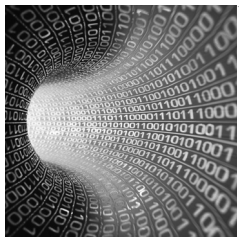

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ARTICLE

Old wine in a new technology, or a different type of digital divide?

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Abstract

Gender differences exist in both general and specific uses of information and communication technologies (ICTs). Most of this research has focused on computers and the internet to the exclusion of mobile phones. Little research has examined gender differences in specific types of mobile phone usage, especially among youth. This issue is examined using data from a random sample of middle-school students. Although gender differences exist at the bivariate level, the picture changes in multivariate models. Boys exhibited greater frequency of use for non-social, gadget-like features of mobile phones; no gender differences existed in more traditional communicative mobile phone uses.

Key words

digital divide • gender • mobile phone • youth

Research shows that a gender divide exists in usage of computers and the internet, with males being more likely to use, more advanced in their use of and more comfortable with these technologies (Cooper, 2006; Gurer and Camp, 2002; Hargittai and Shafer, 2006; Sutton, 1991; Volman and Eck, 2001; Whitley, 1997). Usage patterns of these technologies are related to

intentions to enter information technology careers (American Association of University Women Educational Foundation, 2000; Gupta and Houtz, 2000; Margolis and Fisher, 2002). Although some researchers (Brodie et al., 2000; Fallows, 2005; Freeman, 2004; Kaiser Family Foundation, 1999; Shaw and Gant, 2002) and governmental organizations (National Telecommunications and Information Administration (NTIA), 2002, 2004) suggest that the gender divide in computer and internet usage is narrowing, others suggest that there are multiple layers to the digital divide beyond connectivity and usage levels (Davison and Cotten, 2003; Hargittai and Shafer, 2006; Hou et al., 2006).

We suggest that mobile phones represent a new type of technology that researchers should examine in relation to the digital divide (Rice and Katz, 2003; Robbins and Turner, 2002). Little is known about mobile phone use among youth or whether a mobile phone digital divide exists (Rees and Noyes, 2007). Given the increasing functionality of, and reliance upon, mobile phones by youth, better understanding the access, usage and social impacts of mobile phones is warranted. This study advances others by focusing not just on ownership and basic usage, but also on gender differences in general and specific uses of mobile phones such as talking, Short Message Service (SMS, 'texting') and multimedia applications.

Context-dependent social exclusion (Haddon, 2000) may result from differential usage patterns rather than from simple dichotomies of access/non-access and use/non-use. We examine issues surrounding use, functionality and skills that Hargittai and Shafer (2006) have suggested are important for understanding further layers of the digital divide. Understanding gendered usage patterns of new technologies is especially important in the light of work examining how different modalities of relating to technology interrelate with the social construction of gender (Cockburn and Ormrod, 1993; Henwood, 1993; Wajcman, 1991). Just as pink becomes a 'girl' color through selective social affirmation, technology (especially 'gadgetry') and the use of it becomes associated with masculinity, attracting boys and signaling to girls that such technology use is to be avoided.

Such gendering of technology can have implications for career intentions and choices. Margolis and Fisher found a strong divergence between the trajectories of male and female computer science students. Males often expressed having 'fallen in love' with the machine early in their childhood; females valued what they could do *with* the machine, not what they could do *at* the machine (Margolis and Fisher, 2002). Other researchers have reported similar results (Eccles, 2005; Turkle, 1988). Lent et al. (1994) suggest that factors such as gender, race and ethnicity may relate to career choices through psychosocial shaping processes, in which different activities evoke dissimilar reactions from the social and cultural environment, so that the outcomes

that young people receive for performing different activities diverge based upon their gender or ethnicity. Given the shortage of females going into technology careers and the drop-out of females along the various stages of the pipeline (Charles and Bradley, 2006; Durndell et al., 1995), mobile phone skill and usage may be an under-explored type of technology usage which may be related differentially by gender to career trajectories.

YOUTH MOBILE PHONE OWNERSHIP AND USAGE

Mobile phone usage among youth is high. Salaway et al. (2007) found that 86 percent of 18–19-year-old US college students in their multi-college study owned a simple mobile phone (e.g. one without internet access), while another 12 percent owned smartphones (e.g. a combination mobile phone/personal digital assistant; PDA). Ling and Helmersen (2000) found that by age 15, more than 80 percent of Norwegian teenagers had access to a mobile phone, with nearly 69 percent owning phones. In a study of pre-adolescent mobile phone ownership and usage in the UK, Davie et al. (2004) found that nearly half of the 10–11-year-olds had mobile phone access. Recent research shows that 71 percent of teens own a mobile phone; however, 58 percent of teens report having sent or received text messages, with 36 percent of teens having reported sending text messages every day (Lenhart et al., 2008a, 2008b). Although these numbers are lower than the 93 percent of US teens aged 12–17 who use the internet (Lenhart, 2007), adolescents are likely to cite the mobile phone as their favorite method of communication (Campbell, 2005).

Mobile phone research (e.g. Kaiser Family Foundation, 1999; Lenhart et al., 2005; Ling, 2000; Ling and Helmersen, 2000; Roberts et al., 2005) looks at ownership patterns and general usage or examines usage concurrently with other information and communication technology (ICT) use. Researchers have examined mobile phone usage among a range of populations in other countries (e.g. Ling and Helmersen, 2000 and Ling and Haddon, 2001 in Norway; Ito 2004, 2005 in Japan). However, mobile phone ownership and usage research among pre-adolescent youth is sparse (Davie et al., 2004), particularly in the USA.

While children of relatively young age have the ability and social sense to use the telephone, little evidence supports the idea that children younger than 12 would have social networks of such size to warrant significant telephone use (Skelton, 1989, in Campbell, 2005). However, US-based research indicates that youth are using ICTs at younger ages (Kaiser Family Foundation, 1999; Roberts et al., 2005) and may be interested in them as symbols of status, fashion, independence and for providing the capability for peer-group members to communicate with each other without

adult supervision (Campbell, 2005, 2007; Davie et al., 2004; Ling and Helmersen, 2000).

Research examining the predictors of mobile phone adoption and use among youth has focused primarily on non-US populations. Ling (2000) identified age and employment status as important predictors of youth mobile phone use in Norway. Parental support of youth mobile phone use seems to be related to safety and monitoring concerns (Campbell, 2005; Ling, 2000). In Norway, often accessibility, safety and 'micro-coordination' (the real-time coordination of plans and activities) are cited as primary motives for mobile phone ownership among youth (Ling, 2000). Lenhart et al. (2005) found 33 percent of US teens aged 12–17 had used the phone for text messaging. Other research notes broader reasons for use (e.g. Wilska, 2003 in Finland; Campbell, 2007 for a review article), such as fashion or communication.

Much of the published research as of 2008 is descriptive, showing gender differences in mobile phone use and ownership, but not examining in detail the role that gender plays in these processes (see Davie et al. 2004; Rees and Noyes, 2007; Wilska, 2003 for exceptions).

GENDER AND MOBILE PHONE USAGE

Early business models ignored or repressed the use of the telephone for sociability, a use pioneered by women. In 1928, an AT&T vice-president decried the use of telephones, a kind of 'business telegraph', for 'visiting' and other 'frivolous' uses, based on the perception that it was women who made social calls (Fisher, 1992). Women persisted, sociability uses spread and business leaders gave in to demand over their gendered imperatives. As telephones became incorporated increasingly into households, they came to be considered a 'feminine' technology (Kelan, 2007; Smoreda and Licoppe, 2000), used more for casual communication.

Mobile phones combine a 'feminine' social technology with a 'masculine' gadget, with multiple functions. This combination of masculine and feminine in one device presents a rare opportunity to examine the process by which gender socialization extends into and incorporates artifacts and, ultimately, career intentions. Selwyn (2007) found that among UK college students, mobile phones were perceived as a somewhat feminine technology, but less so than landline phones, attesting to the place the mobile phone occupies between the socially-oriented connotations of the traditional phone and the technical bent of the new gadgets – not as heavily associated with femininity as the phone, but neither out of its orbit.

Mobile phone ownership and general usage is matched fairly evenly ?among boys and girls in the USA and UK (Davie et al., 2004; Roberts et al., 2005), with nearly half of 10–11-year-olds having access. In the UK, Rees and Noyes (2007) found that while there were no gender differences

in general mobile phone use or ability, there might be gender differences in affinity toward specific uses of the mobile phone; this suggests that 'equal experience' with mobile phones among males and females may account for the lack of gender differences in use and ability (2007: 483). Similarly, Wilska (2003) and Kelan (2007) suggest that males would be more likely to use functions such as games or internet access, while females would be more likely to use a phone's communication features.

Distinctions in previous ICT research between machine-focused or device-focused use and people-focused technology use (Boneva, 2001; Faulkner, 2001; Hou et al., 2006; Margolis and Fisher, 2002) may be important when studying mobile phone usage. One such distinction that seems particularly appropriate is of expressiveness versus instrumentalism, or 'tool versus toy' (Kelan, 2007). From early ages, boys tend to interact with technology in an instrumentalist fashion as 'toys', while girls tend toward a more expressive approach, interacting with technology according to what it can help them to accomplish; gender differences in the perceptions and use of a technology in one setting may disappear or reverse if the context of the technology changes (French and Richardson, 2005). Whether something is a 'tool' or 'toy' may depend on the context of use. While traditionally phones have been 'gendered' as feminine, based on their communicative use (Kelan, 2007), it may be that mobile phones will be (or already are) differently gendered, based on their additional features such as gaming, internet access or global positioning systems, or even that we will find no gender differences in certain types of usage, as suggested by Rees and Noyes (2007).

Research has suggested that at younger ages, there are fewer gender differences in mobile phone use (Wilska, 2003). As children age, a divide may develop, particularly in 'consumption style'. Boys tend to emphasize trendiness and gadgetry, looking for the latest features and capabilities in their phones. Girls tend to emphasize 'use' value, looking for phones that will allow them to perform the tasks that interest them. In Wilska's view, these represent 'stereotypically gendered mobile phone use styles' (2003: 457). This is consistent with research on other technologies, which found that girls tend to turn toward the more practical uses of ICTs while boys tend to maintain a 'playful' attitude (Livingstone and Helsper, 2007). Research on ICTs shows that US women tend to value the communicative uses of technologies, their social rewards resulting from computer use and ease of use more than men (Margolis and Fisher, 2002; Venkatesh and Morris, 2000). Although limited research considers younger age groups, mobile phones appear to be no different from other technology in this regard.

For example, recent studies find that US school-age girls and boys express similar levels of use and liking of computers (Creamer et al., 2004). However, a finer-grained analysis reveals significant gender differences in

usage types and levels of perceived skill. In US general population and high school samples, males perceive themselves as being more skilled than females (Gupta and Houtz, 2000; Hargittai and Shafer, 2006). Hargittai (2007) suggests that skill level is an important factor in the use of newer ICTs. However, the results have been mixed in middle school or earlier, with some research indicating no difference in perceived skills (Bain and Rice, 2006 and Miller et al., 2001 in the USA; King et al., 2002 in Australia) while others found that boys felt more confident in their skills (Young, 1999 in the USA).

In addition, strong gender differences in gaming practices have been identified (Cassell and Jenkins, 1998; Schumacher and Morahan-Martin, 2001 in the USA; Selwyn, 2007 in the UK). This could translate into mobile phone practice, as it may be that boys are more likely to treat the phone itself as a toy, especially as many phones include digital games.

HYPOTHESES

Given prior research, we propose the following hypotheses:

> H1: There will be no significant gender difference in general mobile phone ownership.
>
> H2: There will be no significant gender difference in general usage.
>
> H3: Gender differences will exist in the number of mobile phone features used. Males will report using more features than females, given prior research showing that men react more enthusiastically to new technologies (Broos, 2005), and that being male is associated with a fascination with gadgets (Selwyn, 2007).
>
> H4: There will be significant gender differences in the frequency of particular uses of the mobile phone. Boys will report more frequently using the more technologically advanced and/or 'toy' functions of the mobile phone (e.g. gaming, email and multimedia functions). Girls will use the mobile phone's communicative and sociability functions more often (e.g. calling and text messaging). In other words, boys will tend to use the mobile phone as a toy, while girls will use it as a tool.
>
> H5: Mobile phone affinity and skill level will be related to ownership and usage, with youth who report higher levels of affinity and skill being more likely to own and use mobile phones.
>
> H6: Mobile phone affinity and skill level will mediate gender differences in mobile phone ownership and usage.

METHOD

Sample

The data for this study were drawn from a 2006 survey of a random sample of middle-school students in a county school system in the mid-Atlantic region

of the USA. The schools in the sample were stratified into lower and higher socioeconomic strata based upon the percentage of students receiving free or reduced price lunches (20% or higher versus fewer than 20%). Two schools were selected randomly from each stratum. This is a common technique that is used in school studies to enhance sample socioeconomic heterogeneity (Kim and Sunderman, 2005; Puma et al., 1993). A fifth school with relatively high free and reduced lunch program participation was included for purposes of contrast.

Measures

Dependent variables Mobile phone ownership and usage were measured dichotomously (where 1 = yes). General usage was operationalized as hours of use per day (Ln used due to a skewed distribution), and the total number of features used (0–8). Eight specific uses were measured: making/receiving calls, text messaging, game playing, music listening, picture taking, picture or video sharing, email and phonebook use. Each was measured using a five-point scale (where 0 = never to 5 = several times a day). Each measure was modified and/or adapted from existing Pew Studies assessing mobile phone, computer and internet usage (Lenhart and Madden, 2005; Lenhart et al., 2005).

Independent variables Gender was the primary independent variable (where 1 = female). How much the respondent liked using a mobile phone to make or receive calls (hereafter, 'mobile phone affinity') was measured on a five-point scale (where 1 = dislike it a lot to 5 = like it a lot). The respondent's self-reported mobile phone skill was measured on a 10-point scale (where 1 = not skilled to 10 = expert).

'Race' was coded as a series of dummy variables, with white as the reference category. Grade in school was the student school-reported grade level. Student reported mother's and father's mobile phone skill was measured using a scale (where 1 = not skilled to 4 = very skilled). Mother's and father's education was measured on a scale (where 1 = less than high school to 4 = college degree or higher). To reduce attrition from missing data, values for parents' mobile phone skill and education were imputed in 20 percent of the cases in the full survey data.

Data analysis

Univariate and bivariate statistics were examined in order to assess sample descriptive characteristics. Next, bivariate gender differences were examined. Hypotheses were tested using ordinary least squares and logistic regression. First, we examine whether gender differences existed in our outcomes when controlling for sociodemographics. Second, we examine mobile phone affinity and skill level and whether these factors mediate the relationship

between gender and mobile phone usage. Third, we examine phone ownership and usage for the full sample ($N = 976$). Finally, we examine hours of use, number of functions used and frequency of specific usage types among those students who report using mobile phones ($N = 744$).

RESULTS

The sample was close to evenly split between males and females (see Table 1). The majority of respondents were white, with approximately equal distribution across grade levels (mean age = 12.6 years).

Mobile phone use and ownership was high, with nearly 61 percent of the sample owning mobile phones and 76 percent reporting using a mobile phone (see Table 2). Mean daily use was 1.7 hours. Girls reported slightly higher mean daily hours of use than boys; they also reported liking making and receiving mobile phone calls and being more skilled in using mobile phones than boys.

• Table 1 Sample characteristics ($N = 976$)

	MEAN
Gender	
Male	50.7%
Female	49.3%
Ethnicity	
White (non-Hispanic)	55.9%
Hispanic	7.9%
African American (NH)	13.3%
Asian or Pacific Islander (NH)	11.4%
Other/multi-racial	11.4%
Age	12.6
Grade	
6	29.1%
7	39.1%
8	31.8%
Father's education	3.7 – some college
Mother's education	3.7 – some college
When using a mobile phone do you: (% answering 'at least every few months')	
Make or receive calls	81.8%
Use text messaging	54.1%
Play games	64.2%
Take pictures	64.7%
Listen to music	46.9%
Share pictures or video	45.0%
Send or receive email	30.2%
Use as phonebook	68.9%

• Table 2 Bivariate comparisons by gender

Variable	Full sample (N = 976)	Mobile phone users only: Male (N = 358)	Mobile phone users only: Female (N = 386)	Sig.
Own a mobile phone				
Yes	60.7%	74.6%	78.8%	***
Use a mobile phone				
Yes	76.2%	–	–	
Hours of use	1.70	1.82	2.18	***
Number of features used	4.56	5.24	5.48	
How often do you:				
Make or receive calls	3.24	3.73	4.05	**
Use text messaging	2.01	2.24	2.77	***
Play games	1.90	2.27	2.07	
Take pictures	2.34	2.55	2.98	**
Listen to music	1.78	2.12	2.16	
Share pictures or video	1.45	1.76	1.81	
Send or receive email	0.90	1.12	1.10	
Use as phonebook	2.58	2.80	3.52	***
How much do you like making or receiving calls?	4.14	4.10	4.61	***
How skilled are you at using a mobile phone?	7.93	8.37	8.96	***
Parent's skill with mobile phone				
Father	3.2	3.18	3.19	
Mother	2.88	2.79	2.94	*

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

Girls who used mobile phones reported significantly more frequent usage than did boys in making or receiving phone calls, text messaging, picture taking and phonebook usage. The bivariate results illustrate more frequent mobile phone liking, skill and usage among girls, both in general usage and more specific uses.

Odds of ownership and usage

Girls have greater odds of ownership and usage compared to boys (see Table 3). After controlling for ethnicity, grade in school, parents' education and parents' mobile phone skill, girls were more likely to own a mobile phone than boys, with the odds of girls owning a mobile phone being 48 percent higher than the boys. The odds of girls using a mobile phone were 63 percent higher than the odds of boys using one. Ethnic differences appeared as well, with African Americans and Hispanics more likely to own a phone than whites. Compared to whites, African American youth had 100 percent greater odds of owning a mobile phone and

• Table 3 Logistic regression results: ownership and use

	Mobile phone ownership				Mobile phone usage			
Model	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Gender (female = 1)	1.48**	.871	1.11	.822	1.63**	.937	1.24	.936
Like using mobile phone		2.54***		1.80***		2.78***		1.84***
Skill at using mobile phone			1.61***	1.49***			1.63***	1.49***
Ethnicity (reference: white)								
African American	2.00**	1.64*	1.38	1.29	2.34**	1.88*	1.52	1.44
Asian	1.26	1.31	1.04	1.13	1.42	1.54	1.13	1.24
Hispanic	1.29	1.07	.978	.894	2.04*	1.73	1.61	1.49
Other	1.16	1.13	.875	.914	1.62	1.89	1.25	1.35
Grade in school (6–8)	1.68***	1.66***	1.54***	1.56***	1.51***	1.45***	1.27*	1.27*
Nagelkerke R^2	.092	.261	.336	.378	.073	.264	.364	.404

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$, $N = 976$.

All models control for father's and mother's mobile phone skill and education level.

• Table 4 Regression results: general usage

	Hours of use (ln)				Number of features used (0–8)			
Model	1	2	3	4	1	2	3	4
Gender (female = 1)	.189***	.044	.119**	.023	.271***	−.207	.028	−.280
	(.040)	(.039)	(.038)	(.037)	(.163)	(.161)	(.157)	(.157)
Like using mobile phone		.276***		.222***		.908***		.715***
		(.022)		(.023)		(.092)		(.095)
Skill at using mobile phone			.118***	.082***			.413***	.298***
			(.011)	(.011)			(.047)	(.047)
Ethnicity (reference: white)								
African American	.146*	.097	.077	.058	.937***	.776***	.695**	.635**
	(.060)	(.055)	(.057)	(.053)	(.243)	(.229)	(.233)	(.225)
Asian	.016	.052	.020	.048	.683**	.803***	.699**	.789***
	(.065)	(.059)	(.060)	(.057)	(.260)	(.245)	(.247)	(.239)
Hispanic	.077	.030	.043	.016	.457	.303	.339	.251
	(.075)	(.068)	(.070)	(.066)	(.300)	(.283)	(.286)	(.276)
Other	−.038	−.036	−.063	−.053	.089	.097	.003	.034
	(.064)	(.058)	(.060)	(.056)	(.258)	(.242)	(.245)	(.237)
Grade in school (6–8)	.043	.026	.018	.013	.078	.024	−.006	−.026
	(.026)	(.023)	(.024)	(.023)	(.104)	(.098)	(.099)	(.096)
Constant	.434	−.706**	−.398	−1.065***	4.92***	1.164	2.01	−.138
Model F	4.63***	19.17***	14.67***	23.27***	2.73***	11.60***	9.92***	14.49***
Adj. R^2	.047	.212	.168	.265	.023	.136	.117	.179
R^2 change	.059	.164	.121	.217	.036	.112	.094	.156

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$; $N = 744$.
All models control for father's and mother's mobile phone skill and education level; Standard Errors in parentheses.

134 percent greater odds of using one compared to their white schoolmates. The odds of Hispanic youth using mobile phones were twice the odds of a white student. Grade in school was also a significant predictor, with the odds of mobile phone ownership increasing by 68 percent for each grade level increase, and the odds of mobile phone usage increasing by 51 percent for each grade level increase.

However, after controlling for mobile phone affinity and skill, gender and ethnicity, the differences disappeared. The grade in school remained significant. For each one-point increase in mobile phone affinity, the odds that a respondent owned a mobile phone increased by 80 percent, and used a mobile phone increased by 84 percent. For each one-point increase in reported mobile phone skill, respondents had 49 percent higher odds of owning and using a mobile phone.

Table 4 presents the results examining hours of use and number of features used. Gender differences in hours of mobile phone usage were mediated in Model 2 by the inclusion of mobile phone affinity. The same was not true when controlling for respondent mobile phone skill (see Model 3). When controlling for mobile affinity, the coefficient for gender became non-significant. When controlling for mobile phone skill, gender remained significant. In the presence of both affinity and skill (Model 4), gender became non-significant. The explained variation level increased in the affinity, skill and affinity/skill models to .212, .168 and .265, respectively. These results suggest that mobile phone usage differentials have less to do with gender and more to do with affinity and skill. The same pattern is seen for number of features used. Gender differences disappear when controlling for affinity and skill. However, ethnic differences are not negated when controlling for affinity and skill, with African Americans and Asians showing a greater number of features used compared to whites.

Specific mobile phone usage

Among those who reported using a mobile phone, some interesting specific usage patterns emerged (see Table 5). Whereas in the bivariate comparisons, females had higher usage rates, after controlling for affinity and skill all but one of the female advantages disappeared: females still reported more usage of the mobile phone as a phonebook. In other cases, where gender differences remained after controlling for affinity and skill, boys scored higher, using the mobile phone for game playing, music listening, picture or video sharing and email. While gender differences in favor of girls were apparent initially, controlling for affinity and skill negated all but one of those advantages. Affinity and skill level partially mediated, and in some cases fully mediated, gender differences in specific mobile phone usage. The specific use that showed an advantage for boys in the bivariate comparisons (game playing)

• Table 5 Regression results: frequency of specific usage (scale: 0–5)

	Make or receive phone calls				Use text messaging			
Model	1	2	3	4	1	2	3	4
Gender (female = 1)	.323**	−.090	.103	−.158	.567***	.061	.321*	−.012
	(.107)	(.100)	(.098)	(.095)	(.153)	(.149)	(.147)	(.145)
Like using mobile phone		.785***		.605***		.962***		.771***
		(.058)		(.057)		(.085)		(.087)
Skill at using mobile phone			.375***	.278***			.419***	.295***
			(.029)	(.028)			(.043)	(.044)
Ethnicity (reference: white)								
African American	.236	.096	.016	−.035	.299	.127	.053	−.012
	(.159)	(.143)	(.145)	(.135)	(.229)	(.212)	(.217)	(.207)
Asian	.063	.166	.077	.153	−.229	−.103	−.213	−.117
	(.171)	(.153)	(.154)	(.144)	(.245)	(.226)	(.231)	(.220)
Hispanic	.056	−.077	−.051	−.126	.282	.119	.162	.067
	(.197)	(.176)	(.178)	(.166)	(.283)	(.261)	(.267)	(.254)
Other	−.099	−.091	−.176	−.151	−.492*	−.484	−.579*	−.547*
	(.169)	(.151)	(.153)	(.142)	(.242)	(.224)	(.229)	(.218)
Grade in school (6–8)	.187**	.140*	.110	.094	.345***	.287**	.259**	.239**
	(.068)	(.061)	(.062)	(.058)	(.098)	(.090)	(.093)	(.088)
Constant	2.90***	−.350	.253	−1.563*	−.344	−4.32***	−3.30***	−5.61***
Model F	2.70**	20.01***	18.28***	28.62***	3.50***	15.29***	12.08***	18.70***
Adj. R^2	.022	.220	.204	.308	.033	.175	.141	.222
R^2 change	.036	.196	.180	.284	.046	.141	.108	.189

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$; $N = 744$.

All models control for father's and mother's mobile phone skill and education level; Standard Errors in parentheses.

• Table 5 *(Continued)*

	Play games				Take pictures			
Model	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Gender (female = 1)	−.210	−.391**	−.317**	−.426***	.463**	.104	.284*	.050
	(.126)	(.131)	(.126)	(.130)	(.146)	(.146)	(.143)	(.145)
Like using mobile phone		.345***		.253***		.683***		.543***
		(.075)		(.079)		(.084)		(.087)
Skill at using mobile phone			.182***	.141***			.304***	.217***
			(.037)	(.039)			(.042)	(.044)
Ethnicity (reference: white)								
African American	.668***	.607***	.562**	.540**	.567**	.445*	.388	.343
	(.188)	(.186)	(.187)	(.186)	(.217)	(.209)	(.212)	(.207)
Asian	.356	.401*	.363	.395	.708**	.797***	.720***	.787***
	(.201)	(.199)	(.198)	(.197)	(.233)	(.223)	(.225)	(.220)
Hispanic	.345	.286	.293	.261	.512	.396	.425	.357
	(.232)	(.230)	(.229)	(.228)	(.268)	(.258)	(.260)	(.254)
Other	.301	.304	.263	.274	.129	.136	.066	.089
	(.199)	(.197)	(.197)	(.195)	(.230)	(.221)	(.223)	(.217)
Grade in school (6–8)	−.279***	−.299***	−.316***	−.323***	−.107	−.148	−.169	−.184*
	(.080)	(.079)	(.080)	(.079)	(.093)	(.089)	(.090)	(.088)
Constant	3.74***	2.31**	2.46**	1.70	3.18***	.350	1.03	−.599
Model F	4.88***	6.48***	6.74***	7.12***	2.86**	8.83***	7.49***	10.43***
Adj. R^2	.050	.075	.078	.090	.024	.104	.088	.132
R^2 change	.062	.026	.030	.042	.038	.080	.064	.109

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$; $N = 744$.

All models control for father's and mother's mobile phone skill and education level; Standard Errors in parentheses.

• Table 5 *(Continued)*

	Listen to music				Share pictures or video			
Model	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Gender (female = 1)	.078	−.320⋆	−.114	−.377⋆	.063	−.265	−.111	−.319⋆
	(.156)	(.156)	(.153)	(.154)	(.141)	(.143)	(.139)	(.141)
Like using mobile phone		.758⋆⋆⋆		.609⋆⋆⋆		.625⋆⋆⋆		.482⋆⋆⋆
		(.090)		(.093)		(.082)		(.085)
Skill at using mobile phone			.328⋆⋆⋆	.230⋆⋆⋆			.297⋆⋆⋆	.220⋆⋆⋆
			(.045)	(.046)			(.041)	(.042)
Ethnicity (reference: white)								
African American	1.10⋆⋆⋆	.965⋆⋆⋆	.908⋆⋆⋆	.857⋆⋆⋆	.430⋆	.319	.256	.215
	(.232)	(.222)	(.226)	(.220)	(.211)	(.204)	(.205)	(.201)
Asian	.381	.480⋆	.393	.469⋆	.443⋆	.525⋆	.455⋆	.515⋆
	(.248)	(.238)	(.240)	(.234)	(.226)	(.218)	(.218)	(.214)
Hispanic	.682⋆	.554⋆	.588⋆	.513	.612⋆	.506	.527⋆	.467
	(.287)	(.274)	(.277)	(.270)	(.260)	(.251)	(.252)	(.247)
Other	.315	.322	.247	.272	.075	.081	.013	.034
	(.246)	(.235)	(.238)	(.232)	(.223)	(.215)	(.216)	(.212)
Grade in school (6–8)	−.181	−.226⋆	−.248⋆⋆	−.264⋆⋆	.010	−.027	−.050	−.063
	(.099)	(.095)	(.096)	(.094)	(.090)	(.087)	(.087)	(.086)
Constant	3.90⋆⋆⋆	.768	1.59	−.235	1.77	−.811	−.323	−1.772
Model F	3.95⋆⋆⋆	10.45⋆⋆⋆	8.63⋆⋆⋆	11.93⋆⋆⋆	2.04⋆	7.28⋆⋆⋆	6.78⋆⋆⋆	9.15⋆⋆⋆
Adj. R^2	.038	.123	.102	.150	.014	.085	.079	.116
R^2 change	.051	.085	.064	.113	.027	.072	.065	.103

⋆$p \leq .05$; ⋆⋆$p \leq .01$; ⋆⋆⋆$p \leq .001$; $N = 744$.

All models control for father's and mother's mobile phone skill and education level; Standard Errors in parentheses.

• Table 5 *(Continued)*

	Send or receive email				Use as phonebook			
Model	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Gender (female = 1)	−.001	−.247	−.126	−.285⋆	.730⋆⋆⋆	.356⋆⋆	.488⋆⋆⋆	.274⋆
	(.125)	(.128)	(.124)	(.127)	(.135)	(.135)	(.128)	(.129)
Like using mobile phone		.468⋆⋆⋆		.369⋆⋆⋆		.712⋆⋆⋆		.496⋆⋆⋆
		(.073)		(.077)		(.077)		(.078)
Skill at using mobile phone			.212⋆⋆⋆	.153⋆⋆⋆			.413⋆⋆⋆	.333⋆⋆⋆
			(.037)	(.038)			(.038)	(.039)
Ethnicity (reference: white)								
African American	.683⋆⋆⋆	.600⋆⋆⋆	.558⋆⋆	.527⋆⋆	.300	.173	.058	.016
	(.186)	(.182)	(.184)	(.181)	(.202)	(.192)	(.189)	(.184)
Asian	.294	.355	.302	.348	.093	.186	.109	.170
	(.199)	(.195)	(.195)	(.193)	(.216)	(.205)	(.201)	(.196)
Hispanic	.795⋆⋆⋆	.716⋆⋆⋆	.734⋆⋆⋆	.689⋆⋆	.224	.104	.106	.045
	(.230)	(.225)	(.226)	(.222)	(.250)	(.237)	(.232)	(.226)
Other	.298	.303	.254	.270	−.103	−.097	−.189	−.168
	(.198)	(.192)	(.194)	(.191)	(.214)	(.203)	(.199)	(.194)
Grade in school (6–8)	−.140	−.168⋆	−.184⋆	−.194⋆	.296⋆⋆⋆	.254⋆⋆	.212⋆⋆	.199⋆
	(.080)	(.078)	(.078)	(.077)	(.086)	(.082)	(.080)	(.078)
Constant	2.64⋆⋆	.704	1.14	−.037	.991	−1.950⋆	−1.917⋆	−3.41⋆⋆⋆
Model F	3.81⋆⋆⋆	7.35⋆⋆⋆	6.65⋆⋆⋆	8.21⋆⋆⋆	4.83⋆⋆⋆	12.60⋆⋆⋆	16.00⋆⋆⋆	18.84⋆⋆⋆
Adj. R^2	.036	.086	.077	.119	.049	.147	.182	.224
R^2 change	.049	.050	.041	.069	.062	.097	.132	.174

⋆$p \leq .05$; ⋆⋆$p \leq .01$; ⋆⋆⋆$p \leq .001$; $N = 744$.

All models control for father's and mother's mobile phone skill and education level; Standard Errors in parentheses.

not only remained, but became statistically stronger. The previously non-significant email usage advantage for boys became statistically significant, while picture or video sharing and listening to music moved from a non-significant female advantage to a statistically significant male advantage.

Ethnic differences also appeared. Compared to whites, game playing, music listening and email usage were higher among African Americans, picture taking and picture or video sharing were higher among Asians, and Hispanics had higher levels of email usage, even when controlling for affinity and skill. Grade in school was also important, with those in higher grades reporting higher usage of text messaging and phonebook usage, but lower usage of game playing, picture taking, music listening and email.

DISCUSSION

The purpose of this study was to assess whether a gender digital divide existed in relation to mobile phone ownership and usage among middle-school students. This study found evidence to support a gender divide, but this divide is more complex than prior research indicates.

General usage

This article hypothesized that no significant gender differences in mobile phone ownership or general usage would exist (H1 and H2). Female advantages in terms of mobile phone ownership and usage existed at the bivariate level; however, patterns are more complex at the multivariate level. Gender differences disappear in mobile phone usage and ownership levels once affinity and skill are taken into account, supporting H1 and H2. H3 is not supported, as no significant gender differences in the number of mobile phone features used existed. These results suggest that whatever the greater frequency of mobile phone use that girls have, it may be due more to their affinity and skill at mobile phone use than to their gender.

Specific usage

H4 was partially supported, with gender differences in frequency of use for some specific uses. Boys had greater frequency of usage for game playing, music listening, picture or video sharing and email. Girls had greater frequency of usage as a phonebook. It is interesting to note that after controlling for affinity and skill, the strength of the relationship between being a boy and using video games increased, and in the case of sharing pictures and video, the advantage turned from females to males. This suggests that for boys, gender and propensity to play games were linked more directly. The addition of affinity and skill increased the explained variation level in all specific usage models, illustrating that more of the variation in usage can be attributed to

differing affinity and skill levels than to gender differences. However, gender is not a significant predictor of affinity or skill (results not shown), suggesting that these two variables are not merely proxies for gender differences.

In addition, H5 and H6 were supported. Individuals with higher levels of affinity and skill were more likely to own, use and have higher frequencies of specific uses of mobile phones. Both these factors alone and in combination often mediated the female mobile phone usage advantages. While in some cases (overall ownership and usage, hours of use, number of features used, talking, texting and picture taking) a gender difference in favor of girls was apparent initially, controlling for affinity and skill mediated that difference. In other cases, controlling for affinity and skill resulted in gender differences in favor of boys (e.g. game playing, music listening, picture or video sharing and email).

In sum, the results show, when controlling for affinity and skill, that there are no significant gender differences in more traditional communicative uses of the mobile phone, including text messaging, which functions much like voicemail except that it uses text instead of sound. However, regarding more recreational and non-communicative uses (e.g. game playing, music listening, picture or video sharing and taking and email), boys exhibit greater use than females. Although sharing pictures and video and using email also might be considered 'communicative' uses, they are technologically different from more traditional communicative uses, requiring set up and configuration not necessary for more traditional uses.

Salaway et al. note that 'as a technology becomes widely owned, gender no longer makes a difference' (2007: 38). At first glance, this appears to be true with mobile phones. However, while gender may not determine whether one has a mobile phone, it seems to have much to say about how one specifically uses a mobile phone. Our results support the assertions made by Hargittai and Shafer (2006) concerning gender and the digital divide; looking at broad use or non-use disregards important layered divisions of the digital divide such as intensity and frequency of use, confidence in ability and user skill, where women are often disadvantaged. As with many other technologies, we need to move from 'access to equity' with regards to mobile devices (Wajcman, 2004).

CONCLUSION

Limitations of the study

Our findings suggest that gender differences in mobile phone usage among youth are complex and that factors such as affinity and skill are important to understanding gender differences in types of usage. Given that Salaway et al. (2007) report that US college students in general, and male students more so

than females, tend to overrate their skills with ICTs,we do not know whether the results of the present study would have differed if assessments of mobile phone skills had been triangulated (e.g. participant observation, user self-report and mobile phone usage records) rather than self-reported.

Other limitations of our study include the examination of students in only one county school district. There may be dramatic regional, cultural and sociodemographic differences that were obscured by the use of one county school system. Although the gender distribution of the sample was comparable to that reported by the 2000 US census, the sample was more diverse than one would expect from a review of census data, with fewer whites and African Americans and a greater representation of other minority groups. Additionally, the school system that was used is fairly affluent, with a median household income of $74,167. This is a serious limitation of the study and raises further research questions related to its findings in terms of socioeconomic differences. The results are offered here as preliminary findings, urging further research on how the interactions among ethnicity, gender and socioeconomic class play out in terms of adoption and usage of mobile technologies.

Another limitation involves missing data. In general, younger students were less likely to complete the survey than older students. As a result, the data from questions appearing later in the survey (with the exception of demographic data, which students were encouraged to complete) were biased toward older respondents, a limitation reflected in the questions concerning parents' education and mobile phone skill. In addition to appearing late in the survey, these were questions that many students may have been unable to answer, resulting in even more missing data. To retain these variables in the models without reducing the *N* to unacceptable levels, missing values were imputed for parents' education and mobile phone skill based on the school, grade and demographic characteristics of each student.

This study concurs with French and Richardson (2005), who note that although gender differences may be present in the perceptions and use of a particular technology in one setting, those differences may disappear or reverse if the context of the technology changes. Although context matters, the data used in this study did not permit an examination of a range of contexts and how they might affect usage patterns.

Suggestions for future research

As Ling (2000) found in Norway, accessibility, safety and 'micro-coordination' are often primary motives for mobile phone ownership among youth. Future researchers should continue to explore the importance of these motives for mobile phone ownership and usage across a variety of societies. We encourage future researchers to continue the work presented here by examining not only

how context, culture and lifestyle affect ICT usage, but also by examining the social impacts of this usage across a range of outcomes, including health status, psychosocial resources and career intentions, among others.

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