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The Power of Youth: How the Bottom-Up Technology Transmission From Children to Parents Is Related to Digital (In)equality

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This study explores to what extent youths' perceived influence on their parents' adoption of and learning about digital media is related to digital inequality. Particularly, it investigates whether bottom-up technology transmission is associated with a possible reduction of socioeconomic-, age-, and gender-based digital gaps. Using a dyadic survey conducted in Chile, this study found that youths' perceived influence on their parents' adoption of digital media and their learning processes were associated with reductions of socioeconomic gaps in technology use, particularly regarding computer and Internet use.

Keywords: ICTs, digital media, family, youth, socialization, dyadic data, survey

Digital inequalities are hard to overcome because they are reproduced from one generation to another (e.g., Straubhaar, Spence, Tufekci, & Lentz, 2012). Just as parents transmit their socioeconomic status (SES) and cultural capital across generations (e.g., Bertaux, 1981; Bourdieu, 1984), people's attitudes toward and knowledge about digital media are also likely to be transmitted from parents to children in a family (Straubhaar et al., 2012). This top-down transmission across generations, however, does not always follow a linear pattern. Young people, who have grown up with more familiarity regarding new technologies, may become key brokers in including older generations in the digital environment.

Although young people are not a monolithic group with universal talent for using technology (see, e.g., Correa & Jeong, 2011; Hargittai, 2010; Selwyn, 2009), they are more digitally connected than their parents (Livingstone & Haddon, 2011; Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013). Furthermore, evidence suggests that youth act as digital facilitators within their families by helping parents adjust to technological innovations (e.g., Ito et al., 2009; Katz, 2010; Kiesler, Zdaniuk, Lundmark, & Kraut, 2000), particularly among people from a lower socioeconomic status and women (Correa, 2014; Correa, Straubhaar, Chen, & Spence, 2013). These results are meaningful because studies consistently find that older people, women, and lower-SES individuals tend to lag behind in digital media adoption and use (e.g., Cooper, 2006; Correa, 2010; Helsper, 2010; van Dijk, 2005). This bottom-up influence suggests

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that youth provide a convenient means of incorporating parents who suffer from "double technology jeopardy" for being older and poorer or "triple technology jeopardy" for being women, older, and poorer. Thus, it is relevant to explore whether young people, by acting as digital media brokers in their families, can narrow digital gaps based on age, socioeconomic status, and gender.

Using the literature on socialization and digital inclusion as a theoretical framework, this study explores to what extent bottom-up technology transmission is related to a possible reduction of digital gaps. The specific focus is on the degree to which the perceived influence of children on parents' adoption of learning about technology is associated with narrowing gaps related to age, gender, and socioeconomic status in parents' use of technology.

The investigation was conducted in Santiago, Chile's capital city. This country of 17 million people represents a useful case to study this process because it has relatively high but diverse degrees of technology diffusion, which provides an appropriate scenario for exploring technology transmission across groups. Although computer and Internet penetration rates are among the highest in Latin America, Internet diffusion is wide ranging. Almost two-thirds of the population (65%) use the Internet (International Communication Union, 2013). Among younger people, Internet penetration reaches more than 90%, but this figure steadily decreases as age increases (World Internet Project Chile, 2014). Gaps by socioeconomic status and gender also exist (World Internet Project Chile, 2014). And in most Latin American countries like Chile, families tend to be more interdependent. At the same time, studies have found that Chilean parents, as well as their U.S. counterparts, are less controlling and young people feel less obliged to obey rules than do, for example, Asian youth (Darling, Cumsille, & Peña Alampay, 2005). This family cultural context that combines interdependency and autonomy provides a good setting to study family interactions, children brokering activities, and bidirectional influences that may challenge traditional top-down socialization patterns in families.

Because family structures have evolved over the past decades (Bianchi & Casper, 2000; Salinas, 2011), this project defines *family* broadly as members who live in the same household and have a relationship, excluding roommates. Similarly, digital media and ICTs include telecommunications, computers, software programs, and Internet applications. Despite their increasing convergence (Lin, 2003; Madianou & Miller, 2012), in this study these technologies were divided into three clusters: computers (i.e., desktop computers and laptops), mobile phones (from basic cell phones to smart phones), and the Internet, which includes Internet applications. Finally, the bottom-up technology transmission was defined as youths' perceived influence on their parents' digital media adoption (i.e., the parents' buying of new technology or the youths' convincing their parents to purchase the new technology) and learning process (i.e., the extent to which children have taught their parents how to use ICTs).

Digital Inclusion

The concept of digital inclusion involves multiple dimensions, such as technological access, skills, differentiated uses, social contexts, and support (e.g., Hargittai, 2002; Livingstone & Helsper, 2007; van Deursen & van Dijk, 2011; Warschauer, 2004). Perhaps the most persistent digital inequality is the difference in use of digital media between young people and older generations (Eynon & Helsper, 2011; Madden et al., 2013; Pan & Jordan-Marsh, 2010; World Internet Project Chile, 2014). In the United States, 95% of people between ages 18 and 29 go online. After age 29, the percentages steadily decrease to 52% for those who are age 65 and older (Madden et al., 2013). In Chile, 93% of young people ages 18 to 29 go online, 32% of middle-aged people (45–59) use the Web, and only 14% (age 60 and older) do the same (World Internet Project Chile, 2014). Eynon and Helsper (2010) found that older people tend to be more disconnected not only because of involuntary structural reasons but because they choose to. They suggest providing a more informal learning context that increases people's motivations and interests rather than a formal type of learning. Thus, a family context would offer an informal everyday learning experience.

There are also differences by socioeconomic status (e.g., Cho, Gil de Zúñiga, Rojas, & Shah, 2003). The digital divide by SES mirrors socioeconomic inequalities (Helsper, 2012). Generally, studies have demonstrated that people of a higher SES have greater digital skills (van Deursen & van Dijk, 2011) and use more advanced applications of the Web (information, education, services), while people of lower SES use simpler applications (communication and entertainment) (e.g., Bonfadelli, 2002; Van Dijk, 2005). Chile follows a similar pattern: Although more than 70% of higher-SES people use the Internet, 35% of lower-SES people go online (World Internet Project Chile 2014). Furthermore, research suggests that if household income increases 1%, the probability of having an Internet connection at home increases by 10%. Similarly, if the head of household has a college education, the probability of having an Internet connection at home is 41% higher compared to families in which the head of household does not have a college education (Agostini & Willington, 2012).

Regarding the gender-based digital gap, the evidence suggests that differences in Internet access are disappearing (Fallows, 2005; Meraz, 2008). However, research has consistently found that men use computers and the Internet more than women, and they are more motivated to learn digital skills (Cooper, 2006; Fallows, 2005; Livingstone & Helsper, 2007; Ono & Zavodny, 2003). Helsper (2010) also found gender differences according to life stages, in which women and men used the Web for different purposes depending on their employment and marital status. In Chile, gender gaps still exist in Internet use. For example, a representative face-to-face national survey showed that 55% of male heads of household have used the Internet, but only 45% of female heads of household have done the same (Agostini & Willington, 2012).

Family and Socialization

From a socialization viewpoint, the reproduction of inequalities is based on the idea that families—mostly parents—transmit their social and cultural capital across generations, which includes the reproduction of expectations, attitudes, competencies, and knowledge (Bertaux, 1981; Bourdieu, 1984; Putney & Bengston, 2002). This intergenerational socialization influences children's perceptions about what is possible to attain (Putney & Bengston, 2002). Applying this argument to digital inequalities, technology capital—which includes knowledge and skills—as well as technology dispositions—attitudes and beliefs—would also be transmitted from parents to children (Straubhaar et al., 2012). That is, if children are born in a technology-rich family, their technology capital and technology dispositions will be better than those of children who are born in a technology-poor family.

Socialization was traditionally seen as a system for reproduction of culture, which suggested a unidirectional and deterministic process (Kuczynski & Parkin, 2007). Current approaches, however, conceptualize the process as bidirectional and interactive, a process in which both parents and children influence one another (Kuczynski & Parkin, 2005).

In line with the more interactive approach of socialization, the literature on immigrant children has found that children can become active contributors in some contexts (e.g., García-Sánchez, 2010; Katz, 2010; Valenzuela, 1999; Wong & Tseng, 2008), particularly regarding cultural and language brokering activities. These brokering roles open up opportunities to redraw the traditional top-down socialization processes. García-Sánchez (2010) and Valenzuela (1999) found that this phenomenon is gendered. Usually, immigrant girls bear more responsibility and perform more brokering tasks than do boys (García-Sánchez, 2010). Evidence in other contexts has also challenged the traditional top-down socialization in families. McDevitt and Chaffee (2000, 2002) documented what they called a "trickle-up influence" in political socialization in which children who attended a civics curriculum program in their school prompted more political discussion, greater news media use, and, eventually, increased political knowledge among their parents. This bottom-up transmission occurred more among lower-SES families, and the curriculum intervention narrowed SES-based gaps in political knowledge (McDevitt & Chaffee, 2000).

Bottom-Up Technology Transmission

The fact that households with children are more connected than those without them (Kennedy, Smith, Wells, & Wellman, 2008) suggests that children have a direct or indirect influence on their parents' adoption of digital media. Furthermore, in households with children, the utility of digital media for children is a significant factor in the adoption of computers (Brown & Venkatesh, 2005).

Investigations conducted in different cultural and geographic settings have found this trend: When the computer and the Internet were in the early stages of diffusion, interviews revealed that teens played a crucial role in their parents' adoption of these new technologies (Kiesler et al., 2000; Wheelock, 1992; Kiesler, Lundmark, Zdaniuk, & Kraut, 2000). More recent ethnographic studies also have found that children sparked an interest in their parents' digital media use (Ito et al., 2009), and recent surveys suggest a similar pattern: For people age 35 and older, their children were the third most important source for learning how to use the Internet, after themselves and a friend. For those who were age 55 and older, their children became the second most important learning source after themselves (Correa et al., 2013). Further evidence established that this process was more likely to occur among people of a lower SES and women, both in the United States and in Chile (Correa, 2014; Correa et al., 2013; Katz, 2010; Tripp & Herr-Stephenson, 2009). Similar to what happens among low-income immigrant families, where children act as translators and links between their families and the new environment, youths of lower SES have more exposure to new technological ideas through their school and friends. Thus, they act as useful technological brokers in their families. For example, only 8% of people with a college degree or graduate studies asserted that their children taught them how to use the Internet, but more than half of the respondents (56%) with a high school level of education or less were taught by their children (Correa et al., 2013). Also, mothers, rather than fathers, were more likely to be taught by their children (Correa, 2014; Correa et al., 2013).

Bottom-Up Technology Transmission and Digital (In)equality

To date, research on the bottom-up technology influence from children to parents has mostly focused on the process itself. That is, scholars have explored whether children influence their parents in the adoption of new technologies and help their parents learn how to use them. This study takes a step further by analyzing potential outcomes of this phenomenon.

Previous evidence suggests that the bottom-up technology transmission is particularly relevant among older adults, women, and people of lower socioeconomic status (e.g., Correa, 2014; Correa et al., 2013; Katz, 2010). Therefore, it is hypothesized that:

H1: *The bottom-up technology transmission process will be associated with a reduction of age-based gaps in technology use, so that when the perceived influence on parents' technology adoption and learning is high, the age differences in computer, mobile, and Internet use will be smaller than when the perceived influence is low.*

H2: *The bottom-up technology transmission process will be associated with a reduction of gender-based gaps in technology use, so that when the perceived influence on parents' technology adoption and learning is high, the gender differences in computer, mobile, and Internet use will be smaller than when the perceived influence is low.*

H3: *The bottom-up technology transmission process will be associated with a reduction of socioeconomic-based gaps in technology use, so that when the perceived influence on parents' technology adoption and learning is high, the SES differences in computer, mobile, and Internet use will be smaller than when the perceived influence is low.*

Method

To explore the relationship between bottom-up technology transmission within families and a possible reduction of digital gaps, a self-administered paper-and-pencil survey was administered to dyads of one 12- to 18-year-old child and one parent or legal guardian who lived with the child. This survey mode includes people who do not feel comfortable filling out a survey online (Hargittai & Walejko, 2008), allows respondents to answer at their own pace, provides privacy, insulates respondents from the expectations of the interviewer (Mangione & Van Ness, 2009), and yields fewer social desirability biases in the responses.

The data were collected among students who were contacted through three schools in Santiago, Chile, in November 2011. The three schools were coeducational and included at least the last two years of middle school education (7th and 8th grades) and full secondary education (9th to 12th grades). Because SES is a key variable, the questionnaires were administered in a private-paid school located in a high-income area, a semiprivate school in a middle-income area, and a foundation-owned school that serves disadvantaged populations in a low-income district.[2]

In each school, one class per cohort was randomly chosen. As a result, five classes per school were surveyed (from 7th to 11th grades).[3] Each student answered a paper-and-pencil questionnaire during school hours and received one extra paper-and-pencil questionnaire to be completed by one parent/guardian. The children's and parents' surveys had the same ID number to facilitate the identification of the dyad. If more than one child brought a survey home, parents had to complete the survey with that specific child in mind.[4] The children received an incentive—a cinema ticket—if they returned the parents' questionnaire. All the children who were in class at the time of the data collection responded to the survey. In total, 381 children and 251 parents completed the questionnaire, yielding a response rate among parents of 66%. Of the completed surveys, 242 child–parent pairs were useful for the dyadic data analysis.

Analytical Strategy

Because this project surveyed both parents and children, statistical examinations use the parent–child dyad as the unit of analysis. The dyad is "the fundamental unit of interpersonal interaction" composed of two members who are not totally independent from each other (Kenny, Kashy, & Cook, 2006). Most common statistical techniques such as multiple regressions assume independence of factors. Because dyads are related to each other (e.g., parent and child belong to the same family and influence each other), dyadic data violate the independence assumption. Therefore, it is important to account for the nonindependence of the dyad members.

Because the individuals in this study belonged to only one dyad, a standard dyadic design was used (Kenny, Kashy & Cook, 2006), in which both persons were measured, and for some factors, both were measured on the same variables. Some variables (i.e., youths as brokers of technology adoption and learning) were reciprocal, and some (i.e., family income, parents' education) were only measured in the parents' survey. Following common dyadic analysis (Kenny et al., 2006), the nonindependence level among distinguishable dyads such as parent–child was measured with Pearson *r* correlation for continuous

[2] The survey revealed that, on average, parents from the lower-SES school had completed their high school education and made between USD$600 and USD$800 per month; parents from the middle-SES school had completed their technical postsecondary education (similar to a two-year U.S. community college) and made between USD$1,000 and USD$1,500 per month. Parents from the higher-SES school had completed a five-year college degree and made between USD$6,000 and USD$8,000 or more monthly.

[3] Because the survey data were collected three weeks before the national standardized test for college admission, 12th graders were excluded from the sampling frame.

[4] Only one parent submitted two questionnaires. However, the parent did not provide the same answers for all the variables.

variables. The Pearson *r* correlations between parents' and children's scores for youths' perceived influence on parents' computer, mobile, and Internet adoption and learning ranged from .21 ($p \leq .001$) to .47 ($p \leq .001$) (see specific Pearson *r* correlations in the description of variables). Therefore, a dyadic data set with dyadic variables was created by computing the average of each member score in these variables of interest. This technique follows the analyses recommended by Kenny and colleagues (2006) for dyadic interval-level variables and has been conducted by other scholars (e.g., Klump, McGue, & Iacono, 2000; Moore, Slane, Mindell, Burt, & Klump, 2011; Vaughn, Colvin, Azria, Caya, & Krzysik, 2001). After performing this procedure, regression analyses were conducted.

To test whether the bottom-up technology transmission narrows digital gaps, I employed moderated multiple regressions. Moderated multiple regressions allow exploring how the relationship between two variables potentially changes as a result of the effect of a third independent variable called the moderator. For example, we can determine how the relationship between SES and parents' computer use differs across levels of perceived influence that youth exert on their parents. Using Hayes' SPSS macro for probing interactions in regressions (Hayes, 2005, 2012; Hayes & Matthes, 2009), a multiplicative term between the focal variable (e.g., family SES) and the moderator variable (e.g., youths' perceived influence on computer learning) was included as an additional predictor of the regression model. If the interaction was statistically significant, it was probed to understand how this interaction occurred. This procedure revealed the conditions under which the relationship between, for example, SES and parents' computer use increases or decreases. Hayes' macro identifies the points in the distribution of the moderator where the effect of the focal variable changes from significant to nonsignificant and vice versa. To facilitate interpretation of the interaction, a graph of the moderation was produced comparing the effects of the focal variable at one standard deviation above the mean and one standard deviation below the mean of the moderating variable while keeping all other variables fixed at their sample means.

Description of Variables

Youths' perceived influence on technology adoption: Youths' influence on parents/ guardians may occur through adoption and learning. To explore youths' perceived influence on their parents' adoption of digital media, parents were asked this question: "Many parents or guardians buy a new technological device because: they notice their children need it, their children ask for it, or their children show them that it is on the market and explain how it works. If you think about the child who is answering the survey at school, to what extent has your child influenced you to buy the following technologies?"

In the youths' survey, the question was: "If you think about your parents or guardians, to what extent have you have influenced them to buy the following technological devices?" The response categories ranged from 1 (*not at all*) to 5 (*a lot*). There was also an option, *I don't have it*, for which the score was 0. The technological device options were: home computer, laptop, basic cell phone, touch cell phone, smart phone, and Internet connection. Because digital media was defined by three clusters—computers, mobiles, and Internet—for the hypothesis testing, three different dependent variables were created: (1) perceived influence on computer adoption, (2) perceived influence on mobile adoption, and (3) perceived influence on Internet adoption.

Because parents' and children's scores were correlated and, therefore, nonindependent, dyadic dependent variables were created by averaging both scores. The adoption of desktop computers versus laptops as well as different mobile devices was, in many cases, mutually exclusive. For example, 21% of the parents and students (50 cases) had either a desktop computer or a laptop but not both. Therefore, they scored 0 in either the variable "influence on desktop computer adoption" or "influence on laptop adoption." In 47% of both the parents' and children's samples (114 cases), the adoption of different types of mobile devices was also mutually exclusive. If the scores of the variables would have been averaged, the mean of the variables "influence on computer adoption" and "influence on mobile adoption" would have been artificially deflated by including the scores of people who did not have the technology. If those scores would have been converted into missing values, 50 and 114 out of 242 cases would have been lost. Also, theoretically, this study aimed to measure youths' influence on computer (either desktop or laptop) and mobile adoption (either basic cell phone, touch cell phone, or smart phone). Thus, to create the dyadic variable "perceived influence on computer adoption," the highest score on either perceived influence on desktop computer adoption or laptop computer adoption for both parents' and children's samples was chosen. Then, as explained in the analytical strategy of dyadic variables, both scores were averaged (Pearson r = .42, p < .001, M = 3.47, SD = 1.06). Similarly, to create the dyadic variable "perceived influence on mobile adoption," the same strategy was employed. The highest score on either perceived influence on basic cell phone adoption, touch cell phone adoption, or smart phone adoption was chosen for both parents' and children's samples. Then, the scores were averaged (Pearson r = .29, p < .001, M = 3.29, SD = 1.12). Finally, to create a dyadic variable "perceived influence on Internet adoption," the variable "influence on Internet adoption" was averaged for both parents' and children's samples (Pearson r = .34, p < .001, M = 3.08, SD = 1.48).

Youths' perceived influence on technology learning: By following the same strategy as perceived influence on adoption, youths' perceived influence on their parents' learning of new technologies by teaching them how to use them, a dyadic variable was created. Parents were asked this question: "Sometimes children teach their parents to use new technologies in various ways: teaching them to set it up, solving a problem or showing how different applications work, so their parents or guardians can learn. If you think about the child who is answering the survey at school, to what extent has your child taught you to use the following technologies and applications?" The youths' survey asked: "If you think about your parents or guardians, to what extent have you taught them how to use the following technologies? Response options ranged from 1 (*not at all*) to 5 (*very much*). There was also an option, *I don't have it*, for which the score was 0.

The list of technologies and applications included the following: home computer; laptop; basic cell phone; touch cell phone; smart phone; Internet; e-mail; upload files, photos, videos; and social media (Facebook, Twitter). Following the same analytical strategy as the previous variable, three different dependent variables were created: (1) perceived influence on computer learning, (2) perceived influence on mobile learning, and (3) perceived influence on Internet learning. The highest value among desktop computer learning and laptop computer learning and the highest score among basic cell phone learning, touch cell phone learning, and smart phone learning was chosen, and then these scores were averaged (perceived influence on computer learning: Pearson r = .47, p < .001, M = 3.31, SD = 1.06; perceived influence on mobile learning: Pearson r = .21, p < .01, M = 2.98, SD = 1.06).

Finally, "perceived influence on Internet learning" was created from a scale that averaged four dyadic variables: perceived influence on learning Internet in general; e-mail; upload files, photos, and videos; and social media. Each dyadic variable was previously created by averaging both parents' and children's samples (α = .84, *M* = 2.19, *SD* = 0.97). This scale was created based on a principal component analysis that found that a single component with eigenvalues greater than one could be used for the four items related to the variable "perceived influence on Internet learning."

Sociodemographics: Age was determined via an open-ended question and was measured as a continuous variable. Gender was dummy-coded (1 = woman; 0 = man). Consistent with other research (e.g., Maynard, Fang, & Petri, 2012; Reynolds, Temple, Ou, Arteaga, & White, 2011), socioeconomic status was measured by an average of the parent's education and income. For education, parents were asked: "What is the highest degree or level of school you have completed?" Nine response categories ranged from *incomplete primary school* to *graduate degree*. For family income, they were asked: "Thinking about your income and the income of everyone else who lives with you, what was your total household income in a typical month over the past 12 months?" The options were divided into 11 categories that ranged from *less than $100,000 pesos* (less than USD$200), to *more than $4,000,000 pesos* (more than USD$8,000). The Pearson *r* correlation between these two variables was .70 ($p \leq .001$). Thus, the variables were first standardized and then averaged.[5]

Parent–child relationship: Because previous research has found that family interaction and parent–child relationships are related to youths' perceived influence on parents' technology use (Correa, 2014), this variable was included as a control.[6] Based on previous research (Barnes & Olson, 1985; Tilson, McBride, Lipkus, & Catalano, 2004), this construct was measured as accessibility, closeness, and open communication. This variable was measured for both parents and children, and parents were asked to think about the specific child who was answering the survey at school. With a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), both parents and children were asked to rate the following statements: "We spend a lot of time talking, playing, and/or doing sports," "I usually have time to talk about things that interest my children"/"My parents usually have time to talk about things that interest me," "My child is a good listener"/"My parents are good listeners," "Overall, I am satisfied with the communication I have with my child (parents)." These four items were averaged on a scale. For the parents' survey, the Cronbach's α was .81 (*M* = 3.5, *SD* = 0.96). For the youths' survey, the Cronbach's α was .85 (*M* = 3.5, *SD* = 0.87). Because parents' and children's answers were significantly correlated (Pearson's $r = .39$, $p < .001$), which suggested nonindependence between factors, both scores were averaged, and I created a dyadic variable of parent–child interaction (Cronbach's α = .86, *M* = 3.5, *SD* = 0.76).

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[5] Thirty-three cases for education and eight cases for income were replaced by the mean and median, respectively (6.0 in both cases).

[6] A previous study that focused on the predictors related to youths' perceived influence on technology learning found that more fluent parent–child interactions were associated with mobile learning (Correa, 2014).

***Technology use*:** To explore whether bottom-up technology transmission narrows digital gaps, it was necessary to create indexes of technology use. Parents were asked to rate from 1 (*never*) to 5 (*always*) how often they use the following technological devices: computer, laptops, basic cell phone, touch cell phone, smart phone, and the Internet in general. They were also asked how often they perform the following activities on the Internet: Read or send e-mails; upload files, photos, or videos; and use social networking sites. To be consistent with the three clusters of computers, mobiles, and the Internet, three variables that measure frequency of use of computers, mobiles, and the Internet were created. For computer use, frequencies of computer and laptop use were averaged (M = 3.13, SD = 1.21). For mobile use, frequencies of use of basic cell phone, touch cell phone, and smart phone were averaged (M = 2.64, SD = 0.81). Finally, Internet use was based on the same categories as "perceived influence on Internet learning": use of the Internet in general; use of e-mails; uploading files, photos, or videos; and use of social networking sites (M = 3.32, SD = 0.92).

Results

Description of Samples

Of the 251 parents who completed the survey, 63% were women and 37% were men. Their ages ranged from 28 to 74 with a mean age of 44 years. The majority were between ages 35 and 44. On average, parents had completed technical/professional education, which is similar to a U.S. two-year college (M = 5.51, Mdn = 6,00, SD = 2.15), and their median monthly family income ranged from USD$1,000 to USD$1,500 (Mdn = 6.00, SD = 3.13). Of the 381 students who answered the survey, 52% were girls and 48% were boys. Their mean age was 15 years (SD = 1.57).

Relationships Between Main Effect Variables and Technology Use

To investigate whether bottom-up technology transmission reduced generational, gender, and socioeconomic gaps in technology use, moderated multiple regressions were performed. The results were organized in three tables. Table 1 shows the factors associated with computer use; Table 2, the factors related to mobile use; and Table 3, the factors associated with Internet use. Each table contains two types of analyses. The first two models are two-step multiple regressions related to perceived influence on adoption, and the last two models examine perceived influence on learning. The first model included the control and main effect variables, and the second model incorporated the interactive factors.

As shown in Models 1 of Table 1, only socioeconomic status was positively associated with computer use. That is, parents of higher SES tended to use the computer more. Neither the other sociodemographic variables nor youths' perceived influence on parents' adoption of and learning about computer were significant. As shown in Models 1 of Table 2, family socioeconomic status and parents' age were related to mobile use. Particularly, younger parents of higher SES were more likely to use their mobile phones. Youths' perceived influence on parents' mobile adoption was marginally associated with mobile use. Finally, Models 1 of Table 3 reveal that, again, socioeconomic status was positively associated with Internet use. In addition, contrary to the traditional gender gap, women tended to use the Internet more. Finally, youths' perceived influence on Internet adoption and learning were positively correlated with Internet us

Table 1. Moderated Multiple Regression: Factors That Predict Parents' Computer Use.

	Computer adoption		Computer learning	
	Model 1	Model 2	Model 1	Model 2
Control factors				
Parents' age	.004	−.02	−.003	−.03
Parents' gender (1 = woman)	.11	.34	.08	.07
Family socioeconomic status	.40***	.82***	.52***	.89***
Parent–child interaction	.11	.12#	.04	.04
Perceived influence on computer adoption	.02	.10	—	—
Perceived influence on computer learning	—	—	.12	.10
R^2	21%***		23%***	
N	194		189	
	Interactive factors that predict parents' computer use*			
Perceived influence on computer adoption ×age		.02		—
Perceived influence on computer adoption × gender		−.26		—
Perceived influence on computer adoption × socioeconomic status		−.44*		—
Perceived influence on computer learning × age		—		.03
Perceived influence on computer learning × gender		—		.02
Perceived influence on computer learning × socioeconomic status		—		−.39*
R^2		24%***		24%***
N		194		189

$p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 2. Moderated Multiple Regression: Factors That Predict Parents' Mobile Use.

	Mobile adoption		Mobile learning	
	Model 1	Model 2	Model 1	Model 2
Control factors				
Parents' age	−.15*	−.40*	−.17*	.06
Parents' gender (1 = woman)	.03	−.21	.01	.02
Family socioeconomic status	.31***	.28	.38***	.41#
Parent-child interaction	.12	.14#	.05	.05
Perceived influence on mobile adoption	.12#	−.60	—	—
Perceived influence on mobile learning	—	—	.23**	.79
R^2	15%***		22%***	
N	168		161	
Interactive factors that predict parents' mobile use*				
Perceived influence on mobile adoption × age		.67		—
Perceived influence on mobile adoption × gender		.28		—
Perceived influence on mobile adoption × socioeconomic status		.03		—
Perceived influence on mobile learning × age		—		−.61
Perceived influence on mobile learning × gender		—		−.03
Perceived influence on mobile learning × socioeconomic status		—		−.01
R^2		15%***		22%***
N		168		161

$p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 3. Moderated Multiple Regression: Factors That Predict Parents' Internet Use.

	Internet adoption		Internet learning	
	Model 1	Model 2	Model 1	Model 2
Parents' age	−.06	−.09	.05	.30#
Parents' gender (1 = woman)	.24***	.26	.13#	−.02
Family socioeconomic status	.26***	.59**	.29***	.29
Parent–child interaction	−.01	−.02	−.01	−.02
Perceived influence on Internet adoption	.23**	.22		
Perceived influence on Internet learning			.40***	1.10*
R^2	15%		19%	
N	176		167	
Interactive factors that predict parents' Internet use*				
Perceived influence on Internet adoption × age		.05		—
Perceived influence on Internet adoption × gender		−.02		—
Perceived influence on Internet X socioeconomic status		−.35*		—
Perceived influence on Internet learning × age		—		−.80#
Perceived influence on Internet learning × gender		—		.20
Perceived influence on Internet learning × socioeconomic status		—		−.003
R^2		17%		19%
N		176		167

$p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Testing the Hypotheses: Can Gaps be Narrowed in Technology Use?

This study tested whether a bottom-up technology transmission process may help narrow generational, gender, and socioeconomic digital gaps.

Generational gaps: The moderated multiple regressions that predicted computer use (Models 2 of Table 1), mobile use (Models 2 of Table 2), and Internet use (Models 2 of Table 3) revealed that none of the interactions that involved age was significant. That is, it was not possible to demonstrate that the bottom-up technology transmission process was associated with a reduction of age gaps in computer, mobile, and Internet use. H1 was not supported.

Gender gaps: Similar to the analyses that involved age, none of the interactions that deal with gender were significant, so it was not possible to conclude that the bottom-up technology transmission process was associated with a reduction of gender gaps in computer, mobile, and Internet use. H2 was not supported.

Socioeconomic gaps: Regarding the interactions that involved socioeconomic status, the analyses revealed three significant moderations. As shown in Table 1, Model 2 of the first moderated multiple regression, socioeconomic status negatively moderated the relationship between youths' perceived influence on computer adoption and parents' computer use. In the same vein, Model 2 of the second regression revealed that SES also moderated the relationship between youths' perceived influence on computer learning and parents' computer use.

To better understand these relationships, these significant interactions were probed by estimating the effect of low (one standard deviation below the mean) and high (one standard deviation above the mean) perceived influence on computer adoption and learning by SES. As shown in Figure 1, the SES gap with respect to computer use closed when youths had a high level of perceived influence on parents' adoption of technology. In families in which youths' influence on computer adoption was lower, the gap in computer use between lower- and higher-SES parents was 1.6 points. However, when youths' influence on computer adoption was higher, computer use among lower-SES parents increased, and the gap between lower- and higher-SES parents decreased to 0.5 points. As shown in Figure 2, the parents' computer gap explained by SES narrowed (from 1.1 to 0.1 points) when youths had more perceived influence on computer learning. That is, when children acted as technology brokers and brought technology home by influencing computer acquisition or by teaching their parents how to use computers, people of a lower SES used computers more.

The same analyses were conducted to explore whether bottom-up technology transmission was associated with a reduction of mobile or Internet usage gaps. None of the interactions that predicted mobile use was significant (see Table 2). However, as shown in Table 3, socioeconomic status negatively moderated the relationship between youths' perceived influence on Internet adoption and Internet use. The gap in Internet use explained by SES narrowed (from 1.1 to 0.1 points) when youths had a higher perceived influence on parents' Internet acquisition (see Figure 3). As was the case with computers, when children acted as technology brokers by persuading their parents to acquire an Internet connection, people of a lower SES used the Internet more. In sum, H3 was supported for computer and Internet use. When the perceived influence on parents' computer adoption and learning was high, the socioeconomic differences in computer use were smaller than when the perceived influence was low. Also, when the perceived influence on parents' Internet adoption was high, the SES gaps in Internet use were reduced compared to the scenario where youths' perceived influence on Internet adoption was low.

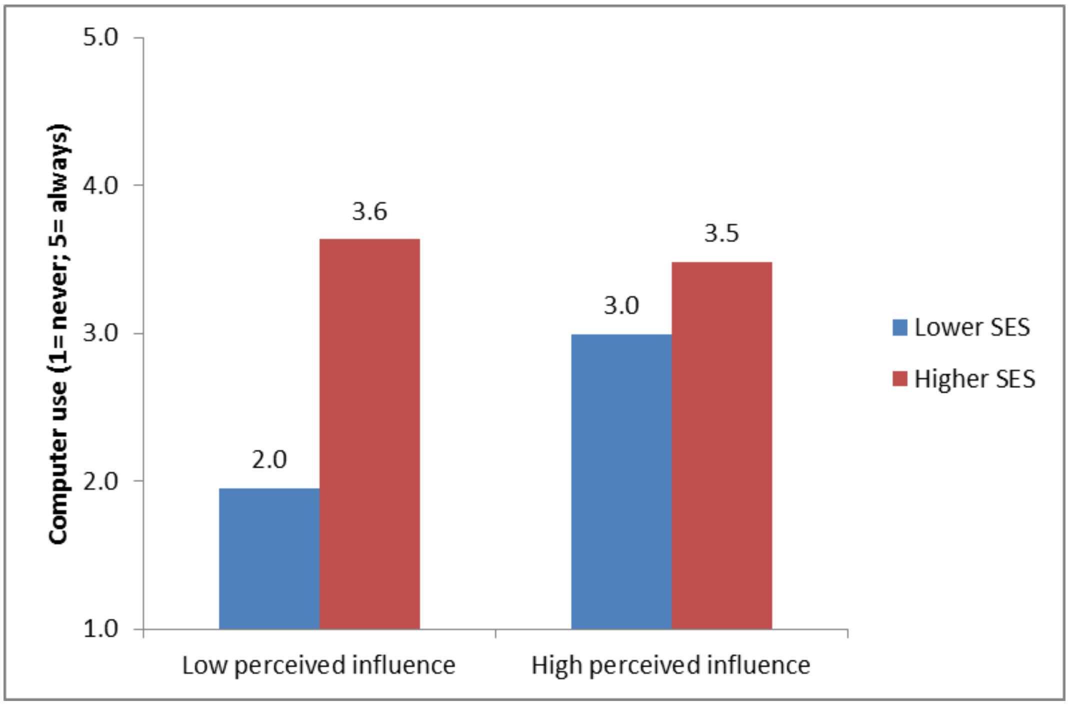

Figure 1. Closing the socioeconomic gap? How the relationship between socioeconomic status and parents' computer use changes by youths' perceived influence on computer adoption.

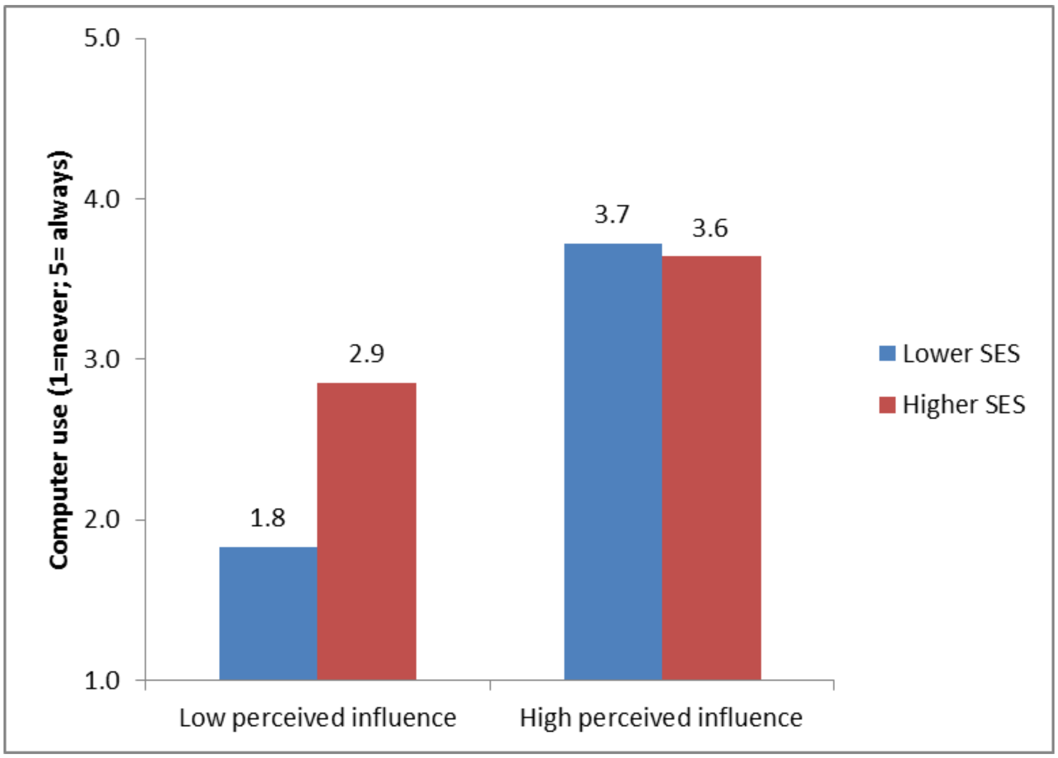

Figure 2. Closing the socioeconomic gap? How the relationship between socioeconomic status and parents' computer use changes by youths' perceived influence on computer learning.

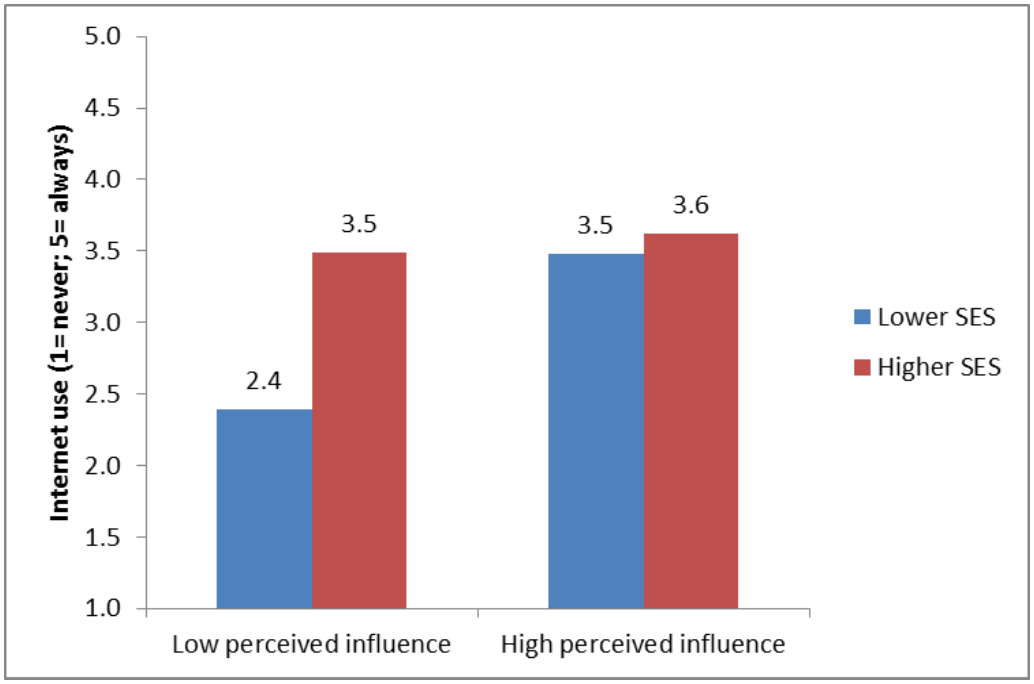

Figure 3. Closing the socioeconomic gap? How the relationship between socioeconomic status and parents' Internet use changes by youths' perceived influence on Internet adoption.

Discussion and Conclusion

Research has established a bottom-up technology transmission process, whereby children influence their parents' digital media use (Correa, 2014; Correa et al., 2013; Katz, 2010; Tripp & Herr-Stephenson, 2009, Kiesler et al., 2000). This study extended research in this area by examining the relationship between bottom-up technology transmission and the reduction of generational-, gender-, and SES-based gaps in technology use. By taking into account both parents' and children's perceptions, this study hypothesized that when youths' perceived influence on parents' technology adoption and learning is high, the age, gender, and socioeconomic differences in computer, mobile, and Internet use will be smaller than when youths' perceived influence on technology adoption is low.

This project was conducted in Chile because the country provides a context with wide-ranging levels of technology diffusion and a cultural setting where family roles and practices combine interdependency and autonomy (Darling et al, 2005). These factors are important for exploring children's brokering activities that may alter the traditional top-down socialization pattern.

This research is relevant because the process in which youths influence their parents' adoption of and learning about digital media suggests how older generations may be incorporated into the digital environment. The study is also important for its examination of technology adoption among women and poor people, two groups that usually lag behind in digital and social inclusion. It was important to test whether bottom-up technology transmission was associated with reductions in age, gender, and socioeconomic gaps in use of digital media. The results revealed that a higher perceived influence by youths reduced SES-based gaps in technology use but not gender- or age-based gaps.

Socioeconomic Gaps

The survey data revealed a strong SES divide in technology use, where poor people lagged behind. The interactions, however, showed an encouraging scenario. Greater perceived influence by youths on computer adoption and learning reduced the SES divide in their parents' computer use. Similarly, youths' perceived influence on Internet adoption closed the gap in their parents' Internet use, although this process did not occur for mobile use. It is possible that lower-income parents feel more comfortable and familiar with mobile devices than with computers or the Internet.

Although it is possible that higher-SES parents reached a ceiling in digital media use, digital gaps in technology use narrowed particularly because parents from lower SES used computers and the Internet more when children had higher perceived influence on their parents than when they had lower perceived influence. The fact that bottom-up technology transmission occurs more among lower-SES families and potentially mitigates disparities in digital use suggests that the bottom-up technology transmission process is worth exploring because it may become an important means for reducing digital gaps.

Previous research has suggested that this phenomenon occurs not only for digital media. In political communication, McDevitt and Chaffee (2000, 2002) found that a civics curriculum intervention in schools triggered a bottom-up political socialization where children influenced their parents' attention to political news, which increased parents' political knowledge. This bottom-up transmission occurred more among lower-SES families, and the curriculum intervention narrowed SES-based gaps in political knowledge. Research on immigration has studied how traditional family roles are altered when immigrant children act as language and culture brokers by helping their parents to be included in the new environment (e.g., García-Sánchez, 2010; Katz, 2010; Valenzuela, 1999; Wong & Tseng, 2008). Children who act as brokers in politics, immigrant families, and digital contexts share that they are low income and have parents with lower levels of education, which suggests that children's brokering activities are perhaps a socioeconomically situated practice.

Gender and Age Gaps

This study did not find that bottom-up technology transmission reduced gender-based gaps in technology use. Furthermore, compared to the digital gaps based on socioeconomic status, this study did not find strong gaps by gender, except with Internet use, in which the divide occurred contrary to the expected direction; mothers were more likely to use the Internet than fathers. Although this result would suggest that Chile is following the trend of developed countries, in which the gender gap in technology access is disappearing (Fallows, 2005; Meraz, 2008), it contradicts national data that reveal that a gender gap in Internet use still exists (Agostini & Willington, 2012). It is possible that mothers who answered this survey were more comfortable with technology.

Consistent with the generational divide, the findings suggested a negative relationship between parents' age and mobile use. However, this study did not find that bottom-up technology transmission narrows age-based gaps in technology use. It is possible that the parents' age range was somewhat young (more than half of the parents were between ages 35 and 44), which may have affected the analyses. In sum, the results of this study may suggest that bottom-up technology transmission only narrows deep and very consistent gaps such as differences by socioeconomic status.

Limitations, Strengths, and Future Research

Because this study employed cross-sectional data to answer questions about a transmission process, which implies changes over time, future investigations should use panel data to elucidate cause-effect relationships and changes over time. In addition, despite the nonprobabilistic nature of the sample, it was relevant for this study, because the main purpose was to establish relationships among variables and to understand how bottom-up technology transmission occurred rather than to investigate to what extent this process is present in the general population. Still, a stratified sampling method by selecting three schools that catered to low-, middle-, and high-income populations provided a more diverse sample in terms of socioeconomic status. Also, one class per cohort was randomly chosen, and extra efforts were made to obtain cooperation from both mothers and fathers. Future studies should try to infer causal relationships by using more appropriate techniques, such as panel data or quasi-experimental designs.

The analyses and conclusions of this study were bolstered by the use of dyadic data. By surveying both the parent and the child with the same questions, two observations were used to measure key variables, which reduced the potential errors of relying on one informant only. From a theoretical perspective, this study demonstrates that children's brokering role can be investigated in settings not related to immigration. The fact that this role can be fulfilled by native-born children, particularly from poorer families, suggests that it is necessary to focus on family practices and how new roles can alter traditional authority and socialization patterns in other contexts.

From a policy-making perspective, this evidence suggests that policy makers should develop digital curriculum or program interventions that particularly focus on schools from lower-SES areas. In families of lower socioeconomic status, parents are less likely to have exposure to new technological devices and ideas, so they tend to reproduce inequalities in technology adoption and dispositions. However, a school intervention program potentially reaches all students and may mitigate disparities in digital media use at home and eventually become a tool of social inclusion.

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