third type of multitasking—between a medium and human interaction—revealed that text interruptions during a class lecture had significant, though moderate, decrements on a test based on the lecture (Lim & Rosen, 2010). A similar study was done by Hembrooke and Gay (2003). Students in a communication studies class were encouraged to use laptops during class in order to explore lecture topics in greater detail on the Internet and through library research. All the students had laptops, but half were randomly selected to keep their laptops closed during class. A surprise quiz at the end of class revealed that the students with open laptops learned significantly less of the lecture material. These studies suggest, in several different ways, that multitasking causes a decrement in higher-level cognitive skills; the study by Foerde et al. (2006) suggests a neural basis for this decrement.

Effects of Online Content on Youth

The Internet is a repository of content and provides access to vast amounts of freely available information. Search engines such as Google, encyclopedic websites such as Wikipedia, and online bulletin boards are some of the tools that youth can use to access these resources. The Internet provides access to useful information, such as for school as well as for health-related needs, but it also

exposes youth to hateful, violent, and other undesirable content. There are simply too many different content kinds to enumerate here; instead, we focus on the developmental implication of young people's access to health-related material and exposure to online hate.

Survey studies suggest that youth use the Internet to access health information, and such use has been increasing since these trends have been tracked (Rideout, 2001; Roberts, Foehr, & Rideout, 2005). Suzuki and Calzo (2004) conducted a content analysis of a health-related online bulletin board for adolescents and found that the most frequent health-related concerns and questions dealt with the following topics: sexual health, pregnancy/birth control, body image, and grooming of genital areas. The Kaiser report similarly found that sexual health issues such as pregnancy, AIDS, and other sexually transmitted diseases (STDs) were the second most frequently searched topic after diseases like cancer and diabetes (Rideout, 2001). These results suggest that youth access online resources to find out more about specific adolescent concerns, especially sensitive ones, which they may not be comfortable discussing with parents, teachers, or physicians. Although the information they obtain from the Internet may result in their talking to their peers or adults, it does not consistently lead to long lasting behavior changes, and only a very small minority report going to the doctor because of information they saw online (Rideout, 2001). Online health resources have other benefits, such as their 24/7 availability and passive access to information (e.g., questions and the responses on bulletin boards and other sites remain long after they are initially posted). Moreover, they also expand support networks as youths can go online and get information, advice, and support from a wider network of people than would be possible from offline contacts alone (Suzuki & Calzo, 2004). These advantages could be especially valuable for youths who may be too shy to post questions themselves, or who might not have adequate offline support because of their location (e.g., rural areas, areas steeped in poverty), social isolation, or illness (e.g., teens with cancer). Research has documented online access of health information by rural

teens living in Accra, Ghana (Borzekowski, Fobil, & Asante, 2006), teens with cancer (Kyngas et al. 2001; Suzuki & Beale, 2006), as well as youth with self-injurious behaviors (Whitlock, Powers, & Eckenrode, 2006) and eating disorders (Winzelberg, 1997).

Despite these advantages, online health content also presents some challenges—for instance, youth are not very good at searching and retrieving high quality health information (Skinner, Biscope, Poland, & Goldberg, 2003) or at evaluating the credibility of sources (e.g., a government website versus one hosted by a commercial entity; Eysenbach, 2008). There is also the concern that the Internet provides easy access to dangerous and potentially harmful content, such as those that portray and sell prescription drugs that adolescents tend to abuse (e.g., stimulants; Schepis, Marlowe, & Forman, 2008) or those that endorse eating disorders (Wilson, Peebles, Hardy, & Litt, 2006). In experimental work with college students who were exposed to different kinds of websites (a pro-anorexic website, a website of female fashion showing average-sized models, or a home décor site), those who viewed the pro-anorexic website showed a decrease in self-esteem, appearance, self-efficacy, and perceived attractiveness, and an increase in negative affect and perceptions of being overweight (Bardone-Cone & Cass, 2006). In addition, because self-injurious behaviors seem to follow epidemic-like patterns in hospitals and other institutions, Whitlock and colleagues (2006) cautioned that problem behaviors such as cutting might become socially contagious through the Internet.

Two aspects of online content that we briefly examine are violence on websites and interactive online games with violent content. Websites that youth may access include those with violent and aggressive themes that advocate violence and aggression and websites that sometimes provide detailed directions for committing violent actions: examples include those that provide bomb making information, contain violent gore content such as pictures of torture and mutilation, online music (particularly rap and hip hop music), and hate sites (Subrahmanyam & Smahel, 2010). Given the dynamic and vast nature of the World Wide Web, it is hard to know what

percentage of content includes such violent and disturbing themes. Although estimates vary, many teens report exposure to online violence (Fleming, Greentree, Cocotti-Muller, Elias, & Morrison, 2006), much of it inadvertent or unintentional (Aisbett, Authority, & Insights, 2001; Livingstone, Bober, & Helsper, 2005). Based on a review of extant survey research (Slater, 2003; Slater, Henry, Swaim, & Anderson, 2003), Subrahmanyam and Smahel (2010) concluded that violence-oriented websites may not be harmful for a majority of adolescents, but may pose threats for a subset of youth, particularly those who are alienated from their immediate contexts, are sensation-seekers, and are generally at risk for problem behaviors.

Online hate sites generally contain violent and aggressive messages against individuals and groups (Tynes, 2005), and researchers have begun to document both the nature of their content and the strategies they use to target and recruit young people to their cause (Gerstenfeld, Grant, & Chiang, 2003; Tynes, 2005). Relevant is an experimental study that investigated the persuasiveness of hate messages such as those found on White supremacist web pages. The results revealed that even brief exposure to negative messages such as those found on online hate sites can lead to persistent changes in young adolescent Internet users' attitudes. Furthermore, youth who were already susceptible to such messages were most at risk for such changes (Lee & Leets, 2002).

Finally, we consider the role that online content can play with regard to learning. Because of their immersive nature, virtual worlds have been touted for their potential to engage young people in learning activities. It is argued that, compared to traditional modes of classroom instruction, they are more appealing for even disinterested learners and can help them develop critical thinking and problem solving skills that can be applied to real-world settings (Wu, 2010). A participatory simulation study integrated a virtual experience with a science curriculum at school (Neulight, Kafai, Kao, Foley, & Galas, 2007). The virtual world was Whyville, which targeted 8- to 16-year-olds and provided opportunities to engage in science and social activities (Fields & Kafai, 2007). Participants were two sixth

grade classrooms who experienced a virtual epidemic of Whypox, an infectious disease within Whyville. Concurrently, as part of their science curriculum, they learned about natural infectious diseases. From the answers on a pre- and posttest, it was clear that although the students' had made significant advances in their understanding of natural disease, their explanations still emphasized prebiological mechanisms (e.g., mechanical transfer of disease through contact) versus truly biological ones (e.g., biology of germs or white blood cells). As in the case of interactive games, this finding is disappointing and more research is necessary to determine the true potential of online contexts for learning and to see whether such learning transfers to more traditional academic contexts.

A new approach to the issue of learning online has been pioneered by Ito and Bittani (2009). Utilizing the example of Japanese anime fans who create subtitles on Japanese animation, they point to interest-driven online communities (called *networked publics*), within which learning activities are primary. These communities promote and develop sophisticated technical skills, which are motivated by publicity and fame. There is also a step-by-step learning progression built into each genre and scaffolded by peers in the network. In the case of anime, fans progress from consumption to production. This progression eventually leads to what might be called precocious professionalism. As the authors point out, there is a need for formal institutions such as schools to recognize the cognitive and technical skills being developed in these informal online learning communities and to interface with them in classroom-based teaching and testing.

Online Communication Contexts and Development

As we noted earlier, online communication tools such as email, instant messaging, and social networking are popular among youth. The communication environment within them has important developmental implications, and in this section we consider this fourth pathway of influence. Most mediated environments are disembodied, and information about the body, face, and other

face-to-face cues such as gestures and eye contact are not readily available. Even though true anonymity on the Internet is something of an illusion, users do have control as to how anonymous they wish to be. Research to date suggests that, at least among adolescents, online interactions center around core offline developmental concerns such as sexuality, intimacy, and identity (Smahel & Subrahmanyam, 2007; Subrahmanyam, Greenfield, & Tynes, 2004; Subrahmanyam, Smahel, & Greenfield, 2006). To understand how the disembodied and potentially anonymous nature of online contexts might mediate development, we provide examples that relate to the development of intimacy and identity.

In an earlier section, we examined the issue of time online and well-being. Here we reconsider this question, taking into account the particular affordances of online communication environments. First, many Internet forums enable communication with strangers, and such interactions may be more superficial and poorer in quality. Second, most mediated contexts (e.g., email, text messaging, and instant messaging) do not contain facial cues, voice, gestures, or other elements of body language. Consequently, online communication might not be of the same quality as face-to-face communication, and online interactions may lead to superficial and weak ties (Krackhardt, 1994; Kraut et al., 1998). Therefore, an important question is whether online interactions and relationships provide the same kinds of intimacy and support as their offline counterparts.

Research on this topic has presented a complex picture. To start with, at the time of writing this chapter in 2010, relationships that were exclusively online were not the norm among youth, at least in the United States and other Western countries. When purely online relationships do occur, they are qualitatively different from offline ones. For instance, Mesch and Talmud (2006) found that among Israeli adolescents, online friendships were shorter in duration and not as close when one considered the topics discussed (e.g., less personal topics) and the frequency of shared activities. Furthermore, adolescents' online relationships rarely move from online to offline contexts (Wolak, Mitchell, & Finkelhor, 2002).

Young people's online interactions (via text messaging and social networking sites) seem to mostly involve peers their offline worlds, including schools, after-school settings (e.g., sports and clubs), and neighborhoods. (See Subrahmanyam & Smahel, 2010, for an in-depth discussion of this issue.) Interestingly, their online communication with their offline friends may actually have positive effects on these offline friendships. In Valkenburg and Peter's (2007) survey of adolescents, 80% reported that they used the Internet to maintain existing friendship networks. Those who communicated more often on the Internet felt closer to existing friends, but only if they interacted online with friends rather than strangers. Participants who felt that online communication was more effective for self-disclosure also reported feeling closer to their offline friends compared to adolescents who did not view online communication as allowing for more intimate self-disclosure compared to offline communication. At the same time, online communication may present some costs. For instance, youth participants in one study found instant messaging to be less enjoyable than phone and face-to-face conversations, and they also reported that they felt psychologically less close to their instant messaging partners than in phone or face-to-face communication (Boneva, Quinn, Kraut, Kiesler, & Shklovski, 2006).

Regardless of the quality of intimacy and support accrued from online communication, tools such as instant messaging, text messaging, and social networking sites have made it possible for young people to access their offline friends and peer groups at any time, anywhere, and in any manner, public or private (e.g., Kaare, Brandtzaeg, Heim, & Endestad, 2007; Subrahmanyam & Smahel, 2010). Interestingly, this increased online peer contact does not seem to be at the expense of face-to-face interactions (Subrahmanyam & Smahel, 2010). In addition, digital tools have helped to widen or broaden young people's peer networks. For instance, in one study of high school students' social networking use, the number of social networking "friends" ranged from 0 to 793, with a mean of 176, a standard deviation of 166, and a median of 130 (Reich et al., 2009). Clearly, the notion

of friendship is undergoing a transformation, and for youth, the word *friends* now seems to include both close, intimate others as well as acquaintances, with whom they might not otherwise interact with face-to-face. Subrahmanyam et al. (2010) noted that such a "wider circle of friends" could be valuable for adolescents and help them learn more about themselves and their social world. Future research should also examine the developmental implications of online peer interactions that occur, at times in very public ways, such as on social networking sites.

Another domain that may be impacted by the unique affordances of online contexts is that of identity and self-development. Given the disembodied and potentially anonymous nature of many online forums, scholars initially speculated that online users could leave their bodies behind and create new and different selves or personas online (Kendall, 2003; Stallabrass, 1995; Turkle, 1997). Turkle (1997) famously wrote about a youth who assumed four different selves in three different MUDs (Multi User Dungeons): a seductive woman, a "macho cowboy" type, a rabbit of unspecified gender, and a furry animal; in his words, "'rl' [real life] is just one more window, and it's not usually my best one" (p. 13). Formulating a coherent sense of self is an important task for adolescents, and we examine some of the ways that young people might use technology to negotiate and present aspects of their developing selves.

Contrary to early speculation, the evidence indicates that "identity experiments" are not very common among youth. For instance, among U.S. adolescents in 7th (12- and 13-year-olds) and 10th grade (15- and 16-year-olds), Gross (2004) found that assuming a different identity was rare; it occurred when youths pretended to be someone older or when they wanted to make fun of friends and not as part of an alternative or preferred identity.

Although youths do not actively assume different identities while online, nonetheless, they adopt a variety of strategies for identity expression and self-presentation. For instance, they use digital tools (e.g., nicknames, avatars, profiles, photos, and videos) and digital contexts (e.g., blogs and social networking sites) to test aspects of their self in front of a

peer audience and to create narratives about themselves (Subrahmanyam & Smahel, 2010). Here we briefly describe their use of nicknames, avatars, and blogs in the context of their online self-presentation. In our own research with online teen chat rooms, we have found that users adopt nicknames that present aspects of their selves such as their gender (e.g., *prettygirl245*) and sexualized identities (e.g., *straitangel*) as well as interests (e.g., *soccerchick*). Within the anonymous and disembodied chat space, such nicknames could serve as a proxy for a person's body and intentions. Thus, sexualized nicknames may be adopted by chat users to portray a sexual persona or an interest in sexual activities (Subrahmanyam et al., 2006).

As mentioned in the section on video games, identity expression and development are relevant to avatars, which are three-dimensional versions of nicknames and are adjustable, motion-enabled graphical representations assumed by users within online contexts such as computer games (e.g., Massively Multi Player Online Role Playing Games, or MMORPGs) and complex virtual worlds (e.g., *Second Life*). Depending on the particular online space, avatars can assume a variety of forms, ranging from human-like to fantastical creatures. A qualitative study of Whyville, a virtual world, found that youth users adopted a variety of avatars: Some were like them in offline life, others were different, and still others were either for or against a popular trend (Kafai, Fields, & Cook, 2007). Other research has found that children's avatars in a MUD mostly mirrored offline properties such as their gender and interests (Calvert, Mahler, Zehnder, Jenkins, & Lee, 2003). Again, contrary to speculation, gender-bending (where users assume the gender opposite to their offline one) was infrequent; when it did occur, children were generally interacting with familiar peers. Similarly, content analysis of teen web blogs, or *blogs*, revealed that blog entries were narrative and reflective in style, and they generally described the authors' peers and everyday activities (e.g., school, after-school activities) and often carried a strong emotional tone (Subrahmanyam, Garcia, Harsono, Li, & Lipana, 2009). Based on McAdams's (1997) suggestion that such life stories help individuals to construct a coherent

sense of their self, Subrahmanyam et al. (2009) speculated that these online narratives might help youths with formulating their sense of self. Although it is clear that youths are taking advantage of digital tools for self-presentation and to construct self-narratives, we do not fully understand how these online negotiations mediate their identity development.

While identity exploration is developmentally appropriate for adolescents, social networking sites have now become very popular with children. Club Penguin, with 22 million accounts, is now owned by Disney (Marsh, 2010). Marsh's (2010) study in the United Kingdom of children between the ages of 5 and 11 who used Club Penguin found that their play on Club Penguin and a second online children's game, Barbie Girls, mirrored offline activities for this age group. However, age-appropriate gaming is prominently featured in social networking sites for this age group. In contrast, the social networking aspect is totally downplayed by participating children. Comparing this pattern to that of adolescents, we see that each is different but equally age appropriate. Caring for virtual pets is another popular activity in Club Penguin and other children's social networking sites. Again, this activity is distinct from what is going on in the social networking of emerging adults, but equally developmentally appropriate. It confirms a theme we have struck for a number of years: that old developmental issues are projected onto new media (Subrahmanyam et al., 2006; Subrahmanyam & Smahel, 2010).

Conclusions

In conclusion, the proliferation of digital media such as computers, interactive games, the Internet, cell phones, and other handheld devices has raised questions about the extent of their use by youth and the impact of such use on their activities and development. Survey studies suggest that youth are spending an increasing number of hours consuming media content through a variety of platforms. Despite the diffusion of digital technologies, there remain differences based on parental education, family income, and racial and ethnic differences in the presence of a home computer and access

to the Internet, playing of video games, overall media consumption, and mobile access to the Internet. Although gender differences in the use of the Internet are mostly narrowed, there remain gaps in computer game playing that could impact access to technology networks.

To understand the role of interactive games and the Internet on development, we considered four potential pathways. The first pathway examined whether time with media displaces other activities such as physical play, sleep, and face-to-face social interaction. Because of the multitasking nature of much media use, it is not possible to know the extent to which such displacement actually occurs. However, research to date suggests that time spent gaming might be related to obesity, sleep difficulties, and adjustment challenges. Of particular concern are those youths who spend excessive amounts of time gaming, to the detriment of their school and family activities. Research regarding the effects of time spent online is similarly complex, and it suggests that other factors play a role, such as user characteristics and the particular activities that youth engage in while spending time online.

The second pathway of influence considers the effects that may stem from the particular symbolic and representational systems utilized by a media form. Research suggests that interactive games may help to change the balance of cognitive skills from the verbal to the visual. From a cognitive perspective, they prepare children and adolescents for the increasingly visual domains of science and technology. Although there is little research on the verbal, spatial, and other representational skills utilized by the Internet, the multitasking that it affords has been shown to have cognitive costs.

The third pathway of influence takes into account the particular thematic content in a media form and its potential effect on development. The content effects of interactive games and online virtual worlds with regard to learning in academic contexts have generally been disappointing, and we need more research to understand whether and how the learning that occurs in informal interactive contexts can transfer to more formal settings. Some online content can be useful, and youth report using online content for school, health information, and entertainment purposes; but the Internet

can also provide easy access to inappropriate and potentially dangerous content, and some youth might be more at risk than others.

The fourth pathway of influence considers the features of online communication environments, such as disembodied and potentially anonymous users. There is no question that youth are taking advantage of the opportunities afforded by digital tools to connect with their peers and to express their identities. They are also forming interest-based communities online. Children have also begun to use social network sites in large numbers; their interests are quite different from those of teens and emerging adults. They confirm the principle that the same developmental issues that manifest offline are projected into young people's online worlds. Nevertheless, we need to know more about whether and how new digital technologies are transforming fundamental developmental processes and what effect they will ultimately have on young people's development.

References

- Aisbett, K., Authority, A. B., & Insights, E. (2001). *The Internet at home: A report on Internet use in the home*. Retrieved January 16, 2009, from <http://www.acma.gov.au/webwr/aba/newspubs/documents/internetathome.pdf>
- Bardone-Cone, A. M., & Cass, K. M. (2006). Investigating the impact of pro-anorexia websites: A pilot study. *European Eating Disorders Review*, 14, 256.
- Bessière, K., Kiesler, S., Kraut, R. E., & Boneva, B. (2008). Effects of Internet use and social resources on changes in depression. *Information Community and Society*, 11, 47–70.
- Boneva, B. S., Quinn, A., Kraut, R. E., Kiesler, S., & Shklovski, I. (2006). Teenage communication in the instant messaging era. In R. E. Kraut, M. Brynin, & S. Kiesler (Eds.), *Computers, phones, and the internet: Domesticating information technology* (pp. 201–218). New York: Oxford University Press.
- Borzekowski, D. L. G., Fobil, J. N., & Asante, K. O. (2006). Online access by adolescents in Accra: Ghanaian teens' use of the Internet for health information. *Developmental Psychology*, 42, 450.
- Bruner, J. S., Olver, R. R., & Greenfield, P. M. (1966). *Studies in cognitive growth*. New York: McGraw-Hill.
- Calvert, S. L., Mahler, B. A., Zehnder, S. M., Jenkins, A., & Lee, M. S. (2003). Gender differences in preadolescent children's online interactions: Symbolic modes of self-presentation and self-expression. *Journal of Applied Developmental Psychology*, 24, 627–644.
- Calvert, S. L., & Wells, J. (2007). *Age and gender effects of multitasking on academic performance*. Paper presented at the Hawaii International Conference on Education, Honolulu, Hawaii.
- Carrier, L. M., Cheever, N. A., Rosen, L. D., Benitez, S., & Chang, J. (2009). Multitasking across generations: Multitasking choices and difficulty ratings in three generations of Americans. *Computers in Human Behavior*, 25, 483–489.
- Chou, C., Condon, L., & Belland, J. C. (2005). A review of the research on Internet addiction. *Educational Psychology Review*, 17, 363–368.
- De Lisi, R., & Wolford, J. (2002). Improving children's mental rotation accuracy with computer game playing. *Journal of Genetic Psychology*, 163, 272–282.
- Dominick, J. R. (1984). Videogames, television violence, and aggression in teenagers. *Journal of Communication*, 34, 136–147.
- Dye, M. W., & Bavelier, D. (2010). Differential development of visual attention skills in school-age children. *Vision Research*, 50, 452–459.
- Dynarski, M., Agodini, R., Heavyside, S., Novak, T., Carey, N., Campuzano, L., et al. (2007). Effectiveness of reading and mathematics software products: Findings from the first student cohort. Retrieved March 5, 2009, from <http://hal.archives-ouvertes.fr/hal-00190019/>
- Egenfeldt-Nielsen, S. (2009). Third generation educational use of computer games. *Learning and Teaching with Electronic Games*, 263–281.
- Eysenbach, G. (2008). Credibility of health information and digital media: New perspectives and implications for youth. In M. J. Metzger & A. J. Flanagan (Eds.), *Digital media, youth, and credibility* (pp. 123–154). Cambridge, MA: MIT Press.
- Fields, D. A., & Kafai, Y. B. (2007). *Stealing from grandma or generating cultural knowledge? Contestations and effects of cheats in a tween virtual world*. Paper presented at the Situated Play, Proceedings of DiGRA 2007 Conference. Retrieved March 4, 2009, from http://www.gseis.ucla.edu/faculty/kafai/paper/whyville_pdfs/DIGRA07_cheat.pdf
- Fleming, M. J., Greentree, S., Cocotti-Muller, D., Elias, K. A., & Morrison, S. (2006). Safety in cyberspace: Adolescents' safety and exposure online. *Youth & Society*, 38, 135–154.
- Flynn, J. R. (1999). Searching for justice: The discovery of IQ gains over time. *American Psychologist*, 54, 5–20.
- Foerde, K., Knowlton, B. J., & Poldrack, R. A. (2006). Modulation of competing memory systems by distraction. *Proceedings of the National Academy of Sciences*, 103, 11778–11783.
- Gerstenfeld, P. B., Grant, D. R., & Chiang, C. P. (2003). Hate online: A content analysis of extremist Internet sites. *Analyses of Social Issues and Public Policy*, 3, 29–44.
- Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature*, 423, 534–537.
- Greenfield, P. M. (1994). Video games as cultural artifacts. *Journal of Applied Developmental Psychology*, 15, 3–12.
- Greenfield, P. M. (1998). The cultural evolution of IQ. In U. Neisser (Ed.), *The rising curve. Long-term gains in IQ and related measures* (pp. 81–123). Washington, DC: American Psychological Association.
- Greenfield, P. M. (2009). Technology and informal education: What is taught, what is learned. *Science*, 323, 69–71.
- Greenfield, P. M., Camaioni, L., Ercolani, P., Weiss, L., Lauber, B. A., & Perucchini, P. (1994). Cognitive socialization by computer games in two cultures: Inductive discovery or mastery of an iconic code? *Journal of Applied Developmental Psychology*, 15, 59–85.
- Greenfield, P. M., DeWinstanley, P., Kilpatrick, H., & Kaye, D. (1994). Action video games and informal education: Effects on strategies for dividing visual attention. *Journal of Applied Developmental Psychology*, 15, 105–123.
- Greenfield, P. M., & Subrahmanyam, K. (2003). Online discourse in a teen chatroom: New codes and new modes of coherence in a visual medium. *Journal of Applied Developmental Psychology*, 24, 713–738.
- Griffiths, M. (2000). Does Internet and computer "addiction" exist? Some case study evidence. *Cyberpsychology & Behavior*, 3, 211–218.
- Gross, E. F. (2004). Adolescent Internet use: What we expect, what teens report. *Journal of Applied Developmental Psychology*, 25, 633–649.
- Gross, E. F., Juvonen, J., & Gable, S. L. (2002). Internet use and well-being in adolescence. *Journal of Social Issues*, 58, 75–90.
- Grüsser, S. M., Thalemann, R., & Griffiths, M. D. (2006). Excessive computer game playing: Evidence for addiction and aggression? *CyberPsychology & Behavior*, 10, 290–292.
- Hargittai, E. (2007). Whose space? Differences among users and non-users of social network sites [Electronic version]. *Journal of Computer-Mediated Communication*, 13, Article 14. Retrieved November 27, 2009, from <http://jcmc.indiana.edu/vol13/issue1/hargittai.html>
- Harris Interactive. (2008). *Teenagers: A generation unplugged*. Retrieved March 1, 2010, from http://files.ctia.org/pdf/HI_TeenMobileStudy_ResearchReport.pdf
- Hembroke, H., & Gay, G. (2003). The laptop and the lecture: The effects of multitasking in learning environments. *Journal of Computing in Higher Education*, 15, 46–64.
- Herring, S. C. (1996). Introduction. In S. C. Herring (Ed.), *Computer-mediated communication: Linguistic, social, and cross-cultural perspectives* (pp. 1–12). Philadelphia, PA: John Benjamins.
- Hinduja, S., & Patchin, J. W. (2008). Cyberbullying: An exploratory analysis of factors related to offending and victimization. *Deviant Behavior*, 29, 129–156.
- Ito, M., & Bittani, M. (2009). Gaming. In M. Ito, S. Baumer, & M. Bittani (Eds.), *Hanging out, messing around, geeking out: Living and learning with new media*. Cambridge, MA: MIT Press.
- Jones, S., & Fox, S. (2009). *Generations online in 2009*. Retrieved February 9, 2009, from <http://pewresearch.org/pubs/1093/generations-online>
- Juvonen, J., & Gross, E. F. (2008). Extending the school grounds? Bullying experiences in cyberspace. *The Journal of School Health*, 78, 496–505.
- Kaare, B. H., Brandtzaeg, P. B., Heim, J., & Endestad, T. (2007). In the borderland between family orientation and peer culture: The use of communication technologies among Norwegian tweens. *New Media & Society*, 9, 603–624.
- Kafai, Y. B. (2006). Playing and making games for learning: Instructionist and constructionist perspectives for game studies. *Games and Culture*, 1, 36–40.
- Kafai, Y. B., Fields, D. A., & Cook, M. S. (2007). *Your second selves: Resources, agency, and constraints in avatar designs and identity play in a tween virtual world*. Paper presented at the Situated Play, Proceedings of Digital Games Research Association 2007 conference, Tokyo, Japan.
- Kafai, Y. B., Franke, M. L., Ching, C. C., & Shih, J. C. (1998). Game design as an interactive learning environment for fostering students' and teachers' mathematical inquiry. *International Journal of Computers for Mathematical Learning*, 3, 149–184.
- Kearney, P. (2005). *Cognitive calisthenics: Do fps computer games enhance the player's cognitive abilities*. Paper presented at the DiGRA 2005 Conference: Worlds in Play, Vancouver, Canada.

- Kendall, L. (2003). Cyberspace. In S. Jones (Ed.), *Encyclopedia of new media* (pp. 112–114). Thousand Oaks, CA: Sage.
- Kiesler, S., Sproull, L., & Eccles, J. S. (1985). Pool halls, chips, and war games: Women in the culture of computing. *Psychology of Women Quarterly*, 9, 451–462.
- Ko, C.-H., Yen, J.-Y., Chen, C.-C., Chen, S.-H., Wu, K., & Yen, C.-F. (2006). Tridimensional personality of adolescents with Internet addiction and substance use experience. *The Canadian Journal of Psychiatry/La Revue Canadienne de Psychiatrie*, 51, 887–894.
- Krackhardt, D. (1994). The strength of strong ties: The importance of philos in organizations. In N. Nohria & R. Eccles (Eds.), *Networks and organizations: Structure, form, and action*, (pp. 216–239). Boston, MA: Harvard Business School Press.
- Kraut, R. E., Kiesler, S., Boneva, B. S., Cummings, J., Helgeson, V., & Crawford, A. (2002). Internet paradox revisited. *Journal of Social Issues*, 58, 49–74.
- Kraut, R. E., Patterson, M., Lundmark, V., Kiesler, S., Mukopadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being? *American Psychologist*, 53, 1017–1031.
- Kubey, R. W., Lavin, M. J., & Barrows, J. R. (2001). Internet use and collegiate academic performance decrements: Early findings. *Journal of Communication*, 51, 366–382.
- Kyngas, H., Mikkonen, R., Nousiainen, E. M., Ryttilähti, M., Seppanen, P., Vaattovaara, R., et al. (2001). Coping with the onset of cancer: Coping strategies and resources of young people with cancer. *European Journal of Cancer Care*, 10, 6–11.
- Lee, E., & Leets, L. (2002). Persuasive storytelling by hate groups online: Examining its effects on adolescents. *American Behavioral Scientist*, 45, 927.
- Lenhart, A., Ling, R., Campbell, S., & Purcell, K. (2010). *Teens and mobile phones*: Pew Internet. Retrieved June 4, 2010, from <http://pewinternet.org/Reports/2010/Teens-and-Mobile-Phones.aspx?r=1>
- Lim, A. F., & Rosen, L. D. (2010, April 23). *The impact of text message interruptions on memory during classroom lectures*. Paper presented at the Western Psychological Association, Cancun, Mexico.
- Linn, S., & Lepper, M. (1987). Correlates of children's usage of video games and computers. *Journal of Applied Social Psychology*, 17, 72–93.
- Livingstone, S., Bober, M., & Helsper, E. (2005). Internet literacy among children and young people: Findings from the UK children go online project. Retrieved January 16, 2009, from <http://eprints.lse.ac.uk/3971/1/UKCGOonlineLiteracy.pdf>
- Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science: A Multidisciplinary Journal*, 5, 333–369.
- Marsh, J. (2010). Young children's play in online virtual worlds. *Journal of Early Childhood Research*, 8, 23–39.
- Maynard, A. E., Subrahmanyam, K., & Greenfield, P. M. (2005). Technology and the development of intelligence: From the loom to the computer. In R. J. Sternberg & D. D. Preiss (Eds.), *Intelligence and technology: The impact of tools on the nature and development of human abilities* (pp. 29–53). Mahwah, NJ: Lawrence Erlbaum.
- Mazalin, D., & Moore, S. (2004). Internet use, identity development and social anxiety among young adults. *Behavior Change*, 21, 90–102.
- McAdams, D. P. (1997). The case for unity in the (post)modern self: A modest proposal. In R. D. Ashmore & L. J. Jussim (Eds.), *Self and identity: Fundamental issues* (pp. 46–78). New York: Oxford University Press.
- Mesch, G. S. (2003). The family and the Internet: The Israeli case. *Social Science Quarterly*, 84, 1039–1050.
- Mesch, G., & Talmud, I. (2006). The quality of online and offline relationships: The role of multiplexity and duration of social relationships. *The Information Society*, 22, 137–148.
- Mitchell, K. J., Wolak, J., & Finkelhor, D. (2007). Trends in youth reports of sexual solicitations, harassment and unwanted exposure to pornography on the internet. *Journal of Adolescent Health*, 40, 116–126.
- Nardi, B., & Harris, J. (2006). *Strangers and friends: Collaborative play in World of Warcraft*. Paper presented at the proceedings of the 2006 20th anniversary conference on Computer Supported Cooperative Work, Alberta, Canada.
- Neulight, N., Kafai, Y. B., Kao, L., Foley, B., & Galas, C. (2007). Children's participation in a virtual epidemic in the science classroom: Making connections to natural infectious diseases. *Journal of Science Education and Technology*, 16, 47–58.
- Nie, N. H., & Hillygus, D. S. (2002). Where does Internet time come from? A reconnaissance. *IT & Society*, 1, 1–20.
- Okagaki, L., & Frensch, P. A. (1994). Effects of video game playing on measures of spatial performance: Gender effects in late adolescence. *Journal of Applied Developmental Psychology*, 15, 33–58.
- Plester, B., Wood, C., & Joshi, P. (2009). Exploring the relationship between children's knowledge of text message abbreviations and school literacy outcomes. *British Journal of Developmental Psychology*, 27, 145–161.
- Reich, S. M., Subrahmanyam, K., & Espinoza, G. E. (2009, April 3). *Adolescents' use of social networking sites—Should we be concerned?* Paper presented at the biennial meeting of the Society for Research on Child Development, Denver, CO.
- Rideout, V. (2001). Generation rx.Com: How young people use the Internet for health information [Electronic version]. Retrieved December 18, 2008, from <http://www.kff.org/entmedia/upload/Toplines.pdf>
- Rideout, V. J., Foehr U. G., & Roberts, D. F. (2010). *Generation M² Media in the lives of 8- to 18-year-olds*: Menlo Park, CA: A Kaiser Family Foundation Study. Retrieved June 5, 2010, from <http://www.kff.org/entmedia/mh012010pkg.cfm>
- Rideout, V. J., Vandewater, E. A., & Wartella, E. A. (2003). Zero to six: Electronic media in the lives of infants, toddlers and preschoolers. Retrieved November 10, 2009, from <http://www.kff.org/entmedia/3378.cfm>
- Roberts, D. F., Foehr, U. G., & Rideout, V. (2005). Generation M: Media in the lives of 8- to 18-year-olds [Electronic version]. Retrieved December 16, 2008, from <http://www.kff.org/entmedia/7251.cfm>
- Roberts, D. F., Foehr, U. G., Rideout, V. J., & Brodie, M. (1999). *Kids and media@the new millennium: A comprehensive national analysis of children's media use*. Menlo Park, CA: Kaiser Family Foundation.
- Rosen, L. D., Chang, J., Erwin, L., Carrier, L. M., & Cheever, N. A. (2010). The relationship between "textisms" and formal and informal writing among young adults. *Communication Research*, 37, 420–440.
- Rosser, J. C., Jr., Lynch, P. J., Cuddihy, L., Gentile, D. A., Klonsky, J., & Merrell, R. (2007). The impact of video games on training surgeons in the 21st century. *Archives of Surgery*, 142, 181.
- Salomon, G. (1979). *Interaction of media, cognition, and learning*. San Francisco, CA: Jossey-Bass.
- Schepis, T. S., Marlowe, D. B., & Forman, R. F. (2008). The availability and portrayal of stimulants over the Internet. *The Journal of Adolescent Health*, 42, 458–465.
- Skinner, H., Biscope, S., Poland, B., & Goldberg, E. (2003). How adolescents use technology for health information: Implications for health professionals from focus group studies. *Journal of Medical Internet Research*, 5:e32. doi: 10.2196/jmir.5.4.e32
- Slater, M. D. (2003). Alienation, aggression, and sensation seeking as predictors of adolescent use of violent film, computer, and website content. *The Journal of Communication*, 53, 105–121.
- Slater, M. D., Henry, K. L., Swaim, R. C., & Anderson, L. L. (2003). Violent media content and aggressiveness in adolescents: A downward spiral model. *Communication Research*, 30, 713–736.
- Smahel, D., & Subrahmanyam, K. (2007). "Any girls want to chat press 911": Partner selection in monitored and unmonitored teen chat rooms. *CyberPsychology & Behavior*, 10, 346–353.
- Stallabrass, J. (1995). Empowering technology: The exploration of cyberspace. *New Left Review*, 1(211), 3–32.
- Stanger, J. D. (1998). *Television in the home 1998: The third annual national survey of parents and children*. Philadelphia: University of Pennsylvania.
- Steen, F. F., Greenfield, P. M., Davies, M. S., & Tynes, B. (2006). What went wrong with *The Sims Online*? Cultural learning and barriers to identification in a massively multiplayer online role-playing game. In P. Vorderer & J. Bryant (Eds.), *Playing computer games—Motives, responses, and consequences* (pp. 307–323). Mahwah, NJ: Erlbaum.
- Steinfeld, C., Ellison, N. B., & Lampe, C. A. C. (2008). Social capital, self-esteem, and use of online social network sites: A longitudinal analysis. *Journal of Applied Developmental Psychology*, 29, 434–445.
- Stettler, N., Singer, T., & Sutter, P. (2004). Electronic games and environmental factors associated with childhood obesity in Switzerland. *Obesity Research*, 12, 896–903.
- Subrahmanyam, K. (2009). Developmental implications of children's virtual worlds. *Washington and Lee Law Review*, 66, 1065–1084.
- Subrahmanyam, K., Garcia, E. C., Harsono, S. L., Li, J., & Lipana, L. (2009). In their words: Connecting online weblogs to developmental processes. *British Journal of Developmental Psychology*, 27, 219–245.
- Subrahmanyam, K., & Greenfield, P. M. (1994). Effect of video game practice on spatial skills in girls and boys. *Journal of Applied Developmental Psychology*, 15, 13–32.
- Subrahmanyam, K., & Greenfield, P. M. (1998). Computer games for girls: What makes them play? In J. Cassell & H. Jenkins (Eds.), *From Barbie to Mortal Kombat: Gender and computer games* (pp. 46–71). Cambridge, MA: MIT Press.
- Subrahmanyam, K., & Greenfield, P. M. (2008a). Communicating online: Adolescent relationships and the media. *The Future of Children*, 18, 119–146.

- Subrahmanyam, K., & Greenfield, P. M. (2008b). Media symbol systems and cognitive processes. In S. Calvert & B. Wilson (Eds.), *The Blackwell handbook of children, media, and development*. (pp. 166–187). England, UK: Blackwell Publishing.
- Subrahmanyam, K., Greenfield, P. M., & Tynes, B. M. (2004). Constructing sexuality and identity in an online teen chat room. *Journal of Applied Developmental Psychology: An International Lifespan Journal*, 25, 651–666.
- Subrahmanyam, K., Kraut, R., Greenfield, P., & Gross, E. (2001). New forms of electronic media: The impact of interactive games and the Internet on cognition, socialization, and behavior. In D. Singer & J. Singer (Eds.), *Handbook of children and the media* (pp. 73–99). Thousand Oaks, CA: Sage.
- Subrahmanyam, K., & Lin, G. (2007). Adolescents on the net: Internet use and well-being. *Adolescence*, 42, 659–677.
- Subrahmanyam, K., Reich, S. M., Waechter, N., & Espinoza, G. (2008). Online and offline social networks: Use of social networking sites by emerging adults. *Journal of Applied Developmental Psychology*, 29, 420–433.
- Subrahmanyam, K., & Smahel, D. (2010). *Digital youth: The role of media in development*. New York: Springer.
- Subrahmanyam, K., Smahel, D., & Greenfield, P. M. (2006). Connecting developmental constructions to the Internet: Identity presentation and sexual exploration in online teen chat rooms. *Developmental Psychology*, 42, 395–406.
- Suzuki, L. K., & Beale, I. L. (2006). Personal web home pages of adolescents with cancer: Self-presentation, information dissemination, and interpersonal connection. *Journal of Pediatric Oncology Nursing*, 23, 152–161.
- Suzuki, L. K., & Calzo, J. P. (2004). The search for peer advice in cyberspace: An examination of online teen bulletin boards about health and sexuality. *Journal of Applied Developmental Psychology*, 25, 685–698.
- Tikhomirov, O. K. (1974). Man and computer: The impact of psychological processes on the development of psychological processes. In D. E. Olson (Ed.), *Media and symbols: The forms of expression, communication, and education* (pp. 357–382). Chicago: University of Chicago Press.
- Tizard, B., Phillips, J., & Plewis, I. (2006). Play in pre-school centres: Play measures and their relation to age, sex, and IQ. *Journal of Child Psychology and Psychiatry*, 17, 251–264.
- Tsai, C.-C., & Lin, S. S. J. (2003). Internet addiction of adolescents in Taiwan: An interview study. *Cyberpsychology & Behavior*, 6, 649–652.
- Turkle, S. (1997). *Life on the screen: Identity in the age of the Internet*. New York: Simon & Schuster.
- Turow, J., & Nir, L. (2000). *The Internet and the family 2000: The view from parents, the view from kids*. Annenberg Public Policy Center of the University of Pennsylvania. ERIC Document Reproduction Service No. ED448874.
- Tynes, B. M. (2005). Children, adolescents and the culture of online hate. In N. E. Dowd, D. E. Singer, & R. F. Wilson (Eds.), *Handbook of children, culture, and violence* (pp. 267–289). Thousand Oaks, CA: Sage.
- Valkenburg, P. M., & Peter, J. (2007). Preadolescents' and adolescents' online communication and their closeness to friends. *Developmental Psychology*, 43, 267–277.
- Valkenburg, P. M., Peter, J., & Schouten, A. P. (2006). Friend networking sites and their relationship to adolescents' well-being and social self-esteem. *CyberPsychology & Behavior*, 9, 584–590.
- Van den Bulck, J. (2004). Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. *Sleep*, 27, 101–104.
- Vandewater, E. A., Shim, M., & Caplovitz, A. G. (2004). Linking obesity and activity level with children's television and video game use. *Journal of Adolescence*, 27, 71–85.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Whitlock, J. L., Powers, J. L., & Eckenrode, J. (2006). The virtual cutting edge: The Internet and adolescent-self-injury. *Developmental Psychology*, 42, 407.
- Wilson, J. L., Peebles, R., Hardy, K. K., & Litt, I. F. (2006). Surfing for thinness: A pilot study of pro-eating disorder web site usage in adolescents with eating disorders. *Pediatrics*, 118, e1635.
- Winzelberg, A. (1997). The analysis of an electronic support group for individuals with eating disorders. *Computers in Human Behavior*, 13, 393–407.
- Wolak, J., Mitchell, K. J., & Finkelhor, D. (2002). Close online relationships in a national sample of adolescents. *Adolescence*, 37, 441–456.
- Wu, W. (2010, May 6). Avatars go to school, letting students get a feel for the work world. *The New York Times*. Retrieved May 6, 2010, from <http://www.nytimes.com/2010/05/07/nyregion/07avatar.html>
- Young, K. S. (1998). *Caught in the net*. New York: John Wiley & Sons.

CHAPTER 5

Social Networking, Social Gaming, Texting

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Social media are dominating forces in the lives of teenagers nowadays. They spend an average of more than 7.5 hours a day and seven days a week on social media—more time than in any other activity besides (maybe) sleeping, according to the 2010 survey study by the Kaiser Family Foundation on the media consumption of American teenagers from 8- to 18-years-old (Rideout, Foehr, & Roberts, 2010). While not all media consumption is related to social media, it is not exaggeration that social media occupy a sizable portion of teenagers' media consumption. In fact, the same study showed that 7th to 12th graders spend an average of 1 hour and 30 minutes per day on just one media activity: text messaging (Rideout et al., 2010, p.3).

Against the backdrop of teenagers' avid social media consumption, parents, educators, and the general public have been trying to understand and debate about the phenomenon of social media mania among teenagers. By putting this phenomenon into a global perspective, this chapter seeks to understand the similarities and differences of teenagers

around the world, in terms of their social media consumption, the motivations behind their embracement of social media, and the potential effects facing them. A global view of teenagers' social media activities might facilitate parents, educators, and policy makers to make reasonable judgment about and constructive responses to teenagers' engagement with social media. More important, it will help us as a society to consider how to integrate digital media into current curricula and to transform learning experiences, so that the young generation will be better prepared for a world that is ever-changing.

What Are Social Media?

As the case with all new phenomena, it is almost impossible to define social media because they are evolving constantly and rapidly. Scholars, the social media industry, and social media enthusiasts provide various definitions of social media. An example of