

THEORETICAL ARTICLE

Multilevel theory of emerging technologies: Implications of historical transformation for human development

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Abstract

Integrating a theory of social change, culture, and human development with earlier theoretical work on media effects, this article explores developmental implications—social, cognitive, and neural—of the march of media through historical time and across geographical space. It draws on studies 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. In this theoretical article, I first present an overview of the theory and then use it to analyze and discuss the effects of three examples of emerging technologies: mobile phones, social networking, and multimedia.

KEYWORDS

emerging technologies, historical transformation, human development, multilevel theory, mobile phones, social networking multimedia

1 | INTRODUCTION

Developmental implications of emerging technologies are critical and complex. Integrating a theory of social change, culture, and human development (Greenfield, 2009, 2016, 2018) with earlier theoretical work on media effects (Greenfield, 1984/2014), I explore developmental implications—social, cognitive, and neural—of the march of media through historical time and across geographical space. I draw on studies 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.

An expanded version of this article has explored the cultural, socialization, and developmental implications of the long-term, globalized shift that has taken place from direct, in-person communication, and the communication environment in which human beings evolved, to increasing amounts and complexity of technologically mediated communication (Greenfield, 2019). In line with the focus of this journal on emerging technologies, I begin this shortened history with mobile technologies. In this theoretical article, I first present an

overview of the theory and then use it to analyze and discuss the effects of three examples of emerging technologies, mobile phones, social networking, and multimedia.

2 | 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, 2009, 2016, 2018). It incorporates sociodemographic variables at the top of the causal chain (with 19th century roots in the German sociologist Tönnies, 1957), cultural values at the next level down, and more traditional variables from developmental science at the next two levels—learning environment and individual development (Figure 1).

“Community” and “Society” summarize the features that anchor each end of the sociodemographic dimension (top level of Figure 1). “Community” denotes a small-scale social entity with social relations based on close personal and lifelong ties—e.g., a rural village, whereas

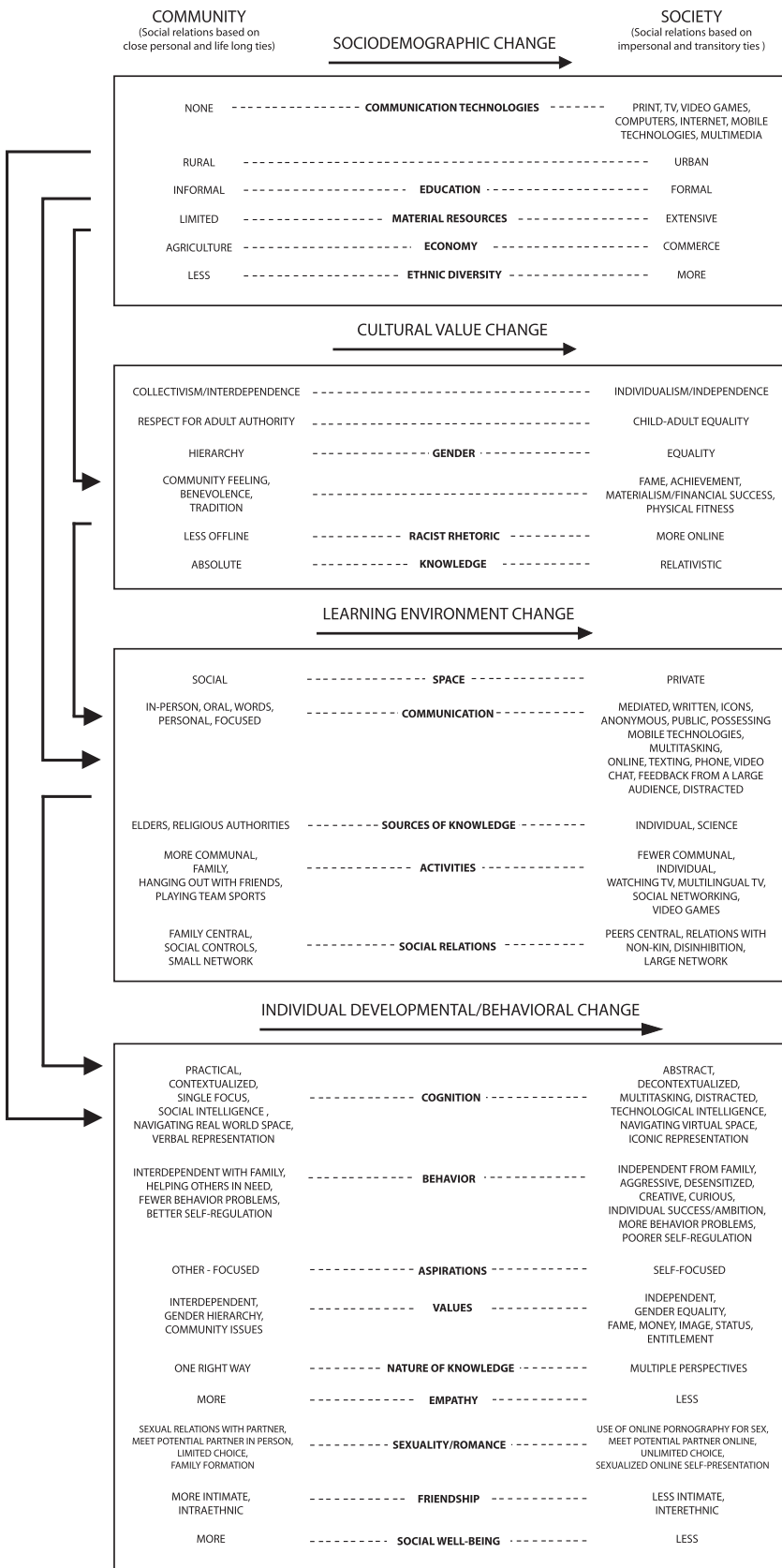


FIGURE 1 Model of social change, culture, and human development. Relationships for which there is empirical evidence, described here and in Greenfield (2019), have been selected for inclusion. While the horizontal arrows represent the dominant direction of social change in the world, sociodemographic change can go in the opposite direction. In that case, all the horizontal arrows would be reversed. The vertical arrows represent directions of influence, causal relations. When there is a directional shift on one level, it causes a shift in the same direction on one or more lower levels. Note that all the shifts that are diagrammed did not take place simultaneously. A sense of chronological order is given by the ordering in the text

“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 end-points for specific dimensions, listed on the sociodemographic level (top rectangle of Figure 1). All of the dimensions in the

sociodemographic rectangle of Figure 1, including communication technologies, tend to covary and shift together (Greenfield, 2018).

The top horizontal arrow in Figure 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 article 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 1, Communication Technologies).

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 1) therefore denote a direction of movement, not absolute locations on various scales.

Most important, the sociodemographic level (top rectangle, Figure 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 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, including a shift in the available communication technologies, 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 1. Each shift on a lower level is a theoretically driven prediction. Driven by sociodemographic change, including the introduction of new Communication Technologies, these correlated changes on multiple levels constitute the heart of the theory of social change, culture, and human development. With a focus on emerging technologies, the remaining sections of this article 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 1).

Figure 1 is a guide to the full history of communication and communication technologies; it lists the particular shifts on the levels of Cultural Values, Learning Environment, and Individual Development (bottom three rectangles of Figure 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 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 1) (Santos, Varnum, & Grossmann, 2017). Findings are placed on the Cultural level if they relate to cultural products or group as a whole (rather than to specific individuals).

Both Sociodemographic shifts (top rectangle in Figure 1) and shifts in Cultural Values (second rectangle down, Figure 1) produce shifts in the Learning Environments of children and adolescents (third

rectangle down, Figure 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.

Developmental change—the bottom of the causal chains depicted in Figure 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 behavioral 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 1. Although neural variables 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, culture, 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 1 furnish a guide for this article.

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 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, 2016; UNICEF, 2017). While moving historically in a common direction, the sociodemographic factors defining Community (left side of top rectangle, Figure 1) cluster together and the sociodemographic factors defining Society (right side of top rectangle, Figure 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, 2009, 2016, 2018).

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

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 1) to summarize effects produced by communication technologies that developed at different chronological periods.

Figure 1 is a guide to the whole history of communication technologies and their multilevel effects. However, in what follows, I focus on the emerging technologies of the present time. Using my theory as a framework, the rest of the article analyzes the effects of mobile technologies, social networking, and multimedia.

3 | MOBILE TECHNOLOGIES

3.1 | 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 is a major feature of the shift from small communities to large, urban societies. Manago has studied the effect of cell phone communication on the social networks of Maya adolescents in Zinacantán, Chiapas, Mexico, a place in which cellphones are a very recent introduction into their close-knit community (Manago & Pacheco, 2019). She found that both owning a mobile device and Facebook use predicted greater overall proportion of non-kin in social networks. Thus, the introduction of a cellphone tower into the community (Sociodemographic level) led to interrelated shifts in Learning Environments (Figure 1): Individuals possessing cellphones, social networking activity, and reduction of family presence in social networks.

3.2 | 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, Ganayem, Igbariya, Manago, & Greenfield, 2014). 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 1).

3.3 | 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 which smart phones became popular very early. Teens used their

phones to establish boundaries, that is, 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, as well as to assert their independence from family (Ling & Yttri, 2005, p. 227) (Figure 1, Individual Development). 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 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 (Schiffman et al., 2014).

3.4 | Adults' use of mobile technology: A new component of the child learning environment

Radesky et al. (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 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, and then scolded; they repeated instructions in a robotic manner, insensitive to the child's expressed needs. Clearly, adult attention was elsewhere. Here we see the predicted relationship between mobile technologies (right side of Learning Environment rectangle) and multitasking (right side of Individual Behavior rectangle).

3.5 | 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.

3.6 | Effects of parental technofence 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 technofence. Technofence 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 5 years of age. Problematic mobile technology use by parents predicted their perceptions of greater technofence in their interactions with their child. Greater technofence 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 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.

3.7 | 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, & Schwebel, 2018).

4 | SOCIAL NETWORKING

4.1 | The cost to family relations

Surveys of U.S. teens and their parents have shown 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% of parents had not seen their child's social network profile; 62% of parents had never talked to their teen about social networking; 50% of teens accessed social network profile from bedroom, out of sight of parents (Rosen, 2007; Rosen, Cheever, & Carrier, 2008). That percentage would be much higher now with the proliferation of smart phones. Surveys around the world—United States, New Zealand, 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 1, Learning Environment Change).

4.2 | 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% 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 1.)

4.3 | 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, 2018; Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016). The neural evidence is backed up by young people's personal experience: James, a college student in Georgia, 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).

4.4 | 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.” (Chou & Edge, 2012; Gardner & Davis, 2013, pp. 101–102). The activation of social comparison appears to be the culprit (Manago et al., 2012). 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 with the poster in the photograph receive consistently more “likes” than those without them (Greenfield, Evers, & Dembo, 2017); thus, the narcissism of constant self-presentation is, at least in part, 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.

4.5 | 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 (10 or more hours) on social networks are more likely to value materialism and entitlement and 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 et al., 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 1).

5 | A MULTIMEDIA WORLD

5.1 | 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. 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 (Figure 1).

5.2 | 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 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, Figure 1), made possible by the development of Communications Technologies (top level, Figure 1), leads to Developmental Change in the direction of distracted cognition (bottom level, Figure 1).

5.3 | 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 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 et al. (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, face-to-face communication was associated with a positive sense of social well-being. The Developmental Change associated with this Communication shift in Learning Environment (Figure 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.

5.4 | 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 et al., 2015).

5.5 | 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 Communication line of Learning Environment Change rectangle, Figure 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.

5.6 | 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% 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." (p. 112–113). Again, we find disinhibited social relations online (Learning Environment Change, Figure 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? 2012–13 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 1).

5.7 | How communication technologies have altered expressions of sexuality and partner choice

5.7.1 | 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

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% 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. Therefore, 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, and Ward (2014) (diagrammed on the Sexuality line of the Developmental Change rectangle, Figure 1).

5.7.2 | 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 (Sexuality line of the Behavioral Change rectangle, Figure 1). 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 and 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 smaller set. So excessive choice in Internet dating (probably in the hundreds for the 18–24 year olds) has its costs in relationship formation.

5.8 | 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 (Learning Environment level, Figure 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 (Developmental level, Figure 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 2 years (Ra et al., 2018). At the start of the study, none had symptoms of ADHD. At the end of 2 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.

6 | 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. As predicted by my theory of social change, culture, and human development, individualistic values and gender equality are promoted by the expansion of technologically mediated communication. In its ability to place a large range of data under a single theoretical umbrella, my theory of social change, culture, and human development (Greenfield, 2009, 2016, 2018) manifests its explanatory power for understanding the implications of emerging technology for human behavior.

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, and clothing. In an urban commercial environment with a high level of educational opportunity, abstract thinking is valued; and communications technology is a force that moves cognition toward 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 article 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. Communication technologies provide the universal culture of a globalized world.

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PEER REVIEW

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