Interacting with Technology in an Ever More Complex World: Designing for an All-Inclusive Society

by Ramiro Gonçalves and Manuel Au-Yong Oliveira

Executive Summary

In a recent study we undertook, we analyzed a relatively simple day-to-day technology—namely, the use of automatic teller machines (ATMs) by older adults. Our results alert to the fact that, for an aging population worldwide, even seemingly simple technological products (such as ATMs) have to be more carefully designed in the future to be all-inclusive (i.e., intuitively usable by all), so that individuals do not feel marginalized by financially oriented (as well as other) technology. This will enable obvious immediate benefits for people, including increased productivity, quality of life, and independence.

Recent studies have proven that belonging to social groups and networks—in sum, feeling included through one's relationships in society—can be just as important for one's health as diet and exercise, while social isolation can be a health hazard comparable to smoking, high blood pressure, and obesity (Jetten et al. 2009). Computers and technology, on the other hand, are to become ever more present in society (Challenger 2009). We thus believe that steps have to be taken to prevent the elderly and other groups with limitations from feeling disconnected in an increasingly technological world. Otherwise, we will incur hidden costs at a growing rate (U.S. Census Bureau).

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Introduction: A Definition of the Problem

Population Aging

Over the course of the next 25 years, the age structure of [the] world population will continue to shift, with older age groups making up an increasingly larger share of the total. For example, during the 1998-2025 period, the world's elderly population (ages 65 and above) will more than double while the world's youth (population under age 15) will grow by 6 percent, and the number of children under age 5 will increase by less than 5 percent. As a result, world population will become progressively older during the coming decades.

Because of population aging, old-age dependency ratios will rise in every major world region during the next 25 years. And the world community as a whole will face an elderly support

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burden nearly 50 percent larger in 2025 than in 1998. (U.S. Census Bureau)

A crucial job going into the twenty-first century will be that of universal design, or meeting the challenge of designing for all. Rather different from the concept of producing specialized products for the elderly, for example, universal design is about designing products for all users, irrespective of their age.

The worldwide population is aging. On the one hand, this demographic tendency has been made possible by advances in technology. On the other, this very same technology is alienating older adults who have a low digital literacy level. Furthermore, adults between 52 and 68 years of age are, according to Rogers et al. (1997), slower and commit more errors than younger citizens, which aggravates interactions with machines.

The fact that computer software engineering is to be one of the jobs with the highest growth rates in the twenty-first century has been mentioned in the literature. John A. Challenger, CEO of Challenger, Gray and Christmas and one of the most highly quoted labor and employment experts in America, in a recent article in *The Futurist* ("Finding a Job in the 21st Century," September-October 2009) forecasted a positive change of close to 45% for these professionals from 2006 to 2016. Similarly, Edward Gordon, president of Imperial Consulting, WorldFuture 2009 speaker, and author of *Winning the Global Talent Show-Down,* also predicted in *The Futurist* ("The Global Talent Crisis," September-October 2009) that we are in the midst of a revolution leading up to a new ultra-high-tech age. So, we would like to emphasize that increases in technology-related jobs should also involve the content of these jobs, and in the case of technological products an emphasis should be on making these products accessible to all, even those with different capacities, and without needing to make adaptations to products, in the spirit of universal design, described below.

Challenger (2009) quite rightly mentioned also that populations of elderly adults are increasing, and with that so is the need for specialists in nursing and health care, to name but another two of the high-growth areas of future employment. Gordon (2009) also spoke of a demographic trend whereby birthrates will be low and retirement levels extremely high. So given that our world is growing ever more complex, a portion of the problems that older citizens experience today could well be magnified two- or threefold into the future. There is a need for us to get around this problem.

A solution growing in popularity is the concept of *universal design.* This concept aims, at low cost, to simplify the lives of all, thus promoting an all-inclusive society with appropriately developed technology. Simple technological products have to, in the future, be more carefully designed to be all-inclusive, meaning easily and intuitively usable by all of the different segments in society, even those with relatively low digital literacy and with one or more limitations, physical or other.

One may already visit very informative Web sites and access important information on the subject of universal design. For example, the Web site of the North Carolina State University *(http://www.design.ncsu.edu/cud/index.htm)* is very detailed in its description of *The Center for Universal Design: Environments and Products for All People*. The Center for Universal Design has as its mission to improve environments and products through design innovation, research, and education. We believe that such initiatives should be welcomed, as they couldn't be more timely. The September-October 2009 issue of *Scientific American Mind,* in its article on "The Social Cure" by psychology professors Jetten, Haslam, Haslam, and Branscombe, focuses on the importance of feeling included in groups and ultimately in society as a whole. Feeling included makes us healthier and more resilient and is one of the best ways available through which to stop cognitive decline, which is associated with aging.

The Growing Presence of Information and Communication Technologies

The growing presence of information and communication technologies in day-to-day life has already profoundly changed so-called "old habits" which characterize our society. In effect, these technologies are focused on ever faster and more-efficient information and knowledge exchange—so much so that we have witnessed a technological revolution with deep repercussions at the economic, social, cultural, political, and military levels. Currently we live in a world mediated by computers, diffused at all levels of society (Boff 2006). Technology can be found everywhere; indeed, it is hard to escape it. Today, even for the simplest everyday tasks, some practical knowledge on how to interact with technology is necessary. The general idea has been to simplify and facilitate a diverse set of routine activities, so that people may become more productive, more effective, and above all more stimulated and independent for what they consider to be fundamental.

So, information and communication technologies play an ever more prominent role in trying to provide ever faster answers to the most recent challenges present in society. Indeed, as mentioned above, finding a job in the twenty-first century will be easier if we choose to develop competencies in the areas of computers, as well as network systems or data communications. What we seem to have overlooked, however, is the fact that a growing segment of our society is having difficulty in keeping up with this trend. While a growing number of professionals will be occupied with the need to develop technologies further, a significant segment of society will simply not be able to keep up with their use in everyday life. There are 650 million people, or around 10% of the world's population, with limitations of various types and degrees (Ki-moon 2008; World Health Organization), which translates to added difficulties in day-to-day technological interactions.

It is safe to say that, in general, we are registering a growing preoccupation by the population in the developed world to gain access to new technologies. New technologies (such as e-commerce and mobile telephones linked to the Internet) are particularly powerful insofar as they can integrate individuals in the process of globalization. Indeed, recent recipients of the 2006 Nobel Peace Prize, Muhammad Yunus and the Grameen Bank, have shown a growing preoccupation with the dissemination of telecommunication services, Internet access, mobile telephone services, data processing, corporate IT, as well as other data exchange services in various regions, no matter how remote the villages in which they reside and irrespective of their income (Yunus 2009). With the rapid worldwide evolution and given the panorama of growing change, it has become an imperative to be conscious of which solutions and options surround us in order for one to be competitive in an increasingly demanding universe.

Unfortunately, even today, entities responsible for the development of a range of products available to the population do not show a concern deep enough for an aging population that is having difficulty in accessing and interacting with those technologies, which are not very user-friendly in some cases. This problem may not seem an important one, but we may tomorrow be a part of that older population having difficulty accessing future day-to-day systems, much the same as automatic teller machines (ATMs) today, only these systems are expected to grow in complexity.

Some consumers suffer from functional limitations, and their needs are not accommodated in the case of a number of products (Beecher and Paquet 2005). In using some digital products that possess quite complex possibilities, a significant number of users are not able to use all of the functionality without prior experience, which leads to learning through trial-and-error or by reading an instruction manual. Some users (very young or quite old) oftentimes give up using certain functions after failed attempts (Lee and Tsai 2007).

With an aging population, producers of digital products must in-

creasingly take into account that they have to build products that can be used by all types of users, by way of simple and accessible interfaces.

Our society is far from homogeneous, despite our beliefs that this may be so. A segment of the population is excluded from this new era, as they don't possess the same set of functionality with which to easily access the technology that is growing ever more important in our society. Thus, technology looms up as a huge barrier to those who are not able to evolve and who succumb in their effort to adapt to a new reality. A segment of individuals is created who are unable to take advantage of the opportunities offered by the tremendous technological development we have witnessed. It is our duty to close this gap toward an all-inclusive society.

A Study of a Relatively Simple Day-to-Day Technology and Its Use by Older Citizens

In a recent study we undertook (in Northern Portugal) we talked to close to 150 older adults concerning their use of automatic teller machines (ATMs). Our research team was made up of more than 20 people with training in psychology, rehabilitation and accessibility engineering, and informatics. We talked to a sample made up of individuals over 65 years of age, with good mobility and not suffering from any debilitating diseases causing limitations beyond those to be expected in older individuals, such as a partial loss of vision, slower reactions to machine feedback, and added difficulty in interacting with keyboards, among others.

Besides filling out questionnaires, with closed as well as open-ended questions, we also observed the sample of elderly users in action, using the ATMs, registering their difficulties in a grid. Users were questioned about their difficulty in interacting with the ATMs. Of note is that not always did the users' comments coincide with the observations of the research team—namely, regarding difficulties encountered, such as location of the card slot, being able to correctly insert the card, and ease of keying in the PIN code for access to the

ATM. Furthermore, we also analyzed the ATM machines themselves (over 20 different models) to try to get a fuller understanding of why certain errors in the human–machine interaction occurred. Given that life expectancy is ever higher, it makes sense for those of us who are today younger, and in a position to make a difference concerning access to technology by older adults, to do so—if only to prepare for the day when we ourselves will be older and in turn having difficulty interacting with the technological environment surrounding us.

Aging brings with it added difficulties linked to mobility, visual, and audio capacities. Our results indicate that in the case of ATMs a new architecture needs to be developed. Given, as we said, that technology is evolving at an ever faster rate, we can only guess what machines we will have to interact with in the future. We can be sure, though, that they will be more complex. We see it as a civic duty to develop, in the future, products accessible to all. This is an excellent way to take care of ourselves, in fact.

A Case Study Involving ATMs: Difficulties Felt by Older Citizens

In the case of ATMs, this technology has evolved so much that banks are concentrating more and more operations in these points of service.

ATMs indeed play an important role in today's society, namely in the financial services sector. The objective is to make services accessible to the population in general (Thatcher, Shaik, and Zimmerman 2005). Significant benefits can be experienced by banks and also by their customers. Bank opening and closing hours are no longer a restriction for ATM users (McAndrews 2003). By making, for example, the withdrawal of money possible at more convenient hours, the daily routine of a great number of people is facilitated. The popularity of ATMs has grown at the expense of bank outlets; indeed, ATMs now make possible a variety of operations at any time of the day or night, often with the added convenience of being situated just round the corner.

Figure 1: ATM Study Answers by older users to the question, "Have you ever used an ATM?"

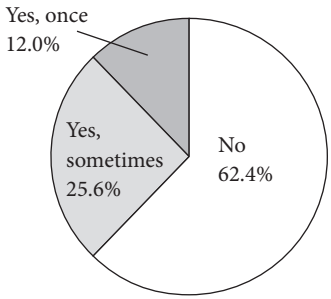
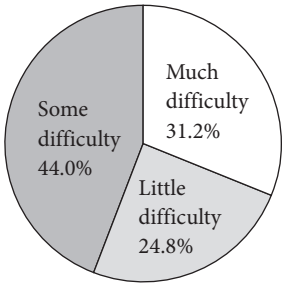


Figure 2: ATM Study Answers to the question, "Did you have any difficulty in reading and understanding the ATM instructions?"



People who cannot access ATMs are the exception and include elderly people, people committed to bed for long periods, and people with deficiencies, each of these groups having functional limitations (Fernandes and Godinho 2003).

As Figure 1 shows, the majority of our sample had never used an ATM, 12% had used an ATM only once before, and approximately a quarter had used an ATM a few times in the past.

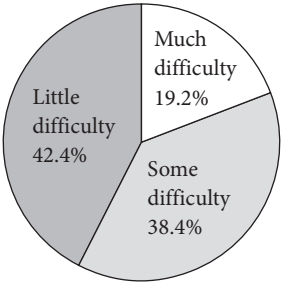
So, why aren't ATMs used by older adults? We found in our sample that older adults prefer to interact with human beings rather than with machines like ATMs (more than a quarter of the total surveyed). Almost another quarter of the older adults we spoke to don't know how to use ATMs. Still others don't feel safe with ATMs (12.5% of the sample), another group (8%) not trusting them at all.

Despite the above results, the older adults we spoke to showed receptivity to this banking operation technology, only most of them just don't know how to use it (62.4% of the sample don't use ATMs at all, Figure 1).

Figure 2 shows the amount of difficulty felt by our sample concerning the reading and understanding of ATM instructions.

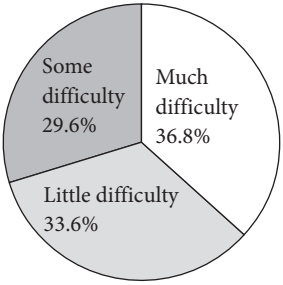
Some or a lot of difficulty was felt by 75.2% of the sample; on the other hand, only around a quarter of the users surveyed felt little difficulty in their interaction with ATMs. Another difficulty felt was in trying to locate the card slot (Figure 3). Over half of the sample had some or much difficulty in locating the ATM card slot.

Figure 3: ATM Study Answers to the question, "Did you have any difficulty finding the ATM card slot?"



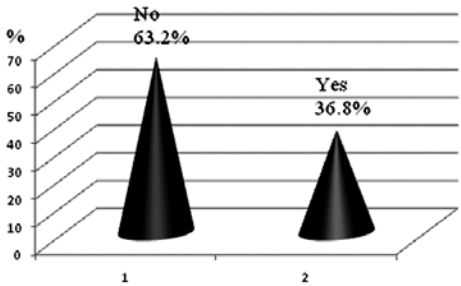
Another difficulty registered concerned placing the card in the slot the right way in (Figure 4). Only a third of the sample felt little difficulty with this operation; the rest had some or much difficulty with this task.

Figure 4: ATM Study Answers to the question, "Did you have any difficulty inserting the ATM card the right way in?"



Finally, Figure 5 refers to being given enough time to complete the selected tasks on the ATM; 63.2% stated that they weren't given enough time to execute the desired tasks and that longer periods during which to interact fully with ATMs are seen as being necessary. In fact, our study revealed that double the time is necessary for older adults to

Figure 5: ATM Study
Answers to the question, "Were you allowed enough time to carry out your operations on the ATM?"



successfully finish their desired operations (which would generally include cash withdrawals, bank account consultations, the charging of mobile telephones with cash credits, and making payments).

Other errors registered in our study are linked to choosing the wrong keys on the keyboard (17.6% of the total errors registered) and forgetting the operation feedback slip (6.4% of the errors observed), as well as selecting the wrong operations (5.6% of the errors observed), and exceeding the time limit given (4% of the total amount of errors).

A Selection of Technological Changes Deemed Necessary

Below we shall mention a few changes that could be implemented in ATM technology. Our suggestions follow on from our study of communication barriers between ATMs and older citizens:

- Instead of PIN codes, which older users may find hard to memorize (not being able to memorize the PIN code represented 12% of the total errors, while keying in the PIN code incorrectly represented a further 9.6% of the errors registered), it might be preferable to use iris recognition or palm vein recognition as alternatives to access ATMs. These technologies are hygienic (as they don't require physical contact) and safe, and are already being

used but not worldwide on a large scale.

- Other adjustments to ATMs by software specialists, to make them more accessible, could simply include using larger font text (between 18 and 36 points, deemed large enough, and preferably in a sans serif font, such as Arial), as well as the use of bold text. Such changes increase legibility and facilitate access.
- Visual and audio warnings, accompanied by colored messages on the ATM screen (green signaling that everything is OK, yellow alerting to a specific task at hand, and red signaling errors), complete and emphasize messages. These warnings might help insofar as users may thus not forget their card or money in the machine, for example.
- Too many menus are another problem. The necessary steps to be followed are at times unclear, and the lack of a Help Menu aggravates this.
- Having ATM machine screens facing the sun makes visibility even more difficult among the elderly, we observed. This could be easily avoided with some care in choosing the location of ATMs, or alternatively by placing ATMs under a form providing shade.

Concluding Remarks

In sum, a lack of training and instruction manuals and the fact that automatic teller machines (ATMs) are just not intuitive has left the older users in our sample at the margin of society. Thus, their quality of life and independence has suffered, a situation that will tend to be aggravated—due to an increasingly elderly population operating in an ever more complex and technological world—if we don't take action today and in the near future.

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