9 Communication Technologies and Social Transformation: Their Impact on Human Development

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This chapter focuses on the developmental effects of communication technologies and their social transformations over human history – from print literacy to the Internet and smart phones. I use both diachronic (longitudinal) and synchronic (cross-sectional) comparison to shed light on historical shifts in both our own culture and across cultures. Because I have found no evidence that basic media effects are country or ethnicity specific, evidence from multiple countries provides a single unified portrait of how the historical march of media has affected values, learning environments, and individual development. Indeed, the cross-cultural evidence suggests that this is indeed a portrait of globalized social change and its implications for human development around the world. Nonetheless, I provide an example of how the global culture engendered by new communications technologies is expressed in a culture-specific way (Boz, Uhls, & Greenfield, 2016).

One major global trend is developmental: "Youth (ages 15–24) is the most connected age group. Worldwide, 71% are online compared with 48% of the total population. Children and adolescents under 18 account for an estimated one in three Internet users around the world. A growing body of evidence indicates that children are accessing the Internet at increasingly younger ages. In some countries, children under 15 are as likely to access the Internet as adults over 25" (UNICEF, 2017, p. 3). In the US in 2017, 42 percent of children between 0 and 8 had their own tablets, up from less than 1 percent in 2011 (Common Sense Media, 2017). While total screen time for US children zero to eight has not changed from 2011, there has been a major shift in the device used to access screens. In 2011, only 4 percent of screen time was used on mobile devices (tablets, smartphones); by 2017, the proportion of time had risen to 35 percent. Every other platform, including the TV, had lost time share.

Using a theory of social change, culture, and human development as a framework (Greenfield, 2009a, 2016), I explore developmental implications – social, cognitive, and neural – of the march of media through historical time and across geographical space. I draw on studies

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employing a variety of methods – content analysis, focus group, survey, field, lab, and fMRI experiments. While before–after comparisons are valuable but rare, there-are a number of other research designs that allow us to infer effects of the historical introduction and expansion of a particular communication technology.

Theory of Social Change, Culture, and Human Development

This theory of social change, culture, and human development is interdisciplinary, integrating concepts from sociology, anthropology, and psychology. It is also multilevel, positing causal relations among the levels (Greenfield, 2009a, 2015, 2018a). It incorporates sociodemographic variables at the top of the causal chain (with nineteenth-century roots in the German sociologist Tönnies, 1887/1957), cultural values at the next level down, and more traditional variables from developmental psychology at the next two levels – learning environment and individual development (Figure 9.1).

"Community" and "Society" summarize the features that anchor each end of the sociodemographic dimension (top level of Figure 9.1). "Community" denotes a small-scale social entity with social relations based on close personal and lifelong ties – e.g., a rural village, whereas "society" denotes a large-scale social entity with many relationships impersonal and transitory – e.g., an urban city. Each term, Community and Society, summarizes a complex of sociodemographic elements. These features of Community and Society provide anchors or endpoints for specific dimensions, listed on the sociodemographic level (top rectangle of Figure 9.1). All of the dimensions in the sociodemographic rectangle of Figure 9.1, including communication technologies, tend to covary and shift together (Greenfield, 2018a).

The top horizontal arrow in Figure 9.1 denotes the dominant direction of globalized social change – from Community to Society along multiple dimensions exemplified in the top rectangle. The focus in this chapter is on isolating effects of the shift from in-person communication to ever greater reliance on technologically mediated communication (top line of top rectangle, Figure 9.1, Communication Technologies). Relationships for which there is empirical evidence, described in the chapter, have been selected for inclusion. While the horizontal arrows represent the dominant direction of social change in the world, sociodemographic change can go in the opposite direction. In that case, all the horizontal arrows would be reversed.

We can think of Community features as being close to the environment in which human beings evolved. However, we have almost no "pure" communities left in the world. Most actual environments are somewhere in between the extreme endpoints on the various dimensions. The horizontal change arrows (Figure 9.1) therefore denote a direction of movement, not absolute locations on various scales.

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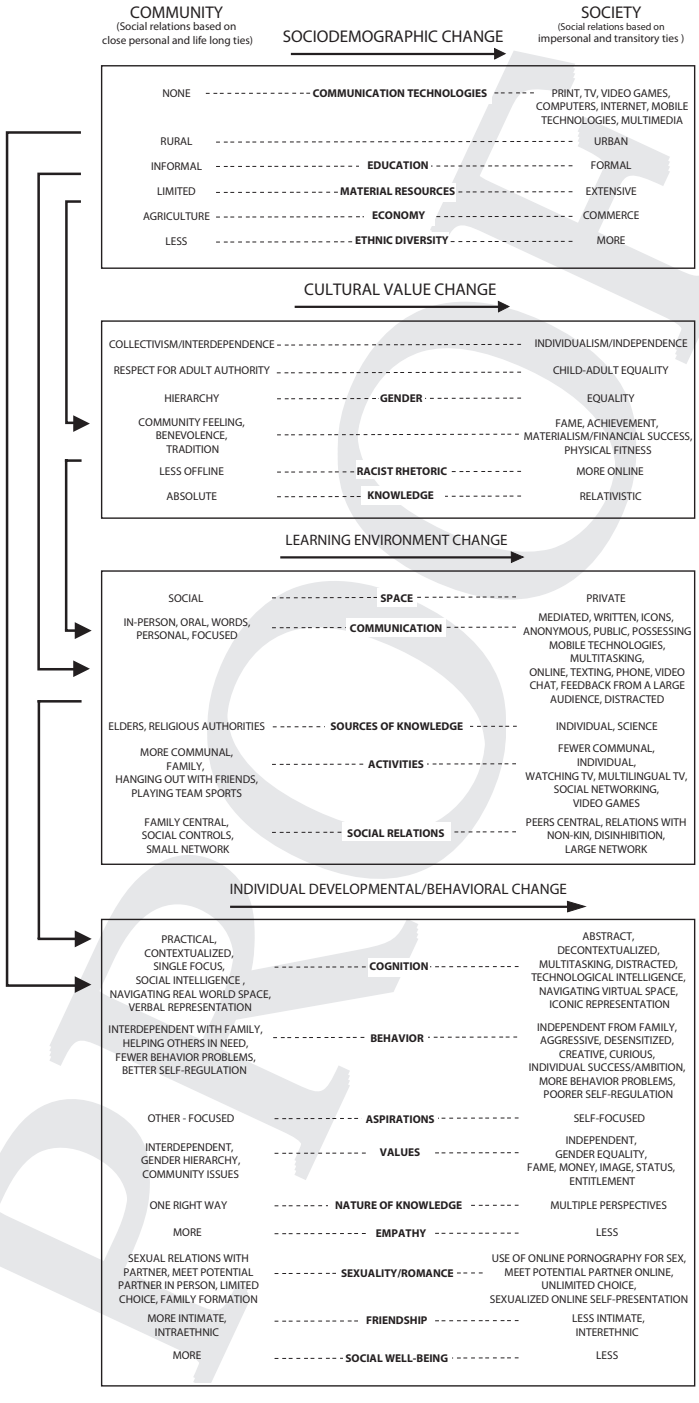

Figure 9.1 Model of social change, cultural evolution, and human development.

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Most important, the sociodemographic level (top rectangle, Figure 9.1) is at the top of the causal chain, influencing each lower level (vertical arrows from Sociodemographic level to Cultural Values, Learning Environment, and Behavioral Development (lower three rectangles, Figure 9.1). Each lower level is influenced by and adapted to the ones above it (see the vertical arrows from the Sociodemographic level to the Cultural Value level, from the Cultural Value level to the Learning Environment (which includes socialization), and from the Learning Environment to Individual Development and Behavior).

So when there is a shift on the top, Sociodemographic level from "Community" features in the direction of "Society" features, then there are correlated shifts on the lower levels of Cultural Values, Learning Environment, and Individual Development in the same direction; these shifts are denoted by the horizontal arrows in Figure 9.1. Each shift on a lower level is a theoretically driven prediction. Driven by sociodemographic change, these correlated changes on multiple levels constitute the heart of the theory of social change, culture, and human development. The remaining sections of this chapter provide empirical evidence for the predicted changes on the various levels triggered by changes in Communication Technologies (seen at the top of the Sociodemographic rectangle, Figure 9.1). Note that all the shifts that are diagrammed did not take place simultaneously. A sense of chronological order is given by the ordering in this chapter.

In summary, this chapter explores the cultural, socialization, and developmental implications of the long-term, globalized shift that has taken place from direct, in-person communication, the communication environment in which human beings evolved, to increasing amounts and complexity of technologically mediated communication. Figure 9.1 is a guide to the chapter that follows; it lists the particular shifts on the levels of Cultural Values, Learning Environment, and Individual Development (bottom three rectangles of Figure 9.1) brought about by the development of mediated communication in concert with the global rise of cities, commerce, formal education, wealth, and ethnic diversity (right side of top rectangle in Figure 9.1). On the level of cultural values, these global shifts have taken the world from greater collectivism to greater individualism (top line of Cultural Value Change rectangle in Figure 9.1) (Santos, Varnum, & Grossmann, 2017). Findings are placed on the Cultural level if they relate to cultural products or the group as a whole (rather than to specific individuals).

Both Sociodemographic shifts (top rectangle in Figure 9.1) and shifts in Cultural Values (second rectangle down, Figure 9.1) produce shifts in the Learning Environments of children and adolescents (third rectangle down, Figure 9.1). Socialization is taken to be part and parcel of the Learning Environment. Three important aspects of the Learning Environment are Social Relations, Activities, and modes of Communication.

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Developmental change – the bottom of the causal chains depicted in Figure 9.1, is most directly influenced by sociodemographic shifts and shifts in the learning environment. Findings are placed on the Developmental level if they relate to understanding individual differences within a group or groups. The discussion of behavioral changes brought about by using mediated communication will, in most cases, focus on developmental populations – children, teens, and emerging adults. These changes are shown in the bottom rectangle of Figure 9.1. Although they are not included in the diagram, I will also discuss neural underpinnings of behavioral changes where known.

One tenet of the theory is that whatever sociodemographic factor or factors is/are changing most rapidly at a given time or place will be the major factor driving cultural and psychological change at that time or place. In the United States and many other parts of the world, digital communication technologies are currently changing more rapidly than any other aspect of the ecology, so my theory of social change and human development would predict that they would be the largest sociodemographic force shifting cultural values, learning environments, and human development. The shifts on all levels depicted in Figure 9.1 furnish a guide for this chapter, as I discuss each communication technology in historical order.

However, I begin with an overview of the sociodemographic level and the place of communication technologies in globalized social change. New technologies are part of a global sociodemographic cluster that has been moving over time away from social relations based on close personal and lifelong ties (Community) towards social relations based on more impersonal and transitory ties (Society). As the world has become wealthier, more urban, and more educated, advanced communication technologies have also become more widespread; they are a key part of the complex of variables at the top right side of Figure 9.1. At the same time, global disparities in wealth, education, and urbanization, both within and between countries, are associated with corresponding disparities in household Internet, mobile phone subscriptions, and broadband subscriptions (International Telecommunications Union, 2015, 2016, 2017; Pew Research Center; UNICEF 2017). While moving historically in a common direction, the sociodemographic factors defining Community (left side of top rectangle, Figure 9.1) cluster together and the sociodemographic factors defining Society (right side of top rectangle, Figure 9.1) cluster together, differentiating technology use both between and within countries. These patterns of intercorrelation and differentiation are all posited by the theory of social change, culture, and human development (Greenfield, 2009a, 2015, 2018a).

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In the last 20 years, the major development in communication technologies lies in mobile cellular telephone subscriptions. In 1998, about 6 percent of the world's population had mobile cellular telephone subscriptions; by 2015, it was 96.8 percent (International Telecommunications Union, 2015). Accordingly, mobile technologies will receive extensive attention in this chapter.

Nonetheless, as each communication technology bursts upon the world stage, it functions (albeit more slowly) as a major social change, moving human development in the same direction as current technologies, which have then taken the trends much farther in the same direction. This is the rationale for creating one diagram (Figure 9.1) to summarize effects produced by communication technologies that developed at different chronological periods. Each major communication technology appears in this chapter in chronological order; I therefore begin with print and print literacy.

Print

Effect on Cultural Values and Learning Environment

Although the printing press was invented in the fifteenth century, we can still see the effects of print through various research designs carried out in the twentieth and twenty-first centuries. In Nigeria, Mallory Wober (1975/2014) discovered a social effect of introducing print literacy into a formerly oral environment. He found that acquiring literacy led to an increase in the individualistic value of privacy. In the 1960s, when literacy and schooling were just starting to expand in Nigeria, workers chose to live in a suburban housing development with yards in a quiet residential development (in preference to living in a crowded, noisy, sociable urban environment with lots of street life) in order to *be alone in peace and quiet* to read! So literacy not only increased the value of privacy, it was also the first (but not the last!) communication technology to modify the Learning Environment by reducing in-person interaction. These shifts in learning environment are diagrammed in Figure 9.1 as shifts from social space to private space and from in-person, oral communication to mediated, written communication (top of Learning Environment rectangle).

Effects on Cognitive Development: Decontextualized Thought

For the effects of literacy on cognitive development, I consider the case of Russia. As Russia developed formal education in rural areas after the Revolution of 1917, the learning environments of peasant farmers came to include literacy and schooling. The Russian Revolution ushered in social

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transformation – such as school-based literacy – in rural areas. Luria (1976) compared the cognitive strategies of farmers from remote villages without any school experience with participants having one to two years of school experience – and therefore basic literacy skills. Farmers with no schooling addressed his cognitive problems as concrete practical situations. After a few years of schooling with basic literacy skills, they took a more abstract cognitive approach, separating their thought processes from the practical situation. Again, this comparison was a cross-sectional model of what happened historically when print literacy and elementary schooling for children were introduced into an oral culture.

Here is a qualitative example of Luria's findings. Participants were shown drawings of a hammer, saw, log, and hatchet. They were asked, "Which ones are alike?" Rakmat was 39 years old and illiterate. He groups items by their use in a practical context (Luria, 1976, p. 56):

RAKMAT: "They're all alike. I think all of them have to be here …"
LURIA: "But one fellow picked three things – the hammer, saw, and hatchet – and said they were alike … Why do you think he picked these three things and not the log?"
RAKMAT: "Probably he's got a lot of firewood, but if we'll be left without firewood, we won't be able to do anything."

Thus, Rakmat constructs a practical situation in which all the items are necessary.

Contrast his response with that of Yadgar, who has had two years of school experience and has acquired basic literacy skills. He is shown drawings of a glass, saucepan, spectacles, bottle and is asked "Which ones are alike?" He answers: "The glass, spectacles, and bottle all fit together. They're made of glass, but the saucepan is metal." He immediately makes a category – material – that is removed from the practical context of use.

Quantitative analysis showed that Rakmat was typical of the group with no school or literacy experience, whereas Yadgar was typical of the group with one to two years of school and print literacy experience. In sum, learning environments that introduce literacy into a formerly illiterate environment (historical change) lead to a shift from practical, contextualized cognition to abstract, decontextualized cognition (diagrammed at the top of Developmental Change rectangle, Figure 9.1).

Literacy Development and the Brain

What neural changes underlie the development of print literacy? Comparing literate and illiterate adults in Brazil and Portugal, DeHaene and colleagues (2010) found that reading recruits speech areas of the

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brain – particularly for those who learned to read as children rather than as adults. Hence, we see a cost of learning to read to those neural circuits subserving oral communication. And potentially a cost to oral communication itself – in favor of print, a more abstract medium. Print is more abstract than oral communication because a spoken word refers to something in the real world; in contrast, a written word refers to a spoken word, which refers to something in the real world (Vygotsky, 1962). Hence, the written word is intrinsically more abstract than the spoken word – because it is farther removed from its referent in the real world. In essence, the brain is becoming more specialized for abstraction.

These findings on the neural differences between literate and illiterate individuals can serve as a proxy for what occurred historically when print literacy and schooling were introduced into cultures that had been exclusively oral in their communication. This cross-sectional research suggests a historical sequence: that the first medium, print, had neural costs in terms of the substrate used for oral communication; speaking and listening are key skills in a world in which all communication is in person and mediated communication does not exist (top left-hand line of Sociodemographic rectangle, Figure 9.1).

However, the place of print has been reduced in the total media landscape: reading for pleasure is currently in a decline. For example, from the mid 1970s to 2014, the number of twelfth graders and college freshmen in the US who did not read any books for pleasure in the prior year increased; and from 1991, the percentage of 8th and 10th graders who read magazines once a week or more plummeted from about 65 percent to about 10 percent in 2015 (Twenge, 2017). To a great extent, reading was initially replaced by our next medium, television.

Television

A unique field experiment compared what happened to children and to the community before and two years after television was introduced into a Canadian town that still did not have TV reception in 1973 (called Notel). Williams (1986) compared Notel with one town that had a single TV channel (Unitel) and a third town (Multitel) that had multiple channels. All three towns were assessed at both points in time.

Communal and Family Life

TV had the effect of reducing communal activities:

> Both adolescents and adults in a town without television participated in more of their community's organized activities than did residents of towns with television;

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however, their participation fell dramatically during the two years following TV's arrival. This was especially true of sports, but television also apparently affected attendance at community dances/suppers/parties, especially for youths, and attendance at meetings of clubs and other organizations, especially for adults. (Williams 1985, p. 272)

This reduction in communal activity as a result of a new communications technology is depicted on the first line of Activities in the Learning Environment rectangle, Figure 9.1.

Although television splintered the *community* of Notel, Livingstone (2009) sees television's initial stages as bringing a smaller collective unit, the *family*, together. However, this is a short-lived phenomenon that was very much at the mercy of larger sociodemographic and cultural trends:

For a time the arrival of television signaled a temporary but significant grouping of the family around the living room set … However, historical evidence reveals that this only briefly bucks the longer-term trend toward the multiplication and diversification of media that has facilitated …"living together separately" or, more abstractly, the processes of individualization, consumerism and globalization that characterize Western societies in late modernity. (Flichy, 2002; Livingstone, 2009, p. 153)

This second shift from family activity to individual activity is shown on the second line of Activities in the Learning Environment rectangle, Figure 9.1. Both changes are part of a trend toward individualization (top line of Cultural Value Change rectangle) as the social environment shifts away from the features of a community environment (Sociodemographic Change, top of Figure 9.1).

Children's Independence

In an examination of the relationship between children's independence and media exposure, Bailyn (1959) documented media in the life of fifth and sixth grade children in the United States in the 1950s. In support of the hypothesis that high exposure should be related to greater independence from family Bailyn, using visual media (television, movies, comic books) as an exposure index, found greater independence with more visual media exposure (top line of Behavior variables, Individual Developmental Change rectangle, Figure 9.1), but only for boys. Perhaps in the 1950s and at age 10 or 11, independence was not a possibility for girls (Ortner, 2003).

The cultural value of independence leads to the separation of self from the nuclear family and increased contacts with unknown others. Meyrowitz (1985) noted that this phenomenon of relating to strangers began with television where programming brought you into the homes

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and lives of people you would not otherwise know. Meyrowitz notes that television, by showing the adult lives of authority figures, such as parents, displaying behavior that is usually hidden from children in real life, has contributed to the decline of authority relations and rise of child–adult equality. Extended behind-the-scenes views of family life in reality television programming continue this trend. This cultural decline over time in respect for parental authority and rise in adult–child equality (diagrammed on the second line of the Cultural Value Change rectangle of Figure 9.1) is confirmed by the lived experience of today's grandparents in China and the United States (Huang, Greenfield, Zhou, & Wu, in preparation; Zhou, Yiu, Wu, & Greenfield, 2017).

Televised Violence, Aggression, and Desensitization

Returning to the study of Notel, we note that both verbal and physical aggression, as observed in the schoolyard, greatly increased in the community in the two years after television was introduced (Williams, 1986). Levels of aggression in Unitel and Multitel did not change over the same two-year period. However, rather inexplicably, Notel's overall level of physical and verbal aggression did not differ significantly from the other two towns at the time of the pretests, when Notel did not yet have television reception. Perhaps social controls were already in place in Unitel and Multitel in response to the communities' long-term experience with television. Another possible reason was that, in the longitudinal analysis, amount of time spent watching TV was not taken into account. Indeed, when self-reports of time spent watching TV were integrated into the data analysis, the role of TV was implicated: Aggregating data from all three towns two years after Notel had received television reception, the number of hours of TV watching was a significant predictor of physical aggression on the playground. In interpreting this result, we must keep in mind that violence was part of the TV offerings in all three towns.

The Notel experience reinforces the US Surgeon General's 1972 report that violent television stimulates aggressive behavior. Studies relating violent television to aggressive behavior have used short-term lab experiments, short-term field experiments, cross-sectional field studies, and longitudinal field studies. All research designs show the same findings: televised violence increases aggression (Bushman & Huesman, 2001).

One of the most alarming mechanisms in the TV-aggression connection is desensitization, whereby repeated exposure to televised or filmed

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violence "makes children more tolerant of aggression in other children and less emotionally responsive to violence themselves" (Drabman & Thomas, 1974; Greenfield, 1984, 2014, pp. 50–51). One eleven-year-old interviewed by *Newsweek* said, "You see so much violence that it is meaningless. If I saw someone really getting killed, it wouldn't be a big deal. I guess I am turning into a hard rock" (Greenfield, 1984/2014, p. 51).

In a sense, society's acceptance of media violence indicates that desensitization has taken place across at least two generations since the 1970s. Because TV violence is often glamourized, sanitized, and trivialized (Bushman & Huesmann, 2001), it lacks the inhibiting qualities of in-person violence, which is terrifying, as bystander reactions to any of the recent mass shootings clearly indicate. Consequently, the transfer of social relations from the physical world to the virtual world opens the door to increased aggression in the real world. Technology's role in augmenting aggression and desensitizing viewers to violence is diagrammed on the second line, right-hand side of the Behavior cluster in the Individual Development rectangle, Figure 9.1.

Developing Prosocial Behavior and Reflection

But content and style can make a difference, even within the medium. For example, on public television in the United States, the Mr. Rogers program consistently modeled and talked about prosocial behavior. After watching Mr. Rogers once a day for ten days, preschool children improved in cooperating with adults more than with Sesame Street (which actually produced a decline) or a control group who watched nature and animal films (Tower, Singer, & Singer, 1979). However, cooperation with parents is probably not valued in society as much today as it was then: Our research indicates a significant decrease in cooperating with parents by obeying them (Huang, Greenfield, Wu, & Zhou, in preparation) from the generation who watched Mr. Rogers as young children (in our study, born between 1970 and 1990) to today's generation of children (in our study, born in the 2010s, a decade after the end of Mr. Rogers). Indeed, cooperation defined as a part of intelligence is found in small-scale agricultural communities in which social relations are based on personal ties (Serpell, 1984); it declines in importance as a society moves toward a more urban commercial ecology (Garcia, Rivera, & Greenfield, 2015).

Rates of diagnosed attention deficit/hyperactivity disorder (ADHD) quadrupled from 1989 to 2000 (Mandell, Thompson, Weintraub,

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DeStefano, & Blank, 2005). At least some of this increase in impulsivity can be attributed to children's television viewing. Gadberry (1980) showed that restricting first grade children's TV for six weeks led to a more reflective cognitive style, while also leading to half as much viewing of commercial programs and one-sixth as much viewing of violent programs, compared with a matched group who had unrestricted viewing.

Indeed, on Public Television Mr. Rogers made young children more reflective: With his slow pace and reflective style, watching his program produced an increase in task persistence in play activities in kindergarten children (Friedrich & Stein, 1973). But Mr. Rogers' slow pace, his prosocial behavior, and teaching respect for adults were going against the grain of culture change even then. And this countercultural trend has not been maintained by any other children's show. Because slow-paced and prosocial television have been an exception to larger social and cultural trends, their influence has not been diagrammed in Figure 9.1.

So far, all of the media have been passively consumed by their users. But what happens when they become interactive? In general, we would expect effects to be stronger, and that is exactly what we find with video games.

Videogames

Links to Aggression and Prosocial Behavior

I begin in the 1990s with the connection between video game violence and aggressive behavior. Calvert and Tan's 1994 experiment showed that playing a violent electronic game enhanced physiological arousal and aggressive thoughts to a greater extent than simply watching the game. So, while myriad studies have linked TV violence and aggressive or violent behavior, we should not be surprised that enacting virtual violence in a game has stronger effects on motivation and behavior than simply watching it on a screen.

Anderson and Dill (2001) explored the connection between playing violent video games and aggressive or violent behaviors in both the lab and real life. First, real life: College students who reported frequently hitting (or threatening to hit) other students or attacking others with the idea of seriously hurting or killing them in the last year were often the same ones who enjoyed violent video games and played them most often. In the lab: Undergraduates pummeled their video game opponents with longer blasts of noise after playing a violent video game, compared with

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when they played a non-violent game. The effect was stronger for students who had been identified as having more aggressive personalities.

How generalizable are these effects? In 2010, Anderson and a group of international collaborators published a meta-analysis based on 136 studies around the world; they explored effects of violent video game play in the United States, Germany, Japan, and China. In all of the countries, playing violent video games increases the risk of aggressive behavior, aggressive thoughts, and aggressive feelings. Their meta-analysis also showed that violent video game play reduces the occurrence of both empathy and prosocial behavior, two reactions that could potentially curb violent behavior. This meta-analysis not only was the largest to date; it also was the first international comparison; and the researchers found no difference in video game effects on aggression, empathy, or prosocial behavior between Eastern and Western countries.

Obsessive video game playing (e.g., eight to 15 hours a day) has been linked to two mass shootings in the US, one in Columbine, Colorado and one in Parkland, Florida (Greenfield, 2018b; Greenfield & Juvonen, 1999). The question then arises: Why are violent video games popular all over the world, but mass shootings occur only in the US? The answer is that video games can provide an opportunity to practice and learn how to carry out mass murder (e.g., *Call of Duty*, the most popular game in the United States). But a potential shooter still needs the tools. The United States is unique in making those tools available: We are one of the very few countries in the world in which AR-15s and other semi-automatic and automatic assault weapons are readily available to consumers. So it is not violent video games alone, but the combination of video games with the availability in real life of the weapons used in the games that magnifies the risk (Greenfield, 2018b). Add in a lack of empathy, a trait that has been in decline over past decades in the United States (Konrath, O'Brien, & Hsing, 2011), and desensitization; and you have a recipe for occasional mass violence when these factors all come together.

On the other hand, prosocial video games promote prosocial behavior and prosocial behavior leads to playing prosocial games; these conclusions are solidly based on a correlational study of middle schoolers in Singapore, two longitudinal samples of Japanese children and adolescents, and an experimental study of US undergraduates (Gentile et al., 2009). However, around the globe, prosocial games are not nearly as popular as violent games: Although different games were at the top of the popularity list in different countries, ten of the 11 most popular video games around the world in 2017 were violent (Dilley, 2017). Clearly video games reflect and engender a global culture of violent behavior.

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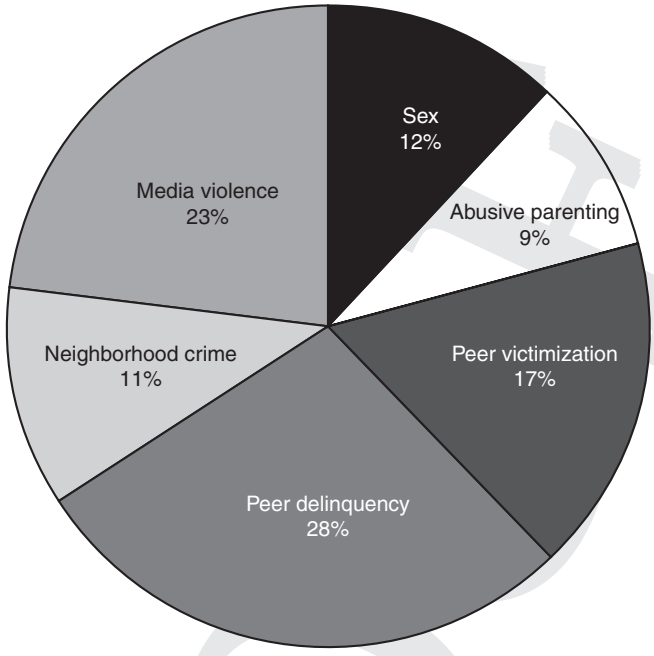

Figure 9.2 Percentage of variance in aggressive behavior accounted for by six predictors
Source: From Anderson et al. (2017). Reprinted with permission of author and Sage Publications

Multimedia Violence

But video game violence is just part of the contemporary picture. Video games simply add to the cumulative picture of media violence that includes television and film violence. Anderson and international colleagues (2017) included these three sources in a cross-cultural survey study of media violence, as well as other risk factors for aggression in seven nations: Australia, China, Croatia, Germany, Japan, Romania, and the United States. Figure 9.2 shows all risk factors and reveals the important role of media violence in the total causal picture. In the Developmental Change rectangle of Figure 9.1 (Behavior and Empathy lines), the influence of technology in reducing empathy and increasing desensitization and aggression are diagrammed.

Links to Cognitive Skills

In a community environment, not far removed from the environment in which human beings evolved, children learn about the physical

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world by observing, using, and creating real objects: helping adults to create clothing, shelter, and cultivating or hunting food. They learn about space by navigating in real outdoor space. In the shift to more urban, technological environments, more complex skills with the physical world, such as many types of engineering, are valued. Growing up in such environments, children are socialized to gain experience with many physical skills, from tying shoelaces to crafts to building with construction toys, a set of skills that has been termed "technological intelligence" (Mundy-Castle, 1974). What happens to technological intelligence when one learns about the physical world by observing, using, and creating virtual objects? What happens to spatial intelligence when one learns about space by mentally navigating and representing virtual space on a screen?

While television, with its necessity to coordinate different views of the same space, enhances children's ability to mentally construct space from a two-dimensional display (Salomon, 1994), more complex mental mapping is required and developed through video game play (Greenfield, 1993). And these skills in virtual space enhance technological intelligence applied to the real world. For example, video game players are well prepared for certain medical specialties such as laparoscopy (diagnosis or surgery performed in the abdomen or pelvis with the aid of a camera). Action video game skill and expertise predicted skill in laparoscopic tasks; in contrast, neither laparoscopic experience in the operating room nor years of surgical training predicted laparoscopic skill (Rosser et al., 2007). Hence, as shown on the Cognition line of the Developmental Change rectangle, Figure 9.1, the shift from navigating real space to navigating virtual space is enhanced by interaction with technology, particularly video games (right side of the Activities line, Learning Environment rectangle, Figure 9.1).

Another important visual skill in virtual space is reading icons. Icons and iconic representation are omnipresent throughout the virtual world, starting with the Macintosh interface (see the top, right side of the Communication line in the Learning Environment rectangle, Figure 9.1). A cross-cultural study (Los Angeles and Rome) of cognitive effects of video games demonstrated that college students' written representations of an electronic circuit simulation used more icons (and fewer words) after playing a computer-based version of the memory game, Concentration, compared with a more traditional physical version of Concentration (Greenfield, Camaioni, Ercolani, Weiss, Lauber, & Perucchini, 1994). The results linked iconic representation to technological intelligence: representing the circuits by drawing icons (rather than writing words) was positively correlated with better understanding of the simulated circuits.

At the time of that experiment, experience with computers was much less diffused in Italy than in the United States. In Rome, students used written words more frequently than they drew icons to represent their understanding of the electronic circuits. In contrast, students in Los Angeles drew icons more often than they wrote words to represent their understanding of the circuitry. The Roman sample also showed less understanding of the circuitry after watching the simulation than did the Los Angeles sample. Hence, iconic representation and the ability to process scientific/technological information on a screen can be seen as two components of advancing technological intelligence (shown on the right side of the Cognition line in the Developmental Change box). Video games are an important Communication Technology (right side, Sociodemographic Change rectangle), one that enhances the learning environment (right side of Activities line in Learning Environment rectangle) for technological intelligence (Cognition line in Developmental Change rectangle (Greenfield, 2009b). But because popular video games are overwhelmingly violent in content, this advance in technological intelligence comes at a cost to society.

Computers

Cognitive Effects

Computers continue the trend that began with print literacy towards abstract reasoning as technology advances. OLPC (One Laptop Per Child) is a US-based non-profit organization whose mission is to provide educational opportunities for the world's poorest children by giving them a laptop with software designed for self-empowered learning. A field experiment in Ethiopia explored the effect on abstract reasoning of computers distributed by OLPC to 10- to 15-year-olds (Hansen et al., 2012). Across seven schools, 202 children in Grades 6 and 7 were given laptops (all the children in three schools, half the children in a fourth); they were compared with 210 children who were not given laptops (all the children in three sociodemographically matched schools and the other half of the children in the fourth school). Laptops were mainly used at home and during breaks at school; they were rarely used for teaching purposes in class. The most frequent computer activities were writing, reading, and gaming. Hence, like the video game studies, this is a study of the cognitive effects of computers as informal learning environments.

Children with laptops significantly outperformed children without laptops on two abstract reasoning tests (analogies and categories).

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Interestingly, the effects of laptops did not improve school performance. In line with the theory of social change and human development, the laptop effects were specific to cognitive abstraction. Hence the progression begun by print literacy, as shown in Luria's study of categorization and other cognitive skills, was continued by computer technology in the form of laptops (top right side of Cognition line, Developmental Change rectangle, Figure 9.1).

Social Effects

Another Ethiopian field experiment based on the OLPC program focused on the role of computers in group value change (Hansen, Postmes, Tovote, & Bos, 2014). Three control and three experimental schools were matched on several variables such as social status of the students. The organization had provided a laptop to all fifth and sixth graders in schools in the experimental condition. Two schools in each condition were located in the urban capital. One school in each condition was located in a rural area. The measurement of values took place at baseline and six months after laptop deployment in the experimental schools. A value measure adapted for children (Schwartz et al., 2001) and translated into two Ethiopian languages was used at both points in time. Laptops were set up so that the students could engage in a wide variety of activities including writing, taking photos, making videos, painting, and games.

All the results conformed to the theory of social change and human development that guides this chapter (Greenfield, 2009a, 2016). In both rural and urban schools, self-enhancement values (success and ambition), as well as the value of gender equality and multiple perspectives increased more over time for the children with laptops than without. (See Aspirations, Behavior, Values, and Nature of Knowledge lines of Developmental Change rectangle, Figure 9.1.) The same was true for self-direction (creativity, independence, and curiosity). (See Behavior line on right side of the Developmental Change rectangle of Figure 9.1.) In line with the guiding theory, all of these are values adapted to a highly educated, urban, wealthy, commercial, high tech society (right side of top rectangle, Figure 9.1). Also in line with the theory, laptop use often had a larger effect in rural schools than urban – because the technological and social change they brought about was much larger.

Contrary to theoretical expectations, benevolence and traditional values also increased as a function of laptop access and use. However, the enhancement of traditional values along with the augmentation of new values often occurs when a country is in the midst of rapid social

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transformation (e.g., China: Zhou, Yiu, Wu, & Greenfield, 2017). Or this may have happened because benevolence to outgroups (instead of family) becomes an adaptive trait in urban society.

Teen Chatrooms: Disinhibition, Anonymity, and Social Controls

The existence of public teen chatrooms in the 1990s provided a window into how adolescents communicate about two important social issues: ethnicity and sexuality. Because the chatrooms were anonymous and some chatrooms had adult monitors whereas others did not, we were also able to see interaction in an anonymous setting and how social monitoring moderated communications about these two topics.

Concerning ethnicity, we found that race and ethnicity were frequently mentioned in teen chat: 37 out of 38 half-hour transcripts had at least one racial or ethnic utterance (Tynes, Reynolds, & Greenfield, 2004); this frequency is patently greater than in offline interactions. While most references had a neutral or positive valence in both monitored and unmonitored chat rooms, chat participants, nonetheless, had a 19 percent chance of being exposed to racial or ethnic slurs (potentially about their own group) in monitored chat and a significantly higher (59%) chance in unmonitored chat. (See Racist Rhetoric line in Cultural Value Change rectangle.) Even in monitored chat, racist comments occur more often than one would expect offline. However, in the absence of social controls, such as a monitor, negative intergroup attitudes are disinhibited and surface even more frequently. The absence of social controls intrinsic to in-person communication produce disinhibited communication in this anonymous environment. This shift is diagrammed on the Social Relations line of the Learning Environment rectangle.

Disinhibition was also a feature of sexual communication in the same chatrooms (Subrahmanyam, Šmahel, & Greenfield, 2006). Sexual themes constituted 5 percent of all utterances (one sexual comment per minute); bad or obscene language constituted 3 percent of the sample (one obscenity every two minutes). The protected environment of monitored chat (hosts who enforce basic behavioral rules) contained an environment with less explicit sexuality and fewer obscenities than the freer environment of unmonitored chat. Our analysis again pointed to disinhibition in an anonymous environment, as it is unlikely that a teen would experience a sexual comment every minute in a group environment offline! Equally, our results again point to the inhibiting effect of an adult monitor, something that is absent from teen communication in today's virtual world.

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Television in a Multimedia World

Societal Values and the Preteen Media Environment Shift in Synch Over Five Decades

In the United States, content analysis of millions of books showed the rise of individualistic values, as well as materialism, from 1800 to 2000; these are values adaptive in an urbanized, commercial, technological ecology (Greenfield, 2013). These value trends in the overall cultural environment were mirrored in the learning environment provided by the most popular television shows watched by the preteen audience in the United States – at a time when television was still the most popular medium with this age group (Rideout, Foehr, & Roberts, 2010). At the Children's Digital Media Center of Los Angeles, we carried out a content analysis of changing values transmitted in the two most popular television shows with preteen audiences in each decade from 1967 to 2007 (Uhls & Greenfield, 2011). Each show was rated by participants for 17 values. Mirroring the rise of materialism in the general culture, desire for financial success became increasingly important in preteen shows from 1967 to 2007. Lagging behind in time, but nonetheless mirroring in a general way the rise of individualistic self-focus in the overall cultural environment, the value of fame, near the bottom of the value hierarchy for the first four decades of the TV study, rose in importance between 1997 and 2007, becoming the top-rated value in the fiction show *Hannah Montana* and the reality show, *American Idol*, the two most popular shows with preteen audiences in 2007. In this same ten-year period, the values of community feeling, benevolence, and tradition declined in importance in the top-rated shows and the more individualistic values of achievement and physical fitness rose significantly. These value shifts are all shown in the Cultural Value Change rectangle of Figure 9.1. During this period (1997–2007) the Internet expanded greatly as well. The hypothesis is that this expansion of a Communication Technology on the Sociodemographic level (Figure 9.1) was a causal factor in the Cultural Value shift shown at the next level down.

Learning Environment and Individual Development: Preteen Discourse Reveals Uptake of Fame and Wealth Values Portrayed in the Shows in a New Multimedia Context

Our subsequent qualitative research showed uptake of the portrayed values in preteen focus groups conducted in Los Angeles in 2010 (Uhls & Greenfield, 2012); the groups consisted of children between 10 and 12 years of age. Before the group conversation began, children wrote

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down individually their one or two most important values from a list of seven. The individualistic value of fame was the only value to appear significantly above chance as the children's top value; this result mirrored its importance in popular preteen television.

The focus group discussions made it clear that these preteen children were processing values from their favorite television shows. The following quote from a middle-school boy highlights awareness of fame as a value being transmitted by both *Hannah Montana,* a favorite show in 2007, and *iCarly*, the favorite show in 2010, when the focus groups were conducted: "both get famous from sponsors" (Uhls & Greenfield, 2012, p. 320).

Another middle-school boy was explicit about the importance of audience size, a key component of fame:

[BOY 1]: Um, my friends and I are making a YouTube Channel …
[M]: Why are you doing that? … For fun? Or do you have a goal?
[BOY 1]: Our goal is to try and get a million subscribers. (Group V, Middle-school boys) (Uhls & Greenfield, 2012, p. 321)

This dialogue also exemplifies the fact that children were enacting the value of fame by posting videos on YouTube, a video-sharing site, and trying to become famous themselves. They were going from being consumers to actors in an interactive, multimedia environment.

But adults were a socializing force in this transition: In several cases, children reported that an authority figure such as a teacher was posting their activities on YouTube. The implicit message from these authority figures was the value of seeking a broader audience than could be acquired face-to-face.

A last example illustrates the perceived connection between fame and wealth, two values adapted to a technological urban commercial ecology. An elementary school boy says, "Oh, so when I'm famous, I'll get more rich. And I'll become a millionaire" (Uhls & Greenfield, 2012, p. 319). Hence, he links two of the values that rose together in preteen television over the decades; this quote exemplifies the subjective reality of the link between fame and money. Thus values portrayed on the cultural level in TV shows are reflected on the individual level (see right side of Values line in the Developmental Change rectangle).

Learning Environment and Individual Development: The Same Pattern on a Larger Scale

Connections between new media and this set of values were generalized by our national survey of 315 US youth between 9 and 15 years of age (Uhls, Zgouru, & Greenfield, 2014). Watching television and using a social

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networking site (right side of Learning Environment rectangle) predicted self-focused aspirations – fame, image, money, and status (right side of Developmental rectangle). Non-technology activities, most of which had a significant social component (left side of Learning Environment rectangle), were associated with collectivistic other-focused aspirations – e.g., helping your family, helping others in need (left side of Developmental rectangle). The non-technology activities – such as hanging out with friends and playing team sports – were all activities that existed historically before television and social networking sites. Hence, we can infer that the advent of television and social network sites led to an historical augmentation in self-focused aspirations and values, while reducing other-focused aspirations.

Mobile Technologies

Enter the Cell Phone: Expansion of Social Networks Beyond the Family

The decline of family as the center of one's social network and the inclusion of unrelated others are major features of the shift from small communities to large, urban societies. Manago (2019) has studied the effect of cell phone communication on the social networks of Maya adolescents in Zinacantan, Chiapas, Mexico, a place in which cellphones are a very recent introduction into their close-knit community. She found that both owning a mobile device and Facebook use predicted greater overall proportion of non-kin in the entire network. This was a predicted relationship between Activities and Social Relations in the Learning Environment (right side of Figure 9.1).

Intergenerational Value Shift: The Role of Mobile Technologies

Among Arab citizens of northern Israel, adolescent girls are the first generation to have mobile technologies during their teenage years; correlatively, they value female independence and egalitarian gender roles more than their mothers or grandmothers (Weinstock et al., 2015). In terms of individual differences, statistical modeling showed that possessing more mobile technologies (Learning Environment) predicts a higher value placed on gender equality and independence (Individual Development) (right side, bottom two levels, Figure 9.1).

Peer Relations Benefit at the Cost of Family Relations

Ling and Yttri (2005) expanded this theme of independence from family with their study of cellphone use by teens in Norway, a country in

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which smart phones became popular very early. Teens used their phones to establish boundaries, i.e., separation from their parents. Here is an example from their focus-group study:

NINA (18): "With some telephones, you can do it like [if a call comes] from some numbers it goes right into voicemail. Like if your parents call, it goes right into voicemail."

…

ARNE (17): "If I'm out on the weekend and things like [that], then I do that."
MODERATOR: "Whom do you exclude?"
ARNE (17): "The family"
Then three other kids in the group say they do it too.

Norwegian teens also used their phones to increase the privacy of their communications, expanding on the effect of print, as well as asserting their independence from family (Ling & Yttri, 2005, p. 227) (right side of Learning Environment and Developmental Change rectangles, Figure 9.1). Here is an example:

RITA (18): It's okay for somebody to leave a message in my voice mail, instead of the family's voice mail. I can call them back. It's more private.
ERICA (17): If I'm not home and if I didn't have a mobile telephone, then my parents would know about all the people I hang out with … When you have a mobile telephone, you have a private voice mail and a private telephone.

Clearly the cell phone is being used to enhance peer relations at the expense of family relations. This change in the Learning Environment is diagrammed in the Social Relations line of Figure 9.1.

Yet parents often give phones to their emerging adolescents so that they can keep track of them. This practice can cause conflict between parents and their adolescent children (Turkle, 2011). At the same time, technology makes possible helicopter parenting whereby parents and children are in close touch – often by mutual agreement – while emerging adult children are in college or traveling. This practice has produced negative reactions from those who think that children should be developing more independence at this stage of life (Turkle, 2011) or have found associations with depression and lowered life satisfaction (Schiffrin, 2014).

Adults' Use of Mobile Technology: A New Component of the Child Learning Environment

Radesky and colleagues (2014) carried out observations in fast-food restaurants in 15 neighborhoods in Boston. They observed groups in which there was an adult with one or more children between 0 and 10 years of age. In 40 out of the 55 observations, the adult used a mobile device after sitting down. The researchers focused their observations on

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caregiver absorption with the device, which was defined as the extent to which the primary focus of caregiver's attention and engagement is with the device rather than the child. Of those 40, 16 of the adults engaged in almost continuous use, with typing. That is, the caregiver was multitasking between childcare and electronic communication. In response, the children they were with tested the limits or engaged in provocative behaviors. The adults, for their part, generally ignored child behavior, then scolded; repeated instructions in robotic manner, insensitive to child's expressed needs. Clearly, adult attention was elsewhere. Here we see the predicted relationship between mobile technologies (right side of Sociodemographic Change rectangle) and multitasking (right side of Learning Environment Change rectangle).

Older Children Use Mobile Technologies While with Their Parents

As Turkle in her book *Alone Together* (2011) notes, the same situation as in the fast food restaurants can occur not only to the child, but to the parent when a child is focused on a mobile device to the exclusion of a parent. Turkle recounts a trip to Paris with her college-age daughter. They are sitting in a café when her daughter receives a call from a friend in Boston and makes a lunch date with her for later in the week – without even telling her friend that she is out of town. The idea that her daughter's attention was distracted from the here and now of Paris by her mobile phone is disturbing to her mother. Turkle catalogues all the situations in which parents and children alike split their attention between the present social situation and a virtual one: parents check e-mail as they push strollers; children text their friends, and parents email and text coworkers during family dinners and during shared television viewing sessions. Again, communication technologies lead to distraction from the here and now.

Effects of Parental Technoference on Children and Adolescents

McDaniel and Radesky (2018) followed up the qualitative study in fast-food restaurants with a quantitative survey study of problematic technology use by parents and technoference. Technoference was defined as technology-based interruptions in parent–child interactions. Problematic technology use was diagnosed by questions such as "When my mobile phone alerts me to new messages, I cannot resist checking them" and "I often think about calls or messages I might receive on my mobile phone." Mothers and fathers, almost all European American, were surveyed in 170 families; focal children were between one and five years of age. Problematic mobile technology use by parents predicted their perceptions of greater technoference in their interactions with their

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child. Greater technoference in the mother–child relationship, in turn, predicted greater child externalizing and internalizing behaviors. More mediated communication in the learning environment predicted more behavior problems (right side, Figure 9.1: Communication line, Learning Environment rectangle; Behavior line, Developmental rectangle).

Turkle (2011) notes the same problem in adolescence: "Hannah, sixteen, is a solemn quiet high school junior. She tells me that for years she has tried to get her mother's attention when her mother comes to fetch her after school or after dance lessons. Hannah says 'the car will start; she'll be driving, still looking down, looking at her messages, but still no hello'" (Turkle, 2011, p. 164). Turkle reports hearing many such stories. Uhls (2015) notes how this type of parent behavior will then serve as a model for the children parents are raising.

Distracted Walking, Bicycling, and Driving

Indeed, parental absorption with their phones may be one cause of distracted walking, bicycling, and driving by adolescents. Texting while driving is a serious teen issue. Turkle (2011) tells of Roman, an 18-year-old high school senior, who "admits that he texts while driving and he is not going to stop" (p. 162). He, like his high school peers, needs to feel connected all the time. Many studies show that, contrary to some popular ideas, multitasking leads to doing no task well (Ophir, Nass, & Wagner, 2009; Turkle, 2011); so it should be no surprise that when youth walk, bicycle, or drive distracted by mobile technologies, accidents happen (Stavrinos, Pope, Shen, & Shwebel, 2018).

Social Networking

The Cost to Family Relations

Surveys of US teens and their parents showed that nearly one in three parents felt that the time their teen spent on social networking interfered with family life. The more time a teen spent in social networking, the less support they felt they were receiving from their parents. Teens generally were operating quite independently of parental knowledge online: 38 percent of parents had not seen their child's social network profile; 62 percent of parents had never talked to their teen about social networking; 50 percent of teens accessed social network profile from bedroom, out of sight of parents (Rosen, 2007; Rosen et al., 2008). That percentage would be much higher now with the proliferation of smart phones. Surveys around the world – United States, New Zealand,

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Canada, Israel, Korea, and China – show correlations between time spent online and lower levels of perceived closeness to parents (Manago, Guan, & Greenfield, 2015). Teens have strategies for using social networking sites to expand their independence from their families: they often fabricate key identifying information like name, age, and location to protect themselves from the watchful eye of parents (boyd, 2007). Hence, as predicted by the theoretical model, social networking activities make families a less important part of the adolescent learning environment (Figure 9.1, Learning Environment Change).

The Explosion of "Friends"

With social networking, the number of contacts has exploded. But this trend began well before social media. In 1985, Meyrowitz wrote: "Through television, strangers are experienced as intimates" (p. 137). In social media, strangers can be "friends." Manago, Taylor, and Greenfield (2012) found that college students' Facebook averaged 440 "friends." In these networks, only 21 percent were close connections (best friend, very good friend, good friend, current boy- or girlfriend, family member, roommate). Nonetheless, the average size of this category of close connections was 80. We can surely question how close one can feel with such a large number of "close" connections. This study also uncovered the psychological importance of audience size. Larger estimates of the audience for one's status updates were correlated with greater self-esteem. Controlling for self-esteem, overall network size was the only variable to significantly predict life satisfaction. Given its importance for self-esteem and life satisfaction, one can imagine the psychological pressure that is created for young Facebook users to attract a large audience and a large network of "friends" (feedback from a large audience and large network, right side of Communication and Social Relations lines in Learning Environment Change rectangle, Figure 9.1).

The Power of the "Like"

This pressure is increased with the power of the "like." In a study simulating Instagram in an fMRI scanner, both giving and getting "likes" activated the reward centers of the teen and emerging adult brain – the same neural networks activated in classical addictions (Sherman, Greenfield, Hernandez, & Dapretto, 2017; Sherman, Hernandez, Greenfield, & Dapretto, in press; Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016). The neural evidence is backed up by young people's personal experience: James, a college student in Georgia,

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said: "When you go on social media you post a status or you post a picture and all of a sudden you get all those likes, you get all those affirmations from people, and it can be addictive because you have the constant pats on the back" (Twenge, 2017, pp. 56–57). Interviews across the USA by reporter Nancy Jo Sales indicated that this experience is common: girls are constantly in search of "likes" and positive comments. They also feel pressured to post sexy and revealing photos because they know that those get the most "likes" (Sales, 2016; Twenge, 2017). Their Learning Environment includes feedback from a large audience (right side of Communications line in the Learning Environment Change rectangle) and it impels them to create a sexualized self-presentation (right side of Sexuality/Romance line in the Developmental Change rectangle).

The Cost in Well-Being

"College students who had used Facebook for a longer time and those who spent more time each week on the site tended to agree more often that others were happier … Students who included more people whom they didn't personally know as their Facebook 'friends' agreed more often that others had better lives" (Gardner & Davis, pp. 101–102).

The activation of social comparison appears to be the culprit (Manago et al., 2008). Turkle (2011) describes the agonies of self-presentation that teenagers go through in constructing their Facebook profiles. Identity becomes self-presentation in one's social network profile. Photos including the poster receive consistently more "likes" than those that do not (Greenfield, Evers, & Dembo, 2017); thus the narcissism of constant self-presentation is audience driven.

While the importance of self-presentation is a universal attribute of the social networking culture, pre-existing differences in cultural values play a role in how individualistically the self is presented. For example, in a comparison of adolescent Facebook users in Turkey and the United States, self-promoting presentations were significantly more frequent in the United States than in Turkey (Boz, Uhls, & Greenfield, 2016). This difference reflects the more individualistic value system of the United States, compared with Turkey.

Social Media Augment a Suite of Values Adapted to an Urban, Educated, Commercial, and Ethnically Diverse World

Twenge's (2017) analysis of the national teen survey, Monitoring the Future, shows that teens who spend more time (ten or more hours) on social networks are more likely to value materialism and entitlement

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and are less likely to care about most social issues that involve the community than teens who spend less time. More time on social networks is also linked to gender equality and a positive attitude toward ethnic diversity in friendships. These findings indicate that social media further reinforce the materialistic value that we found on preteen television (Uhls & Greenfield, 2011). And they indicate that the effects of mobile technology in developing the value of gender equality in our Arab study (Weinstock, Ganayiem, Igbariya, Manago, & Greenfield, 2014) may generalize to an effect of social media in the United States. Given that one of the features of an urban ecology is ethnic diversity, it appears that social media help to make this characteristic valued positively in friendship. All of these changes in individual values (shown on the Values and Friendship lines of the Developmental Change rectangle) are linked to an increase in social networking in the Activities line on the right side of the Learning Environment Change rectangle (Figure 9.1).

A Multimedia World

Cognitive Effects: Epistemic Thinking Becomes More Relativistic

Weinstock (2015) explored intergenerational shifts in epistemology as a function of the role of technology in the same multigenerational sample of Arab citizens of Israel introduced earlier. In the domain of metacognition, Community-adapted epistemologies stress familial or religious authority as sources of knowledge and a single correct perspective. In contrast Society-adapted epistemologies emphasize science or personal experience as sources of knowledge, along with multiple viewpoints. As expected on theoretical grounds, science and personal experience as sources of knowledge, along with diverse perspectives, increased from grandmothers to mothers to teenage daughters. Relevant to the role of communications technologies, greater exposure to multilingual TV and possessing more mobile technologies were elements of the Learning Environment Change that predicted increase in acceptance of multiple perspectives on the level of Individual Development (Nature of Knowledge, right side of Figure 9.1).

The Cognitive Cost of Multitasking

Everyday multitasking with electronic devices, common among all age groups, is most frequent in the youngest generations (Carrier, Rosen, Cheever, & Lim, 2015). Summarizing multiple studies, the authors conclude that studying, doing homework, learning during lectures and

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from other sources, grades, and GPA are all negatively affected by concurrent multitasking with technology (Carrier et al., 2015). We conclude that the shift to multitasking in the Learning Environment (third level, right side of Communication line, Figure 9.1), made possible by the development of Communications Technologies (top level, Figure 9.1), leads to Developmental Change in the direction of distracted cognition (bottom level, right side of Cognition line, Figure 9.1).

Mediated Communication: The Cost to Close Relations

Human beings evolved in a world of in-person communication. All forms of mediated communication are chronologically subsequent. We all know about the convenience of textual communication, but what about its costs? And what are the social implications of other types of mediated communication? Telephone was the first synchronous technology for vocal communication. Audio-visual chat added a visual dimension, making it most similar to in-person communication. We explored the relationship of these diverse ways of communicating to social bonding and sense of closeness with a college friend (Sherman, Michikyan, & Greenfield, 2013). In a laboratory experiment, students felt closest to a friend and emitted more behavioral signs of closeness (e.g., smiling, gesturing) when they talked to the friend in person. They felt most distant and emitted fewest behavioral signs of closeness when they communicated by text. Audio communication (a simulation of telephone) was a little better for the sense of intimacy than text; and audio-visual chat, adding another feature of in-person communication, was better still. But no medium was associated with the same sense of closeness as in-person communication. Hence, we can conclude that one cost of the convenience of textual communication in the proximal Learning Environment is social intimacy, a Developmental Change (Figure 9.1). Because text is a chronologically recent addition to the communications armoire, whereas in-person communication is the oldest, this study models what happened historically in the shift toward textual (and other kinds of) mediated communication.

Perhaps the evolutionary history of human beings is such that they crave the closeness of in-person communication. Perhaps the sacrifice of social closeness found by Sherman and colleagues is one reason that Pea and colleagues (2012) found, in a 2010 online survey of 3,461 North American girls ages 8–12, that social well-being was associated with lower levels of uses of media for interpersonal interaction (e.g., phone, online communication). Video use and media multitasking were also associated with lower social well-being. Conversely and most important,

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face-to-face communication was associated with a positive sense of social well-being. The Developmental Change in Friendship associated with this Communication shift in Learning Environment (Figure 9.1) emphasizes the social cost of going against our evolutionary heritage. The findings also provide a developmental precursor to Sherman et al.'s study of bonding between college friends.

Family Relations at a Distance

Nevertheless, as young lives become more global – such as the lives of international students – new media can bridge distance. Among Chinese international students, students who had open phone and email communication with family members also had a greater sense of family cohesion, compared with students who did not have this communication (Kline & Liu, 2005; Manago, Guan, & Greenfield, 2015).

Cyberbullying

The question for a volume focused on social change is: What difference does it make to have cyberbullying transferred to the screen from the schoolyard? Swiss seventh and eighth graders identified two characteristics that make bullying the most severe: publicity (in their experiment, being available to one's whole class vs. communicated only to the victim) and anonymity (Sticca & Perren, 2013). Publicity and anonymity are two characteristics that cyberbullying (by text or social media) frequently has, but classical in-person bullying never has (see right side of Communication line of Learning Environment Change rectangle, Figure 9.1). These qualities make bullying feel the most severe. So, given the normative situation of having hundreds of "friends" on social media, large audience size of the perpetrator becomes a negative for the victim of cyberbullying. Besides anonymity and publicity, another factor that makes cyberbullying worse than schoolyard bullying is that there is no way to get away from the tormentors. For all these reasons, it is not surprising that the suicide risk for cyberbullying is higher than for offline school bullying (Twenge, 2017).

A cross-cultural study exploring cyberbullying and cybervictimization in Tanzania and Canada concluded that the phenomena are very similar in both locations, despite the slower uptake of the technology in Tanzania, a country with very limited material resources (Shapka, Onditi, Collie, & Lapidot-Lefler, 2018). This lack of cross-cultural difference in two very different ecologies raises the possibility that the basic phenomena of cyberbullying are universal, a function of the affordances provided by the technology.

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Disinhibition in Cybercommunication

In line with findings in teen chat in the 1990s (Tynes, Reynolds, & Greenfield, 2004), a national poll in 2011 found that 71 percent of 14 to 24-year-olds said people are more likely to use racist and sexist language online or through texting (Gardner & Davis, 2013). A teen interviewed by Gardner and Davis said, "I think kids my age find it easier to make fun of someone through a veiled post on Facebook or Twitter. I think they forget who they are online and use [their online profile] as a separate identity almost that loses responsibilities and is invincible to consequences because it is just black ink on a screen" (pp. 112–113). Again we find disinhibited social relations online (right side, Social Relations line, Learning Environment Change, Figure 9.1).

At the same time, a national survey, Monitoring the Future, showed that psychological well-being of adolescents dropped noticeably starting in 2012, after rising for many years (Twenge, Martin, & Campbell, 2018). Why? The years 2012–2013 marked the market saturation of smartphones. Indeed, the psychological well-being of adolescents was lowest in years when adolescents spent more time online and on social media and when more Americans owned smartphones. Psychological well-being was highest in years when adolescents spent more time with their friends in non-mediated activities. Increases in new media screen activities preceded the decrease in psychological well-being, rather than the reverse. In terms of individual differences, adolescents who spent more time on electronic communication and screens (e.g., social media, texting, electronic games, Internet) were less happy, less satisfied with their lives, and had lower self-esteem. "In contrast, adolescents who spent more time on non-screen activities such as in-person social interaction, sports/exercise, print media, and homework had higher psychological well-being" (Twenge et al., 2018, p. 8). "The least happy adolescents were those low in in-person social interaction and high in electronic communication, and the happiest were those high in in-person social interaction and low in electronic communication" (Twenge et al., 2018, p. 10). In short, more in-person communication and less mediated communication in the Learning Environment predicts more social well-being in Development (Figure 9.1).

How Communication Technologies have Altered Expressions of Sexuality and Partner Choice

Sexuality. Watching a porn video was a minority experience in the 1970s for young adult men; it became a majority experience in the 2010s. The

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age of access also went down: "As early as 2005, 42% of 10- to 17-year-olds said they had seen some online pornography in the last year, two-thirds of them unwittingly" (Twenge, 2017, p. 212). Unwitting exposure to sexuality on a screen can have a lasting negative effect (Cantor, Mares, & Hyde, 2003).

In a sample of male college students, 89.1 percent were currently using pornography, and almost all used the Internet to access it. "Of the 413 participants who reported current pornography use, 99.5% used it at least occasionally for masturbation." (Sun, Bridges, Johnson, & Ezzell, 2016, p. 988). In addition, pornography users tended to integrate pornography into sex with a partner. Finally, more frequent use of pornography was related to lesser enjoyment of sexually intimate behaviors, such as cuddling and kissing.

Overlapping the chronological period in which the use of pornography has risen is a period in which there has been a decline in having sex with a partner. From 1989 to 2016 there was a steady increase between the ages of 20 and 24 in the percentage of men and women that had had no sexual partners since age 18 (Twenge, 2017). Hence there has been a decline in sex with a partner, a social form of sexuality, and a rise in masturbation to pornography, an individualistic form of sexuality made possible by Internet technology. The use of online pornography was also correlated with lesser enjoyment of sexual intimacy, as well as integrating pornography into sex with a partner. So we see a continuation of technology as promoting ever more depersonalized and less intimate human relations. Masturbation to pornography is at the opposite end of a spectrum anchored by sexual relations in a committed relationship. It is very far from the evolutionary meaning of sex as an expression of commitment to family formation (Manago, Greenfield, Kim, & Ward (2014) (diagrammed on the Sexuality line of the Developmental Change rectangle, Figure 9.1).

Partner choice. The importance of choice is a fundamental individualistic value. Dating websites offer choice of partners that can be overwhelming and even counterproductive (D'Angelo & Toma, 2017). In line with the hypothesis that communications technologies push values and behavior in an individualistic direction, an increasing number of people in almost every age group are expanding their choice of partners by using dating websites. Between 2013 and 2015, the largest increase was among emerging adults, the 18- to 24-year-old group (Pew Research Center, 2016). Focusing on this age group, D'Angelo & Toma (2017) created a lab simulation of online dating. They found that college students who had been given a larger set of potential partners were less satisfied with their choices a week later than those who had been given a

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smaller set. This relationship is diagrammed on the Sexuality line of the Developmental Change rectangle. So excessive choice in Internet dating (probably in the hundreds for the 18–24-year-olds) has its costs in relationship satisfaction.

Mental Health: ADHD and Conduct Disorder

In a large long-term survey using daily momentary assessments with a diverse group of high-risk teens, daily reports of time spent using digital technologies and number of text messages sent (right side, Communication line, Learning Environment level, Figure 9.1) were associated with increased symptoms of ADHD and conduct disorder that same day, plus poorer self-regulation and increases in symptoms of disordered conduct 18 months later (right side, Behavior line, Developmental level, Figure 9.1) (George, Russell, Piontak, & Odgers, 2018). However, digital technology use on a given day was also associated with lower same day anxiety levels. This may be because technology use was allaying FOMO – fear of missing out.

Another study confirms the ADHD findings. A large cohort of teens in Los Angeles was followed over two years (Ra et al., 2018). At the start of the study, none had symptoms of ADHD. At the end of two years, those who reported engaging in various digital media activities (such as texting or social networking, the most common activity) many times a day exhibited significantly more ADHD symptoms than others who were less active in various forms of digital communication. Turkle's (2015) experience with a group of emerging adults explains how and why this may occur: To demonstrate their preferred mode of communication, they included her in a group chat on WhatsApp, switching rapidly between talk in the room and chat on their phones, which often took the form of images, photos, or videos. Rapid behavior switches are a real-world example of ADHD style; but this behavior had become normative in this high tech communication environment.

Conclusion

The spread and development of ever more effective communication technologies is an important component of the global sociodemographic cluster that includes urbanization, formal education, and wealth. These elements are synergistic; but the focus here has been on technology, currently the most powerful motor of social change in the United States and, arguably, the world. Individualistic values and gender equality are promoted by the expansion of technologically mediated communication,

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while violent media, especially the interactive medium of video games, cause real-world aggression on a global scale.

In the world in which human beings evolved, all communication was in person; bonding and intimacy are promoted by this modality. In-person communication also exerted implicit social controls. As more and more communication has become technologically mediated, the opportunity to be with someone else who is not present has mushroomed; the in-person social setting has decreased in importance. Communication has also become more anonymous and depersonalized, leading to the disinhibition of racism, sexuality, and cyberbullying in cyberspace and to less intimate communication. In the realm of sexuality and partnering, sexuality has become more depersonalized, while the individualistic value of choice overwhelms and breeds dissatisfaction with romantic choices. At the same time, mediated communication is adaptive in a globalized, mobile world where friends and family may be far away. However, we have seen that the implications of departing from our evolutionary heritage of in-person social relations are broad and deep.

In the environment in which human beings evolved, cognition was focused on acting on the physical world to meet subsistence concerns – food, shelter, clothing. In an urban, commercial environment with a high level of educational opportunity, abstract thinking is valued; and communications technology – whether it be print literacy or computers – is a force that moves cognition towards ever greater abstraction. Over time the world has gone from in-person to mediated communication. Therefore, the values and cognitive processes induced by expanding communication technologies represent historical change, as this chapter has endeavored to show. Research is desperately needed to counteract the dehumanizing aspects of expanded communication technologies and reduce the costs to well-being and social closeness, without losing the benefits of efficiency and connection with those at a distance. Technological tools elicit common reactions around the world. Communications technologies provide the universal culture of a globalized world.

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