Household technology adoption, use, and impacts: Past, present, and future

Susan A. Brown

Abstract Since the 1980s, researchers have been studying the phenomenon associated with technology being diffused to the household. In this paper, three themes in that stream of research, specifically adoption, use, and impacts, are explored. Key studies from prior research within each theme are discussed and directions for future research are offered. The directions for future research range from investigating adoption issues associated with the digital divide to understanding the impacts of new technology and social networking sites on individuals and families. The evolving nature of the technology continues to offer interesting research directions and challenges, with the study of unintended consequences of technology use presenting, perhaps, the greatest opportunities.

Keywords Adoption · Household · Technology impacts · Technology use

1 Introduction

Research on household technology adoption and use is an important area of inquiry. According to Neilsen, approximately 73% of US households have acquired some sort of personal computing technology. However, the true power of home technology in the information age is through connectivity—specifically, Internet access and use. When

S. A. Brown (✉)
Department of Management Information Systems, Eller College of Management, University of Arizona,
430W McClelland Hall,
Tucson, AZ 85721-0108, USA
e-mail: suebrown@eller.arizona.edu

compared to other countries, the USA is behind in broadband Internet access in the home, with only about 50% of US households having broadband Internet access, compared to nearly 80% in Hong Kong and 90% in South Korea; the USA is 25th worldwide in terms of broadband Internet access (Website Optimization 2007). Two important issues become clear form these numbers—first, the USA is not a world leader in this arena and second, and more important, this is clearly a worldwide phenomenon that has the potential to change how people interact, conduct commerce, and exist in a technology-enabled society.

Research in the area of household technology adoption can be classified along a variety of dimensions. In this paper, I focus on three broad streams of research associated with household technology: adoption, use, and impacts. Also note that 'household technology' encompasses more than personal computers, including both the technologies that people use to do work and be entertained as well as the wired and wireless access that enables those technologies to connect to the Internet and interact with people and companies in a global arena.

Research on technology adoption has examined the factors associated with why households do and do not acquire personal computers and other technologies for home use (e.g., Brown and Venkatesh 2005; Brown and Venkatesh 2003; Venkatesh and Brown 2001). Research on technology use has examined the various tasks and activities that people engage in with household technology (e.g., Brown and Venkatesh 2005; Shih and Venkatesh 2004; Venkatesh 1996; Venkatesh and Nicosia 1997; Venkatesh et al. 2001). Research in the area of technology impacts has examined the potential outcomes of using household technologies, both intended and unintended (e.g., Kraut et al. 1998, 2002). The remainder of this paper discusses key studies conducted in

these three broad areas and identifies potential directions for future research.

2 Adoption

2.1 Prior research

In the 1980s, the view of the computer was as a work technology, not a home technology (Venkatesh 1996). Over time, that view has evolved to the point that we now see nearly 75% of households with a computer. In fact, a variety of technologies has been developed specifically for the home. Adoption rates for these technologies follow predictable patterns where the most innovative individuals are out in front of the adoption curve (Rogers 1995).

In examining household PC adoption, Venkatesh and Brown (2001) elicited input from household adopters and non-adopters to understand the factors that influenced them to adopt and not adopt a PC for home use. Their findings revealed two important things: beyond the typical ease of use and usefulness factors identified in much prior research (Davis et al. 1989; Venkatesh et al. 2003), different factors influenced *household* adoption and non adoption. Second, households where there was an indication that a PC would not be purchased were more accurate in their predictions than were households in which PC purchase was intended. Overall, it seemed that the negative beliefs prevailed. In follow-up studies (e.g. Brown and Venkatesh 2003, 2005), findings were consistent and the research was augmented to discuss both 'chasm' effects (Moore 1999) and household lifecycle effects (Gilly and Enis 1982) on adoption patterns.

2.2 Directions for future research

Building on Moore (1999), Brown and Venkatesh (2003) proposed that as adoption of household technology diffused, there would be different challenges as we crossed 'chasms' form one adopter group to the next. With about 25% of the US population currently in the non-adopter category, we are now faced with encouraging the latest of the late majority and the laggards (Rogers 1995). According to Brown and Venkatesh (2003), these individuals are most influenced by the rapid rate of change in technology that renders one thing outdated shortly after it is purchased. It would seem that these last-to-adopt individuals need to be convinced now, more than ever, that even though operating systems change every 2 years or so, the technology is not outdated. Further, given the nature of Brown and Venkatesh's sample, it is possible that a large segment of society, namely low income households, is under-represented in their work. Thus, research targeted at understanding

and addressing the digital divide will likely be very beneficial in bringing the last set of potential adopters along, or identifying the reasons for their continued decision to not adopt. Hsieh et al. (2008) is an example of the direction this research can and should be taking.

Another interesting question in terms of adoption relates to the discrepancy between the number of households with a PC and those with broadband Internet access. Some might argue that PC adoption, without Internet adoption minimizes the potential value of the technology. Indeed, Hoffman et al. (2004) suggest that the Internet has become 'indispensible' for those who use it. However, there are a significant number of households that have not yet adopted the Internet. Just as fear of obsolescence influenced late adopters of household PCs, there may be other fears that stand in the way of households accessing the Internet. Certainly, news articles abound about Internet-based abductions, pedophiles preying on unsuspecting children, and identity theft. Whether or not these are the inhibitors of Internet adoption needs to be examined. Regardless of the reason, with the evolution of eGovernment initiatives and other Internet-based information sharing, this group of households will be missing out on relevant information. Research that identifies the factors inhibiting Internet adoption in the household is an important first step in helping all households have equal access to the resources and information available online.

3 Use

3.1 Prior research

As America ages and the "wired from birth" generation comes to expect everything to be computerized, adoption is likely to become less of an issue. Rather, like the telephone, we will soon come to expect that everyone has some sort of personal computing technology in their home. Once people have made the decision to acquire the technology, understanding how and why they use it becomes the next important question. Research in the workplace has already begun to demonstrate the importance of distinguishing between merely adopting (deciding to use) and actually using technology (e.g., Karahanna et al. 1999; Jasperson et al. 2005). Likewise, research in household use generally (e.g., Shih and Venkatesh 2004) and the digital divide more specifically (e.g., Hsieh et al. 2008) has acknowledged the importance of understanding use.

Since the 1980s Venkatesh and colleagues (e.g., Shih and Venkatesh 2004; Venkatesh 1996; Venkatesh and Vitilari 1992; Vitalari et al. 1985) have been examining household technology use. The trend in household use has

been from very work-focused in the 1980s, to more of a mixture of home-based utility and entertainment in the 1990s, with more advanced social networking and household automation emerging in the twenty-first century. Over time, connectivity and Internet use have become central aspects of home technology use (Venkatesh 2005).

3.2 Directions for future research

Venkatesh (1996) provides valuable guidance for studying household technology use: "Don't assume that what the technology can do in the household is the same as what the household wants to do with the technology" (p. 53). Given that we have a generation of technology users that has known nothing but a world that is technology-enabled, we can expect that they will identify new and improved uses for the technology. Due to their familiarity and comfort with technology, we should anticipate that the 'wired from birth' generation will expect that things can be accomplished via technology, rather than wonder if they might be. This has interesting implications for research.

One implication is likely to be a change in how we study household technology use. Rather than simply conducting surveys of households, we should consider alternative methods. One such example is Venkatesh et al. (2001) who conducted an ethnographic study of household technology use. By using this approach, they were able to uncover important themes associated with household technology use, such as the causes of user frustration and the limited integration of technology into the household. This is also consistent with work in HomeNet (Kraut et al. 1996), where households were given computers and asked to keep diaries of computer use and to participate in interviews with researchers. Additional research that uses these more descriptive and open-ended techniques of collecting data will become increasingly important for understanding how households appropriate technology, and subsequently reshape it.

A second implication for research that follows from using different techniques is that the ultimate technology use that is observed may be vastly different than what we, as researchers, expected. Further, as technology evolves, it will become both more integrated (across platforms) and more ubiquitous in our daily lives. This may lead to difficulties in clearly defining the technology being studied or singling out the use of one technology from another. Thus, different theoretical perspectives may become relevant as the very nature of the technology and its use evolves over time. The overarching issue associated with studying use in the future is that research should keep an open mind and avoid pre-assigning or pre-defining use.

4 Impacts

4.1 Prior research

The line between using technology and the impacts of technology use can be somewhat blurry. Clearly, someone must first use the technology to realize outcomes associated with its use. That was the underlying rationale for the HomeNet study (Kraut et al 1996) and the Blacksburg electronic village (Carroll and Rosson 1996). In both of these large scale studies, technology or technology access were provided to study participants and both studies highlighted interesting impacts.

The Blacksburg project's goal was to provide an infrastructure to support a community network. While the researchers had some initial ideas of how the network might evolve, they also found that some unanticipated sub-communities emerged. In addition, the growth of the network spawned new businesses and strengthened community relationships. The goal of the HomeNet project was to see how people would use technology, if they were able to get over the initial barrier of acquiring it. Some of the unanticipated findings in this work include the role of the teenager in facilitating household use (Kiesler et al. 2000) and the somewhat controversial finding that increased Internet use could lead to social isolationism—reduced communication with other household members and even depression and loneliness (Kraut et al. 1998). In a follow-up study, Kraut et al. (2002) suggested that the negative impacts tended to dissipate over time. However, they cautioned that introverts and those without a strong social support system in place were more likely to experience negative outcomes associated with Internet use than extroverted individuals with strong support systems.

Recently, the Wall Street Journal (Rosman 2006) ran a story about the impact of BlackBerry and other mobile device use on households. The article highlights the unintended consequences of parental BlackBerry use, such as parents sneaking to use the devices, family members feeling neglected, and safety concerns associated with emailing while driving. Thus, the technology can potentially be seen as an important component in understanding work–family conflict. Research in this area has a long tradition, but a number of questions remain regarding topics such as the relationship between types of conflict, the emotional responses they engender, and the ultimate outcome for the family members involved (Livingston and Judge 2008) or how choices are made between the competing role demands (Greenhaus and Powell 2003). As more companies outfit their employees with these devices, it will become increasingly important for employees to learn techniques that will enable them to unplug in

order to mitigate the potential negative consequences on their home lives.

4.2 Directions for future research

Outcomes and impacts of household technology use is, perhaps, the most fruitful area for future inquiry. As more and more households adopt technology worldwide, there is great potential for intended and unintended consequences of household technology adoption and use. As the blurring of boundaries between work and home continues, identifying successful strategies for maintaining separation will become an important area for research. Relevant research in organizational behavior and psychology has focused on work-life balance (WLB) and work–family conflict (e.g., Greenhaus and Powell 2003; Livingston and Judge 2008; Valcour 2007). WLB research has examined flexible work arrangements and other mechanisms to help a variety of work force members feel successful in both their work and home lives. The introduction of technologies that blur those boundaries may suggest changes to the theories and practices. Research on work–family conflict may be particularly relevant for understanding the impacts of these blurred boundaries on the family. The focus in this stream of research is on conflict in the home associated with work demands. Thus, it may be particularly relevant for understanding the important role played by technology. Further, understanding the relationship between individual characteristics and successful strategies will help to further enhance guidance to individuals. Minimizing the unintended negative consequences of technology use is an important area for research.

One example of unintended consequences can be seen in the Megan Meier tragedy (Maag 2007). As teens use home computing technology to interact with others on the Internet, they develop relationships—some of which are based on legitimate interactions and others of which are based on deceit. The events surrounding Megan's suicide highlight a number of issues associated with relationship development, trust, and privacy. Understanding the similarities and differences between relationship development in the real world and online is an important area of research. For example, research has identified "swift trust" in virtual environments where groups come together temporarily to solve a common task (Meyerson et al. 1996). The question remains whether or not swift trust is the default in virtual environments, or if it is solely associated with these temporary, task-focused teams. Research in technology adoption has demonstrated that workplace theories do not map directly to the household (e.g., Venkatesh and Brown 2001). Thus, research that could increase our understanding of what leads someone online to believe that the person on

the other end of the communication is who they say they are, would be valuable.

Privacy is also an important and ongoing concern in the virtual world. In the case of Megan Meier, the media and the police would not release the name of the person involved in the hoax, however virtual citizens united to hack systems and unearth the person's name. E-commerce is also affected by Internet user's privacy concerns. Malhotra et al. (2004) suggest that consumers want to be aware of and have control over the information that is kept about them. While individuals have privacy concerns, they also make trade-offs between privacy and convenience. Research that examines how that trade-off may be made more beneficial to all involved will become increasingly important as more sensitive information is shared in an online environment, such as with the use of electronic medical record systems.

The development of SecondLife™, an interactive world in which players have jobs, own homes, and buy and sell real estate, offers interesting opportunities for research. SecondLife can be thought of as a merger between collaboration technology and online gaming. In addition to using virtual Linden dollars in the game, players exchange non-virtual currency, with some second life participants earning over $1M in real life. This blurring of the boundaries between virtual and real lives can pose some interesting challenges for individuals and society. Given that much of what we know about SecondLife is based on the real world, one can conceive of a situation in which something that happens in the virtual world extends back into the real world. Understanding who is more apt to participate in SecondLife will be an important first step in identifying the possible social impacts associated with participation. Further, understanding users' motivations for joining SecondLife and studying how the real and virtual worlds are kept separate are important directions for future research. If, as the study of Kraut et al. (1998) suggested, Internet use is associated with social isolationism (at least initially), what are the implications for SecondLife participation? Is it possible that this virtual world helps users overcome negative impacts of Internet use by allowing them to be whomever they choose? Or, does this ability to fix what's wrong only serve to further highlight the negative aspects of one's life, leading to greater isolation and depression? These are very important questions, the answers to which will have profound implications for the future of society.

A relatively recent phenomenon associated with Internet use is the notion of crowdsourcing (Howe 2006). Crowdsourcing essentially refers to leveraging people on the Internet to help solve problems, aid in branding, or provide products, to name a few. While the term and the associated

activities are controversial, several entities have leveraged crowdsourcing in a positive manner. From a marketing perspective, leveraging customers to co-create brands can be quite powerful (Muñiz and Schau 2007). Jones Soda is an example of this, where customers submit designs for the packaging, customers vote, and the company relies on the voting to select the packaging. By leveraging customers in this manner, Jones Soda is able to generate greater customer loyalty and simultaneously conduct real time market research. Crowdsourcing has also been used successfully by the Obama campaign to raise funds in record amounts. There is also potential for negative outcomes of crowdsourcing. Take iStockphoto for example. Internet users post amateur photographs, companies looking for photographs peruse the site, and if they find a photo they like, can acquire it for $1. This is beneficial for the amateur photographer who hopes to pick up some extra cash, but the implications for professional photographers are staggering. Crowdsourcing promises to have significant implications for business models, the nature of commerce, political campaigns, special interest groups, and just about anything that is or can be done on the Internet. Understanding individuals' roles in this process as well as how best to leverage Internet users from the company's perspective will be important directions for research.

5 Conclusions

We have clearly entered an age where adoption, use, and impacts of technology transcend boundaries from the workplace into the home and society more generally. While a great deal of research has examined the various aspects of home technology use, the increasing diffusion, coupled with the development of innovative new applications, creates many opportunities for continuing research in this area. Perhaps the most fruitful area for future research is in understanding the intended and unintended outcomes associated with home technology use. Just as businesses are compelled to rethink business models in light of customer Internet use, researchers, too, will be compelled to rethink the theories and methods we employ in order to truly understand and explain the variety of emergent outcomes.

References

Brown, S. A., & Venkatesh, V. (2003). Bringing non-adopters along: The challenge facing the PC industry. *Communications of the ACM, 46*(4), 76–80.

Brown, S. A., & Venkatesh, V. (2005). Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle. *MIS Quarterly, 29*(3), 399–326.

Carroll, J. M., & Rosson, M. B. (1996). Developing the Blacksburg electronic village. *Communications of the ACM, 39*(12), 69–75.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*, 982–1002.

Gilly, M. C., & Enis, B. M. (1982). Recycling the family life cycle: A proposal for redefinition. *Advances in Consumer Research, 9*, 271–276.

Greenhaus, J. H., & Powell, G. N. (2003). When work and family collide: Deciding between competing role demands. *Organizational Behavior and Human Decision Processes, 90*, 291–303.

Hoffman, D. L., Novak, T. P., & Venkatesh, A. (2004). Has the internet become indispensable. *Communications of the ACM, 47*(7), 37–42.

Howe, J. (2006). The rise of crowdsourcing. *Wired*, Issue 14.06.

Hsieh, J. J., Rai, A., & Keil, M. (2008). Understanding digital inequality: Comparing continued use behavioral models of the socio-economically advantaged and disadvantaged. *MIS Quarterly, 32*(1), 97–126.

Jasperson, J., Carter, P. E., & Zmud, R. W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. *MIS Quarterly, 29*(3), 525–557.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly, 23*(2), 183–213.

Kiesler, S., Zdaniuk, B., Lundmark, V., & Kraut, R. (2000). Troubles with the internet: The dynamics of help at home. *Human–Computer Interaction, 15*, 323–351.

Kraut, R., Kiesler, S., Boneva, B., Cummings, J. N., Helgeson, V., & Crawford, A. M. (2002). Internet paradox revisited. *Journal of Social Issues, 58*(1), 49–74.

Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukophadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being? *American Psychologist, 53*(9), 1017–1031.

Kraut, R. E., Scherlis, W., Mukhopadhyay, T., Manning, J., & Kiesler, S. (1996). Homenet: A field trial of residential Internet services. *Communications of the ACM, 39*, 55–65.

Livingston, B. A., & Judge, T. A. (2008). Emotional responses to work–family conflict: An examination of gender role orientation among working men and women. *Journal of Applied Psychology, 93*(1), 207–216.

Maag, C. (2007). A hoax turned fatal draws anger but no charges. *New York Times*. November 2007. Accessed online: http://www.nytimes.com/2007/11/28/us/28hoax.html?_r=1&oref=slogin. Last accessed April 4, 2008.

Malhotra, N. K., Kim, S. S., & Agarwal, J. (2004). Internet Users' Information Privacy Concerns (IUIPC): The construct, the scale, and a causal model. *Information Systems Research, 15*(4), 336–355.

Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). Swift trust and temporary groups. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 166–195). Thousand Oaks, CA: Sage.

Moore, G. A. (1999). *Crossing the chasm: Marketing and selling technology products to mainstream customers* (2nd ed.). New York: Harper Collins.

Muñiz, A. M. Jr., & Schau, H. J. (2007). Vigilante marketing and consumer-created communications. *Journal of Advertising, 36*(3), 187–202.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). NewYork: Free.

Rossman, K. (2006). Weekend journal; blackberry orphans. *Wall Street Journal (Eastern Edition)*, p. W.1.

Shih, E. C., & Venkatesh, A. (2004). Beyond adoption: Development and application of a use-diffusion model. *Journal of Marketing*, 68(1), 59–72.

Valcour, M. (2007). Work-based resources as moderators of the relationship between work hours and satisfaction with work–family balance. *Journal of Applied Psychology*, 92(6), 1512–1523.

Venkatesh, A. (1996). Computers and other interactive technologies for the home. *Communications of the ACM*, 39(12), 47–54.

Venkatesh, A. (2005). The tech enabled networked home: An analysis of current trends and future promise. In W. Dutton, B. Kahin, et al. (Eds.), *Transforming enterprise*. Cambridge, MA: MIT.

Venkatesh, V., & Brown, S. A. (2001). A longitudinal investigation of personal computers in homes: Adoption determinants and emerging challenges. *MIS Quarterly*, 25(1), 71–102.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.

Venkatesh, A., & Nicosia, F. (1997). "New technologies for the home-development of a theoretical model of household adoption and use". Advances in Consumer Research 24 (522–528).

Venkatesh, A., Stolzoff, N., Shih, E., & Mazumdar, S. (2001). The home of the future: An ethnographic study of new information technologies in the home. In M. Gilly, & J. Myers-Levy (Eds.), *Advances in consumer research*, vol. 28 (pp. 88–97). Urbana, IL: Association for Consumer Research.

Venkatesh, A., & Vitalari, N. (1992). Emerging distributed work arrangement: An investigation of computer supplemental work at home. *Management Science*, 38(12), 1687–1706.

Vitalari, N., Venkatesh, A., & Gronhaug, K. (1985). Computing in the home: Shifts in the time allocation patterns of households. *Communications of the ACM*, 28(5), 512–522.

Website Optimization, (2007) *US falls to 25th in broadband penetration worldwide—US broadband growth below OECD average—April 2007 Bandwidth Report.* http://www.websiteoptimization.com/bw/0704/, accessed March 13, 2008.

Susan A. Brown is an associate professor of Management Information Systems in the University of Arizona's Eller College of Management. She received her Ph.D. from the University of Minnesota and an MBA from Syracuse University. Her research interests include technology implementation, individual adoption, computer-mediated communication, technology-mediated learning, and related topics. Her research has been published in *MIS Quarterly*, *Organizational Behavior and Human Decision Processes*, *IEEE Transactions on Engineering Management*, *Communications of the ACM*, *Journal of the AIS*, and others. She received *MIS Quarterly's* reviewer of the year award for 2001. She has served or is currently serving as an associate editor for *MIS Quarterly*, *Information Systems Research*, *Journal of the AIS*, and *Decision Sciences*.