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Computers *and Other* Interactive Technologies *for* *the* Home

Want to design information technology for the home? First figure out the interaction between the social space in which family behavior occurs and the technological space in which the technologies are embedded and used.

DESPITE THE RECENT DRAMATIC TRENDS IN THE DIFFUSION of information technology, the significance of these developments is still not clear. Also lacking is a critical understanding of these developments and a sound theoretical and empirical base from which to observe and analyze them. Supporting such an analysis, this article raises both empirical and theoretical concerns in an attempt to capture the structure and dynamics of computer adoption and use in the home.

The technological environment has changed so dramatically in the last three or four years that the 1980s look rather antiquated by comparison.

When we began studying computers for home use in the early 1980s, such use was unexplored territory. The home computer revolution was being heralded as the next major technological social movement. It was apparent the potential for major change existed, but it was not clear what elements would bring about this change or whether these elements even existed. During the later 1980s, discussion among business analysts, social researchers, and other experts about the home-computer revolution began to fade; instead of the computer "revolution," attention, as reported in *BusinessWeek* and other publications, shifted to the computer "bust." [3]

Our studies found there was no justification for either the early hype or the later pessimism. A computer revolution may not have occurred in the precise manner predicted, but there certainly was a transformation.

In the 1980s, the personal computer, although located in the home, had not become a "home computer" and was not sufficiently integrated into the social context of the household. That is, not many household tasks could be performed on or through a computer. Many people were using the computer for job-related activities as if it were an extension of their office space. In addition, software for home use was not well developed. Also, because the computers were standalone units with low-level rudimentary telecommunications links, households could not establish ties to the outside world for information or entertainment; nor could they conduct personal communication with friends, schools, or other entities with whom they normally have contact. Almost a decade later, things began to change dramatically on many of these fronts. For example, the character and the context of the users changed; a whole generation of young people now use computers without having to master the technology, and advances in software and ease of use have reduced the skill required of the average user. Many technological advances, whether pertaining to the hardware, software, or telecommunications links, have been customized for home use. The emergence of online services, external databases, and consumer

services seem to have motivated the average citizen to invest in computer technology.

Our Research

Our studies, which began in the 1980s, included longitudinal and cross-sectional surveys (regional and national) as well as ethnographic field studies of home computer users [20, 22]. We identified certain barriers to technological diffusion in the home, including both technological and social factors. In the early stages of home-computer introduction, there were more barriers than facilitators, including:

- Primitive software for home use
- Lack of telecommunications connectivity
- Unfamiliarity and low-level computer skills among the general public
 - Lack of understanding by computer vendors of households and their needs
- Inapplicability and inappropriateness of the industrial/business model for the household
- Perception among household users that computers could play no major strategic role in daily life



In the 1980s, we also found:

- A majority of the participants in our studies viewed computers as a job-oriented technology, not a domestic technology. It did not matter that computers were used within the physical setting of the home; they were still perceived as tools for job-related work. Close to 70% of computer use in our sample was for job-related purposes. On the positive side was a perception that computers facilitated teleworking and telecommuting. People wanting to work at home for any reason, part-time or full-time, could do so if the nature of their work permitted it. On the negative side, work at home meant less time for the family and the gradual erosion of home life by work life.
- A related finding was that, in terms of the number of hours spent, computer use for work at home was greater among those with telecommunications links than among those without links.

- As long as computers were standalone units, their potential usefulness was limited. This condition did not mean there were no standalone technologies in the household; almost all domestic technologies are unifunctional/standalone units (e.g., refrigerators, vacuum cleaners, microwave ovens, and televisions). But these technologies are well integrated into the household environment and were originally developed as household technologies, not derived from industrial applications. They were all designed to assist in household tasks (e.g., food preparation, house cleaning, family entertainment, and the like). Computers did not fit such a well-defined scenario. Besides, they were perceived as complex machines requiring skills not commonly available to most people.
- There was a definite gender bias in terms of the principal users of home computers. Male adults accounted for 75% of total home use. In two-parent families (with children of either gender), female adults and male children together accounted for 25% of the total use (about 12% each). But computing was generally male-dominated. Compare this finding with most other household technologies, such as telephones and appliances, whose primary users are female.
- Computers in the 1980s would have been more welcome in the home had they been linked to other technologies in the home. This lack of links explains why, for example, market penetration of VCRs, which became available to the household market at roughly the same time as PCs, was faster and deeper. The penetration rate of computers in the mid-1980s was about 10% and reached about 20% by 1990. The VCR penetration rate ranged from 70% to 75% by 1990. The VCR eased naturally into the family entertainment scene as a companion technology to the TV.
- Computers were not given any specific privileged status in the domestic technological context; they were not viewed as essential to running the household. There were more strategic technologies in the home—the telephone, the refrigerator, and the automobile—households felt they could not do without. Within the household's technological space, the computer ranked rather low. Compare this perception with the position of computers in the business or industrial sectors.
- Computers did not occupy a well-defined physical or social space. Many families were not sure where to place the computer. Questions often arose as to whether the computer should be in the living room, the bedroom, or the family room.
- We needed to understand the relationship between the family as a social unit and computers as a formidable technological intervention.

What Changed?

The technological environment has changed so dramatically in the last three or four years that the 1980s look rather antiquated by comparison. Changes include:

- Terms at the technological frontier today—virtual reality, multimedia, interactivity, connectivity, and the like—were hardly known in the 1980s.
- More areas in the household are being targeted for these new technologies; that is, there is a greater diffusion of computer technology within the social context of the home.
- In recent years, software developers have turned out a multitude of new titles, many organized around household needs much more effectively than in the past. Software development has reached sophisticated levels, so the necessary technology is available to meet consumer needs. By the same token, as powerful and versatile as the software applications are, the knowledge and skills required to use the software are easier to acquire and more accessible to a larger population.
- There has been a greater acceptance of computers as a domestically useful technology. In addition, we also see a new generation of young children growing up with computers. It is not uncommon to find children as young as two or three years old using computers as part of their fantasy world of toys and play accessories.
- There is a greater realization that “home” is where the new technologies can realize their full potential. No more is it necessary to assume these technologies need to be transferred from the commercial sector to the home sector. Home itself has become the main site for many technological innovations. Most technologies are being developed with the home as the main target market.

Why has the home become the target? There is no single or even main reason. Since the late 1980s, new information technologies have been successfully introduced into the home (e.g., cordless telephones, answering machines, and fax machines) paving the way for more complex technologies. People are now exposed to more computerization than ever before as part of their routine daily experiences.

Many of the traditional institutions with which families (and the general public) deal on a daily basis have adopted new technologies as part of their normal routine. In work environments, schools, airports, shopping malls, supermarkets, and banks, all kinds of everyday activities are now performed

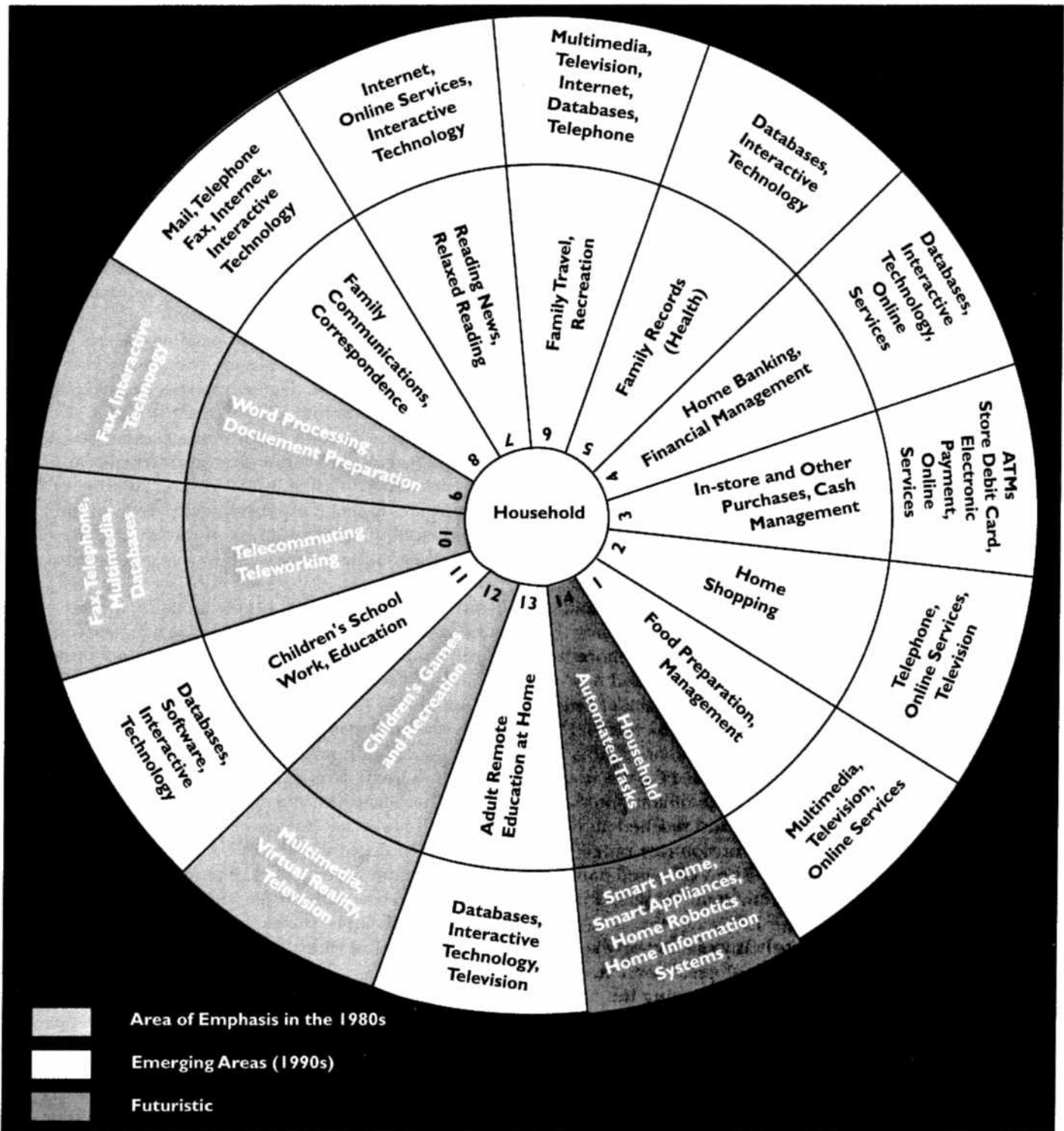


Figure 1. Everyday life for a household in cyberspace

through computer-based technologies. In these institutional settings, the convergence of information and telecommunication technologies is now taking place at an unprecedented scale, but without much fanfare. New electronic services with home applications are now widely available, including video-on-demand, home shopping, home banking,

and home financial management, all with a greater domestic content. In the 1990s, people increasingly live in an information society as it was originally conceived.

We also see the development of such concepts as the smart home and intelligent appliances. The recent introduction of some early versions has

brought such technology within the grasp of residential architects, technology developers, and town planners. Moreover, we seem to be in a postdisciplinary stage (blurring boundaries in the arts and sciences) of knowledge integration and diffusion with respect to these new technologies.

Conceptualizing the Cyberhousehold

To appreciate these changes more vividly, we created the mandala model in Figure 1 depicting the everyday life of the household in cyberspace in historical and contemporary terms. The representation identifies the various household activities that can potentially be performed using the new information and communication technologies. Not meant to be exhaustive, the representation still yields some interesting results and insights:

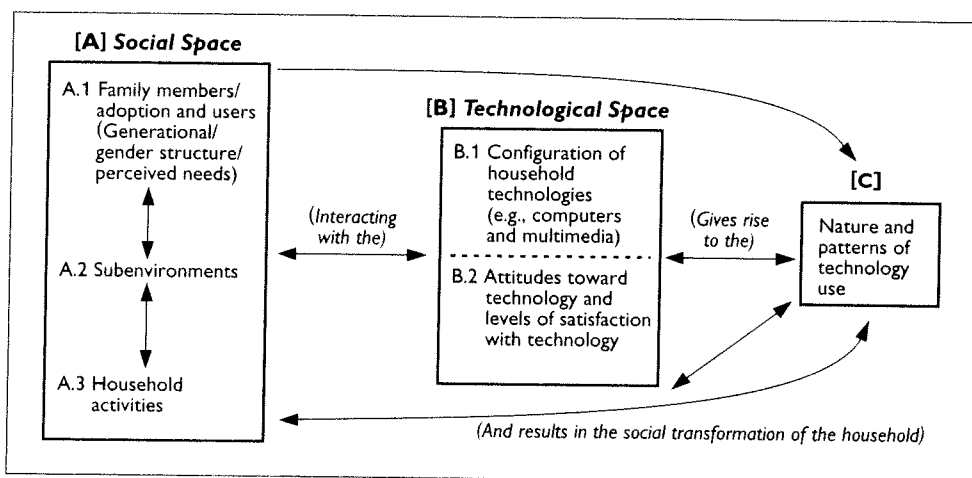


Figure 2. Household structure and technology use

- We can view the household in a holistic fashion while combining the activities into meaningful segments.
- It links activities with the technologies most likely to be used in performing the activities. The figure should not be interpreted too rigidly; the links between the technologies and the activities are suggestive and may vary, depending on specific technological and user environments.
- It shows that in any given household, only a subset of activities may be performed or only a subset of technologies may be used. Not every household fulfills the entire representation in the figure.

At the center of the figure is the household as the object of our inquiry; radiating from the center are wedgelike segments signifying everyday activities engaged in by households as part of their daily life in cyberspace. These segments are classified using a

time scale—according to segments most representative of the 1980s and those with contemporary and with futuristic emphasis. As shown in the figure, only three segments (green) were prominent in the 1980s—work/employment (telecommuting), children's games, and word processing/document preparation. More segments have opened up in the 1990s, signifying greater impact and diffusion of computer technology in the daily life of the household. The activities today suggest expansion into new areas of home life. We have also indicated some futuristic possibilities in terms of smart homes and robotics, still at an experimental stage of development.

Although Figure 1 gives a cross-sectional perspective, it does not provide a dynamic of technology adoption and use. For a thorough understanding of the household adoption and use of new information technologies, we need a theory of household behavior and a theory of household-technology interaction.

Theoretical Framework

Our theoretical framework is motivated by the need to understand the role technology plays in family life. We view the household in terms of two main

interlinked components—the social space in which family behavior occurs and the technological space in which household technologies are embedded and used. The interaction between the social space and the technological space and the resulting behaviors are the subject of our investigation. Figure 2 provides a schematic relationship between the social space and the technological space; Figure 3 is an internal structural representation of the household incorporating the key elements of Figure 2 in greater detail.

The theoretical framework underlying our approach may be called the modified structural-functional approach to the study of family behavior. According to the structural-functionalist view [4, 8, 9, 13], the family is conceptualized as a social organization that has an external orientation in relation to the larger social order and an internal orientation in relation to its own domestic order. Both orientations are related in that the functioning of the inter-

	A.2 Subenvironments**					
	Food Management	Household Maintenance Finance	Leisure/ Recreation Entertainment	Social/ Family Communication	Work/ Employment	Family/ Development/ Well-being
A.1 Family members (as adopters and users of technology)**	Primarily adults (parents)	Primarily adults	Whole family	Whole family	Primarily adults	Children and adults
A.3 Household activities targeted for technology use**	Meal preparation and consumption Washing dishes Grocery shopping	Family shopping Cleaning Tax preparation Family budget	Watching TV Holiday travel Movies Games	Telephone conversations Family communication Holiday reunion Correspondence	Job-related activities Telecommuting	Children's education Adult education Family fitness dieting Holiday gathering
A.1 Configuration of household technologies #	Kitchen appliances Automobile ATMs Computer Home shopping (Online)	Washer, dryer Automobile ATMs Computer Online Home banking	TV, VCR, stereo Automobile Computer Multimedia Online services	Telephone answering machine Fax Computer/email Internet Online services	Telephone answering machine Fax Automobile Computer Internet	Typewriter VCR Telephone Computer Internet
Links to Figure 1	1, 2, 3	2, 3, 4, 5	2, 3, 6, 7	8, 9	9, 10	11, 12, 13

** Elements of Social Space;
Elements of Technological Space

Figure 3. Internal structure of the household-technology interaction

nal order ensures successful external involvement.

As shown in Figure 2, the social space is configured in terms of the family members who adopt and use household technology, the subenvironments in which family members conduct their lives, and household activities performed within the subenvironments by the family members. Family membership is structured generationally (parent/child) as well as by gender (male/female); the family members are presumed to be motivated by personal and social needs in performing household activities.

Figure 3 gives a more detailed picture of the subenvironments in which family life takes place—food management, household management/finance, leisure/recreation/entertainment, social/family communication, work/employment, and family development/well being. Similarly, it identifies the family members who adopt and use technology and the household activities they perform.

In the first component (Figure 3, first row), the subenvironments correspond to the categories identified in [15, 16] through time-budget studies. The second component (Figure 3, second row) suggests the characteristics of the family members as adopters and users of technology are relevant in terms of the nature and patterns of technology use and the social roles and responsibilities they assume within the household. The third component (Figure 3, third row, the household activities performed by family members in each subenvironment) suggests these activities are targeted for technology use. (The activi-

ties in the figure are illustrative, not exhaustive.)

Within this broad structural/functionalist view of the family, we introduce some basic theoretical ideas concerning the technological space. As explained by Arturo Escobar, an expert on material culture, technology is viewed by some researchers as a system of tools and tool-using behavior [7], following the notion that technology is a means to achieve practical ends and therefore must be viewed in utilitarian terms.

In contrast to this utilitarian approach, Kling [10], a noted writer on organizational computing, proposes that information technology should also be assessed in terms of the social context in which it is embedded—implying that since the household is a social organization giving rise to various social interactions and dynamics, technologies acquire meanings in relation to such family dynamics. Adoption of technologies may be a socially motivated decision rather than a purely utilitarian decision. Our view is that both the utilitarian and social perspectives are relevant in determining the nature of the technological space.

The technological space consists of the configuration of household technologies used within each subenvironment and subject to uses by the family members in their activities. Technological space also involves family attitudes and levels of satisfaction with technologies.

In sum, the theoretical framework helps us identify two key building blocks for our proposed model:

- The social space, which is constituted by the

social structure of the household and the activities performed within the household

- The technological space, which represents the nature of the technological environment within the household

Practical Significance

From the technology side, this conceptualization shows how computers and new media technologies may be adopted and used; from the user side, it helps identify the internal dynamics of family life that determine the successful (or unsuccessful) adoption and use of the technologies. This dynamic can be summed up as the interaction between the social space and the technological space.

Our 1980s research found that computers were once located in the subenvironment called Work/Employment and did not significantly diffuse into other subenvironments. With the emergence of new technologies for multimedia applications and online services and their potential for a variety of family applications, coupled with growing user sophistication, we see more intense technological activity within the household (see Figure 1). The schema in Figure 1 provides an enabling structure

as well as adult women. The diffusion of information technology occurs not only across the subenvironments but among all family members. As more young people begin to use technology in the household, technological literacy also expands. Household members develop more efficient mechanisms for learning and coping with these new technologies. Technology also becomes more integral to family life and is less likely to be perceived as imposed from outside.

There is also evidence from our current work that new household activities are emerging that did not exist before. Not only do existing household activities determine the nature of information technology use, there is feedback in the opposite direction from technology to household activities (see Figure 2). Some recent examples include email for expanding family and social networks, family archives and medical histories, and up-to-date financial records and asset management.

Our model is also useful for examining the claim that the new information technologies are gradually becoming the key technology in the home, replacing the telephone and television, both of which currently enjoy this status. Our 1980s research showed

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.

for examining intrahousehold technological diffusion. For example, the nature of multimedia diffusion into other subenvironments is a critical development in the last two or three years.

However, successful diffusion depends on various factors coming together. We cannot assume that what the technology can do in the household is the same as what the household wants to do with the technology. For example, in certain households, certain activities may be performed and not others; in some households, the lifecycle stage of the family may call for certain activities and not others; and in other cases, household priorities and circumstances might change.

There is growing evidence from our current field work [18] that the adopter and user profiles are changing and expanding. For example, the model user in our earlier study [21] was the adult male in the family. Current trends suggest that a growing number of users are young children and teenagers

the home computer had a rather low ranking or priority in the technological space. Many of our respondents felt the telephone, the refrigerator, and the automobile were the most important or essential technologies in the home. In our recent field trials [18], we found the computer increasingly used and perceived as an essential communication tool by many households—a major shift from the 1980s.

Finally, the model enables us to evaluate the dynamic relationship between the social space—the subenvironments, the users, the activities—and the technological space—the configuration of the technologies—leading to a better understanding of the social transformation of the household in terms of its internal environment and its external environment. Such a transformation may take years. To understand this process, we must examine the new information and communication technologies as well as the general technological milieu in which

they are located.

Entry of new technologies into the household means entry into both the social space and the technological space. Entry into the social space can be investigated by posing several questions:

- Across which subenvironments does (has) the technology diffuse(d) into the home?
- Which of the subenvironments are the most hospitable?
- What activities are targeted by the household for computer use, and is there any order or pattern to such targeting?
- Who among the household members act as diffusion agents in the home and under what circumstances?

In terms of the technological space, computers were competing with other entrenched technologies serving household needs better, except in the work subenvironment—typewriters (for inexpensive document preparation), telephones (for external connections and social communication), automobiles (for commuting), and televisions and VCRs (for family entertainment). Computers can enter the technological space in two ways:

- By competing with the entrenched technologies, performing the existing tasks better or more efficiently) and at less cost
- By permitting activities not possible through these entrenched technologies, creating new realities and possibilities only computers are capable of creating

Many technology providers may have sound knowledge of the technological perspective but pay inadequate attention to the social organization. Our analysis should help them see both sides of the picture.

Conclusion

Exploring key aspects of the changes occurring in both the technological environment and the user environment, this article offers a theoretical model of household-technology interaction, introducing two key constructs—the social space and the technological space—that define the main parameters of household-technology interaction. Many technology providers have a sound knowledge of the technology they produce but not of the social context in the use of technology. The insights provided here can guide them in balancing the two perspectives. ■

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