

Internet Enabled Personal Choice - The Culmination of Domesticated Information and Communication Technologies

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Internet Enabled Personal Choice

The Culmination of Domesticated Information and Communication Technologies

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Abstract

This report seeks to extend and apply the conceptual framework about the domestication of information and communication technologies. The domestication framework understands the adoption of technologies as a feedback process that converts technology artifacts from cold, lifeless tools to comfortable and useful consumer goods. This framework has been successful in helping us understand the adoption of past information and communication technologies, represented by physical and shared household appliances. We will illustrate how changing technology and business trends have posed challenges to the existing domestication framework and require a change in focus. At the same time, key aspects of the domestication framework remain helpful in understanding the adoption or rejection of technologies. We will extend the domestication framework to allow it to transcend the changing nature of technologies and consumers. We will then demonstrate the value of the extended framework by using it to project future technology-consumer trends and to identify innovation opportunities. The key result from our analysis is that the predominant technology-consumer relationship in the foreseeable future would involve Internet and other multi-directional networked technologies interacting with individual consumers. This interaction enables an ecosystem of technologies and allows consumers to directly participate in technology creation. Domesticated technologies would become more than just meaningful; they also become a part of who we are.

1. Introduction

We live in a technology-driven consumer society. People engage in the consumption of technology simply by using technology-enabled goods and services. Consumers hope to select perfect products. Technologies seek to anticipate consumers perfectly. Therefore, it is crucial to understand the decision process within technology consumption and technology innovation.

This paper is about the domestication of Information Communication Technologies (ICTs). The domestication framework understands the adoption of technologies as a feedback process in which design and domestication anticipate and complete each other. Domestication itself is the process by which new and foreign technology artifacts find their places within the familiar spaces, routines, and patterns of everyday life. Domestication represented a shift away from models which assumed technology adoption to be rational, linear, mono-causal, and technology determined. Instead, the focus is on understanding the complexities of everyday life, and how technology artifacts fit within the context.

To date, the domestication framework has been successful in explaining the adoption of past technologies. However, various recent technology and consumer trends have led scholars to question the domestication framework. Applying the traditional domestication approach to the latest technologies indeed reveals problems with the prior focus on physical artifacts, family routines, and the home setting. We believe that as the pace of technology innovation increases, the value of a conceptual framework should not merely be limited to understanding past technologies. We are confident that the domestication framework can be extended to a more general framework that understands technology innovation without being tied down to the particular technology artifacts or consumer behavior being evoked. The goal of this paper is to motivate, outline, and apply this extended framework.

We have taken on this project because we believe we can contribute some unique perspectives. We are fortunate to be situated near Silicon Valley, a global center of technology innovation, enjoying cutting edge technology infrastructure. We are simultaneously technology creators, entrepreneurs, and consumers. Thus, we have personally benefited from using the domestication framework to understand all parts of the domestication-innovation loop. Based on our experience, we believe that a more general domestication approach can help us not only understand technology adoption in the past, but also guide technology adoption in the future.

Concretely speaking, we offer three contributions. First, we will analyze the challenges to the existing domestication framework posed by some poignant technology and business trends. Based on our own personal experiences, we will also provide a descriptive case study of current educational and consumer technology use in our university setting. Second, we will synthesize the underlying domestication concepts and approaches that transcend particular technology artifacts and consumer behaviors. This forms the basis of a more general domestication framework. Third, we will apply this extended domestication framework to speculate about technology development and adoption in the near future.

The structure of the paper is as follows. We begin with a review of the domestication framework in Section 2, retracing its motivations, concepts, and methodologies. We focus in particular on the objections to the domestication framework that other researchers have already raised. These existing objections offer a preview of the most systematic challenges that we describe in Section 3. We continue in Section 4 by extending the domestication framework to allow it to transcend existing challenges. In Section 5, we demonstrate the value of this more general domestication framework by surveying the near-future opportunities and challenges it

has helped us identify. Lastly, in Section 6, we discuss what domestication has taught us about people's values with regard to technology choices and technology consumption.

2. Background and prior work in domestication

In this section, we review where domestication comes from, what it is, and why it is important. We will collect applications of domestication and perspectives on domestication, both past and present. We will also critically reflect on the theoretical legacy of the domestication framework, and highlight existing objections.

2.1. Origins of domestication

Domestication has its roots in many disciplines and traditions. The sensibilities expressed by the domestication framework are first developed in the Science, Technology, and Society (STS) tradition and Information Studies (IS). Subsequently, ideas directly leading up to domestication have been nurtured within the media studies literature and the studies on Information and Communication Technologies (ICT).

STS is an interdisciplinary field, itself rooted in many disciplines, including history, philosophy, sociology of science and technology, anthropology, cultural studies, critical theory, feminist theory, gender studies, postmodern philosophy, and others [Van House 2003a]. There are three main subfields within STS: scientometrics, qualitative STS, and policy studies [Van den Besselaar 2001]. There was little integration across the three. In particular, qualitative STS examined the nature of knowledge, the collective processes of knowledge production, and the practice of knowledge use in technology. Since the 1980s, researchers in STS have looked at information and communication, with particular focus on the inseparable and mutually constituted relationship between the technology and social aspects of communication. A typical example of this relationship is how computers shape, and are shaped by, the actions of their human users [Star 2002].

We can think of this body of work as the precursor to work in IS. The IS field itself studies information systems that are largely technological systems, designed to support knowledge work and carry information across space and time. Designing useful information systems requires an understanding of people's knowledge processes, practices, and artifacts [Van House 2003]. Successful information systems often end up as information infrastructure, a key outcome of the design and implementation undertaken by information scientists [Bowker & Star 1999].

Concurrent with the work in IS, work in media studies focused on the content, history, and effects of various media technologies, in particular technologies in the mass media. Scholars in media studies varied in their theoretical and methodological approaches to studying the media's political, social, economic and cultural impacts. In the 1980s, there was a strong interest in media

audiences, segmented by the audiences' household roles [Hobson 1980], nationalities [Lull 1988], and ethnographies [Lull 1990]. There was also a shift towards studying household media consumption as a collective process [Bausinger 1984]. This line of work mostly originated in Europe, culminating in efforts such as the European Media, Technology and Everyday Life (METEL) project [Silverstone 2005a].

By the late 1980s, technologies such as interactive games and personal computers were entering the home, competing for time with television viewing and even making use of the television screen as a display. In response, the ICT discipline appeared, focusing on the ensemble of these technologies [Haddon 2007]. This broadening of the domestication sensibilities beyond traditional media led to the first studies of people's combined experiences with satellite television, VCR, telephone, and the home computers. As the ICT discipline matured, scholars have used the conceptual framework developed there to study media technologies across several technology generations, from the radio [Forty 1986], to video [Keen 1987], to the personal computer [Haddon 1988].

Domestication is the continuation and the convergence of these traditions and interests. The insights and sensibility developed from these earlier studies formed the basis of the conceptual framework that we call domestication.

2.2. The domestication framework

The earliest public and most cited reference to the concept of domestication was [Silverstone et al. 1992], which appeared in a collection of some of the first empirical studies of ICTs. The metaphor of 'domestication' came from the taming of wild animals. Domesticating ICTs involves a process of bringing new technologies into the home, and taming or 'house-training' these strange and wild technologies. These technologies then become a part of the family, integrating into daily household routines, the values of the users, and the home environment.

The process of domestication implies that, in the long run, technologies can become an integral part of everyday life. When the domestication of technologies has been successful, the technologies are not regarded as cold, lifeless, challenging, and problematic tools at the root of family arguments or work-related stress. Rather, they are comfortable and useful consumer goods, with both functional and symbolic value, simultaneously reliable and trustworthy. The phone, radio, and television have all experienced the same process [Berker et al. 2006].

This theoretical framework distinguished four concurrent processes. The first process, appropriation, describes the managed entry of ICTs into the home. The second process, objectification, locates these technologies within the home, both physically and symbolically. The third process, incorporation, fits the technologies into our routines and time structures. The last process, conversion, represents how we display the technologies to give out messages about ourselves [Silverstone et al. 1992, Silverstone & Haddon 1996, Haddon 2007].

Framed in this fashion, domestication is a process that links consumption with design and transforms technologies into public and symbolic objects of value and desire [Silverstone 2005]. Domestication is also a process of bringing home artifacts and ideas, a bridge connecting established meanings with new values and information. Consumers specify the dimensions of the new technology space through appropriation, objectification, incorporation and conversion, fitting the new technology into existing environments and routines. The dynamics of domestication are constantly renegotiated, and the outcome of domestication feed back into design. In short, domestication is the process that connects the household and its surroundings, the private and the public, the moral and the formal or objective economy, thereby making them mutually constitutive [Silverstone et al. 1992].

2.3. Contributions of domestication

Domestication emerged as a framework within media and ICT studies, and traced a particular analytical trajectory. The agenda of the overall analytical project is to explain, explore, and understand the process of technological innovation and consumption, a process that involves producers and consumers in a dynamic interweaving of activities. As a conceptual framework, domestication is useful in guiding empirical research while maintaining theoretical depth. Thus, domestication filled a gap that existed in media studies and STS at the time [Berker et al. 2006].

Also, domestication helps researchers explore the design-consumption interface, connecting the industrial and social dynamics of ICTs and framing design and domestication as two sides of the innovation coin [Silverstone 1996]. Thus, domestication facilitates a coherent survey of the process of creating technology artifacts and influencing consumer behavior. In particular, an aspect of appropriation and conversion represents the commoditization of technology artifacts, a key process in the introduction of new technology through marketing, design, and policy.

Most importantly, domestication tempers the unmediated belief in the one-sided transformative power of technology, represented by the description of technology diffusion that has become industry jargon [Berker et al. 2006]. Domestication considers technology use in subtle, ambiguous, and contradictory contexts, with each context playing a defining and complex role in daily routines and social meanings [Silverstone 2005]. In challenging technological determinism, domestication places an emphasis on analyzing the nature of technology, which, somewhat surprisingly, is unusual within past work media studies and ICT traditions. Since its appearance, the domestication framework has been used by many researchers to look at a diverse range of empirical and theoretical topic. By the early 1990s, domestication sensibilities largely replaced technology determinism as the predominant perspective in research on the social aspect of emerging technologies.

2.4. Domestication methodologies

Domestication studies have mainly used qualitative methods, an understandable choice given the complex relationship between ICTs and their users. This is a continuation of the methodologies used in media studies, which also emphasize the dialogue between psychological, social, economic, and political aspects [Silverstone et al. 1992]. Common techniques involve case studies, ethnographic analysis, interviews, diaries, as well as descriptions and maps of home spaces [Berker et al. 2006].

Some domestication studies have also included theoretical interrogation. The domestication concept is a metaphor, and analysis guided by domestication frequently involves other metaphors. The domestication process represents a complex pattern of interactions between producers and consumers. Theoretical studies attempt to unite the complexities into a coherent and useful framework, in which the various empirical phenomena are conceptualized, and various concepts are given theoretical support [Silverstone et al. 1992].

We take a mixed approach in this paper. We believe that we should ground our analysis in empirical facts if we are to truly understand technology innovation and consumer behavior with regard to technology. Without some degree of empirical analysis, we risk focusing on imagined technology-consumer dynamics that depart from reality. Thus, our work is partly empirical, and we situate the challenges to the existing domestication framework within current technology, business, and consumer trends. Our work is also necessarily theoretical. We need to generalize recent empirical realities and transform them into concepts. Based on these concepts, we can then extend the domestication framework such that it becomes a more powerful tool to understand technology adoption and innovation, both in the past and in the future.

2.5. Objections to domestication

Scholars have observed that the existing domestication framework faces many challenges, especially with the maturing of previously new technologies, such as those driven by the ubiquitous and established Internet. These challenges, briefly surveyed here, are a precursor to the more fundamental issues that we will highlight later in the paper.

To begin, some studies have questioned the traditional domestication methodology privileging qualitative data manually gathered from interviews and case studies. A recent literature survey has framed the problem of detailed documenting of user behavior as an important challenge for future domestication studies [Berker et al. 2006]. The same work also called for future work in domestication to embrace new technologies that facilitate comprehensive and automatic monitoring of user behavior. Data generated thus can provide detailed, personalized and longer-term traces of use-technology interactions.

As summarized in [Silverstone 2005], there are several other objections that appeared during the life of the domestication concept. First, mobile, pervasive technologies are breaking down the boundaries around the household. The distinctions between public and private space and frames of reference are losing their force and their significance. Later, we will see that the distinction between the public and the private remains useful, but the sense of a physical boundary is no longer relevant.

Also, the focus on understanding past and present domestication processes have emphasized technologies that have to some degree started to find their way into the household. The first studies on emerging Internet connected ICTs have revealed the range, speed, and global reach of these technologies. It was said that these technologies will “take the personalization and the mobilization both of the machine and of everyday life to new levels” [Silverstone 2005]. Later, we will see that the personalization and mobilization concept will undermine key assumptions in the domestication framework. The functionalities of digital ICTs are not just affecting our lives, but creating an entire technology-consumer lifestyle.

In addition, the emphasis on processes in the home has led to a framework built on the assumptions and dynamics of the traditional household. Studies outside this setting have required the reframing of many components of the domestication framework. Examples include single parent households [Lemor 2006] and small businesses [Pierson 2006]. Later, we will see that the tie to the physical space and the consumption unit of the household is an artificial limitation, and we will outline a more general framework to address this shortcoming.

Most importantly, scholars have come to realize that “complete” domestication would also be a failure [Silverstone 2005]. This is a subtle point rooted in the way that domestication is a reflexive defense of private moral values. “Complete” domestication means the complete preservation of existing values despite the introduction of new technology. Such a process would be a failure because it would neutralize the potential of new technologies to catalyze positive social change, thus acting as cultural anesthesia and inertia to true innovation. A goal of this paper is to recast domestication as a proactive framework that makes technology-propelled social change more palatable by preserving core human values, and help guide future trajectories by anticipating innovation driven by the same values. This more general framework would also help us understand why complete domestication is unlikely to ever happen.

These objections have become fundamental challenges in the context of recent technology, business, and consumer trends. These trends are having a profound impact on the usefulness of the existing domestication metaphor. In the next section, we will use empirical realities to identify aspects of domestication that should be modified and aspects that should be preserved.

3. Trends beyond the domestic

A good metaphor simplifies complex phenomena without departing too far from reality. Using this criterion, we will examine the domestication metaphor using technology, business, and consumer trends viewed from the perspective of the Silicon Valley area in the United States. Our goal is to motivate the need for a more general framework by looking at the challenges faced by the traditional domestication framework, as well as the insights that it continues to offer.

3.1. Technology trends

The focus of existing domestication approaches has been shaped by the technologies that they analyze. Previous domestication studies have typically involved in-depth analysis of a few users. Each user is assumed to interact with a small number of physical technology artifacts. The domestication of these artifacts involves situating them in the physical environment of either the home or the workplace, and immerses them in the associated private or public routines. This approach has worked well in understanding the adoption of past domestic appliances.

We will use Figure 1 as a starting point to look at recent technology trends that disturb this approach. The figure shows the number of mobile phone subscribers in the U.S. and the number of Wikipedia entries over the 2001-2008 period [U.S. Census 2009, Wikipedia 2009]. This small amount of empirical data is sufficient to highlight several significant changes in the technology landscape that undermine the traditional domestication approach.

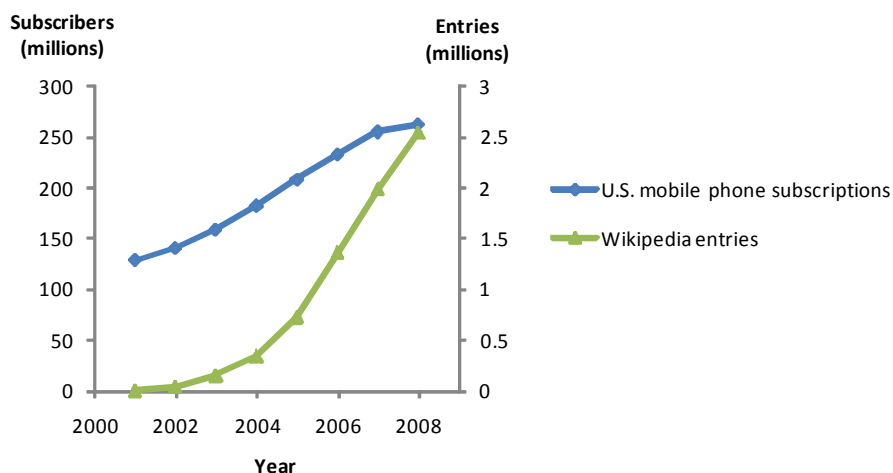


Figure 1. U.S. mobile phone subscriptions and Wikipedia entries 2001-2008.

The first challenge is in the changing nature of technology artifacts. Existing domestication approaches have largely focused on physical appliances. The exponential growth of Wikipedia is a routine example of the growing world of software and content. These technology artifacts are virtual, non-physical, and without the sense of a technology “appliance”. Moreover, innovation in software involves changing code and delivering new content, contrasted with innovation in hardware that requires changing manufacturing processes and distributing new physical products. Consequently, software and content presents a lower barrier to innovation and has been growing and changing at a much faster pace. If the domestication framework seeks to understand technology innovation and adoption, then it should encompass both physical and virtual artifacts. Otherwise, the framework risks losing relevance as the preponderance of innovation and value created shifts from hardware to software.

The second challenge is in the changing nature of technology users. Existing domestication approaches have largely focused on technology adoption within the household. The technology is assumed to be shared, and adoption involves negotiating the technology within existing routines and tensions of the family. The steady growth of mobile phone subscribers is a routine example of the growing world of personalized technology. The number of subscribers already far exceeds the number of households in the U.S. At over 260 million subscribers in 2008, the number is fast approaching the total national population of roughly 300 million. There is usually a mobile phone for each person, instead of a mobile phone for each household. In fact, there are often multiple appliances for each individual, instead of multiple individuals sharing a single appliance. In addition, the mobile phone exemplifies a technology artifact that is not transferable between people, with each person having his own contact list, applications, and preferences. If the domestication framework seeks to understand technology innovation and adoption, then it should be general enough to accommodate the changing meaning of technology users.

The third challenge is in the missing analysis of technology networks and infrastructure. Existing domestication studies have largely focused on multiple examples of a single appliance in a single household. There has been less effort in looking at multiple appliances working together in a large network and the infrastructure that facilitates such a network. The steady increase in mobile phone subscriptions and Wikipedia entries are both driven by the tremendous value created in a large network of interconnected technology artifacts. A single mobile phone has intrinsic value, but a large network of intercommunicating mobile phones can facilitate a near infinite number of possible communication links. Likewise, a single Wikipedia entry has intrinsic value, but a virtual network of Wikipedia topics linked to one another can replicate the conceptual web of knowledge beyond a collection of disjoint topics. Moreover, a common data interface between the mobile phone infrastructure and the Internet infrastructure allows mobile phone users to routinely access Wikipedia on their phones, creating tremendous additional value by merging the virtual network of Wikipedia, the physical network of mobile phones, and the physical network of the Internet. If the domestication framework seeks to understand technology innovation and adoption, then it cannot forgo the analysis of technology networks and

infrastructure. Otherwise, the framework risks neglecting mechanisms that amplify the value and impact of each technology artifacts and each consumer.

3.2. Business trends

In addition to technology trends, there are some strong business trends that also disturb the domestication framework. Some of these phenomena are coupled with the technology trends we presented previously, and lead to the same technology-consumer effects. Instead of repeating the previous discussion, we will focus on business trends that undermine key assumptions in the domestication framework, leading to effects different from that described in the previous section.

We use Figure 2 as the starting point for our examination. The figure depicts an advertisement for the most recent iPhone product found on Apple's official website [Apple 2009]. The image shows a screen capture of the iPhone product while it is accessing the online store of iPhone applications. The advertisement caption lists several major application categories include games, business, finance, fitness, and others. We focus on this particular image because iPhone is a cutting edge technology product, and ties together several business trends that challenge the assumptions in the existing domestication framework.

First to be undermined is the assumption that domestication gives meaning to new technology artifacts by fitting them into daily routines previously devoid of comparable technologies. Such an assumption is valid when the technologies analyzed represent a revolutionary innovation over prior technologies, as was the case with television and the first generation of ICT appliances. However, when technology matures, and innovation is more evolutionary, the adoption of new artifacts often involves replacing old artifacts with improved artifacts in established technology routines. This allows the creation of new business value in the absence of revolutionary technology change. For example, the iPhone device merges the capabilities of the mobile phone and the laptop, as shown by the screenshot in the advertisement. Both the mobile phone and the laptop represent technology artifacts that are, more or less, already domesticated. They have their own technology routines that are already meaningful to their users. Rather than creating a new "iPhone routine," users are more likely to renegotiate the time they spend in mobile phone and laptop routines, as well as transfer personal information and preferences from established artifacts to new artifacts. Thus, a more general domestication framework should consider giving technology meaning simply by fitting one technology routine within another technology routine.



Figure 2. Recent iPhone advertisement.

Also undermined is the assumption of a work-home or public-private boundary. This assumption has shaped domestication ideas by presenting domestication as a “taming” of technologies once they are brought into the home. The domestication process acts as a way to preserve the routines and the meanings of the home in the presence of external technology change. Again, such an assumption is valid when technology artifacts are associated with a particular physical space. The iPhone advertisement offers a striking counter-example. The device is mobile and thus possesses the same functionality whether at work or at home. The functionality permits both public activities, facilitated by business and finance applications, and private activities, represented by game and fitness applications. The business motivation, again, is to displace existing work and home technologies by merging the functionalities of both into a single new artifact. The domestication process then acts as a way to preserve the meanings and the productivity of the workplace and the home in the presence of devices that are active in either

or both places. Thus, a more general domestication framework should not depend on the existence of a public-private boundary, because such a boundary is increasingly blurred.

Last but not least, we should also question the assumption that technology creators and consumers are separate entities. The iPhone advertisement caption highlights the App Store, a marketplace where the user can purchase a variety of applications. App Store includes applications made by Apple, other software vendors, and most importantly, applications made by users. The business case for the App Store is to leverage the technology creativity of other software vendors and of iPhone users. In particular, user created applications would be motivated by first-hand consumer experiences. Application developers set the price for their creations, and retain 70% of the sales revenues [Apple 2009a]. Apple benefits by having a more enriched technology and consumer network, as well as additional revenue from the application sales. The increasing number of user-created applications highlights a proliferation of technology expertise. Technology consumers now have the know-how to be technology creators at the same time. Users can domesticate technology directly by creating new technology artifacts. App Store is not an isolated example. Facebook also has a vibrant user-created application ecosystem. Thus, a general domestication framework needs to encompass environments in which technology consumers are also technology designers.

3.3. Technology use in university campus life

Given the challenges we have outlined, we can either formulate another conceptual framework or extend the existing domestication framework to address the challenges. We choose the latter. Based on our own experiences, we believe the general spirit of the domestication framework remains useful. In the following, we will outline some examples at UC Berkeley where domestication helped us understand the dynamics associated with the adoption of technology. Although we draw on experiences observing a variety of departments on campus, the majority of our first-hand experience comes from interactions within our home departments.

The most significant impact of new ICTs is the way they have improved classroom related communications. Email is the standard channel for making announcements, arranging office hours, and exchanging similar communications. Most courses distribute classroom material electronically and have their own class websites. The adoption of new technology has been near universal and without resistance in these areas because the new technologies fit exactly into the established routines and meanings for the manual tasks they replaced, with the advantage of accomplishing the same tasks more efficiently. In other areas, the adoption of ICT has never even been contemplated, because the technology involved cannot meet the functional requirements, or they fundamentally alter the meaning of the process involved. Examples include hands-on laboratory exercises, office hours consultations, or the grading of qualitative assignments. The adoption or rejection of new technologies for classroom communication

exactly follows the trajectory traced by the domestication process – technologies that fit into established routines and meanings are adopted, technologies that cannot are rejected.

We find a similar dynamic in the way ICTs have impacted classroom instruction itself. Many lectures on campus are recorded as webcast – video of the lecture delivered live on the Internet and accessible later through an online archive. After this technology was deployed, there was an initial period in which many students watched lectures at home and skipped class altogether. However, students realized very quickly that the webcast cannot capture all the classroom dynamics, as the students at home would be unable to raise questions in real time, nor would they hear other students' discussions because the instructor has the sole microphone. The webcasts continued because they do offer enormous archival value. This allows students to partially “re-live” the lectures during exam review, or to view lectures by high profile speakers even when they cannot be physically present. Again, the dynamics of balancing this new technology fit the domestication narrative regarding the complexity of routines and meanings.

It turns out that the subtleties of the physical artifacts remain, notwithstanding our discussion about virtual technologies earlier. Many classes initially allowed students to bring laptops. The intent is to add value to the classroom by allowing students to access electronic course materials or cross check additional online references during the lecture. However, it became apparent very quickly that laptops in fact inhibit student interaction. Students quickly began using their laptops to access email, chat with friends, interact with online social networks, or engage in other private routines that previously have had no place in the classroom. More importantly, the physical design of the raised laptop screen acts as a barrier between the speaker and the audience. Many instructors find it unsettling to speak to an audience of raised laptop screens instead of an audience of faces. The physical design of the laptop keyboard also presents a problem. When typing, many keyboards emit a low volume but clearly audible sound. In some settings, one or two students' continuous typing can distract a large number of their neighbors. These concerns prompted many instructors to enforce a “no laptop” policy in their classrooms.

These changes in campus life are in part facilitated by the presence of a broader technology infrastructure and lifestyle. For example, lecture webcasts would not be possible without an Internet that can deliver quality video, or classrooms with audio-visual recording equipment. Laptops in classrooms would never have become an issue if laptops had not been universally affordable or wireless Internet had not been ubiquitously available. Similarly, people's comfort and proficiency with regard to ICTs would be far less without the broader technology lifestyle in which everything from paying bills to buying textbooks can be done online. It is this technology lifestyle, infrastructure, and the ecosystem of artifacts that has propelled the changing meanings of artifacts and users, as well as the changing assumptions about routines, boundaries, and consumers. The general ideas of the domestication framework remain valid, but its specific formulation should be extended.

4. Domesticating Domestication

In the previous section, we have examined at length the challenges faced by the existing domestication framework, and the aspects of the framework that remain valid. Now, it becomes a more straightforward task to extend the framework to fit new technology-consumer realities while preserving the useful central ideas.

Based on our analysis earlier, we believe the following aspects of the domestication framework are changing. The location of technology consumption is changing – it can be at home, at work, or mobile. The meaning of the consumer is changing – it can be a household, an individual, or an organization, such as the university. The nature of the technology artifact is changing – it can be physical or virtual. The nature of delivered information content is changing – it can be broadcast originating from a central source, or user-generated from a network of distributed sources. The nature of technology-consumer relationship is changing – it can be a lifestyle that includes technology, or a lifestyle centered on technology. The nature of artifact-artifact relationships is changing – it can be artifacts that bring stand-alone intrinsic value, or artifacts that bring additional value by forming large networks.

We believe that we should retain the concept of the location of technology consumption, the concept of a consumer, the concept of a technology artifact etc. However, the domestication framework and methodologies should not be tied to one particular of location, consumers, or type of technology artifacts. Otherwise, the domestication conceptual metaphor would not survive as the meaning of location, consumers, and artifacts evolve.

With this in mind, we believe that the core idea of domestication is a process of technology consumption such that the technology becomes a meaningful part of everyday life. We reframe the four concurrent and mutually dependent aspects of domestication as follows.

Appropriation describes the managed introduction of technology artifacts into a new environment. There are no restrictions on the technology artifacts involved. They can be physical or virtual, stand-alone or networked. The new environment is defined as necessary. They can be a combination of physical and virtual space, occupied by users and other technologies.

Objectification represents how these technology artifacts are symbolically located within the environment. Again, the definition of the environment is general, determined more by time and focus instead of physical space. The meaning of symbolic location is also general. It can mean different things depending on whether the user is an individual, a household, or other technology artifacts, and whether the environment is private, public, or both.

Incorporation involves fitting the technologies into existing routines and meanings. The concept of routines is general. It can be user-technology routines, user-user routines, or technology-technology routines. The concept of “meanings” is also general. What is meaningful depends on the specific users of the technology. There may be existing routines and meanings, constructed on a timescale determined by the pace of innovation and domestication. Alternately, there may be no established routines and meanings since the both are constantly and rapidly changing. In that case, analysis would be centered on the disturbance caused by the new

technology, compared with the trajectory of changing routines and meanings if the technology had not been present. Small, evolutionary advancements have little barriers to incorporation, as long as the new technology replaces an earlier technology in a near identical niche in daily life.

The last process, conversion, represents how the users give out messages about themselves through the new technologies. The form of the message is general. It can be using or displaying the technology involved, altering the technology, or even using the technology to create other technology artifacts. The forum where the message appears and has impact is also general. The forum could be as large as the consumer society at large, as small as the community of niche users, or as virtual as an online social network or an application ecosystem.

Reframed in this fashion, domestication becomes applicable for nearly all technology artifacts, situated in different environments, with innovation occurring across different time frames. Consequently, since our society is saturated with technology and driven by consumption and innovation, the domestication framework becomes a tool to study human artifacts, ideas, and values as expressed through human-technology and technology-technology interactions. A part of such a study would necessarily be theoretical, extracting the general concepts and dynamics underlying the shifting technology-consumer landscape. Another part of the study would be empirical, documenting the changing technology-consumer landscape and distilling the motivating values and ideas. The choice of what technologies to study would depend on the analytical focus. If the focus is to understand the past, we should look at established technologies. If the goal is to anticipate the future, then we must look at emerging technologies.

Until now, the domestication framework has focused on understanding how established meanings are preserved in a changing technology environment, and we have identified the values that are preserved across technology-consumer change. These values are likely to be constantly re-negotiated and re-synthesized. Thus, an extended domestication framework is an active tool that helps us project into the future, anticipate the re-negotiation of established values, and guide the creation of new technologies and new meanings.

5. Domesticating the future

In this section, we apply the extended domestication framework and identify the predominant technology and consumer characteristics in the near future. We believe the predominant future communication technologies would be the Internet, and the predominant future consumer would be the individual. The extended concepts of appropriation, objectification, incorporation, and conversion help us understand this projection.

5.1. Predominance of the Internet

The Internet would be the dominant communications technology because the domestication of Internet related technologies absorbs other technologies and is self-accelerating.

A key strength of Internet related technologies is the presence of an existing ubiquitous Internet infrastructure. Thus, all physical devices are expected to be able to interact with this infrastructure, incorporating virtual artifacts, deriving great networked values from interacting with other similar devices, and increasing the value of the Internet ecosystem as a whole.

This expectation of being connected to the Internet also allows the Internet to act as a universal language, allowing all new artifacts to immediately communicate with each other. New physical artifacts would find a fitting location around existing wired or wireless access points, which would be designed and placed to anticipate the frequent arrival and departure of new physical artifacts. Virtual artifacts need even less effort situating themselves within the virtual environment, as the common Internet interface allows effortless integration and linking to existing physical and virtual Internet artifacts.

In addition, in the Internet virtual space, displays of technology use can reach a large audience and create immediate effect, regardless of whether the display is a photo, a screen shot, or even the simple act of using the technology. In addition, the Internet offers platforms for consumers to participate directly in technology creation, a more intense form of engagement than just the display of technology. The inherent message is that the artifact's creator derives great value from the ecosystem, and believes that other consumers can extract similar value. Thus, consumer-created artifacts often spread quickly through the network of artifacts.

However, the domestication of Internet related technologies would not be without some resistance. The resistance comes not from difficulties in fitting new Internet technologies into existing routines, which we believe is a near effortless process due to increasing consumer proficiency with Internet technologies. Rather, the challenge comes from whether the established and desirable meanings can be preserved in the presence of new Internet technologies. The no-laptops classroom policy exemplifies such challenges – the meaning of the classroom was disturbed by the private uses of the laptop. Even then, due to the presence of the larger Internet ecosystem, the laptop is rejected only in a limited context and not outright.

Thus, the existence of a ubiquitous network, infrastructure, and technology ecosystem has established and would preserve the Internet as the predominant communication technology. It would require a great amount of risky and long term investment to create a separate network, infrastructure, and ecosystem that can match the Internet in terms of functionality, affordability, and ubiquity. It would be far more likely that new networks become absorbed into the Internet, as the radio, telephone, mobile phone, and television networks have been in the past.

5.2. Predominance of the individual consumer

We can use the same reasoning to understand why the individual would remain the predominant consumer of the future. Again, the reason is that the domestication of individualized technologies would be self-accelerating and uniquely intense.

First, marketing towards the individual would be more effective. Internet marketing systems such as Google advertisements or Amazon recommendations can display items that closely resemble users' spending behavior based on extensive and automatic logs of user interactions. Also, individualized artifacts warrant the purchase of more artifacts for a given population. This encourages technologies which achieve the economy of scale in manufacturing and have the added value created through networks. As a result, such artifacts cost less and deliver more. In addition, the appropriation of individualized technologies would often be individual purchasing decisions. Such decisions often can bypass the economic tensions and negotiations associated with joint purchasing decisions for household appliances or other shared technologies.

Individualized technologies would be incorporated as a part of the personal space of the individual users. Technologies situated in the personal space would avoid the inevitable tensions and negotiations associated with shared technologies within shared spaces. It would be less likely that one artifact situated within someone's personal space would affect another person, adversely or otherwise. Even if there is tension, most cultures would consider it an inappropriate intrusion to intervene in another individual's personal space.

Furthermore, individualized technologies allow the conversion process to be expressed as a fashion experience. Indeed, there are as many individualized technologies as there are kinds of individuals. Thus, the choice of color, preferences, applications, contacts, and links are as much technology choices as fashion statements. Many existing products are marketed as fashionable, such as the iPhone product line we explored earlier. The display of fashionable technologies in turn makes it easier to market future products in the same ecosystem. This dynamic is absent in shared technologies, since the idea of a shared fashion is harder to define.

Nevertheless, individualized technologies would not be without tension. On the one hand, the pre-existence of individualized technologies would allow future individualized technologies to be slotted effortlessly into existing technology routines. On the other hand, since we live as a society of individuals and not individuals in isolation, the change in personal routines, even if acceptable to the person involved, may be disruptive to the routines and meanings of others. Again, the no-laptops classroom policy exemplifies such challenges – the private uses of the laptop disrupted the learning routines of fellow students. Even then, the rejection of individualized routines in one context would not lead to the rejection of a technology in all contexts. Rather, the problematic part of the routine would be substituted with a different routine that is less problematic. An individual user has complete freedom to make that change.

Thus, the predominance of individualized technologies comes from their ability to magnify value, avoid tensions, and amplify desirability. We believe that the individual is the ultimate consumer, since the individual is the smallest unit of making decisions, participating in routines,

and expressing social values. One can view past domestication processes as the evolution of technologies from being merely useful to being also meaningful. Individualized technologies would represent the next stage in this trajectory, in which technologies evolve from being merely meaningful to also being a part of who we are.

5.3. Identifying opportunities

Based on the resistance to Internet and individualized technologies, we can predict several areas with uncharted and significant opportunities for new businesses and technologies.

First, we expect more technologies whose chief value comes from domestication and individualization. These technologies would be packaged and presented as incomplete shells, into which consumers can place their preferences and content. Instead of artifacts that anticipate domestication, these technologies would be valuable only with domestication. Examples include Wikipedia, which would be worthless without consumers actively participating in domestication by writing new entries and expanding existing topics. Another example is the iPhone App Store, which would also be worthless without consumers' writing new applications.

Also, we expect the information indexing industry to mature and expand. The existing Internet information infrastructure is still in its infancy. We are only beginning to appreciate the usefulness of a massive amount of descriptive information about the world. In the future, we foresee information becoming a part of the world, which would be indexed, and thus made accessible and useful. Current players in the industry include web search companies such as Google and e-retail companies such as Amazon. There would be increasing data on niche information beyond the domain expertise of established Internet companies. Thus, we expect room for new entrants focusing on highly specialized indexes.

In addition, we expect more technologies dedicated to domesticating other technologies. The motivation is that technology artifacts of today and the future exist in networks and ecosystems. Thus, artifacts that are left out have greatly diminished value. Differences between artifact designers would inevitably create barriers to the intercommunication. Thus, there would be the need for technologies that situate other technologies within existing networks and ecosystems. Examples include automobile navigation systems, multi-network text message relays, electronic financial trading mechanisms, and the like. These technologies do not need to be visible to the consumer, a property not seen in traditional ICTs.

Moreover, we expect the creation of an entire industry in affordable utility computing. Existing Internet technologies have reduced the cost of communicating information to close to zero. However, due to infrastructure and economic limits, it is still impossible for consumers at large to routinely process a large amount of information. There is ongoing and significant effort to make it universally affordable and ubiquitously feasible to process large information datasets. If this is achieved, then we could enter a world in which a single researcher in domestication could routinely and instantaneously extract insights from, say, logs of Wikipedia access behavior

of all mobile phone users within a particular country. The speed of knowledge production and technology innovation in such a world would be extremely rapid.

Lastly, we expect a new industry in technology agent services. Just as traditional human skills have specialized, we expect technology skills to specialize, even though people's technology proficiency as a whole would increase. As the world of information technologies steadily merge with the world of established technologies, we expect future information technologies to become as diverse and specialized as the world itself. All these technologies would still be a part of the same network and same ecosystem, but proficiency with technologies associated with one profession would not translate to proficiency with technologies of a different profession. Thus, just as we have lawyers, doctors, and accountants today to help us negotiate the mechanics of law, medicine, and accounting, we expect future technology agents to help us negotiate different kinds of technology. It remains to be seen whether this new industry will reflect today's distinctions between different professions.

5.4. Anticipating challenges

Thus far in the paper, we have extended the domestication framework to meet new-found challenges, and applied the extended framework to identify Internet and individual technologies as the predominant technologies of the future. However, a world saturated with Internet and personalized technologies is not without its own challenges.

Legal and policy concerns would become more prominent. Private spaces risk being further invaded as the Internet continues to increase in ubiquity. It would become an increasingly serious challenge to control data ownership and protect private property in a shared Internet infrastructure. It would also be an increasingly difficult and profound question to draw the public-private boundary online. We need to answer the key question of whether we need a new "law of the Internet" or whether existing legal and policy doctrines already suffice.

More importantly, social and moral challenges would pose problems for our very sense of being in a society. The virtual and physical worlds are superficially different, but both are reflections of our society. As the virtual world gains prominence, asymmetrical information and asymmetrical technology access can lead to severe economic and political imbalances. This imbalance is a moral issue, since morality refers to the ways in which human beings relate to each other. Would the Internet be an egalitarian virtual space, in which all "netizens" are equal regardless of race, gender, beliefs, and politics? Would the prejudices and biases of the physical world migrate online? Or would information and technology introduce new kind of inequality, creating a world where the less informed and the less connected face even fewer opportunities?

In a world filled with individual oriented Internet interactions, we may face a dilemma of being ever closer while being ever further apart. Would we retreat into our individual, segregated technology enclosures? Would we surrender diverse traditions to merge into an online mono-culture? Would we see increasing gaps between generations, people, and communities of

different interests and beliefs? The challenge is to enrich an amplified sense of individuality with an equally enhanced sense of morality, responsibility, community, and integration between different cultures and beliefs of the world. Thus, we must not permit future technologies to become completely detached from the physical world outside the Internet, and we must create a new sense of community beyond the individual. Otherwise, for a different set of technologies and consumers, we would be facing the failure of complete domestication yet again.

6. Final remarks

We can no longer view home appliances as the focus of innovation. The Internet and the individual would be the new engines that drive the emergence of new artifacts and new routines, and the new catalysts for technological and social change. In the next stage of technological and social innovation, the Internet would continue to be the main medium, incorporating existing networks such as radio, television, and phones. Personalized Internet related technologies would also continue to be the main way to communicate, socialize, and participate in life.

We believe the study of technology consumption in a technology-driven consumer society is equivalent to studying people's values. Our experiences in developing and applying a conceptual framework have allowed us to distill several human values that are re-synthesized and re-negotiated across technological change. These values include a desire to manage and control the world to benefit the individual, a desire for community interaction and a sense of belonging, and a sense of satisfaction from expressing our individuality and our values. These values have previously driven the adoption of televisions, radios, and other household appliances. The same values, in turn, are increasing the prominence of the personalized Internet.

We have applied domestication as a research tool to examine the manifold dynamics between consumers and technologies. While new artifacts and routines push the boundaries of our sense of self and society, domestication ensures that new ideas remain relevant to human values. Information and communication technologies are only tools. When these tools fail to balance of human beings with the technologies we create, they will be abandoned like any other tools that have ceased to be useful. Traditional values remain inseparable parts of what it means to be a human being. Even when each technology-oriented decision is entirely individual, each person cannot and should not detach from the society at large.

Consequently, we believe that there is a need to guide technology and business evolution beyond just offering an explanation of the past. Technology and business practitioners also need conceptual tools that go beyond the one-way understanding of technology adoption. Domestication is such a framework. Without it, we would understand innovation as a rejection of the past instead of a cyclic process that re-synthesize the past into an improved future. The sensibilities we develop through the domestication perspective would allow us to contribute to a better world, a world where technologies enhance a greater sense of self and responsibility for others, where technologies help us carry human values everywhere.

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