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Connecting with technology in lower-income US families

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Abstract

Digital equity initiatives traditionally enable access to devices and Internet service, but increasingly, designers are also recognizing the importance of access to people and programs that support digital skills development. Families in under-served communities are most likely to need such supports but least likely to have them available. We explore the extent to which parents and children might serve as these sources of support for each other in low- and lower-middle-income families, who have seldom been the focus of research on children, families, and technology. We examine how sociodemographic factors and parents' own technology use relate to patterns in how parents and children guide each other's technology experiences. We then explore how siblings' collaborative experiences are influenced by the extent to which inter-generational technology practices are either parent- or child-driven. We conclude by discussing the implications of our findings for strengthening digital equity initiatives targeting school-age children and their families.

Keywords

Digital equity, family technology engagement, parental mediation, child brokers, siblings, digital inclusion

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It is effectively a truism that US children are growing up in a technologized world. The evidence also shows that across the income spectrum, those technologized worlds are not created equal. In the United States, more than 90% of the families with school-age children living below the median household income report having Internet access. However, more than half of these families report that their connectivity is constrained by interrupted or slow service, outdated devices, or having to share devices (Rideout and Katz, 2016). As technological innovation becomes synonymous with educational innovation, ensuring equitable access to the Internet and Internet-capable devices (i.e. *digital equity*) has become a call to action for various stakeholders committed to facilitating educational and social opportunity for all children (Warschauer et al., 2014).

Digital equity initiatives can also indirectly benefit children by supporting family stability and access to social opportunity. As more resources and services migrate online, parents' abilities to apply for jobs, locate health services, or stay updated on local news are often contingent on the extent of their connectivity (Gonzales, 2016; Powell et al., 2010; Ragnedda and Muschert, 2013). Digital equity initiatives have traditionally focused on ensuring access to devices and Internet service. However, the success of these initiatives also depends on access to people and programs to help develop and reinforce the skills required to engage digital technologies in broad, productive ways (Dailey et al., 2010). Parents and children living in under-served communities across the United States are most likely to need these forms of support, but least likely to have them available (Waldman, 2011).

Most research on how family members support each other with learning about technology has focused on how parents guide their children's experiences (Nathanson, 2015; Valkenburg et al., 1999). More recently, scholars have also begun to amass evidence of "bottom-up" influence—that is, how children affect their parents' engagement with technology. For example, Correa (2015) revealed that lower levels of parental education and household income were predictive of greater bottom-up influence among Chilean families. Katz (2014) examined these same dynamics in Spanish-dominant, immigrant, Hispanic families living in the United States and found that parents' limited English proficiency was an additional determinant of bottom-up influence. We build on these findings by examining sociodemographic factors associated with parent–child, child–parent, and sibling–sibling influence on a range of family technology activities, in families headed by parents with varied racial/ethnic origins, language proficiencies, educational attainment, and household income.

We examine these family activities using data from the first large-scale, national survey of lower-income US parents with school-age children. Digital inequality scholars have established that low-income adults face technology-related constraints that seldom concern wealthier Americans. These include the "dependable instability" of their Internet connections (Gonzales, 2014), difficulties maintaining the functionality of their digital devices (Gonzales, 2016), and (for parents) prioritizing monthly Internet bills and device purchases over other expenses (Katz and Gonzalez, 2016a). Most research on children, families, and technology has focused on wealthy and upper-middle class populations (Alper et al., 2016; Clark, 2012; Wartella and Reeves, 1985). Consequently, there is a gap between what we know about digital inequality among low-income adults and about how those challenges are manifest within families. To explore the technology practices of these families, we limited our sample to include only low- and lower-middle-income parents,[1] since both income brackets have been overlooked in prior studies.

Our analyses are guided by Livingstone and Helsper's (2007) conceptualization of digital inclusion/exclusion as a spectrum, such that comparisons between lower-middle and low-income families can identify key variations for digital equity initiatives to address. We balance a focus on the digital challenges associated with sociodemographic variation by examining inter- and intra-generational family technology engagement; these often-overlooked family strengths could be mechanisms for addressing digital exclusion (Katz and Gonzalez, 2016a). In the following sections, we review extant scholarship on how family members influence each other's learning with technology.

How parents and children influence each other's technology learning and use

Past research on family interactions with media and technology has focused primarily on parents' leadership roles in their children's experiences. Much of this literature examines *parental mediation*, which refers to how parents restrict, discuss, and use media with their children (Valkenburg et al., 1999). To reframe relationships between parents, children, and technology, Clark (2011) proposed a parental mediation theory for the digital age that shifts away from *co-viewing* (which was appropriate for television), to *co-learning*. Clark considers co-learning as a socially situated activity, which, when enabled by the interactive affordances of new technology, allows parents and children to support each other in acquiring and honing new digital skills and knowledge (see also Wartella et al., 2016).

Clark's (2011) co-learning formulation treats parental mediation as a potentially dynamic interplay between generations rather than as a parent-driven set of activities. This is consistent with recent research in which scholars argue that interactions around technology are two-way learning experiences because parents' orientations to media and technology evolve by guiding their children's engagement (Guernsey and Levine, 2015; Nabi and Krcmar, 2016). Among school-age children, the learning opportunities that technology can foster across generations become even clearer. Children's seemingly natural facility with new technologies and capability to guide parents and other adults in using them have been noted across the income spectrum (Eynon and Helsper, 2015; Ito et al., 2009).

Prior research suggests that such practices are more frequent in certain social groups than others. Katz (2010, 2014) documents how children of Spanish-dominant Hispanic immigrants *broker* their parents' connections to a range of media devices and content, often as part of their broader family responsibilities to negotiate multiple languages and cultural frameworks. Yip et al.'s (2016) research with children of immigrant Hispanic parents reveals that brokering is more challenging in digital than mass media formats, largely because of the former's more immersive and interactive nature. Since low- and lower-middle-income children often have less consistent, quality access to new technologies, such brokering challenges may be symptomatic of their limited opportunities to develop and sustain digital skills (Horrigan, 2014; Ito et al., 2009; Katz, 2016).

Prior studies have not established whether children of low-income, US-born parents might also broker technology on behalf of parents who have limited experience with digital resources. We address this oversight by exploring inter-generational technology engagement across racial and ethnic groups. Extant research consistently documents differences in how children use media and technology, both alone and with their parents, along racial/ethnic lines (Common Sense Media, 2016; Louie, 2003). Connell et al. (2015) offer an important qualifier to that body of evidence by calling attention to the potentially confounding effects of race, family income, and parental education. We build on their work by investigating the relationships between family technology activities and sociodemographic differences, including racial/ethnic variation.

Assessing diversity and difference in family technology activities

Most research on children, families, and media has focused on WEIRD families; that is, families that are Western, Educated, Industrialized, Rich, and Democratic (Henrich et al., 2010), and on families that are native-born rather than immigrant (Alper et al., 2016). Mediation research has thereby focused primarily on parents who can more easily afford to purchase new technologies and have greater capacities (through education, occupational experiences, English language proficiency, and other social privileges) to facilitate their children's technology activities. Thus, research on affluent families cannot adequately account for how sociodemographic variation influences parenting practices, including those related to technology adoption and engagement.

A focus on diverse families can yield rich insights about the structural mechanisms that shape meaningful connectivity and influence the parenting practices and family dynamics that provide opportunities for inter-generational collaboration and learning (Katz and Gonzalez, 2016b). Prior research establishes the association of sociodemographic characteristics with parenting practices, including those related to media and technology use. These include how the long work hours of low-income parents constrain their interactions with their children and lead to more restrictive (rather than active or co-viewing) mediation strategies (Warren, 2005). Jordan (1992) offers a complementary finding that parents' occupations influence their orientations to time management. Professionals who bring work home (compared with shift workers) are more likely to treat time as currency to be wisely spent, including their and their children's time with media.

There is a close relationship between parents' occupations and both their education levels and household incomes, which have also been linked to specific parenting practices. For example, although children whose parent(s) have not completed high school spend more time daily with media than children with college-educated parents, the latter are more likely to control their children's Internet use through pre-screening, content blocking, and strict usage rules (Common Sense Media, 2016; Wang et al., 2005). College-educated parents' abilities to enact such restrictions reflect their extensive online experience and high technological self-efficacy (Valcke et al., 2010). Although these studies draw connections between individual-level characteristics and family-level dynamics, they generally describe a unilateral experience of technology engagement that only certain parents can navigate effectively. A deeper investigation into how parent–child exchanges emerge through specific activities can reveal family strengths that contextualize connectivity concerns and can enrich digital equity efforts.

Clark's (2012) qualitative examination of how social class affects parents' orientations to family media connections is an example of this kind of strengths-based approach. Unlike higher-income parents who often limit children's technology time to "productive" purposes, Clark frames lower-income parents' stance as an *ethic of respectful connection* that reflects their priority on raising children who are loyal and caring toward their families and communities. In accordance with those values, media time is equated with family time, resulting in a preference for television and other shareable screens over devices that are hard to use together. She also links these parenting practices to structural realities by explaining, for example, how sharing is more broadly embedded in lower-income family activities because they tend to have smaller homes and fewer devices (Clark, 2012; Rideout and Katz, 2016). Because sharing can engender trust, Clark suggests that collaborative learning with technology occurs frequently in these families and makes children's roles as learning resources central to those experiences.

Our first research question examines sociodemographic variation among lower-income families with regard to parent–child and child–parent assistance with technology use:

> *RQ1a*. What sociodemographic variables matter most for inter-generational assistance with technology?
>
> *RQ1b*. How do top-down (parent-to-child) and bottom-up (child-to-parent) flows of technology assistance vary by family sociodemographics?

How siblings guide each other in learning with technology

Inter-generational learning experiences have received considerable (albeit largely one-sided) scholarly attention, but scholars have understudied how siblings learn together. Gregory (2001) describes the "reciprocal synergy" that occurs when older siblings reinforce their own learning by guiding younger ones. For example, reading together or "playing school" allows older siblings to solidify skills as they model learning practices for younger ones (e.g., listening quietly during story time). These activities facilitate knowledge sharing in a comfortable setting and socialize younger siblings to the expectations of future, formal learning environments.

Siblings' shared activities increasingly implicate technology use. Takeuchi (2012: 50) refers to siblings as "backdoor providers" who act as media gatekeepers for each other by sharing favorite websites or encouraging family device purchases. Older siblings also model technology-related behaviors for younger children and expose them to new devices and platforms. Takeuchi notes the need for more research to fully understand how siblings become play and learning partners; similarly, family literacy scholars have called for investigations into how technology can support siblings in guiding each other's learning (Anderson et al., 2010).

Although scholars have largely overlooked *intra*-generational technology engagement, extant literature clearly suggests that *inter*-generational dynamics affect the extent to which siblings engage each other as learning partners more generally. Researchers have noted that older siblings in immigrant families, single-parent households, and families with many children often assume quasi-parental roles (Orellana, 2009). These roles often involve older siblings' involvement in younger children's schooling, particularly if parents are unfamiliar with the vagaries of US schools because they have limited education, are immigrants, or both (Louie, 2012). Furthermore, evidence suggests that the outcomes of these family dynamics differ by race and ethnicity. Khafi et al. (2014) find that African American children experience more positive outcomes (including enhanced parent–child relationship quality) from children's early assumptions of familial responsibility than European Americans. Buriel (1993) reports similarly positive associations for youth from Mexican-heritage families.

Taken together, these findings suggest that siblings' learning activities are important, understudied, and linked to parent–child learning dynamics. Our second set of research questions examines how parent–child interactions around technology set a family tone for the kinds of activities that siblings are most likely to engage in together:

> *RQ2a*. How do siblings' shared activity patterns vary sociodemographically?
>
> *RQ2b*. How does the technology assistance that children and parents provide each other influence siblings' shared activities?

Method

Data collection

Data were collected in a national telephone survey of 1,191 parents, who had (a) at least one child between ages 6 and 13 years and (b) an annual household income below the median for US households with children in 2014 (i.e. US$65,000; see Note 1). For eligible respondents with two or more children in this age range, we randomly selected one focal child as the reference for survey questions. SSRS, a research firm that conducts a weekly random digit dial (RDD) omnibus survey, conducted the survey. We used two parallel strategies to increase the likelihood of reaching eligible households. SSRS recontacted adults who had previously completed the weekly omnibus survey and had been prescreened for inclusion in this study. SSRS also recruited respondents from omnibus surveys conducted during the study period. Table 1 details the composition of the final sample.

Table 1. Completed interviews by sample source.

	Prescreened omnibus sample	Current omnibus sample	Total sample
All eligible completes	871	320	1191
Completed on cell phone[a]	507	211	718
Completed on landline	364	109	473

[a]In total, 500 interviews were completed with respondents in cell phone–only households.

Questionnaire development. The survey instrument was developed inductively and informed by findings from hour-long, open-ended interviews with low-income parents of Mexican-heritage and their focal child (ages 6–13 years; N = 336) conducted prior to the survey as part of a larger study[2] (See Note 2). Survey questions reflect the issues those respondents raised about family technology use. The answer categories for specific inter- and intra-generational activities with technology (used in analyses for RQ1b and RQ2, respectively) were the most common responses provided by parents and children in the qualitative interviews.

Data collection. The survey was fielded between 16 April and 29 June 2015. Respondents could complete the survey in English, Spanish, or a combination of both languages. The survey required an average of 20 minutes for completion; 196 respondents completed it primarily or entirely in Spanish. To maximize response rates, SSRS made at least five attempts to call non-responsive numbers; respondents could also schedule a call-back at a convenient time.

Sample demographics

A total of 1191 respondents completed the survey; the current analyses focus on the 1105 participants who identified as non-Hispanic White, non-Hispanic Black, or Hispanic. Table 2 presents a select set of participant characteristics.

Measures

Race/ethnic origin. Based on responses to questions about race/ethnicity and language(s) used at home, participants were coded as non-Hispanic White, African American, and Spanish-dominant or English-dominant Hispanic, defined by whether they spoke mainly or only English at home.

Education. Education was coded as a three-category variable, representing those with less than a high school degree (0), those with a high school degree or some college (1), and those with a college degree or more (2).

Income. Participants reported their annual household income in increments of US$5,000 (e.g., US$0–US$5,000; US$5,001–US$10,000). We calibrated the median value for each income category (e.g., US$2,500, US$7,500) to household size, so that income is represented as dollars per household member and treated as a continuous variable.

Child tech brokering and parent tech guidance. We measured *general child tech brokering* by asking parents whether their child ever helped them use devices that connect to the Internet. Response options were "Yes" (1) or "No" (0). Only parents with a focal child ages 10–13 years were asked this question, because prior research indicates that children begin brokering intensively for parents (whether that brokering is related to language, cultural norms, or technology) as they enter middle school (Katz, 2014; Orellana, 2009). We measured *general parent tech guidance* by asking parents whether they ever helped

Table 2. Respondent characteristics ($N = 1105$).

Focal child demographics	
Female (%)	45
Median age (years)	10
Parent demographics	
Female (%)	69
Median age (years)	39
Race/ethnic origin (%)	
Non-Hispanic White	50
African American	17
Hispanic (English-dominant)	15
Hispanic (Spanish-dominant)	17
Education (%)	
Less than a high school degree	18
High school degree or some college	65
College degree or more	17
Household demographics	
Median household size	4
Annual household income (%)	
<US$25,000/year	35
US$25,000–<US$40,000/year	30
US$40,000–US$65,000/year	35
Family Internet connection (%)	
Home broadband access	64
Home dial-up access	7
Mobile-only access[a]	23
Family device ownership (%)	
Desktop or laptop computer(s)	81
Smartphone(s)	79
Tablet(s)	67
Family tech activities	
Any parent tech guidance (%)	76
Learning how a computer/mobile device works	48
Fixing things that go wrong with a computer/mobile device	47
Finding information you are looking for online	58
Translating content[b]	42
Downloading things	45
Any child tech brokering (%)	55
Learning how a computer/mobile device works	44
Fixing things that go wrong with a computer/mobile device	36
Finding information you are looking for online	44
Translating content[b]	43
Downloading things	44
Any sibling activity[c] (%)	98
Help each other to learn how to use a computer/mobile device[d]	82
Watch TV shows or online videos together to learn something new[e]	88
Help each other with homework	82
Read together or read to each other	79
Do art or science projects together	68

[a]"Mobile-only access" includes families who only access the Internet on a smartphone or tablet.
[b]Translating content analyzed only for Spanish-dominant Hispanics.
[c]Children engaged in any sibling activity sometimes or often.
[d]Item asked to parents who own a desktop or laptop computer.
[e]Item asked to parents who own a television set and/or smartphone, tablet, desktop, or laptop.

their child use devices that connect to the Internet. Response options were “Yes” (1) or “No” (0). These measures are used in analyses for RQ1a.

Specific child tech brokering and parent tech guidance activities. Parents who answered “yes” to the general child tech brokering question were asked whether their child had ever helped them with five specific tech-related activities. Parents who answered “yes” to the general parent tech guidance question were asked whether they had ever helped their children with the same five activities. The activities were as follows: learning how a computer or mobile device works; fixing things that go wrong with a computer or mobile device; finding information online; translating online content into another language[3] (see Note 3); and downloading things, such as apps, software, music, or movies. Response options were “Yes” (1) or “No” (0). Those who answered “no” to the general child tech brokering and parent tech guidance questions were coded as “No” (0) for these more specific items. Because we were interested in these activities as conceptually distinct outcomes, we use these measures as individual items in RQ1 analyses.

For RQ2b analyses, we used intensity measures of parent tech guidance and child tech brokering, reflecting our interest in how overall patterns in parent tech guidance and child tech brokering foster family norms that can influence siblings’ shared tech activities. We created measures of intensity by calculating the average of all specific child tech brokering and parent tech guidance activities, including translating online content (when applicable). Cronbach’s alpha demonstrated good reliability for the specific parent tech guidance and child tech brokering activities (.867 and .846, respectively).

Sibling learning activities. Parents with two or more children ages 6–13 years (N = 536) were asked how often their children helped each other: learn how to use a computer or a mobile device; watch TV shows or online videos together to learn something new; read together or to each other; help each other with their homework; and do art or science projects together. The first two activities explicitly relate to learning with technology, but the interviews conducted prior to the survey revealed that the latter three frequently implicated technology as well. Children increasingly read e-books alongside traditional ones (Guernsey and Levine, 2015), and homework and projects frequently involve some consultation with online resources (Rideout and Katz, 2016). Response options were as follows: never, hardly ever, sometimes, and often. Those who answered “never,” “hardly ever,” or “did not own the devices specified in the question” were coded as “0.” Those who answered “sometimes” or “often” were coded as “1.” These measures are used in RQ2 analyses.

Covariates

To more accurately assess the amount of variance that sociodemographic factors can explain in the outcomes of interest, we conducted and compared analyses with and without three covariates that extant research confirms as key measures of individuals’ technology use (Eastin and LaRose, 2000; Helsper and van Deursen, 2016; Livingstone and Helsper, 2007). Supplemental File 1 presents the associations between these three covariates and the outcomes of interest.

Years online. Participants were asked how many years had elapsed since they started using the Internet. Response categories were as follows: 1 = "1–4 years," 2 = "5–9 years," 3 = "10–14 years," 4 = "15–19 years," and 5 = "20 or more years ago" (M = 3.09, standard deviation [SD] = 1.41).

Internet use frequency. Participants reported how often they used the Internet, ranging from "never" (0) to "every day" (7) (M = 6.48, SD = 1.19).

Internet confidence. Participants were asked, "How confident do you personally feel about using the Internet?" Response options ranged from 1 = "not at all confident" to 4 = "very confident" (M = 3.45, SD = 0.73).

Results

RQ1. We sought to identify which sociodemographic variables most influence intergenerational assistance with technology (RQ1a) and how the assistance that flows between parents and children on specific technology-related activities varied across social groups (RQ1b). We conducted bivariate analyses first (chi-square tests for race/ethnic origin and parent education, and bivariate logistic regression for household income) and then conducted a logistic regression including all sociodemographic factors and covariates.

Bivariate analyses (crosstabs and chi-square tests for race/ethnic origin and parent education, and bivariate logistic regression for income) revealed that child tech brokering varied significantly by race/ethnic origin and parent education, but not by income, whereas parent tech guidance varied by race/ethnic origin, education, and income (see Table 3). Non-Hispanic Whites were less likely to report that their child has ever helped them with an Internet-connected device; they were also more likely to have ever provided such help to their children than African Americans and Spanish-dominant Hispanics. Parents with less education were more likely to have received child tech brokering and less likely to have provided tech guidance, than those with more education. Parents with more income were more likely to have provided tech guidance to their children than those with less income.

Multivariate analyses (see Table 4) revealed that although some of the associations between sociodemographic factors and parent tech guidance and child tech brokering vanished after accounting for parents' Internet confidence, years online, and Internet use frequency, race/ethnic origin and education were still significantly associated with several parent tech guidance and child tech brokering activities. English-dominant Hispanics were significantly more likely than non-Hispanic Whites to receive child tech brokering to fix things that go wrong with devices. African Americans and Spanish-dominant Hispanics were significantly more likely than non-Hispanic Whites to receive child tech brokering to find information online. African Americans were significantly less likely to provide tech guidance for learning how to use devices and marginally less likely to provide tech guidance when things go wrong with them. Spanish-dominant Hispanics were less likely to provide tech guidance for finding information online. Parents with a college degree were significantly less likely to provide tech guidance translating content from the Internet into another language.

Table 3. Technological assistance activities by race/ethnic origin, education, and income.[a]

	Race/ethnic origin					Education				Income
	Non-Hispanic White % [95% CI]	African American % [95% CI]	Hispanic (English-dominant) % [95% CI]	Hispanic (Spanish-dominant) % [95% CI]	Overall χ^2	Some HS or less % [95% CI]	HS grad or some college % [95% CI]	College grad or more % [95% CI]	Overall χ^2	OR [95% CI], sig
Child tech brokering										
Any child tech brokering	48.4 [46.2, 50.6]	61.9 [58.24, 65.6]	58.3 [54.29, 62.31]	64.5 [60.66, 68.34]	$\chi^2(3)=1.922$, $p<.001$	62.5 [58.57, 66.43]	54.7 [52.77, 56.63]	48.3 [44.58, 52.02]	$\chi^2(2)=6.677$, $p=.035$	0.941 [0.888, 1.137], $p=.941$
Learning how a computer/ mobile device works	37.1 [34.2, 40.0]	45.8 [40.3, 51.3]	45.3 [39.77, 50.83]	60.7 [55.37, 66.03]	$\chi^2(3)=14.823$, $p=.002$	56.6 [50.91, 62.29]	43.3 [40.69, 45.91]	32.1 [27.01, 37.19]	$\chi^2(2)=9.704$, $p=.008$	0.858 [0.728, 1.011], $p=.067$
Fixing things that go wrong with a computer/mobile device	32.4 [29.6, 35.2]	34.9 [29.67, 40.13]	45.7 [40.17, 51.23]	41.7 [36.32, 47.08]	$\chi^2(3)=6.023$, $p=.110$	38.2 [32.63, 43.77]	37.8 [35.24, 40.36]	28.6 [23.67, 33.53]	$\chi^2(2)=2.621$, $p=.270$	0.657 [0.882, 1.221], $p=.657$
Finding information you are looking for online	34.6 [31.7, 37.5]	48.2 [42.72, 53.68]	46.9 [41.36, 52.44]	65.5 [60.31, 70.69]	$\chi^2(3)=24.455$, $p<.001$	57.9 [52.24, 63.56]	44.4 [41.78, 47.02]	27.4 [22.53, 32.27]	$\chi^2(2)=15.401$, $p<.001$	0.824 [0.698, 0.973], $p=.022$
Translating content[b]	–	–	–	56.0 [50.58, 61.42]	$\chi^2(3)=11.702$, $p=.008$	59 [51.9, 66.1]	52.5 [47.35, 57.65]	60 [49.05, 70.95]	$\chi^2(2)=0.371$, $p=.831$	0.779 [0.539, 1.126], $p=.184$
Downloading things	39.7 [36.7, 42.7]	39.8 [34.43, 45.17]	50.6 [45.04, 56.16]	52.4 [46.95, 57.85]	$\chi^2(3)=6.432$, $p=.092$	47.4 [41.67, 53.13]	44.2 [41.58, 46.82]	36.9 [31.64, 42.16]	$\chi^2(2)=2.015$, $p=.365$	0.912 [0.776, 1.071], $p=.262$
Parent tech guidance										
Any parent tech guidance	82.0 [80.31, 83.69]	71.0 [67.58, 74.42]	72.8 [69.18, 76.42]	64.9 [61.07, 68.73]	$\chi^2(3)=23.827$, $p<.001$	63.8 [59.9, 67.7]	75.8 [74.14, 77.46]	87.2 [84.71, 89.69]	$\chi^2(2)=24.846$, $p<.001$	1.233 [1.055, 1.441], $p=.009$
Learning how a computer/ mobile device works	51.8 [48.77, 54.83]	43.4 [37.92, 48.88]	48.1 [42.56, 53.64]	36.9 [31.45, 42.35]	$\chi^2(3)=6.415$, $p=.093$	42.1 [36.44, 47.76]	47.8 [45.17, 50.43]	51.2 [45.75, 56.65]	$\chi^2(2)=1.357$, $p=.507$	1.032 [0.911, 1.169], $p=.622$
Fixing things that go wrong with a computer/mobile device	51.8 [48.77, 54.83]	43.4 [37.96, 48.84]	50.6 [45.04, 56.16]	29.8 [24.81, 34.79]	$\chi^2(3)=13.343$, $p=.004$	28.9 [23.7, 34.1]	48.6 [45.97, 51.23]	54.8 [49.37, 60.23]	$\chi^2(2)=12.343$, $p=.002$	1.259 [1.108, 1.430], $p<.001$
Finding information you are looking for online	63.6 [60.68, 66.52]	49.4 [43.91, 54.89]	54.3 [48.77, 59.83]	48.8 [43.35, 54.25]	$\chi^2(3)=9.306$, $p=.025$	51.3 [45.57, 57.03]	56.4 [53.79, 59.01]	67.9 [62.81, 72.99]	$\chi^2(2)=5.059$, $p=.080$	1.175 [1.031, 1.342], $p=.016$
Translating content[b,c]	–	–	–	41.7 [36.32, 47.08]	$\chi^2(3)=3.721$, $p=.293$	41.0 [30.0, 52.0]	45.0 [36.34, 53.66]	20.0 [0.0, 40.0]	$\chi^2(2)=2.907$, $p=.234$	0.920 [0.685, 1.235], $p=.578$
Downloading things	50.7 [47.67, 53.73]	37.3 [31.99, 42.61]	46.9 [41.36, 52.44]	32.1 [27.01, 37.19]	$\chi^2(3)=11.308$, $p=.010$	35.5 [30.01, 40.99]	43.6 [40.99, 46.21]	59.5 [54.14, 64.86]	$\chi^2(2)=10.196$, $p=.006$	1.260 [1.109, 1.431], $p<.001$

HS: high school; OR: odds ratio; CI: confidence interval.
[a]For specific child tech brokering activities, the sample was restricted to parents of 10- to 13-year olds because parents of younger children were not asked about child tech brokering.
[b]Translating content analyzed only for Spanish-dominant Hispanics.
[c]Only five participants were both Spanish-dominant Hispanics and had a college degree or more.

Table 4. Associations between inter-generational tech activities and sociodemographics.

	Any child tech brokering		Learning how devices work		Fixing things that go wrong with devices		Finding information online		Translating online content into another language		Downloading apps, software, music. or movies	
	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]
Child tech brokering												
African American[a]	**1.767****	**[1.229, 2.539]**	1.486	[0.877, 2.519]	1.236	[0.723, 2.113]	**1.810***	**[1.061, 3.086]**	–	–	0.951	[0.562, 1.607]
English-dominant Hispanic[a]	1.422	[0.972, 2.082]	1.157	[0.678, 1.975]	**1.718***	**[1.019, 2.896]**	1.398	[0.816, 2.393]	–	–	1.344	[0.798, 2.262]
Spanish-dominant Hispanic[a]	1.51	[0.976, 2.337]	*1.69*	*[0.921, 3.1]*	1.462	[0.801, 2.668]	**2.146***	**[1.157, 3.981]**	–	–	1.181	[0.652, 2.14]
HS degree or some college[b]	1.009	[0.667, 1.526]	1.034	[0.576, 1.857]	1.272	[0.707, 2.29]	1.192	[0.657, 2.161]	1.089	[0.481, 2.468]	1.465	[0.822, 2.611]
College degree or more[b]	0.914	[0.541, 1.545]	0.871	[0.404, 1.878]	0.905	[0.414, 1.976]	0.767	[0.348, 1.69]	0.579	[0.155, 2.152]	1.41	[0.664, 2.993]
Income	**1.158***	**[1.008, 1.331]**	1.036	[0.859, 1.25]	*1.178*	*[0.979, 1.417]*	1.047	[0.865, 1.267]	1.087	[0.711, 1.663]	0.997	[0.831, 1.197]
Internet confidence	**0.716****	**[0.582, 0.882]**	**0.634****	**[0.478, 0.84]**	0.834	[0.634, 1.097]	**0.701***	**[0.528, 0.93]**	0.992	[0.620, 1.587]	**0.746***	**[0.567, 0.98]**
Internet frequency	**0.830****	**[0.742, 0.929]**	**0.766****	**[0.65, 0.902]**	0.894	[0.761, 1.051]	**0.721*****	**[0.61, 0.852]**	0.723	[0.544, 0.961]	**0.791****	**[0.674, 0.928]**
Years online	1.074	[0.927, 1.244]	1.088	[0.896, 1.321]	1.015	[0.839, 1.227]	1.012	[0.832, 1.231]	0.788	[0.571, 1.088]	1.012	[0.839, 1.221]
Nagelkerke R^2 and Hosmer and Lemeshow test	$R^2=.067$, $\chi^2(8)=5.463$, $p=.707$		$R^2=.120$, $\chi^2(8)=4.430$, $p=.816$		$R^2=.040$, $\chi^2(8)=8.579$, $p=.379$		$R^2=.160$, $\chi^2(8)=4.880$, $p=.770$		$R^2=.119$, $\chi^2(8)=5.056$, $p=.752$		$R^2=.065$, $\chi^2(8)=6.759$, $p=.563$	

Table 4. (Continued)

	Any child tech brokering		Learning how devices work		Fixing things that go wrong with devices		Finding information online		Translating online content into another language		Downloading apps, software, music. or movies	
	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]	AOR	[95% CI]
Parent tech guidance												
African American[a]	**0.558****	**[0.364, 0.857]**	**0.670***	**[0.466, 0.963]**	*0.698*	[*0.485, 1.006*]	0.75	[0.514, 1.094]	–	–	0.929	[0.645, 1.337]
English-dominant Hispanic[a]	0.693	[0.437, 1.1]	0.724	[0.492, 1.066]	0.859	[0.58, 1.27]	*0.674*	[*0.453, 1.002*]	–	–	0.931	[0.631, 1.374]
Spanish-dominant Hispanic[a]	0.728	[0.446, 1.19]	0.697	[0.451, 1.077]	0.74	[0.472, 1.16]	**0.584***	**[0.376, 0.908]**	–	–	0.931	[0.597, 1.451]
HS degree or some college[b]	1.089	[0.696, 1.706]	1.172	[0.775, 1.771]	1.383	[0.899, 2.128]	0.961	[0.632, 1.462]	*0.572*	[*0.317, 1.030*]	1.155	[0.756, 1.764]
College degree or more[b]	1.563	[0.812, 3.007]	1.26	[0.74, 2.145]	1.362	[0.793, 2.34]	1.251	[0.717, 2.181]	**0.318***	**[0.117, 0.867]**	1.329	[0.779, 2.268]
Income	0.983	[0.823, 1.174]	*0.877*	[*0.762, 1.01*]	1.049	[0.909, 1.21]	0.96	[0.827, 1.113]	1.029	[0.740, 1.431]	1.085	[0.942, 1.251]
Internet confidence	**1.574*****	**[1.256, 1.974]**	**1.561*****	**[1.268, 1.923]**	**1.536*****	**[1.239, 1.904]**	**1.414****	**[1.147, 1.742]**	**1.554***	**[1.071, 2.255]**	**1.477*****	**[1.194, 1.827]**
Internet frequency	**1.234****	**[1.078, 1.413]**	**1.120***	**[1, 1.253]**	**1.245*****	**[1.111, 1.395]**	**1.200****	**[1.068, 1.349]**	1.014	[0.845, 1.216]	**1.207***	**[1.078, 1.351]**
Years online	**1.332*****	**[1.143, 1.552]**	**1.240****	**[1.063, 1.446]**	**1.288****	**[1.088, 1.525]**	**1.307****	**[1.121, 1.524]**	0.901	[0.710, 1.144]	**1.307***	**[1.105, 1.547]**
Nagelkerke R^2 and Hosmer and Lemeshow test	$R^2=.154$, $\chi^2(8)=9.215$, $p=.324$		$R^2=.098$, $\chi^2(8)=8.462$, $p=.390$		$R^2=.143$, $\chi^2(8)=5.790$, $p=.671$		$R^2=.125$, $\chi^2(8)=13.522$, $p=.095$		$R^2=.056$, $\chi^2(8)=11.452$, $p=.177$		$R^2=.117$, $\chi^2(8)=5.765$, $p=.674$	

AOR: adjusted odds ratio; CI: confidence interval; HS: high school.
AORs with $p<.05$ in bold; AORs with $p<.1$ are in italics.
[a]Reference group: Non-Hispanic Whites.
[b]Reference group: some high school or less.
*$p<.05$; **$p<.01$; ***$p<.001$.

	Fixing things that go wrong with a computer or mobile device	Finding information you're looking for online (and translating online content [a])	Learning how a computer or mobile device works	Downloading apps, software, music, or movies	
College grad or more	26	41	19	23	**Parent driven**
Non-Hispanic White	19	29	15	11	**Parent driven**
Above poverty level	19	24	17	10	**Parent driven**
HS grad or some college	11	12	5	<1	**Parent driven**
Below poverty level	5	5	4	2	**Child driven**
Hispanic (English-dominant)	5	7	3	4	**Child driven**
African American	9	1	2	3	**Child driven**
Some HS or less	9	7	15	12	**Child driven**
Hispanic (Spanish-dominant)	12	17(14)	24	20	**Child driven**

Figure 1. Differentials between parent tech guidance and child tech brokering, as percentage point difference.
[a]Translating content reported only for Spanish-dominant Hispanics.

Because we were interested in how assistance flowed between parents and children for various technology activities, we used the data in Table 3 to calculate differentials between reported levels of parental tech guidance and child tech brokering. Figure 1 presents these differentials in parent tech guidance and child tech brokering by education, race/ethnic origin, and income. Our objective was to understand the extent to which technology assistance flows in lower-income families were *parent-driven* or *child-driven* for different technology activities. For each sub-group, we subtracted the percentage of households reporting a specific child tech brokering activity from the percentage reporting parent tech guidance for the same activity[4] (see Note 4).

For example, for families headed by a college graduate, the differential between parent- and child-driven assistance in fixing things that go wrong with a computer/mobile device was calculated by subtracting the percentage of those households reporting that children brokered this activity (i.e. 28.6%) from the percentage reporting that parents guided this activity (i.e. 54.8%). The difference is rounded to 26 in the top left cell of Figure 1. Likewise, the differential between parent- and child-driven assistance in downloading activities among Spanish-dominant Hispanic families was calculated by subtracting the percentage of households reporting that children brokered this activity (52.4%) from the percentage reporting that parents guided this activity (32.1%). The result, −20.3%, is rounded to 20 in the bottom right cell of Figure 1. For ease of presentation, we removed the negative sign for cells where child tech brokering outweighed parent tech guidance and used shading to differentiate them instead. An unshaded cell denotes tech guidance flowing from parents to children for that activity, whereas a shaded cell denotes tech assistance flowing from children to parents.

Family technology activities are entirely parent-driven in families headed by parents who are college graduates, non-Hispanic White, or reported household incomes above the poverty line, although Figure 1 shows that discrepancies between the amounts of guidance that parents provide and receive differed markedly by the activity in question. Parents who have completed high school or some college also guide their children more than they rely on brokering, but they do so by smaller differentials that include an even exchange between the generations for downloading activities (<1% differential).

English-dominant Hispanic and African American parents and those below the poverty line report inter-generational technology flows that are parent-guided for some activities and child-brokered for others. The differentials between parent tech guidance and child tech brokering are the least pronounced overall in these families.

Finally, technology assistance is child-driven across all specific activities in families where parents have not completed high school or are Spanish-dominant Hispanics. The latter group reports the starkest differentials between child tech brokering and parent tech guidance. We note here that we asked all surveyed parents whose homes were not English-only whether they and their children helped each other by translating online information. Spanish-dominant Hispanics were the only group to answer this question in meaningful numbers. Figure 1 shows that children of Spanish-dominant Hispanics not only broker their parents' efforts to locate online information but also translate the information that they have located. These children are brokering both technology and language for parents with limited English proficiency.

RQ2. The second set of research questions asked how siblings engage each other as learning partners. It queried the extent to which their shared activities are related to sociodemographics (RQ2a) and to learning activities that parents and children are doing together (RQ2b). Table 5 presents the results of bivariate analyses (chi-square for race/ethnic origin and parental education, and correlation for income). Overall, parents reported that their children are learning together frequently and in a variety of ways; most parents indicated that siblings engage in each of these activities at least sometimes. These patterns varied minimally across race/ethnic origin, parent education, and household income levels.

Analyses for RQ1 had established that assistance flows with technology are more parent-driven in some families and more child-driven in others. The RQ2b analyses thus explored whether these two arrangements of inter-generational technology assistance set family norms that siblings follow, including the possibility that siblings whose parents provide less tech guidance might compensate by helping each other more intensively. We used multiple regression analysis to examine the associations between intensity of parent tech guidance and child tech brokering on sibling activities, controlling for race/ethnic origin, parent education, and income level.

The results show that intensity of child tech brokering and parent tech guidance relates to different types of sibling activities (see Table 6). Parent tech guidance was positively

Table 5. Intra-generational activity by race/ethnic origin, education, and income.[a,b]

	Race/ethnic origin					Education				Income
	Non-Hispanic White % [95% CI]	African American % [95% CI]	Hispanic (English-dominant) % [95% CI]	Hispanic (Spanish-dominant) % [95%CI]	Overall χ^2	Some HS or less % [95% CI]	HS grad or some college % [95% CI]	College grad or more % [95% CI]	Overall χ^2	OR, p
Help each other to learn how to use a computer/mobile device[b]	80.2 [75.0, 85.4]	76.3 [65.4, 87.2]	87.5 [79.9, 95.1]	86.0 [77.0, 95.0]	$\chi^2(3)=3.821$, $p=.281$	83.3 [73.4, 93.2]	82.0 [77.5, 86.5]	79.2 [70.1, 88.3]	$\chi^2(2)=0.430$, $p=.806$	0.901, $p=.529$
Watch TV shows or online videos together to learn something new[c]	85.7 [81.4, 90.0]	91.4 [84.8, 98]	91.0 [85.1, 96.9]	86.7 [79.4, 94.0]	$\chi^2(3)=2.787$, $p=.426$	90.1 [84.0, 96.2]	87.3 [83.7, 90.9]	86.3 [78.8, 93.8]	$\chi^2(2)=0.696$, $p=.706$	1.115, $p=.432$
Help each other with homework	78.2 [73.2, 83.2]	87.1 [79.2, 9.05]	76.4 [67.6, 85.2]	92.7 [87.1, 98.3]	$\chi^2(3)=11.879$, $p<.01$	88 [81.4, 94.6]	81.3 [77.1, 85.5]	75 [65.5, 84.5]	$\chi^2(2)=4.869$, $p=.088$	0.771, $p=.080$
Read together or read to each other	74.6 [69.3, 79.9]	81.4 [72.3, 90.5]	84.4 [76.9, 91.9]	85.4 [77.8, 93.0]	$\chi^2(3)=6.859$, $p=.077$	81.7 [73.8, 89.6]	78.7 [74.2, 83.2]	77.5 [68.3, 86.7]	$\chi^2(2)=0.540$, $p=.763$	0.834, $p=.207$
Do art or science projects together	65.4 [59.6, 71.2]	65.7 [54.6, 76.8]	74.4 [65.4, 83.4]	72.3 [62.7, 81.9]	$\chi^2(3)=3.407$, $p=.333$	72.0 [62.9, 81.1]	69 [64.0, 74.0]	61.3 [50.6, 72.0]	$\chi^2(2)=2.517$, $p=.284$	0.869, $p=.262$

CI: confidence interval; HS: high school; OR: odds ratio.
[a]Siblings engaged in the activity sometimes or often.
[b]Item asked to parents who own a desktop or laptop computer ($N=445$).
[c]Item asked to parents who own a television set and/or smartphone or tablet or desktop or laptop computer ($N=531$).

Table 6. Multiple regression analysis on sibling activities.

	Help each other learn how to use a computer or mobile device		Watch TV shows (or online videos) together to learn something new		Help each other with their homework		Read together, or read to each other		Do art or science projects together	
	Std *B*	[95% CI]	Std *B*	[95% CI]	Std *B*	[95% CI]	Std *B*	[95% CI]	Std *B*	[95% CI]
African American[a]	0.023	[−0.319, 0.432]	0.019	[−0.295, 0.384]	**0.192***	**[0.110, 0.890]**	**0.160***	**[0.037, 0.862]**	0.096	[−0.149, 0.727]
English-dominant Hispanic[a]	0.111	[−0.092, 0.592]	*0.131*	*[−0.034, 0.585]*	0.056	[−0.222, 0.489]	**0.225****	**[0.199, 0.951]**	**0.233****	**[0.237, 1.036]**
Spanish-dominant Hispanic[a]	0.034	[−0.326, 0.506]	−0.020	[−0.424, 0.328]	*0.152*	*[−0.016, 0.848]*	**0.228****	**[0.216, 1.130]**	0.054	[−0.315, 0.655]
High school degree or some college[b]	−0.057	[−0.229, 0.104]	0.039	[−0.111, 0.190]	−0.025	[−0.201, 0.144]	−0.074	[−0.274, 0.092]	−0.016	[−0.214, 0.173]
College degree or more[b]	−0.060	[−0.518, 0.290]	0.105	[−0.178, 0.552]	−0.113	[−0.646, 0.193]	−0.046	[−0.544, 0.344]	0.021	[−0.422, 0.521]
Income	−0.037	[−0.588, 0.413]	−0.082	[−0.631, 0.274]	−0.112	[−0.796, 0.243]	0.003	[−0.542, 0.558]	−0.016	[−0.603, 0.537]
Parent tech guidance intensity	0.115	[−0.068, 0.559]	0.122	[−0.041, 0.526]	*0.142*	*[−0.008, 0.643]*	**0.148***	**[0.012, 0.701]**	**0.243****	**[0.26, 0.991]**
Child tech brokering intensity	**0.194***	**[0.094, 0.692]**	**0.229****	**[0.162, 0.702]**	0.066	[−0.171, 0.450]	0.021	[−0.281, 0.376]	*0.123*	*[−0.048, 0.649]*
Model R^2	$R^2 = .251$, $p = .154$		$R^2 = .339$, $p = .004$		$R^2 = .286$, $p = .046$		$R^2 = .340$, $p = .004$		$R^2 = .347$, $p = .003$	

CI: confidence interval.
Coefficients with $p < .05$ are in bold; coefficients with $p < .1$ are in italics.
[a]Reference group: Non-Hispanic Whites.
[b]Reference group: some high school or less.
*$p < .05$; **$p < .01$; ***$p < .001$.

associated with siblings reading to each other and doing art or science projects together and (marginally) with siblings helping each other with homework. On the other hand, child tech brokering was positively associated with siblings helping each other learn how to use computers or mobile devices and watching TV shows or online videos together to learn something new.

Discussion and implications

The goal of this investigation was to deepen current understandings of how family members collaborate to learn with technology together. We examined how parents can guide certain technology activities and receive guidance from their children on others. We considered how those patterns are influenced by sociodemographic variation and parents' own experiences with technology. We then explored how siblings' collaborative experiences are influenced by the extent to which inter-generational technology practices are either parent- or child-driven.

The data are drawn from the first large, national survey of parents who are raising school-age children below the median US household income (see Note 1). These low-income and lower-middle-income families have seldom been the focus of research on children, families, and technology. Instead, most studies have focused on wealthier families in which parents are college-educated and tend to have more experience and skills with technology (Alper et al., 2016). Their findings therefore have limited application for initiatives to reduce unequal access to the Internet and digital technologies (i.e. digital inequality). We address this gap by examining how sociodemographic factors established as important by prior digital inequality research—household income, parent education, and variations in race, ethnicity, and English language proficiency—are related to patterns in family technology engagement (Lopez et al., 2013; Rideout and Katz, 2016). We also account for variation in parents' technology experiences with measures commonly employed in research on digital inequality among adults: the number of years that parents have been online, how frequently they use the Internet, and how confident they feel doing so (Eastin and LaRose, 2000; Helsper and van Deursen, 2016).

Our approach to assessing sociodemographic variations and why they matter for family technology engagement is guided by Livingstone and Helsper's (2007) conceptualization of digital inclusion/exclusion as a spectrum (as opposed to a binary "digital divide"), along which members of different social groups are placed. Considering digital inclusion, and the family technology practices that can support it, along a continuum makes it possible to consider similarities among social groups and not just differences between them. Our focus on sociodemographic variation reflects our interest in the structural mechanisms that shape technology experiences, and in how those mechanisms influence family dynamics that facilitate inter- and intra-generational engagement with technology.

Findings for our first set of research questions (RQ1a and RQ1b) underscore the considerable theoretical contribution that Clark (2011) made by reformulating parental mediation to center on *co-learning*. Our results support Clark's shift from presuming that mediation is something that parents do for children, to considering technology engagement as a dynamic interplay between generations.

In RQ1a, we found that inter-generational engagement around technology is occurring, both frequently and intensively, in lower-income families with varied parental education, household incomes, racial/ethnic origins, and language proficiencies. Across the full sample, no fewer than one-third and up to two-thirds of parents and children help each other to learn how new devices work. This finding alone reveals that the process of adopting "personal" devices in lower-income families has collective characteristics (Katz, 2010). Lower-income families also face challenges maintaining the functionality of their devices (Gonzales, 2014); we find that parents and children frequently help each other troubleshoot those issues. Likewise, we find that parents and children are frequently helping each other to find (and translate, in Spanish-dominant Hispanic families) desired information and to download apps, software, music, and movies. Our results demonstrate that individual-level differences among parents' technology experiences explain some of the variance, but important differences between social groups remain even after accounting for those differences.

Findings for RQ1a and RQ1b reveal that parents with lower socioeconomic status and English language proficiency are the most likely to rely on their children to broker technology and least likely to guide their children's technology use. These findings are consistent with prior research on children's technology brokering. With a national dataset, our findings contextualized Katz's (2014) qualitative research by demonstrating that the low-income, Spanish-dominant Hispanic families she had studied broker technology more frequently and intensely than children from other social groups. Our findings also support what Correa (2015) found in a different national context (Chile); parental education and household income matter a great deal for how central children's roles are to family technology practices.

Our RQ1b results show that children's tech brokering and parents' tech guidance are not mutually exclusive processes. Instead, to varying degrees, parents and children are involved in mutual learning exchanges around technology. The differentials we present in Figure 1 display just how dynamic these exchanges can be. Even among parents who guide their children more across all activities (i.e. parents who are college graduates, non-Hispanic White, or have higher household incomes), parents' leadership varies considerably by activity. For example, even college graduates exhibit less leadership when it comes to downloads, as compared with helping children locate content online. Assistance flows from the "top-down" and "bottom-up" are even more clearly demarcated by activity for English-dominant Hispanics, African Americans, and families below the poverty line. For families in which parents are Spanish-dominant or have not completed high school, it appears that children receive relatively more parent support when it becomes necessary to fix devices and provide more leadership for downloading activities, for example.

The dynamism of the inter-generational assistance flows captured in Figure 1 demonstrates how Clark's (2011) more neutral theoretical co-learning frame can help researchers fully capture diverse families' technology experiences. Extant scholarship has primarily focused on parental mediation strategies, wherein parents guide children's media and technology use rather than the reverse. That tendency has been reified by conducting research on parents who (by virtue of income, education, occupational exposure to technology, and other factors) are best equipped to engage in such practices. The consequence has been normative conclusions that parents *should* lead the way when it comes to technology use, such that parents are presumed ineffectual and their children insufficiently protected from risk when families deviate from this decidedly middle-class, majority culture standard (Alper et al., 2016; Livingstone, 2009; Valkenburg et al., 1999; Wartella and Reeves, 1985). More inclusive consideration of the contributions that all family members make to shared technology experiences provides more valid assessments of potential synergies and emphasizes often-overlooked strengths within families that are too frequently framed by their deficits.

Our second set of research questions (RQ2a and RQ2b) took the inquiry a step further to assess whether *intra*-generational technology assistance varies sociodemographically and relates to siblings' shared learning activities. We consider the family as an interdependent system, in which dynamics between certain family members affect interactions between others (Olsen, 2000; Takeuchi and Levine, 2014). Our results reveal that when family technology assistance is predominantly *parent-driven*, siblings are more likely to read with each other, complete art and science projects together, and help each other with homework. On the other hand, when family technology assistance is more *child-driven*, siblings are more likely to help each other learn how to use a computer or mobile device and go online to watch television or videos together.

These patterns are provocative because they suggest that in households where technology assistance is more parent-driven, the stage is also set for sibling collaboration on learning activities that teachers validate as good support for classroom learning. Although reading together, completing art and science projects, and doing homework often involve technology use, teachers view these as productive activities, while unstructured time online or watching television and videos is often dismissed as wasting time (Common Sense Media, 2012). The latter sibling activities are significantly more likely among families in which children provide their parents with more technology assistance than they receive.

These results become troubling when considered in conjunction with RQ1b findings, because they suggest compounded disadvantage for children whose parents have not completed high school and/or are Spanish-dominant. Prior research (Louie, 2012; Reese, 2001) shows that these parental demographics (which are not mutually exclusive) face the greatest challenges in helping their children with homework and other school-related projects. Our findings reveal that siblings' activities do not compensate for their parents' constrained capabilities to support formal learning activities at home. These results therefore also call into question prior findings suggesting that family responsibilities disadvantage child brokers (Weisskirch, 2017), because the adverse outcomes they experience may instead reflect the narrow definitions of appropriate, informal learning activities that are sanctioned by educators.

Study limitations

While our analyses make important contributions to usually disparate literatures, they have some important limitations. The dataset did not include specific questions about parenting strategies related to children's technology use. That omission was not an oversight. We decided to privilege what interviewed parents and children had emphasized about their family practices rather than to rely on established measures of mediation styles (Gonzalez and Katz, 2016; Valkenburg et al., 1999). We therefore make no claims that our analyses holistically assess family technology dynamics. The dataset is also cross-sectional in nature; therefore, we identified associations between variables of interest but do not make causal claims. Finally, we have provided our rationale for collecting data only from families in the bottom-half of the US income distribution. It is our hope that we have established a foundation that enables future research on families' technology experiences across the income spectrum that nonetheless remains mindful of the digital equity challenges that persist at the lower end of that spectrum.

Implications for digital equity initiatives

Despite these limitations, our findings have important implications for designing digital equity programs, as well as for future scholarship. We began this inquiry with an interest in how research on lower-income families' technology practices could inform development of programs and policies to address digital equity concerns for school-age children and their families. Our findings reflect growing recognition among scholars and practitioners that although access to consistent, high-quality Internet and well-functioning devices still matters (Gonzales, 2014, 2016), disparities in access to quality support for developing digital skills and knowledge are as important (Helsper and van Deursen, 2016). Waldman's (2011) assessment of information needs among US populations for the Federal Communications Commission revealed that parents and children in high-need communities are most likely to require local resources to support them in developing technological capabilities, but least likely to have such support available.

We believe our findings suggest both promise and caution about how family members can serve as these supports for each other. Our survey findings reveal frequent and intense co-engagement with technology in lower-income families. The interviews we conducted prior to the survey (Katz and Gonzalez, 2016a; see Note 2) lend qualitative support to our assertion that family members are actively seeking each other's guidance, co-learning, and supporting each other in developing technological skills and confidence. Families are already enacting such practices, which is promising for digital equity programs designed to leverage these familial strengths. Such programs will need to establish quality local resources for parents and children to extend their existing practices and assist them with maintaining their devices or managing interruptions in connectivity (Dailey et al., 2010; Gonzales, 2016). Brokering responsibilities are less likely to have adverse effects for children when their parents and other adults actively support their efforts (Katz, 2014). Quality community support for family technology engagement, in the form of trusted local adults and institutions, can therefore provide critical assistance to the child brokers who need them most. These local resources also provide parents with opportunities to increase their own technological capabilities independent of their children.

There are important cautions for digital equity programs from our findings as well. Parents' reliance on their children's technology brokering is associated with lower household income, parental education, and English language proficiency. It would be misguided to celebrate children's contributions to family technology practices without also being mindful of constraints that they experience in compensating for parents' limited technological capabilities. Our RQ2 findings show that siblings are unlikely to adequately compensate for these challenges. Children growing up in low-income and immigrant families generally have less consistent and quality access to new technologies (Horrigan, 2014), and thus cannot always effectively bridge their families' access to online information and digital resources. In fact, recent research suggests that the immersive experiences new technologies offer to users may more readily reveal limitations in child brokers' capabilities than more finite, traditional media formats (Yip et al., 2016). To gain traction, digital equity programs must address parents' and children's needs for local support and affordable access, while also demonstrating confidence in what families can accomplish when they collaborate and learn together.

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Supplementary Material

Supplementary material is available for this article online.

Notes

1. Parents qualified to participate in the survey if they reported a household income of US$65,000 or lower; the national median for families with one or more children under 18 years of age was slightly below this level in 2015 (specifically, US$63,767), per the Annual Social and Economic Supplement, Table FINC-03 of the Current Population Survey. Retrieved from: http://www.census.gov/hhes/www/cpstables/032015/faminc/toc.htm.
2. See http://www.digitalequityforlearning.org for details on the full study methodology and findings.
3. This question was asked only if parents indicated that they spoke a non-English language at home, either exclusively or in addition to English.
4. We provide differentials as a heuristic to illustrate and facilitate interpretation of differences in parent tech guidance and child tech brokering across racial and socioeconomic groups.

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