An Investigation of Theories of Diffusion in the Global Context: A Comparative Study of the US, Sweden and India

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ABSTRACT

This is a study of computer/Internet diffusion in the household sector in the U.S., Sweden, and India. We investigated how different theories of diffusion (evolutionary, leapfrogging, structural, and agentic) account for the cross-country data. We found that no one particular theory accounts for all the developments, and all four theories apply in varying degrees.

INTRODUCTION

Recently, there has been much interest among marketing and management scholars in technology diffusion in the global context (Corracher and Ordanini 2002; Ganesh and Kumar 1996; Ganesh, Kumar, and Subramaniam 1997; Putsis et al. 1997; Tellis, Stremersch, and Yin 2003; Woolcott and Goodman 2003). The focus on global diffusion has become even more intense with the emergence of the Internet (ITU 2002). According to some authors, the Internet technologies seem to be diffusing across different countries more rapidly than any other technology in recent memory (Castells 2001; Chen and Bellman 2003). One common approach to the study of diffusion globally is country-level analyses using such factors as national wealth, technology investment, and supporting infrastructures (e.g., Caselli and Coleman 2001; Dewan and Kraemer 2000). Comparative studies at the micro consumer level have been rather infrequent, although some country-specific studies have begun to appear in the literature using secondary data (Corracher and Ordanini 2002; Lombardi 2001,). Some prior research suggests that country differences play a key role in decisions regarding technology adoption in organizational settings (Keil et al. 2000). Along the same lines, it would be interesting from a theoretical and empirical standpoint to see if such differences exist in the consumer sector. Our study is intended to fill this gap that exists at the micro-consumer/household level, which is very relevant to the marketing field.

This paper reports an investigation of computer/Internet diffusion in the household sector across three countries—the U.S., Sweden, and India—by employing a use-diffusion model (Shih and Venkatesh 2004). A main purpose of the study is to investigate how different theories of diffusion (evolutionary, leapfrogging, structural, and agentic) account for the cross-country data. Although our analysis is focused on the diffusion of computers and the Internet in the home, the concepts presented here can easily be extended to a host of other technologies intended for home consumption such as smart appliances, personal digital assistants, or networked home entertainment systems. Specifically, the following research questions are addressed:

- What are the use-diffusion patterns among the households in the three countries selected for the study: the U.S., Sweden, and India? What are the similarities and differences?
- What theories of diffusion account for the differences and similarities between the three countries?
- What structural factors account for our findings?
- What are the marketing implications of our findings?

The study is motivated by two important theoretical and empirical considerations. First, given that existing theories of diffusion point to specific structural elements that facilitate adoption and use, the question is what is the relative emphasis of these elements in different global conditions? For example, Appadurai (1996) calls our attention to simultaneous homogenization and heterogenization, while Matei (2004) refers to the tension between globalization and localization. In other words, for our purposes, how do the different theories and adoption processes vary across the three countries selected for the study and why? The answer to this question is relevant to marketers because with the global diffusion of new technologies, they need to make complex decisions regarding product introductions and, consequently, patterns of adoption and diffusion become important inputs into such decision-making processes (Ziamou and Ratneshwar 2002). Second, the current literature on diffusion, as significant as it is, implies but does not specifically address that there is no single theory of diffusion that can explain the empirical trends adequately; different theories seem to account for the diffusion processes—primarily due to varying local conditions. The question then for our study is which theories can best explicate the empirical variations and similarities that we observe across the three different countries.

Country Selection and Rationale

One important reason for the study is that the diffusion of computers and the Internet is a global phenomenon, and the more we learn about it in the global context, the greater our understanding of the phenomenon itself. By selecting these three countries (U.S., Sweden, and India) for our study, we are able to get a slice of the global diffusion picture. In many respects, Sweden is comparable to the U.S. in that it has a highly developed industrial base with a relatively long history of computer diffusion and is a leader in certain areas of communication technologies such as cellular phone penetration and wireless communication (Dobbers and Schroeder 2001; Kruse and Carlsson 2004). India represents a distinctly non-Western culture and, as an emerging information economy, it has become a major global player in the software industry. However, diffusion of the home computer is in an early phase in India (Singhal and Rogers 2001; Wolcott and Goodman 2003). Including India allows us to see how the three countries are placed along the diffusion curve. A major strength of our study is the collection of the primary data on a national scale from three countries during the same time frame using probability sampling procedures. This method allows us to compare technology adoption and use across country/culture while controlling for extraneous effects that may arise over time. Therefore, differences observed are more likely to be due to inherent country/culture differences as opposed to time-dependent variations such as new innovations in the marketplace or increasing fluency and experience with technology over time.

THEORETICAL FRAMEWORK

Theoretical Rationale – Use Diffusion

Research on the issue of technology diffusion at the consumer level has concentrated predominately on the act of adoption—more specifically, on individual or household adoption (Golder and Tellis 1998; Roberston and Gatignon 1986). What is reported less frequently in the literature is the process of diffusion that takes place after adoption. Post-adoption use of technology, which we call use diffusion, considers how the technology, once adopted, is integrated through use (Mick and Fournier 1998; von Hippel 1995; Shih and Venkatesh 2004). The distinction between adoption and use lies in the fact that mere adoption does not complete the diffusion process since it does not guarantee that the product will be integrated within the adoption unit in a meaningful way. This is because, throughout the life cycle of the innovation, both disadoption and abandonment could occur, thus derailing the diffusion process. Adoption is therefore a necessary but not a sufficient condition for the diffusion process to be considered complete. For an innovation to be accepted by its users, it must be put to discernible patterns of use after adoption (Dutton et al. 1985; Lindolf 1992; Rogers 1995).

As new technologies are introduced to consumers, a formal study of use patterns has significant marketing implications. Technologies that are more integrated into the household will become more indispensable to daily life (Hoffman, Novak, and Venkatesh 2004). Further, consumers who intensely use a particular technology are often prime candidates for early adoption of the next generation of the technology. Thus the examination of the use-diffusion process can lead to insights into many issues that are of interest to both marketing scholars and practitioners.

Theories of Diffusion

In this section, we first discuss the theories of diffusion and their relevance for our study.

This will be followed by a theoretical model of use diffusion that guides our empirical work.

From the rather extensive literature on diffusion (see Mahajan, Muller, and Bass 1990 for review), especially the global diffusion of technology (Eaton and Kortum 1999), we discern four different yet somewhat related theories of diffusion, with each having a slightly different slant. In other words, the four theories are not mutually exclusive but are conceptually distinct. The theories are: evolutionary theory (Tellis and Crawford 1981), leapfrogging theory (Brezis and Tsiddon 1998), structural theory (Gatignon, Eliashberg, and Robertson 1989), and agentic theory (Rogers 1995). In our conceptualization, evolution and leapfrogging theories relate to how diffusion (the dependent variable) compares across countries, while structural and agentic theories relate to what drives the diffusion process. We provide a brief description of each below.

Evolutionary Theory

The evolutionary theory states that technology adoption takes place from a lower order to a higher order, from simpler to complex, from an earlier version to a later version, from unfamiliar to familiar, and from old to new. The assumption is that both technology and consumers evolve simultaneously.

Technology: State 1 -----> State 2 -----> State 3

Adopter/User: State 1 -----> State 2 -----> State 3

Some consequences of the evolutionary theory are: a) consumers do not adopt later versions of technology unless they are familiar with older versions; b) consumers unfamiliar with older versions of technology are less likely to adopt later versions (comfort zone hypothesis); c) evolution applies to both technology and consumers; that is, both evolve simultaneously. Evolutionary theories are diachronic in their perspective rather than synchronic.

Leapfrogging Theory

A theory of diffusion that is being discussed in the literature and has relevance here is technological leapfrogging (Pitroda 1993). This theory is usually offered in opposition to evolutionary theory. According to leapfrogging theory, under certain social, economic, and technological conditions, communities or countries can jump several steps to reach a higher level of technology production and consumption and attain parity with countries at the top of the ladder in that particular domain (Brezis and Tsiddon 1998). The development of the software industry in India is often cited as an example of the leapfrogging effect. In biological terms, the leapfrogging theory is more akin to punctuated equilibrium (Gould and Eldredge 1977).

Structural Theory

Adoption takes place because consumers are embedded in structures of activities, life patterns, and infrastructural and social networks (Gatignon, Eliashberg, and Robertson 1989). These structures are important both functionally and symbolically for consumers. These structures meet enduring as well as changing consumer needs, provide both stability and flexibility to their life patterns, and have a utilitarian value. That is, consumers can perform certain desired functions, conduct daily patterns of behavior, and cope with the realities of their lives. Technologies diffuse because existing technological infrastructure and social apparatus are supportive. This assumes that social and technological conditions and networks are key elements for the diffusion. These can be structures of relationships between people, technological infrastructure, and other physical or organic elements.[1]

One such structure that technology diffuses through is consumer channels. These could be communication channels, channels of physical space, and channels of relationships. The

[1] A variation of the structural theory is the contagion theory which is based on epidemiological models. The basic argument is that technology flourishes where the conditions are supportive. One important ingredient of the epidemiological models is the notion of critical mass which is a well established condition in diffusion models.

more crowded or dense the channels are with other competing technologies, the less likely is the possibility of diffusion of a new technology (immunization effect). Diffusion takes place primarily through active marketing processes.

Agentic Theory

The agentic component (i.e., referring to agency) shifts the main burden of diffusion from the structure to the adopter or the user (the agent or the change agent) of new technologies (Rogers 1995). This is indeed the basis of the theory of diffusion widely adopted within the marketing discipline. It relies heavily on the characteristics of the adopter as the primary determinant of adoption. Using these characteristics, the adopters are traditionally classified into four categories: innovators, early majority, late majority, and the laggards. When the focus shifts from adopters to users, the user typology is based on the user profile—e.g., lead users (von Hippel 1995), intense users, specialized users, non-specialized users, and low users (Shih and Venkatesh 2004).

Our Study

The question for our study is: which of the above theories, or what combination of them, is likely to prevail and why? We will examine this question under the following conditions. If the evolutionary theory is correct, we will expect to see that the U.S. is ahead of Sweden and India on almost all characteristics of adoption and use, although the U.S. and Sweden will be closer to each other and India will be a distant third. However, if the leapfrogging effect comes into play, we will see a strong similarity between Indian diffusion processes and those of the U.S. and Sweden. If the structural theory is correct, we will see some supporting structural elements. These structural elements may not be the same in each country or may have a different emphasis. Finally, if the agency is the motivating factor, we will see how users are contributing to the diffusion processes and what roles they play and what their characteristics are.

It is conceivable that these four theories may have a different impact on product use based on which theory dominates. For example, evolutionary theory might suggest that the computer/Internet may evolve in a linear temporal fashion. However, the structural theory might suggest that if communication and relationship structures are in place, there might be considerable demand for computer use. Similarly, if the users are highly motivated and have the right disposition and knowledge base, they may start using the computers in a major way. In other words, in terms of this specific application, the results may reveal some unexpected patterns. We do expect to see such anomalies in our study.

Finally, the structural and agentic theories are presented above as being separate from evolutionary and leapfrogging theories (see Figure 1); in reality they are not totally independent of them. This is because if the structures are favorable (or unfavorable) and the adopters are appropriately positioned (or not positioned), we are more likely to see leapfrogging (or evolutionary) effect. However, for the sake of completeness, we have opted to treat them as distinct because they do provide valid conceptual and empirical bases for our study.

<< Insert Figure 1 Here>>

CONCEPTUALIZATION AND OPERATIONALIZATION OF TECHNOLOGY USE AND DETERMINANTS

The conceptual model guiding our work is adopted from Shih and Venkatesh (2004). It consists of two main elements: patterns of use diffusion and their determinants. In this section we will provide a theoretical discussion of the variables and their operationalization.

Use-Diffusion Patterns

There are two key dimensions to technology use: variety of use, which refers to the different ways technology is used, and rate of use, which refers to the time spent using the technology (Dutton et al. 1985; Ram and Jung 1990; Ridgeway and Price 1994, Shih and Venkatesh 2004). Specifically, for our study we have identified the elements that constitute variety of use in Table 1. The combination of variety (low and high) and rate (low and high) yields four types of uses: intense, specialized, non-specialized, and limited. Thus, intense use describes situations in which an innovation is used to a significant degree both in terms of variety of use (number of applications) and rate of use (hours of use per week). In specialized use, focus shifts to increasing rate of use but lower variety of use. Non-specialized use describes a use-diffusion pattern in which variety of use is more critical than rate of use. Such a pattern best (though not exclusively) describes usage based on trial and error. Finally, limited use diffusion refers to low rate of use and low variety of use. That is, the user finds little, if any, worthwhile application and therefore relegates the product to a relatively minor role, even to the point of "disadoption" (Lindolf 1992). Each of the above diffusion patterns illustrates different ways in which the innovation is integrated.

In terms of operationalization of variety of use, we asked each respondent to indicate whether the household uses the computer for any one of the 17 applications (see Table 1). Thus, variety of use was measured by the total number of different reasons why the computer was used in the household. For rate of use, it is simply the average number of hours that the computer is used by the household in a given week. We use the average instead of total hours to minimize household size bias.

<< Insert Table 1 Here >>

Determinants of Use Diffusion

We examined the following five factors as representing the theoretical categories for our analysis: communication patterns, usage barriers/facilitators, household structure, technological structure, and attitudinal beliefs. Consistent with our conceptualization, 11 independent variables in these five theoretical categories were used as independent variables in the analyses (Table 2).

<< Insert Table 2 Here >>

Communication Patterns

Diffusion of innovation literature has always stressed the importance of interpersonal communication networks because diffusion is primarily a social process. By internal communication, we mean communication among/between members of the unit that has been considered important in diffusion of use (Warlop and Ratneshwar 1993). Communication with other household members serves as a way for individuals to learn new ideas and integrate new uses for the technology into their usage portfolio.

Members of the household often share similar experiences and perceptions so they may lack new knowledge (Burt and Janicik 1996). If communication channels exist with people outside the immediate household, new ideas about the use of the technology may be introduced. According to the theory of the strength of weak ties (Granovetter 1973), diffusion of ideas is often facilitated by contact with people outside the adoption cluster.

In terms of operationalization of communication patterns, internal household communication was measured using the average frequency among computer users in the home (2=frequently, 1=sometimes, 0=never). External communication was measured by asking respondents the frequency with which they communicate with friends, co-workers, and other sources (e.g., helplines, online chat groups, bulletin boards) for advice regarding computer use. The frequencies for each of the sources (0-2 scale) were summed to form an external communication index.

Usage Barriers/Facilitators

Perceived difficulty of use implies that users have to exert greater mental effort to gain a desired outcome from computer use. Such mental costs may make computer users reluctant to prolong their computer usage time or to extend computer applications into other areas of their lives. This is because people generally have limited cognitive resources to devote and will vigorously protect their available resources by finding easier ways to do things. The end result is that a perception of "difficult to use" limits the use-diffusion potential of computers, both in terms of variety and rate of usage.

Information technology is among the most complex of consumer technologies, and its complexity is often cited as a limiting factor in its optimal usability in the home (Kiesler et al. 1997, Norman 1999), despite years of attempts by designers to make the technology more "user friendly." Although operating computers in the home may require only limited computer know-how for simple tasks such as word processing or checking email, the complexity of computers certainly constrains their applicability to a wider array of household tasks. Thus, the lack of operating knowledge needed in advance for satisfactory technology use can act as a barrier to sustained usage and may lead to frustration (and eventual abandonment), resulting in lower rates of usage and less variety of uses.

In terms of operationalizing the variables, difficulty of use was measured by taking the mean of two items, "I often feel frustrated using computers" and "Computers are difficult to use" (reliability= 0.70). Knowledge was measured by asking for the level of computer expertise of the most knowledgeable person in the household where 1=expert and 4=beginner, with intermediate levels in between.

Household Structure

Children in the Home: The composition of the household plays a vital role in determining how computing technologies are integrated into the home. Since all family members are potential computer technology users, it is clear that the larger the household, the greater the use of the computing technology. This occurs most noticeably when there are children in the household (Kraut et al. 1999). Among some recent developments of IT is educational and family development software. Parents may utilize these technologies as part of their children's educational experience, creating another dimension of use for the home computer (Venkatesh 1996).

Competition for Use: Household dynamics also involve the sharing of limited resources. Tensions arise because of possible claims to resources that are not available to all the members at all times. Daly (2001) calls this "the presence of negative valence." Salazar (2000) has shown that members of the household have to "negotiate social boundaries" while working with the computer because others may want to use the computer at the same time or they may tie up the telephone line (for Internet use), making it unavailable to others. Most technology uses in the domestic context can be distinguished on the basis of whether they are potentially social (shared by multiple users during usage) or personal/individual (shared independently of each other and not shared during usage, or not shared at all). For social technologies, variety and rate of use could be enhanced by the existence of other users within the adopting unit (Lindlof 1992). On the other hand, existence of other users within the adopting unit could impede the rate of use for personal technology such as the computer by enforcing competition for a limited resource.

In terms of operationalization of the variables, the existence of children under 18 in the household was treated as a dummy variable. Competition for computer use in the home was taken to be the ratio of the number of computers to the number of computer users in the household.

Technological Structure

System Capabilities: Differences in system features predetermine the potential uses of the systems in the home. In a way, the capabilities of the system define the boundaries of what the user can do with the system. Because the computer is in a constant state of flux and rapid evolution, its usage cannot be expected to remain constant. Computers have also become versatile and now compete with other home technologies, such as the television, stereo, and telephone. In general, we expect users with access to more advanced systems to exhibit a greater variety of use.

Cognate Technologies: Use of any technology must take into consideration the use of all other technologies in the home. Vitalari, Venkatesh, and Gronhaug (1985) refer to this as cognate technologies, and Rode, Toye, and Blackwell (2004) call this the cluster of domestic appliances. One argument made in this connection is that, given limited time, the use of any technology naturally takes away from the use of other technologies, thus limiting the level of use diffusion within the adopting unit. On the other hand, as Shugan (1980) has shown, the cognitive effort required to accumulate knowledge decreases, making the acquisition of related products easier and therefore more attractive. That is, if we consider the complementary nature of technologies or their inter-connective potential, the use of a given technology may increase with the use of other (complementary/connective) technology(ies). If complementary capabilities and connectivity are indeed indicators of acquisition of new technologies, it is logical to conclude that households with computers are more likely to adopt new technologies, such as digital cameras, video consoles, etc., and that ownership and use of these technologies increases the potential applications of the computer in the home and thus the variety of uses. However, the reverse would be true for rate of use because time constraints mean that the use of other technology (e.g., video game console) necessarily takes time away from computer use.

In terms of operationalization, system capabilities were measured by two variables: newness of computer and Internet connection. Newness of the computer was in turn measured by the age of the newest computer available in the home. In other words, if there is more than one computer in the household, for the purpose of measurement of this variable, the latest computer is taken into account. Internet connection was treated as a dummy variable referring to whether the household had an Internet connection or not. Cognate technologies were measured by the presence (equals 1) or absence (equals 0) of other relevant domestic technologies.

Attitudinal Beliefs

Prior research on computer adoption has suggested that attitudes toward utilitarian, hedonic, and social outcomes are important determinants of technology adoption and use (Mick and Fournier 1998). We propose that the role of attitudinal beliefs is also relevant and influential in sustaining computer use in the home even after the adoption process has taken place.

Attitude towards technology use is generated by an individual's salient beliefs about the consequences of continued use and his/her evaluation of these consequences (Karahanna and Straub 1999). Adoption literature has suggested that a primary motivation for computer adoption and use is the adopter's belief regarding the usage outcome or his/her perceptions of the usefulness of the technology (Davis et al. 1989). Service literature also suggests that customer satisfaction and service usage are highly correlated (Bolton and Lemon 1999). Therefore, we argue that positive attitude toward the consequences of computer use results in a higher rate of usage and a greater variety of uses in the household. The effect of attitude on rate of use has been well established in organizational computer use context (Jackson et al. 1997), but we suspect that it should have similar effect on variety of use. Attitude is formed by beliefs, and beliefs regarding computer use can exist on several levels, among which are utilitarian beliefs (Am I more efficient as a result of computer use?) and perceived impact on home life (Do changes in activities occur as a result of computer use?). Diffusion literature also suggests that social outcome belief (public recognition that would be achieved as result of a behavior) is also a strong reason why people adopt certain innovations (Rogers 1995). Similarly, in the mind of adopters, computer usage also provides positive social rewards (Karahanna and Straub 1999).

Attitudinal beliefs were measured with 15 questions that probed users' attitudes toward computer use in the home (1=strongly disagree; 5=strongly agree). Exploratory factor analyses conducted on these 15 items revealed three underlying factors that we labeled as impacts of PC use, utilitarian outcomes of PC use, and social outcomes of PC use. Because the number of items was low, reliability measures recommended by Fornell and Larcker (1981) were constructed for the three attitudinal belief scales, and the results indicate 0.81, 0.80, and 0.72, all above acceptable range. The mean of the items that loaded on each factor was taken as the measure for that factor.

Table 3 summarizes the hypotheses we proposed relating to determinants of rate of usage and variety of uses.

<< Insert Table 3 Here >>

USE-DIFFUSION MODEL AND DIFFUSION THEORIES

Evolutionary theory would suggest that Indian households would lag behind on some variables that have a temporal character. Specifically in terms of the variables selected for our study, the variables most affected by the evolutionary would be the age of the computer at home, the number of applications of the computer/Internet use (rate and variety), male/female gap, the ratio of the sample of users to the entire sample, the availability of an Internet connection, and the level of expertise in the household.

Structural theory would suggest diffusion would be more intense if more people in the household use the computer, if there is more communication between the users and outside contacts (friends, etc.), if there are children in the home, and if conditions permit people in the household to do job-related work at home. Computer/Internet use would be reduced if there is competition for computer use.

Agentic theory would suggest that the user characteristics are most likely to affect the level of computer usage. In our study, the agentic factors are the level of expertise at home, positive perceptions about computers/Internet suggesting that the user is motivated to use the technology, and level of communication with other similar users.

Leapfrogging theory would suggest that if appropriate structural and cultural conditions persist, Indian household product use can advance or even exceed the levels of use seen in the other two countries. For example, in highly advanced economies, there may be some structural barriers that may not exist in lesser developed economies. As a result, it is easy to innovate in the absence of barriers. Leapfrogging is also a result of the state of mind of the users. If users are very enthusiastic about the positive outcomes of technology use and see many other opportunities, they are also likely to display positive attitudes that might become the basis for advanced uses. This is also a hallmark of true innovation.

SAMPLING AND DATA COLLECTION

Data for this study were collected in three countries using random digital telephone interviews in the U.S. and Sweden and personal interviews in India. The interviews were administered by highly reputable professional marketing research agencies in the three countries specially commissioned for this study: The Field Research Institute, San Francisco, USA; Marketing Technology Center, Stockholm, Sweden; and the Indian Marketing Research Bureau (IMRB), a subsidiary of J. Walter Thompson, Bangalore, India. The sampling scheme included a stratified cluster sampling procedure at the household level, with income and geographic distribution balance as bases of sample selection. At the time of data collection (2001-2002), based on population statistics from the Bureau of Census, the penetration of computers into U.S. households was estimated to be about 64 percent, slightly skewed toward higher-income households. Therefore, in order to maximize the probability of representing the computer-owning households, we over-sampled households with higher income levels in the U.S. A similar sampling procedure was used in Sweden. In India, since computer diffusion was a relatively recent phenomenon and had not penetrated into rural areas, we limited our sampling scheme to urban areas, which accounted for 95 percent of the computers installed (IMRB 1999). Personal interviews in India were conducted in eight major cities (Bombay, Delhi, Calcutta, Chennai, Bangalore, Hyderabad, Pune, and Ahmedabad). Our final sample consisted of 910 computer-owning households in the U.S., 906 in Sweden (both national probability sample), and

996 in India (urban probability sample).[2]

The questionnaire was pre-tested on 25 households in each of the three countries for accuracy, validity, and ease of administration before the full-scale study was launched. Interviews in the U.S. and India were conducted in English, while Swedish was used in Sweden. The questionnaire was professionally translated (and back-translated) and pre-tested prior to interviews in Sweden. With few exceptions, the questionnaire was similar in content from one country to the next. At the beginning of the interview process, respondents were given a brief introduction and background for the research and their participation was elicited. They were then asked whether there currently was a computer in use in their home. Those whose household had a computer were then asked to continue with interview. There were two criteria for the respondent of each computer-owning household: he or she had to be at least 18 years old and needed to be considered as having the most information about the household's computer use.

The respondents were asked by interviewers to answer questions regarding their household's computer adoption and the usage behaviors of each member of their household. In addition, a series of questions asked about communication patterns within the household as well as attitudes and perceptions concerning computer experiences and the effects of computer use. Ideally, we would have liked individual interviews with every user in the household, but part of our human subject approval process precluded our interviewing minors. With these practical constraints, we decided to have one primary respondent in each household act as our liaison to the rest of the household members.

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[2] At the time of data collection, roughly 64% of the households in the US and 59% in Sweden owned at least one computer. In India the penetration was the entire country was about 1%. In terms of actual numbers this translates into about 50 million households in the U.S., 5 million households in Sweden, and 5 million households in India. However, in India, since more than 90% of the computers were owned by households living in major metropolitan areas, our study covers the urban population base for computer households.

RESULTS

Preliminary Analyses

As expected, we found in our study that households in the U.S. generally have a much longer history of home computer adoption than in Sweden and India (see Table 4). Based on our data, the average length of computer ownership in the U.S. is 7.02 years, compared to 5.10 in Sweden and 1.92 in India. In the case of India, however, 75 percent of the computers in households had been acquired within the two years just prior to data collection. Higher degrees of computer penetration in the U.S. and Sweden can also be observed by noting that households in these two countries exhibited a greater incidence of multiple computer ownership (28% of the computer-owning households in the U.S. and 20% in Sweden compared to only 0.7% in India).

<< Insert Table 4 Here >>

In sum, the U.S. leads the other countries in terms of years of computer ownership, the number of computers owned per household, and the ratio of male to female users. Sweden is closer to the U.S. while India is far behind on these variables. There are slightly more child users (under 18 years old) per household in Sweden than in the U.S., but India is very much behind the two. However, India is ahead of the other two in terms of the number of adult users per household, which is the first indication that the evolutionary theory of diffusion does not hold entirely.

As mentioned earlier, the two dependent variables, rate and variety of use, were the subjects of our analyses. The correlations between the rate of usage and the variety of uses range from 0.257 ($p<0.05$), 0.197 ($p<0.05$) and 0.003 ($p>0.1$) for the U.S., Sweden, and India, respectively, with an overall correlation of 0.042 ($p<0.05$), all of which indicate that while the two variables are empirically correlated, the correlation is relatively low. We acknowledge the theoretical distinction between rate of usage and variety of uses and treat the two differently in our study. In general, one might say that the three most important reasons people across all three countries gave for their original computer purchase were Education, Recreation/Entertainment, and Job-related work at home (Table 5).

<< Insert Table 5 Here >>

When one looks at the top three ways computers were actually used in the households—Communication, Recreation/Entertainment, and Job-related activities—some differences are noticeable. Education dropped considerably. The highest actual use rank went to Communication (highest in the U.S. and Sweden and second in India). In general, one might say that the computer is viewed as a communication tool par excellence in all the countries. Again, in all three countries, Shopping was given the lowest rank. There are also other interesting comparisons and contrasts. In terms of actual use, the U.S. and Sweden were the closest to each other. The only minor difference is that Home Management was ranked number 2 in the U.S. (number 3 in Sweden), while Recreation/Entertainment was ranked number 3 (number 2 in Sweden). All other rankings for the U.S. and Sweden were similar. The rankings in India were quite different. The high ranking of Home Management in both the U.S. and Sweden shows that computers had already been domesticated to a greater degree in these two countries than in India.

In diffusion terms, some trends may be observed. First, as already mentioned, the computer is domesticated to a greater measure in the U.S. and Sweden. In some respects, Indian experience resembles the U.S. experience in the late 1980s, which suggests that India is in the early stages of diffusion. Further confirming this point, with regard to Shopping, household usages show wide differences (U.S., 51%; Sweden, 52%; India, 7%).

When comparing the countries across variety of use and rate of use, we found some interesting differences. Households in the U.S. report the highest variety of uses (8.28), while India has the lowest (4.75), which is to be expected (evolutionary theory). On the other hand, and quite surprisingly, Indian households have the highest rate of use (12.02 hours per week), and Sweden has the lowest (6.94 hours per week) (leapfrogging theory). The lower variety of use combined with high rate of usage indicates that computers in Indian households may, in general, be used in a more tool-like fashion; that is, they may be put to more continuous use in limited applications as opposed to use in the U.S. and Sweden, where the technology has diffused into more activity spaces. However, the lower variety of use is compensated by the number of hours per household use, a trend that may have some significance for the leapfrogging diffusion effect.

In terms of different combination of users based on use typology, we found no significant differences across the countries (Table 5). There are roughly 30% (or close to) of intense users in each country, about 20% of specialized users, about 20% of non-specialized users, and about 30% of limited (or low) users. Once again the profile of users is a key to understanding the relative parity of diffusion in the adoption unit. This user profile parity suggests that the leapfrogging effect may be operative.

Some additional comparisons were made in terms of a key independent variable. This is the ownership of cognate technologies in the household. The results are shown in Table 6. The table clearly shows that in general, the U.S. leads in terms of household ownership of various technologies, closely followed by Sweden and distantly by India. There are, however, some exceptions worth noting. Sweden scores the highest in terms of cell phone ownership. India is the highest in terms of cable-TV ownership.

<< Insert Table 6 Here >>

We can summarize the data from the results reported so far to draw some conclusions about the theories of diffusion as applicable to the countries under study. Significant differences were found in the case of the following variables: years of computer ownership, number of computers in the home, number of child users in the household, variety of uses, male/female user gap, and percent of households with an Internet connection—all of the differences suggesting that Indian households are behind the U.S. and Sweden in these areas. This suggests that the evolutionary theory is in fact operating at some level. However, other factors point to a different diffusion effect. The rate of use of computers in the home is higher among Indian households, and so is the number of adult users in the household. However, there is no difference in terms of the number of users in each household. These variables suggest a slight leapfrogging effect.

Drivers of Use Diffusion

We next examine the differences among the drivers of use diffusion across the three countries using one-way ANOVA and multiple comparison tests (Table 7). Countries differ significantly on all but two of the drivers examined. With respect to attitudinal beliefs, users in India generally perceive the computer to have the most impact on their lives and derive the most utilitarian benefits, followed by the U.S. and Sweden. This suggests a slight leapfrogging effect. Users in the U.S. and Sweden, on the other hand, perceive more social outcomes from their usage than Indians.

<< Insert Table 7 Here >>

There is more intensive communication, either with other household users or people outside of the home, among U.S. users than in the other countries. Part of this may be explained by the significantly higher perceived difficulty with usage and level of knowledge base in the home. In retrospect, this makes some sense given that computers and the Internet have diffused well beyond the innovators and early majority population, which tend to be more technology savvy and self-sufficient. The later adopters in our U.S. sample may experience more usage barriers and thus require more assistance from others.

Finally, there is significantly more competition among Indian households for computer usage than in the other countries, and they also lag behind in use of other home technologies as well. There was no significant difference in the age of the newest computer at home, however, and this is largely due to the fact that for most U.S. and Sweden households, their newest computer is either an additional computer or second- or third-generation replacements, while the computers in our Indian sample are typically their first computer. Again, all these fit with our reasoning for selecting India because of its early position in the diffusion process.

Hypotheses Testing

To test our hypotheses summarized in Table 3, we regressed separately variety of use and rate of use on the drivers of use diffusion. We pooled all the data across the three countries for analysis and then performed independent analysis for each country. The purpose was to see if our model is robust enough to hold in cross-national context. Results are presented in Table 8.

<< Insert Table 8 Here >>

Regression results indicate that, in general, our hypotheses were well supported. For rate of use, the regression model yielded adjusted R^2=0.299 (F=71.909, p<0.001). The model performed better for variety of uses, with adjusted R^2=0.467 (F=146.53, p<0.001). Because variables of different scales were used, for ease of comparison we report the standardized coefficients in Table 9.

Consistent with the hypotheses regarding communication patterns (H1-2), the degree of communication intensity within the household and with external social networks was positively related to variety of uses. As the intensity of communication across different social networks increases, either within the home or outside the home, so develops the potential to provide assistance related to computer usage problems and to stimulate new usage ideas; this results in the diffusion of technology into other household activity spaces. Although not hypothesized, external communication was also positively related to rate of use.

For usage barriers/facilitators, partial support was found for H3 in that the households that found computers difficult to use exhibited lower rates of use, as expected, but not less variety of uses. Level (lack of) of computer knowledge in the household was negatively associated with usage rates and variety of uses, as predicted (H4). Overall, we can conclude that usability and knowledge issues are critical in the diffusion of computing technology in the home.

Households with children exhibited more variety of uses, as suggested by H5. The role of children in the diffusion of computer use in the home has received much attention recently (Singer and Singer 2001). Our study validates this view. Supportive of H6, we found that households with high competition for computer time had lower rates of use. The social makeup of a user's environment seems to play a key role in the extent of computer use diffusion. In the case of technological structure, the age of the computer in a household was negatively related to the variety of use, but, contrary to H7, it was not significantly related to rate of use in the home. Therefore, H7 was only partially supported. Use of other information technologies in the home has no effect on rate of use and is positively related to variety of uses, as suggested by H8.

Variables relating to attitudinal beliefs were positively related to households' rates and variety of uses, supporting H9-11. Households that believe computers provide positive impact and utilitarian benefits, as well as positive social outcomes, will experience greater diffusion of uses in terms of both rate of usage and variety of uses.

When we reanalyzed the regression for each individual country, we found a high degree of similarities for both rate and variety of use in terms of direction and significance of coefficients. Only four coefficients exhibited differences across countries, all relating to rate of use. Household communication was only significantly related to rate of use in Sweden while external communication was only significant in the U.S. Difficulty of use was significant only in India, although when aggregating the three countries, it was significant as well. Age of newest PC at home was significant in the U.S. Considering the preponderance of evidence, we would conclude that the determinants of use diffusion examined here functioned in comparable manner across the three countries and that the model presented in the paper held up well across different countries.

DISCUSSION

This study is an empirical investigation of home computer adoption and use in three countries: the U.S., Sweden, and India. We approach the issue of country differences analytically from a use-diffusion theory perspective.

In developing this paper, we presented a model of technology use in the home that identified computer usage along two dimensions: variety of use and rate of use. We found that both variety and rate are reliable measures theoretically and empirically. From a diffusion theory perspective, rate of usage suggests the immediate functional value of the computer to the user, and variety of use suggests the versatility of technology and the resourcefulness of users. In addition, variety and rate together point to the social embeddedness of the computer in the household system. One result of our study is that positive attitudes toward consequence/outcomes of computer use result in higher rates of use and greater variety of uses.

In our conceptual development, we proposed that the extent to which households use technology in the home can be explained by five theoretical factors: communication patterns, usage barriers/facilitators, household structure, technological structure, and attitudinal beliefs. Using a cross-sectional survey conducted in the three countries, we found good empirical support for the proposed model of integration of the computer into the everyday life of households.

We positioned the study in terms of how the countries were placed on the diffusion curve, especially in reference to the different theories of diffusion. In this regard, the leapfrogging effect is one aspect that we studied. Our intuition was that, in general, the U.S. and Sweden would provide a comparable picture and that India would be different from both. Or rather, in the case of India, its position on the diffusion curve would be similar to the one observed historically in the U.S. and Sweden in the early phases of computer diffusion. Indeed, our results show that computer adoption and usage in the U.S. and Sweden follow similar courses in terms of usage levels, impacts, and domestication. However, we also hypothesized that if the leapfrog effect were to be taken seriously, India should be closer to the U.S. and Sweden on some key dimensions. Our intuition proved to be generally correct on both issues and, accordingly, we identified the dimensions on which similarities and differences exist.

We have provided evidence to suggest that leapfrogging does indeed exist across some key dimensions. First, we compared the reasons given by the adopters in the three countries for their original adoption of the computers. The reasons of adoption are very similar. We also found that as adopters became familiar with the technology through continued use, the actual uses varied from the intended uses at adoption. While this is true of all three countries, the U.S. and Sweden are most alike on this measure. For example, if we look at the actual uses of the computer, a significant percentage of households in India use the computer for four major activities: communication, recreation/entertainment, information, and job-related work. These are also the major activity spaces in the U.S and Sweden. Since computers represent an important communication/information/work medium, the comparison suggests that India is located at the same point on the diffusion curve on these dimensions. In addition, the rate of use of computers is the highest in India, even after accounting for the household size, further evidence of the leapfrogging effect

As for two other activities, home management and education, Indian households are behind the U.S. and Sweden. As a domestic tool, performance of the computer on these two activities suggests that it has not been integrated into the Indian households to the same extent as in the U.S. or Sweden. With regard to another category, online shopping, India is even further behind. We feel that various infrastructural and social/cultural factors may explain the situation in India. It must be noted here that even in the U.S. and Sweden, online shopping is a lower category compared to other activities performed on the computer. Finally, to confirm the evolutionary aspects of diffusion, households in the U.S. represent the greatest variety of uses, closely followed by Sweden and a little more distantly by India.

In terms of structural and agentic elements of diffusion, here is what we observed. For example, the effects of structural factors were generally stable across the three countries, suggesting the reliability of our model. In general, the cross-country analyses reveal that countries do not differ in the direction of effect on the five factors selected for the study, but instead, country differences are a matter of magnitude. We found that attitudinal structure and communication intensity played a key role in all three countries in promoting use diffusion. On the other hand, on the agentic side, usage barriers, particularly the lack of computer expertise in the home, seem to hinder use diffusion. It is important to note that we only found minimal negative effect for difficulty of use on use diffusion, suggesting that users may believe in the intrinsic value of computers in the home and are willing to put up with the inconvenience associated with computer use. This is consistent with the findings from Davis (1989) and Mick and Fournier (1998), which point out that consumers may continue to use a product despite difficulties because its usefulness outweighs the difficulties in using it.

As mentioned earlier, Indian households reported spending more time on computers as measured by hours per week. This appears to be an agentic factor rather than a structural factor. The finding provides strong evidence that rates of usage, as reported in total number of hours at home, raise the locus of performance to an unexpected level. Mention must be made that there are significant gender differences in terms of male and female users of computers in India when compared to the U.S. and Sweden. Sweden and the U.S. report an equal proportion of male and female users, although in both countries, actual usage rate is slightly lower for females. However, in India, 73 percent of the adult users are males and 27 percent are females. This difference seems to disappear in the case of children, indicating that gender is less of a factor among the younger generation.

It is pertinent to mention here that our sample in India is limited to households in the major cities and does not cover the entire country. The reason is simply that major urban areas in India account for more than 90% of the installed base. However, the rate of growth of computer adoption in India is 15 to 20 percent per year while it is less than 5 percent in the U.S. and Sweden. In actual numbers, the Indian market is currently at 5 million households, and the total potential in the next ten years is likely to exceed 100 million households.

CONCLUSION

The research presented here is among the first efforts toward understanding how technology is being accepted and integrated into households across some parts of the globe. By identifying the dimensions that influence the extent of computer integration in the home, we have extended the traditional diffusion research, which heretofore has focused primarily on adoption, by emphasizing usage and integration into home environments. Our research findings suggest that, although there may be some cultural variations as to why computers are adopted and how they are used, the determinants by which they are integrated into households are similar across cultures.

In our study, we found that impact and utilitarian outcomes are strong factors in determining the level of technology use in the home. If technology does not provide observable utilitarian outcomes, the level of use may not be sustained.

For those interested in developing new information technologies in the home, our study showed a strong relationship between the uses of computers and the uses of other technology products in the home. For future technology design, attention should be paid to how existing technologies are currently being used by adopters and how they interact with other technologies in the home. For example, Sony has taken such design steps by bundling computers with digital cameras and by introducing PlayStation II, which effectively combines Internet access, video games, and a home theatre into one product offering. Such designs may have great potential for extensive diffusion into the household environment and may integrate well into users' lives.

One limitation of our study is in the number of countries we included in our sample. Certainly, time and costs were key factors. To complement the findings presented here, future research should focus on a different set of countries with different cultural backgrounds.

Recently, many countries have adopted policies that would provide easy access to computers to the citizenry at home, schools, and work places. While such policies are intrinsically sound and well-intentioned, much work is needed to make the technology more user-friendly and raise the levels of expertise among users. In our study, users displayed different levels of expertise and knowledge based on their experience with the computers and their interactions with other users within the household. Some sought external assistance from friends, co-workers, or company helplines. Further research is needed to determine the best means to deliver usage expertise among the users, and community-based help groups (virtual or physical) may be an effective delivery mechanism.

Finally, for a long time, the computer industry's approach to the consumer market has been to repackage the business PC and sell it as home computer or treat the home computer market as a segment of the general PC market (Green et al. 2002). However, there is a realization that the two markets are fundamentally different and, as stated by Tim Brown, CEO of IDEO, "There is a fundamental difference between selling truckloads of PCs to a corporate IT buyer and selling a mass-market product to an individual with particular tastes and needs" (as quoted by Redhead 1996). The shift from simple business machinery to customized consumer product orientation is the outcome of a complex set of processes that takes into account the cultural context of the home. Therefore, to improve the ability of marketers to design, market, and promote new information technologies that are poised to be introduced to the consumer market, we need a fundamental understanding of the needs and behaviors of consumers and how they are actively transforming the meaning of technology in the home.

Table 1: Dependent Variables

Variety of Use (Activity Space)	**Activities**
Work/Employment Related	1. Job Related
	2. E-mail (Work related) School related
Family Communication	3. E-mail (Personal)
	4. Writing letters/correspondence other than e-mail
Family Recreation	5. Games/Entertainment
Home Management	6. Home management (Recipes, Family records)
	7. Health Information
	8. Travel information/Vacation Planning
	9. Financial Management
	10. Online Banking
Home Shopping	11. Shopping (Frequently purchased goods)
	12. Shopping (Large ticket Items)
	13. Shopping (Other)
Education/Learning	14. School Related
Information Center	15. Reading News
	16. Sports Information
	17. Community Information
Rate of Use	Avg. total hours of computer use per week in the home

Table 2: Independent Variables

Variables	Measurement
Communication Patterns	
Household internal communication	Avg. frequency of communication with between users at home
External communication	Communication with friends, co-workers and others on computer use.
Usage Barriers/Facilitators	
Level of perceived difficulty (1-5 scale)	• I often feel frustrated using computers • Computers are difficult to use
Level of Knowledge at home (1-4 scale)	Level of computer expertise of the most knowledgeable person in the household
Household Structure	
Children in the home	0 = No; 1 = At least one child 18 or under living at home
Competition for use	Number of computers / Number of users
Technological Structure	
Age of newest computer	Measured in years (and fraction of)
Internet connection	0 = No; 1 = Yes
Use of other home technologies	• PDA or handheld computer • Fax or telex machine • Cell/mobile phone • Pager • Voice mail/answering machine • Video game console • DVD • Stereo system/CD player • Satellite TV • Cable TV • Video Camera • VCR • Digital camera
Attitudinal Beliefs	
Impact of PC use (1-5 scale)	• The computer has changed the way we do things at home. • The computer has replaced the telephone as major communication device in our home. • We have more contact with friends and relatives now that we have email. • My family watches less TV as a result of using the computer or the Internet. • The computer has increased the amount of job-related work at home.
Utilitarian aspects PC use (1-5 scale)	• The computer is as essential as any other household appliance. • It would be difficult to imagine life without a computer in the home. • Households with a computer are run more efficiently than those without a computer. • The computer has saved time at home. • The computer has become part of the daily routine in the home.
Social aspects of PC use (1-5 scale)	• Computers give status to their owners • Those who are not knowledgeable about computers are falling behind

Table 3: Summary of Hypotheses

		Rate of Use	Variety of Use
Communication Patterns			
H1	Household communication		+
H2	External communication		+
Usage Barriers/Facilitators			
H3	Difficulty of using PC at home	-	-
H4	Level of expertise at home	-	-
Household Makeup Structure			
H5	Children in the home		+
H6	Competition for use	-	
Technological Structure			
H7	Age of newest PC at home	-	-
H8	Use of other IT products	-	+
Attitudinal Belief Structure			
H9	Impact of PC use	+	+
H10	Utilitarian outcome PC use	+	+
H11	Social outcome of PC use	+	+

Table 4: Computer Ownership, User and Use Information

	US	Sweden	India	Sig
Sample size (n)	*910*	*906*	*996*	**-**
Years of computer ownership	7.02	5.10	1.92	p<.001
Number of computers at home	1.40	1.38	1.01	p<.05
Number of users per household	2.53	2.41	2.57	ns
Number of adult users per household	1.81	1.70	2.14	p<.05
Number of children users per household	0.68	0.71	0.43	p<.10
Avg. Variety of Use per family (types of uses)	8.28	7.55	4.75	p<.001
Avg. Rate of Use per family (# of hours per wk)	8.81	6.94	12.02	p<.001
% of households in the sample with Internet	83%	78%	42%	p<.01
Total number of individuals in the sample	2681	2562	4081	--
Total number of individual PC users in the sample	2280	2138	2456	--
Male/Female users in the sample	50/50	57/43	75/25	--
Mean Household size	2.95	2.83	4.10	--
Total number of individual PC users in the sample	2280	2138	2456	--

Table 5: Diffusion of Computer in the Home

	Reasons to Adopt			Reasons for Use		
	US	**Sweden**	**India**	**US**	**Sweden**	**India**
Job related work	62.7%	56.7%	64.0%	73.7%	68.7%	76.1%
Communication	35.2	41.5	42.5	92.4	87.1	78.2
Recreation / Entertainment	68.0	57.6	59.4	85.7	79.1	84.7
Home Management	47.3	21.7	26.4	85.9	71.2	41.9
Shopping	--	--	--	50.8	52.8	6.5
Education	72.4	66.7	70.5	59.0	53.4	42.0
Information	39.2	42.1	45.2	64.2	62.0	31.5

Use-Diffusion	**US**	**Sweden**	**India**
Intense Use	30	29	26
Specialized Use	20	22	21
Non-Specialized Use	19	20	21
Limited Use	30	29	31

Table 6: Ownership of Related Technologies

TECHNOLOGY	US (n=882)	Sweden (n=885)	India (n=967)
Electronic organizer / handheld PC	22.3 [a]	10.3 [b]	9.4 [b]
Fax	20.4 [a]	23.2 [a]	9.0 [b]
Pager	36.2 [a]	9.2 [b]	11.9 [b]
Voice mail / answering machine	85.3 [a]	51.2 [b]	8.6 [c]
DVD / laser disk player	13.0 [a]	19.2 [b]	12.7 [a]
Stereo system	95.7 [a]	96.7 [a]	51.6 [b]
Cellular phone	63.7 [a]	87.3 [b]	25.1 [c]
Video camcorder	46.4 [a]	33.9 [b]	9.9 [c]
VCR	97.3 [a]	90.0 [b]	39.6 [c]
Digital camera	13.5 [a]	7.9 [b]	3.4 [c]
Video game console	44.7 [a]	30.8 [b]	--
Satellite TV	14.6 [a]	27.4 [b]	--
Cable TV	73.2 [a]	46.4 [b]	94%

[a, b, c] Different letters indicate significantly different using Z- test. For Country by Use Category, the test is for Use Category difference within each country.

Table 7: Means of Independent Variables and Multiple Comparison Tests

	F-Stat	US	Sweden	India
Communication Patterns				
Household communication	15.29[c]	0.79[a]	0.73[b]	0.62[c]
External communication	12.66[c]	0.72[a]	0.53[b]	0.54[b]
Usage Barriers/Facilitators				
Level of Difficulty of using PC at home	245.75[c]	2.39[a]	2.23[b]	1.70[c]
Level of Knowledge at home	68.51[c]	1.06[a]	1.22[b]	0.86[c]
Household Structure				
Children in the home	--	0.44	0.46	0.43
Competition for use	193.61[c]	2.05[a]	1.96[a]	2.55[b]
Technological Structure				
Age of the newest PC at home	7.67	1.90	1.98	1.91
Use of other technologies at home	10610.44[c]	6.26[a]	5.36[b]	1.84[c]
Attitudinal Beliefs				
Impact of PC use	449.94[c]	2.62[a]	2.10[b]	3.25[c]
Utilitarian aspects PC use	163.67[c]	3.13[a]	2.81[b]	3.49[c]
Social aspects of PC use	138.32[c]	3.01[a]	3.07[a]	2.42[b]

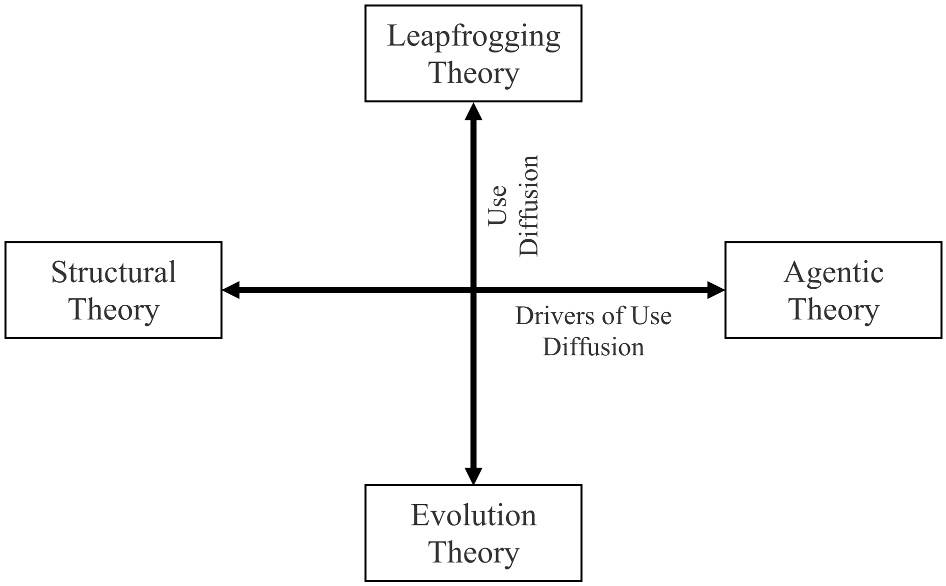
[a] $p<0.05$; [b] $p<0.01$; [c] $p<0.001$

Table 8: Standardized Regression Coefficients

	Rate of Use				Variety of Use			
	All	US	Sweden	India	All	US	Sweden	India
Communication Patterns								
Household communication	-.019	-.064	-.086[b]	.021	.065[c]	.096[b]	.065[a]	.059[a]
External communication	.076[c]	.023	.090[b]	.119[c]	.065[c]	.049[a]	.074[a]	.080[b]
Usage Barriers/Facilitators								
Level of difficulty of using PC at home	-.046[a]	.012	-.020	-.060[a]	.018	-.030	.003	.020
Knowledge Level at home	-.134[c]	-.121[c]	-.180[c]	-.113[c]	-.101[c]	-.234[c]	-.150[c]	-.226[c]
Household Structure								
Presence of children in the household	-.031	-.043	-.012	-.058	.051[a]	.060[a]	.057[a]	.043[a]
Competition for use	-.208[c]	-.241[c]	-.133[c]	-.277[c]	-.015	-.014	.004	.028
Technological Structure								
Age of the newest PC at home	-.029	-.103[b]	-.008	.015	-.087[a]	-.094[c]	-.056[a]	-.067[b]
Use of other technologies in the home	-.109[c]	.038	.013	-.030	.491[c]	.131[c]	.162[c]	.281[c]
Attitudinal Belief Structure								
Impact of PC use	.164[c]	.137[b]	.148[c]	.059[a]	.159[c]	.305[c]	.252[c]	.227[c]
Utilitarian aspects PC use	.192[c]	.241[c]	.226[c]	.089[b]	.182[c]	.173[c]	.216[c]	.085[b]
Social aspects of PC use	.088[c]	.094[b]	.154[c]	.053[a]	.158[c]	.156[c]	.151[c]	.142[c]
Adj. R^2	.299	.355	.320	.229	.467	.495	.422	.335
F-Stat	71.909[c]	.37.461[c]	33.694[c]	21.692[c]	146.53[c]	54.66[c]	39.23[c]	28.00[c]
N	2812	910	906	996	2812	910	906	996

[a] p<0.05; [b] p<0.01; [c] p<0.001

Figure 1: Models of Use Diffusion



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