SEMIOTIC INTERNATIONALIZATION AND LOCALIZATION
OF COMPUTER PROGRAMS

Simone Santini
Escuela Politécnica Superior
Universidad Autónoma de Madrid
simone.santini@uam.es

Abstract
Localization, the process—part of translation studies—of adapting a program to a new linguistic community, is often intended in the relatively narrow sense of translating the messages and labels of the program into the target language. Correspondingly, internationalization, the discipline—which is part of software engineering—of putting in place all the measures that will make localization easier, is also limited in scope.

In this paper we analyze the various systems through which a program communicates with a person (icons, buttons, actions, interface layout, etc.) and find that most of them, far from being iconic, are in reality symbolic semiotic systems related to the culture in which or for which the program was developed (typically American programmers of western office workers). Based on these findings, we argue that during the localization process, the translator should have the option to translate them all, that is, to adapt the whole interface and its founding metaphors to the cultural environment in which the program is deployed.

This conclusion will result in a greater rôle for internationalization in the software development process, and we outline a few architectural principles that should be considered when creating a program for a multi-cultural market.

1 INTRODUCTION

Localization is an area of translation whose purpose is to adapt computer programs (or, more precisely, the programs’ interfaces) to the various linguistic and cultural environments in which they will work. Related to localization is internationalization: a family of design practices whose purpose is to make localization feasible and as painless as possible (Uren, Howard & Perinotti, 1993; Cooper & Rejmer, 2001; Cyr &
Localization and internationalization are often mentioned together and they are, indeed, closely related, but they are not the same thing. Not by a long shot. They are not even part of the same discipline: localization is related to anthropology and translation studies, while internationalization is a quintessential software engineering problem. While this division is such that software engineers will work essentially in internationalization, their work is destined to offer a support to localization, so it is necessary that they be aware of the problems and characteristics for which they are offering support.

Localization is often seen in a fairly narrow sense, as the translation of the various captions and labels that appear in a program into a target language, and internationalization is correspondingly limited to the engineering practices that make this translation easier: reserving spaces in labels and buttons, using full phrases as the display units, making sure that the program works well with a variety of alphabets and writing directions, and so on. As an example of this attitude, out of the 49 principles for internationalization given in (Hall, 2002), only two are not directly related to language:

i) icons, cursors, and bitmaps are generic, are culturally acceptable, and do not contain text;

ii) if ethnocentric graphics, colors, or fonts, are used, they can be replaced dynamically using locale-sensitive switch statements.

This emphasis on the linguistic aspects of localization is, prima facie, sensible: language is pervasive, cultural, symbolic, and its signifiers are opaque (Hodge & Kress, 1988). A program message written in Chinese will provide absolutely no clue to a French reader (unless the reader happens to read Chinese), and vice-versa. Also, even in an age of graphical interfaces and touch screens, language remains the main instrument of communication between a programmer and a user, and few programs can be profitably used by somebody who doesn’t understand the language in which its messages are expressed.

Still, language is not everything. A program and its users communicate through a collection of semiotic systems of which language is but one. The most preminent of such systems, in modern computer programs, is that of icons. Superficially, one might regard icons as the prototypical example of transparent signifiers (iconic, in fact) and, consequently, one might consider that they are in no need of translation. Transparent signifiers work through non-arbitrary associations with their signifieds (Merleau-Ponty, 1964); icons, in
particular, signify by means of a similarity between signifier and signified, and this similarity is supposed to be cross-cultural. Universal, in fact. I will argue that this is not the case: computer icons, their name and of their aspect of little images notwithstanding, are not iconic; rather, they form a sophisticated symbolic code that, as all symbolic codes, works by mutual consent of the cultural community for which it functions. Icons, in other words, are a language no less symbolic than English or Malawi, and no less in need of translation than these. Consequently, I shall argue that the programme of localization should be much more ambitious than it has been heretofore proposed, and that it should involve the cultural adaptation of all the non-transparent semiotic systems that compose a computer interface, from language to icons, and of the actions that the user performs on them.

This is a new task for localization and, especially, for internationalization, because this kind of “total semiotic translation”, so to speak, requires the possibility to reconfigure a program at a much deeper level than that required by the standard acceptance of localization, and exerts an influence on the design process that goes well beyond a simple list of desiderata such as Hall’s. Internationalization, in this view, becomes a much more relevant discipline within software engineering, one that must profoundly influence the very structure of a program, and that should become an integral part of a design from the very beginning.

Modern interfaces are often designed based on a metaphor, that is, on the (more or less complete) analogy between the symbols and operations of the interface semiotic system and those of a second system with which the user is assumed to be familiar. We call the former the manifest system, and the latter the anchor system of the interface. In computers, the manifest system is subject to a certain amount of variation: not only does the manifest semiotic system of, say, a computer with a MacOS operating system look somewhat different from that of a computer with a Linux operating system, but also some portion of the manifest system of, say, a word processor will be different from those of a mathematics program (for instance, the same symbol may mean different things in the two contexts, or be placed in another differential relations with the other symbols of the interface).

The anchor system is often the same, and it has not changed since the technicians at Xerox’s PARC research center created the interface for the ALTO computer in the 1970’s (Lavendel, 1980): an office desk with documents organized in folders. From the localization standpoint, it is important to determine whether
this metaphorical substratum is sufficient to make the signifiers of the manifest system transparent: if it is not, then the manifest system is opaque, and must be localized when the program is adapted to a new culture. For the system to be transparent, two conditions must be met:

i) the relation between the manifest system and the anchor system must be iconic, that is, the actions performed on the interface must correspond iconically to the actions typical of the anchor system, and

ii) the anchor system must be known to the cultural group for which the program is adapted, so that the actions pointed to by the elements of the interface can be recognized.

I claim that none of these conditions is verified in a typical computer interface. On the one hand, the icons stand for certain actions only conventionally and are therefore symbols. On the other hand, the “point and click” interface was born in an environment of technicians who worked in offices, and while the desk-and-documents anchor system was very familiar to the office-working engineers of Silicon Valley, the same is not necessarily true for other users of computer systems. The applications that these technicians were designing were intended as an aid to office workers, and considering computer files as documents made good sense in this context. Today, however, the data that are stored in a computer are not of the nature commonly found in offices (just think of videos and songs), and the people who are using the computers are not necessarily familiar or comfortable with office work. The metaphor has lost its force and its raison d’être. Because of this, the graphical elements and the actions of an interface are just as symbolic as the text that the interface contains, and equally in need of translation in order to be adapted to the different cultural communities to which the program is directed. This requires a fundamental change in the way one designs interfaces. It requires that the interface to an application be designed at a much more abstract level, using either a non-metaphorical language of algebraic operations, or a metaphor with the broadest diffusion: in this paper I propose the use of conversation as a metaphor for the anchor system. The manifest system should be as independent as possible of the rest of the program, easily replaceable and configurable during the use of the program. It should be part of the mission of internationalization to facilitate this change. Ideally, the manifest system should be determined by a series of configuration parameters in the application so that a word processor designed for office workers (with the interface based on a certain model
and with certain assumptions) can be changed quickly in an application for college students (with a different manifest interface based on a different set of assumptions). The same application, running on the same computer, should be able to present completely different manifest systems to different users. The interface, in other words, should be a collection of configurable, independent modules, connected to the application in a standard way, but functionally independent of it.

2 METAPHORS WE PROGRAM BY

The anchor system that we use, and the metaphor that it entails are not simple or neutral issues; far from being just a matter of convenience, they determine the way in which we think. Our everyday language is filled with metaphors (vide the expression “filled with metaphors” that I just used, which is based on the metaphor language is a container), and the metaphors that we use determine to a considerable extent the limits of our possibilities of thinking about the world. Consider the metaphor debate is war, which forms the basis of expressions such as “winning an argument”, “I rebuked his objections”, “when he said that, I changed my strategy”, and so on. This metaphor comes with a set of assumptions that determines how we conduct a debate, what counts as a debate, how to behave in a debate, and so on. This metaphor comes with a set of assumptions that determines how we conduct a debate, what counts as a debate, how to behave in a debate, and so on (Lakoff & Johnson, 1980).

The metaphor allows us certain ways of acting in a debate, and prevents others. Outside of the metaphor, for example, the idea that a debate must have a winner is not at all obvious: one might think of a debate as a way of clarifying a difficult topic by expressing different opinions about it. In this second view, the ideas that there should be a winner of a debate, that one participant should feel compelled to defend one point of view, or to rebuke the arguments of the other would be quite ludicrous.

Metaphors are cultural, and different cultures apply different metaphors to the same topics. Consider, for example, the way people see the changes that occur in their lives and in the society in which they live with the passage of time. In our culture, dominated since the enlightenment by the idea of progress, these changes are perceived as a movement, specifically a movement towards a desirable ideal placed in the future. Change is motion, we are walking from the past to the future, and our gaze points in the direction in which we are walking, so the future is in front of us, and the past is behind us. When we are at the end of a difficult period, we leave our problems behind us, we let bygones be bygones, and we move on (or, at least, some
of us do). In this society, an expression such as “as time goes by” implies a surrender to the flow of time, a renunciation to fight, to determine one’s life, a surrender to the event. It is altogether interpreted as a negative and sad feeling. Something quite fitting for the central musical theme of *Casablanca*.

More contemplative societies might apply the opposite metaphor. We can see the past, but the future is obscure, so the past is in front of us, while the future is behind us, hidden from view. In this case, change might not be a movement at all, but a static contemplation of things as they go by. Things are initially behind us, then they come into view and we see them, first clearly, then, as they start moving farther away into the past, more dimly. The consequence of this metaphor might be important: a society that perceive time as a motion of the subject is more likely to assume that we can control where we are going, and try to devise means to control and predict the future (which amount to the same thing, since we often predict for the sake of controlling). A society that looks at the past and sees time as coming by is likely to be more fatalist, probably more religious or spiritual, and will probably develop tools to deal with the unexpected and the unpleasant (the concept of God’s will, for example). The song *As time goes by* would not seem to them sad at all: it would describe a normal, positive outlook on life.

Just like language metaphors are instrumental in establishing our relation to the subject of our thoughts and in determining, in a way, the orthodoxy of thought—the shape that our ideas are allowed to take—so interface metaphors are instrumental in determining our relation with an information system, not only in the sense of constraining the actions that we are allowed to undertake (any interface will do that) but, more importantly, in directing the way we think about an activity and determining what we can conceive of doing. A computer interface creates a doubly indirect relation between the operations of a program and the elements that represent it on the screen, a relation mediated, on the one hand, by the anchor metaphor and, on the other hand, by the screen element that represents the metaphorical action, as in the following schema:

```
manifest system
screen element

represent (iconic?)

metaphorical action

represent

program action

anchor system
```

The iconicity hypothesis of computer interfaces—that underlies the assumption that non-verbal interface
elements should not be translated—rests on three hypotheses:

i) the screen elements (elements of the manifest system) are transparent iconic signifiers of actions and elements of the anchor system; for example, the picture of a folder “stands” iconically for a folder in the office desktop system (the anchor system of the interface), the paper basket stands for an actual paper basket;[1]

ii) the anchor system is isomorphic to the algebra of the program in that there is a one-to-one correspondence between actions in the anchor system (e.g. throwing a piece of paper into the paper basket) and actions of the program (e.g. erasing a document from the disk);

iii) the anchor system is one with which the intended user of the program is familiar, so that it can accomplish its function of mediating the interactions of the user with an unfamiliar program, and with the unfamiliar activities performed by that program.

In the following sections I shall try to problematize these hypotheses, by showing that they are by no means more obvious than their opposites. If these hypotheses fail, so does the assumptions on the iconicity/metaphoricality of the connection between interface elements and program actions, revealing that such a connection is symbolic (or, at most, if one considers that the syntactic structure of the interface is too simple to support symbols, indexical [Deacon, 1998]). Once we have recognized that all interface elements (and not only labels and captions) are symbolic, it follows that localization must take care of the semiotic-cultural adaptation of all interface elements, be they linguistic or non-linguistic. The whole interface needs translation, not just its labels.

This form of “semiotic translation” entails not only an extension of the usual concept of localization, but also a re-definition and expansion in scope of the internationalization substratum for it. The last sections of this paper will briefly describe some possible directions of these activities and a few of the foreseeable technical issues that their expansion will generate.

1The paper basket is a good example of the relation between the manifest system and local culture, and a clear indication of the relation between icons and the evolution of western culture. In the early computer the “delete” icon used to represent a metallic trash can; in the 1980’s, years in which science was very fashionable, the NeXT computer had a black hole in which the documents would disappear; in the 1990s, more ecologically conscious, the device was transformed into a recycling bin, with a prominently visible recycling sign.
Figure 1: Three icons commonly used in many computer programs that operate with documents. The first icon is associated to the function that creates a new document, the second to the function that opens an existing document, and the third to that which saves on disk the document one is currently working on.

3 ARE ICONS ICONIC?

The working of the manifest system depends on a number of properties, some of which are structural (viz. there should be an isomorphism between the operations of the manifest system and those of the anchor system), and others are immanent properties of the elements. I shall look at the structural properties in the next section while, in this one, I shall consider the basic question related to the intrinsic properties of the element, one of great importance for localization: whether icons are transparent signifiers (and therefore in no need of translation), or whether they are opaque (and therefore, they do need translation). In Peircean terms, icons are transparent signifiers, since they are motivated by an iconic ground (Sonnesson, 1999), that is, by an evident similarity with their signifier, whereas symbols are opaque, since they are conventional.

The point can therefore be driven by the somewhat ironic question: “are icons iconic?” The answer is that, at least on a computer screen, they are not. Computer icons are highly stylized symbolic elements of a somewhat simplified language and, in most cases, they bear little or no resemblance to the original metaphorical operation that they were supposed to illustrate. Much like the iconic signifier of the head of an ox eventually became the highly stylized letter “A,” which bears virtually no trace of its iconic origin, so the icons on a computer are part of a pictorial code that forms, to all practical purposes, a system of opaque signifiers.

Let us consider, by way of example, the three icons that most users of modern operating systems find on the upper-left corner of many applications that they use, and that are reproduced in figure 1. The first icon shows a white rectangle with a corner cut off and a triangle of the same size as the cut drawn just below

---

2 Things are not as sharply cut as this classification might lead one to think, though: even the symbolic system par excellence, language, can be considered completely opaque only in a synchronic way. Diachronically, there are evolutionary effects that modify every language to make it more suitable for very common practical needs and, therefore, towards more transparency. In most languages, for instance, the words for yes or no are very short, a transparent signifier of their relevance.
it. The icon is meant to give the idea of a blank sheet of paper, and the triangle represents a folded corner of the sheet, pointing (iconically) to the fact that the rectangle is made of a flexible material, such as paper, and is not, say, a piece of wood or a brick. The iconic component here is relatively strong, although it is doubtful that many people unfamiliar with the world of computers or offices would immediately recognize this picture as a piece of paper. Once it has been pointed out to them that the icon represent a piece of paper with a folded corner, people will have no problem recognizing its iconic resemblance, but before this is pointed out to them, the icon is not that clear. In this sense, the symbol is no more iconic than, say, the Chinese ideogram ễn (戬: weary, tired), which represents a tree that grows in an enclosed space.

Once the ideogram has been explained, one has little trouble seeing its iconic origin (as well as the poignantly poetic nature of the semantic association) but, before the explanation comes, we are in the presence of a fairly opaque signifier. In the case of the piece of paper on the computer screen, the iconic nature might be a bit more direct, but the signifier still qualifies, at best, as semi-transparent. The connection between the icon and the action is also conventional. The icon is the representation of the action “create a new document”, an action that, of course, exists only in a computer: in the true embodiment of the anchor system (the office) people do not create new documents ex nihilo, rather they grab a (existing) piece of paper and start writing. So, while the relation between the signifier and its physical referent (a piece of paper) is semi-transparent, the relation between the icon and the action is mediated by the highly stylized and highly symbolic nature of the action, and is opaque.

The second icon is the visual representation of the command that allows one to access an existing document for editing purposes. The icon represents a common manila folder partially opened, sometimes with a bent arrow indicating the movement of the opening folder, and the associated program action is that of “opening” a document. This icon has a curious history, moving at the same time in the direction of a greater iconicity and of a more symbolic relation to its referent. The movement towards a greater iconicity is due largely to the greater graphical possibilities offered by faster CPUs and graphic video peripherals. In its early versions, such as in the Xerox’s Alto, the icon was highly stylized, being essentially a rectangle with a protuberance on top representing the protruding label-tab that one finds in offices folders throughout the USA. As the processing speed of personal computers increased, the icon has acquired color and depth.
and it is today easily recognizable as a manila folder, at least to an American office worker. It must be noted, however, that the MacOS operating system steps somewhat away from the icon by making (in the default color scheme) the icon blue. This is done in order to be consistent with the general “cold” color scheme of the interface, and the operation is possible precisely because the picture is not an icon but a symbol: its meaning doesn’t come from its similarity with a manila folder, but from a differential relation with the other elements of the interface. Changing the color, and reducing iconicity, doesn’t change the relation and, therefore, doesn’t change the symbolic meaning of the folder icon. This flexibility would not have been possible had the folder been a true icon: reducing the similarity between the picture and the real manila folder would, in that case, have reduced the signifying power of the picture. To this we should add that the iconic component of the symbol is cultural and, therefore, not universal. Only certain groups of people will be familiar with this kind of folders, namely certain office workers. The label tab, the most distinguishing characteristic of the folder picture, is present in actual folders only in some countries (notably in the US), while it is virtually unknown in others (in Europe, for instance). This cultural connotation, of course, reinforce the need to translate this element.

In the context of a word processor the relation between the icon and its signified action is symbolic not for want of realism, but because the referent of the icon (the manila folder) is connected symbolically to the action. The folder is partially open and has an arrow that indicates the action of opening a document (the use of an arrow to indicate movement is, in itself, an opaque signifier related to the symbolic language of comics (Varnum & Gibbons, 2001)), but the action that it represents in the anchor system (viz. opening a folder) is not the action that it is actually performing: on an actual desk one does not open a sheet of paper in order to change its contents, rather, one grabs it, moves it, uncovers it, or does whatever action is necessary to bring it in a place within the reach of hand and pen. The connection between the word open and the action of editing a document is limited to computer practice and it is, at least from an user point of view, arbitrary. The name of the action comes from the computing term opening a file, which is the action that a program does before it can access the contents of a file. The action is reflected at various levels in a computer. For instance, a program written using the C programming language must call the function fopen (file open) before it can read or write a file. Note that already at this level the association between the word and the action is conventional: when one begins working with a file, there is no actual opening going one simply puts some values in certain fields of a structure in central memory, and reads certain data from the disk. From these origins, deep inside the internal working of a computer, the term has percolated up to the level of the interface.
expression “to open a file” in order to change its contents comes from the programmers’ language and its appearance at the level of the interface—far away from the programming code where it belongs—represents a serious break of the office metaphor, a break that is all the worse because the office language already contained the expression with a different meaning. In a police station, for example, when one “opens a file” for a case, one is performing the action that in a computer is called create: the common expression open a file has been, in the computer parlance, hijacked for a completely different purpose. The arbitrariness of this association can be seen further seen in the fact that the icon represent a folder, which is, stricti dictu, not the thing being opened, while the thing being opened (the document) can’t really be opened in the world of the anchor system. The arbitrariness of the association is such that it would be difficult to represent iconically the computer operation of opening a document. The situation is depicted in the following diagram:

The third icon is the most unapologetically symbolic of the three since, in addition to the representational problems pointed out in the previous case, it breaks the metaphor on which the supposed iconicity is based. I shall dedicate the next section to the analysis of breaks in the metaphor, so I shall not consider the issue in depth here. Suffice it to say that on the actual top of an actual desk there is no “saving” any document: one simply stops writing when one is done. The very use of the term “saving” tells us more about the engineering milieu in which these interfaces were designed than about the action that one accomplishes using this icon,
Figure 2: A series of icons corresponding to functions that to align text in a text editing program. The squares represent the page, and the horizontal lines represent the lines of text. Once the icons are understood as a whole, the relation between them and the text alignments (left, center, right, justified) is indeed iconic, but this iconicity rests on the correct interpretation of the elements of the icons, an interpretation that is possible only when the icons are presented as a system.

since saving is the conventional engineering name for the action of storing the contents of a file on the disk after having copied them in central memory and modified them.

The aspect that concerns us now is the actual appearance of the icon. The icon represents a 3 1/2” floppy disk, of a type very common until about fifteen years ago but that is today virtually disappeared. I can’t quite remember the last time I actually saved a document on a floppy disk rather than on a hard disk or a flash drive. At one time, the picture had a certain iconic connection with the action it represented (but not with the anchor metaphor), but that iconic connection is becoming more and more tenuous, much like the iconic relation between the Phoenician letter gimel and the back of a camel has been lost in the transition to our letter “c”, whose relation with its sound is today fully symbolic.

* * *

An example of a different nature is given by the four icons of figure 2 which activate the commands to align a portion of text in a word processor. The four icons represent a fragment of text aligned on the left, centered, aligned on the right, and justified, respectively. The interesting aspect of these icons is that each one, taken by itself, is quite obscure (they represent a series of horizontal lines of varying length) but they become clearer as a group when they are analyzed differentially. That is, the meaning of each icon depends on its differential relation with the other icons of the group. No element, taken in isolation, is a signifier; it becomes one only as a member of the group, by opposition with the other members, a telling sign of symbolic reference. True icons signify by themselves, while symbols signify when they are part of a system of differences without positive terms (Eco, 1979). Moreover, the icons are part of a relatively
complex grammar that is, to a large extent, not contained in the icons themselves. Consider the possible results of the selection of the center icon in a typical word processor:

i) if no text is selected, the paragraph on which the cursor is currently placed becomes centered;

ii) if now we press a new line in order to start a new paragraph, the new paragraph will also be centered;

iii) if a portion of a text is selected, all the paragraphs that contain selected text will become centered;

and so on. The meaning of the center icon is not determined by the icon itself, but by its relation with other elements of the interface (icons, cursors, text,...) at the time of its use. It is, in other words, defined by a complex grammar of which the icon is but a symbol.

These are but two superficial examples of the type of analysis to which the elements of a computer interface must be subject in order to determine their status as elements of communication. In most cases, the analysis reveals that icons are not icons at all; rather, they are part of a symbolic system of communication whose effectiveness depends on a number of (often unspoken) assumptions about the culture in which the system will be interpreted and used. As such, the iconic system should be considered tantamount to a language that needs translation and cultural adaptation no less than any other linguistic element of the interface.

4 SOMETHING WEIRD ON THE DESKTOP

Icons, menus, and labels are the fundamental constituents of the manifest system, but the metamorphic possibilities of this system rest on more than just the relation between these elements and the corresponding elements in the anchor system. For the metaphor to work, there must be a homomorphic structural relation between the manifest and the anchor systems. The structural relations between screen elements must correspond to relation between the corresponding elements of the anchor system, and actions that alter relations in the manifest system must correspond to structurally homomorphic actions in the anchor systems.

In the parlance of interfaces for desktop and laptop computers, the surface of the screen is called a desktop, the files contained in the computer’s disk are documents, which can be opened resulting in the
appearance of a window in which they can be seen and acted upon. For long documents, the windows only allows the view of a portion of them, and the visible portion can be changed by sliding the windows up and down the document. If we take the metaphor literally, we can observe a few puzzling inconsistencies in the way it works. One rather evident bizarreness is the screen itself: desktops are typically horizontal, while the screen is almost always vertical. Moreover, there is an amount of forcedness in the way every data file in a computer is metamorphosed into a document. This metamorphosis might have been adequate for early office machines such as the ALTO, which dealt almost exclusively with written texts and office drawings, but these days we put many more things in computers than we did 30 years ago, and many of the things are not immediately identifiable with documents, at least at the metaphorical level. In our daily life, we do not ordinarily consider a song or a video as documents. A document is, in its most common acceptation, something written on paper (a legal document, for example) or, in another acceptation—already metaphorical—an artifact conveying information about something ("this vase is a document of the sophisticated pottery technique of the Anasazi indians"). It is important to realize that, in the latter case, it is not the object per se that is a document, but a particular function that the object performs in a given situation. Objects per se are never documents. To assimilate the variety of conceptual artifacts that can be put into a computer with documents stretches the metaphor beyond its point of usefulness and represents an improper combination of abstraction and metaphor. I shall return to this problem later in this section.

The directories of the operating system are modeled as "folders", a metaphor with which people accustomed to work in an office are quite well acquainted, but that will not be as familiar to the majority of people. The arbitrariness of this choice can be highlighted by considering an alternative. If files are "stuff" (documents and otherwise), then directories are containers of stuff, and the containers with which most people are acquainted are boxes. This alternative metaphor has a number of advantages: boxes can contain other

---

4 At least on desktop computers: tablets are a different matter. It is at first slightly puzzling that a tablet—which, for its horizontal position and mode of interaction would seem the best platform to embody a desktop metaphor—has somewhat eschewed the desktop. The reason is probably to be found in the origin of tablet operating systems: they are by and large adaptations of operating systems for telephones, in which the limited size of the screen makes the implementation of a desktop metaphor problematic.

5 Of course, everything in a computer is stored in a file, and files are sequential organizations of data composed of a finite alphabet and, therefore, can be considered as documents. The computer file, however, is a programming concept, not an interface one (in the office world, for instance, a file is a collection of related documents, a connotation that collides with that of most computer files); the file-as-a-document can be a useful metaphor for programmers, but not for the users of the interface, and should stay hidden in the internal organization of the programs, where it belongs.
(smaller) boxes, while folders do not in general contain other folders (putting a folder into another folder typically causes a mess, since all folders are more or less the same size). We are used to put a plethora of different things into boxes (while typically we only put pieces of paper into folders). The boxes metaphor may work better for some people than the folder metaphor, which is probably best reserved to computers used in offices, with the caveat that directories can be nested, while folders typically are a “flat” archival mechanism. New metaphors may require or suggest new operations. For instance, one can break a box, destroying it and at the same time spilling all its contents into the box that contained it. In the algebra of the operating system, this operation corresponds to a local, one-level, flattening of the directory tree. The point here is not that an anchor system based, say, on a warehouse with boxes and things inside them is better per se than one based on folders and documents. Quite the opposite, the point is that there is no anchor system that works for all the situations in which a program might be used. In other words, the anchor system must be localized whenever it is used in different cultural communities. Cultural communities do not necessarily coincide with the national communities to which localization is usually directed: an American and a French office workers have a lot more in common than an American office worker and an American fifth-grader, and localization should take this difference into account.

In order to be useful, a metaphor must be consistent, at least in its general lines. It would be of little use to say that a file is just like a document if the things one can do in the interface with the file did not resemble the things that one does with documents. But, of course, a file is not really a document, so at a certain point the metaphor will break down. You can’t crumple a file in a ball and throw it in anger in your colleague’s face. Not without serious damage to your computer and to your colleague. You can create a “shortcut” to a file, but there is no shortcut to a paper document. The physical differences between the two referents of the metaphor, and the failure of some of the constitutive relations of the anchor system make a certain degree of metaphor break-up unavoidable.

Nevertheless, some of the metaphor break-ups that one finds in interfaces could easily have been avoided by a more careful and informed design. A few examples will suffice. Although word processors work with

---

6The deleterious consequences of using software prepared for office workers in educational setting have been amply studied, especially in connection with presentation software, which may respond to the needs of corporate presenters, but it certainly doesn’t respond to those of educational institutions (Tuft, 2006). The point made here is meant to respond in part, to these concerns.
documents, the first entry in the menu bar of any word processor is normally called “File”, that is, it is named after the thing that the metaphor is supposed to hide, rather than after the thing that the metaphor exposes.

Documents of all sorts are opened or, in some cases, a new document is created. But in the world outside the computer, there is no action corresponding to such an abstract notion of opening. You pick up a written document from a desk, you listen to a song, you turn on an apparatus (the obvious metaphorical base for a program). The idea that the same operation of opening should have such remarkably different effects (from showing a written text to playing a song or doing your taxes) is startling. Note that in order to view a document one does indeed execute a program but, in this case, the program is outside of the metaphor, and its presence should be invisible to the user.

The “new” command is equally perplexing. In an office, one rarely makes something new. If you want, say to type a letter, you would take a piece of paper (an existing one), and start writing on it. A more fitting metaphor in this case would associate to the word processor a “paper tray” from which new sheets can be taken to create new documents.

To make things worse, many of the actions that can be done in modern programs do not respect the interface metaphor at all: most modern programs contain a plethora of “buttons” and “menus” that, of course, have no correspondence into the world of the office. The way we check the spelling of a document in the typical text editing program, for instance, does not involve taking a dictionary object, as the metaphor would require, but activating an entry in a rather counterintuitive menu. In other words, many interface designers have forgotten that they were supposed to design a direct manipulation interface to begin with, and transformed it into a forest of buttons almost as cryptic as an OS/360 JCL script.

4.1 METAPHOR AND ABSTRACTION

The previous inconveniences derive from an unfortunate interaction between metaphor and abstraction. Abstraction (I am simplifying somewhat) is the practice of ignoring the differences between separate instances of a situation in order to concentrate on what they have in common. Abstraction is the main technique to be used in programming design, but its use in an interface based on metaphor is problematic. Metaphor is a horizontal relation between two very concrete and situated sets of elements and actions. Each object in the
anchor system comes to us with its proper type or what Heidegger would call *readiness-at-hand* (Dreyfus, 1992), which determines the specific characteristics of our interaction with that object. A song is ready-at-hand by being played, a document by being taken, read, written, torn into pieces, and so on. Abstraction in an interface destroys our natural interaction with objects and replaces it with idealized actions that don’t fit into the metaphorical relation and that play against the efforts of the designer to find a metaphor.

There are a number of conclusions that can be drawn from these considerations. An interface is a semiotic system, and a metaphor is a relation between two semiotic systems, one of which the intended user of an application is assumed to be familiar with. As was already acknowledged in this paper, if metaphorical interfaces are to work it is necessary that (1) the anchor system be one with which the intended user is really familiar (not everybody is a silicon valley geek... not yet, at least) and (2) that the metaphorical relation be as consistent as possible: every break-up of the metaphor represents a difficulty for the user of the system. The consequence of not respecting these principles are ersatz interaction and obscurity of usage.

Years ago, I taught basic computer literacy to adults who had never used a computer before, and in that occasion I observed quite consistently that for my students using a modern interface was almost as hard for them as using a UNIX shell: the metaphor was so unfamiliar and imperfect as to be virtually of no help. My students simply did not recognize the office metaphor because none of them had ever worked in an office, and even when they could recognize some familiar objects, the behavior of the elements of the interface was so idiosyncratically different from what they expected in the corresponding anchor objects that the metaphor was made completely useless. Or worse: sometimes using the computer from a command line, without a metaphor was easier. The initial learning curve was a bit longer, of course, but once the concepts of file, directory hierarchy, program, etc. were firmly established, things proceeded more smoothly than with the imperfect graphical interface.

If we use a metaphor for the interface, the metaphor should be familiar and its use should be consistent. If not, it is probably better to do without it, which is what some operating systems for very simple environments are beginning to do.
4.2 Touch interfaces

One of the most significant changes in interfaces of the last ten years has been the introduction of devices with a haptic screen of small to medium dimensions. The peculiar characteristics of the input device (e.g. the relative lack of precision in pointing compared to a mouse) and the small size of the screen (especially in telephones) has pushed designers towards new solutions, which have generated an interesting change in the way interfaces are designed.

The most intriguing aspect of this change, from the point of view that concerns us here, is the great simplification of the anchor system. The interfaces of modern telephones (and of tablets, which use the same operating systems) eschew the office metaphor, quite possibly because a reasonable implementation of it would have been impossible on the small screen of a telephone, and because the small size and awkward typing on the screen keyboard caused the importance of the written document to wane, and dethroned it from its position as the centerpiece of the interaction. The metaphor, in this case, is more playful, almost reminiscent of Aladdin: stroke the right spot on the screen/lamp, and wonderful things will happen.

Figure 3: A schematic view of the interface of the message interchange application Whatsapp, very popular in modern telephones. The text is organized in two columns of “bubbles” of the types used in cartoons to signify the utterances of the characters. The icons are divided in two columns, enforcing a geometric metaphor of conversation as opposition, related to some extent to the metaphor “debate is war”, at least in the geometric analogy with the position of two armies prepared for battle.
The simplification of the anchor system is obtained through the possibilities of direct manipulation offered by the haptic screen, as well as the simplified structure of the operating system. In these conditions, the anchor system can be reduced to a minimum: the interface is basically a bunch of buttons organized in a stack of thin sheet that can be slid[7]. One just pushes a button and launches an application. This simplification comes at a cost: things work well as long as one uses simple applications that do not interchange data, that is, as long as the data are hidden inside the applications; manipulating and managing many documents on a tablet can be a frustrating experience.

While the interface of the operating system has been simplified to the maximum, the interface of many applications still relies on many culturally determined models. Consider one of the most popular applications for modern telephones: the message interchange program Whatsapp. The schema of the interface for a typical conversation is shown in figure 3, where the blobs on the left contain incoming messages, and those on the right contain outgoing ones. This bilateral organization is not neutral: it reflects a metaphorical view of a conversation as a spatial arrangement of opposites, the metaphor that lies behind expressions such as “take sides” in a conversation or “the distance” between two positions. It would be interesting to analyze the consequences of organizing an instrument for friendly chats along such oppositional lines, but this is not the purpose of this paper. We shall simply note here that the metaphor along which the conversation is organized is cultural, and it is reasonable to assume that other cultures, used to different metaphorical arrangements of conversations (such as a circle of conversation in which there are no opposites) would be more comfortable with a different metaphor. Note also that the tips on the sides of the blocks denote speech in the conventional semiotic system of cartoon and are therefore highly cultural.

It is at least possible that the optimal adaptation of this program to different cultures will require translating not only the linguistic element, but also aspects of the semiotic system. Once again, we are in the presence of a case in which localization involves more than just labels and messages, and internationalization should consequently take a bigger role in the design of the system.

[7] The sheets are thin because all the things that we can slide with a finger are thin; the notion of a button on a sliding sheet is a bit of a stretch, but it seems to create no problems to most people.
5 DESIGN FOR LOCALIZATION

If we recognize that the interface is a semiotic system akin to a language (in the communicative sense, not necessarily in the structural one), then, in order to adapt to various cultural communities, it must undergo a translation not too different from that that the labels and messages undergo when we adapt it to different language communities. In other words, the process of localization should not be limited to the translation of the interface language, but it should involve either changing the anchor system to adapt it to different cultures, or choosing an anchor system that is truly, from an anthropological point of view, universal. The manifest system will follow suit, and will be translated as part of the normal localization process.

All this implies that most of the elements that compose an interface should not be an unchangeable part of a software system, but should be a configurable part of it, much like the captions in the menus and the explanations in the windows. The “resident” interface of a program will, in this model, consist in a series of abstract operations that determine the general information exchange of the conversation between the system and the user, without determining the details of the semiotic system in which this exchange will take place.

Consider, as an example, the problem of finding 350, Willow lane in an unknown city. The abstract part of the conversation include more or less the following:

i) I communicate to a person that I need help;

ii) the person tells me that he is willing to help me;

iii) I explain that I am looking for an address;

iv) the person might claim that he is not able to help me in this general problem (for instance, the person also is from out of town), in which case the conversation ends, or that he can help me;

v) I communicate the address I am looking for;

vi) the person might claim that he is not able to help me on the specific request (for instance, he is from the town, but doesn’t know the address), in which case the conversation will end, or that he can help me, in which case he will explain how to arrive to the address I am looking for.
This is an abstract flow of conversation, which can (and in general is) be implemented using a variety of semiotic systems. I can ask for help simply by lowering the window of my car and saying “excuse me” to somebody (an ambiguous message that is made explicit by the context); the person may communicate his willingness to help simply by coming near me. I can receive the indications in English, French, Finnish or whatnot; if I don’t speak the local language the person might draw a route on the map, starting by pointing to a location on the map and then to me to say “we are here.” There are endless possibilities to implement this conversation, depending on the specific communicative context.

The same should hold for the type of communication represented by a program’s interface. While the basic flow of conversation (determined, for example, by a conversation-theoretical model (Wooffitt, 2005)) is a characteristic of the program and should be part of it, the metaphorical model of the conversation, and the specific semiotic system in which the conversation will be carried out, should vary with the cultural environment in which the program is used. In technical terms, this entails that the semiotic system on which the interface is based (the anchor system) should be part of the configuration of the program, and should be fixed only when the program is installed. A simple diagram may be of help here. The typical organization of a program, from the point of view of internationalization, is today that of figure 4. The basic

![Diagram of program organization](image)

Figure 4: Organization of a program from a point of view of standard internationalization. The architecture of the program is pretty much fixed at the production site and can’t be changed. The only changes allowed are in the captions file, which is translated in the language of the target culture.
functions, performed by the program core, come equipped with an application program interface (API) that constitutes the internal algebra of the program. This algebra may have several levels, at different stages of abstraction, but these levels are in general neither well separated nor well documented, and are more of an internal structure used by the development group than a formal requirement of the core. The API that is exported and formally defined in the requirements is the one between the core and the program interface. This API is the embodiment of the anchor system, that is, it is based on the office metaphor; its functions are used directly by another program module: the external interface, which includes the icons, documents, buttons, etc. with which the user actually interacts. This whole part of the program is fixed, and it is repeated unchanged in any locale in which the program is used. Outside of the executable portion of the program are the files that contain all the messages and labels of the interface. These files are edited during localization, and are locale-specific.

The analysis carried out in this paper suggests a different structure (figure 5). The static portion of the program, the one that doesn’t change with the locale, includes the core functions and an abstract algebraic interface. This supports a series of anchor systems, configurable depending on the locale in which the program is used. The anchor systems define the metaphorical operations that can be carried out—basically, they define the whole interface except for the things that will appear on the screen. As an example, one anchor system may allow the creation of a “new document” the way it is done with current word processors; another one might place on the screen a ream of paper from which a new sheet is extracted, and so on. This part of the system is quite complex from a software development point of view, and it will require a design effort of considerable sophistication. To each anchor system correspond a number of possible manifest systems, that can be selected and configured. Icons, colors, windows (or other document editing devices), their organization and placement on the screen should be decided at this level, since they might depend, even for the same anchor system, on even more stringent requirements of specific locales (e.g. the position of the title of a window might depend on the typographic conventions of the target community, and the position of the OK button may change depending on the writing direction).

At this level, we also encounter the standard problems of linguistic localization: we must adapt the language of the interface to the different cultural-linguistic communities. This involves linguistic translation
as well as socio-linguistic adaptation: changing the “tone” of the language, adjusting the level of formality to the specific situation (for example: when translating from English to French, should we use the *tu* or the *vous* form?), adapting the jargon for localization to specialized audiences, and so on.

---

Figure 5: Organization of a program from a point of view of semiotic adaptation as proposed here. The interface rests on an anchor metaphor, which can be selected and adapted to the target culture. All aspects of the manifest system (text, icons, colors, layout, relations with the actions in the anchor system) are configured as part of the adaptation of the program to the target culture.

* * *

The previous considerations entail a profound structural change, one that can’t simply be reduced to a few guidelines and a few tricks that make a program more adaptable. The whole process of designing complex inter-cultural programs must change. The main change will be that the program core will no longer include the anchor system and therefore will no longer accept directly commands from an interface. Rather, the program must be thought as a library of functions that communicate with the interfaces using a *universal*
metaphor, implemented as an algebra of operations, and used by the anchor systems. One possibility for such universal metaphor is conversation. Conversation is as universal a human activity as one can find. As universal as language, that is, as universal as consciousness. Conversation is also quite structured (Wooffitt, 2005), possibly structured enough to provide the basis of a formal discipline of program interfaces. A few mechanisms (turn taking; listing options; making, accepting, and declining illocutionary statements) preside to most of it. Conversation analysis is a fairly formal discipline, and even complex structures such as modality are relatively stable across cultures (Roberts, 2008). As a universal foundation for computer interaction, conversation shows definitely more promise than office work. It is beyond the scope of this paper to consider the issue of the universal metaphor any further; the point I should like to make here is that the native interface of a program should be something natural and highly abstract. The anchor systems—the metaphors through which the final user will see the program—should be much more coherent and culturally dependent.

If we take these considerations to their ultimate consequences, semiotic localization entails not only a fundamental change in the structure of a program but also—and most importantly, in the design process and in the professional figure of the programmer. The current praxis of internationalization requires a strict (and basically artificial) separation of two professional cultures. On the one hand, we have the programmers, technically trained and versed in mathematics, who design and implement the data structure and the algorithms necessary to create a compact and efficient core for the program. On the other hand, we have the translators, the anthropologists, the communication theorists or the historians with a more humanist background, who understand the user communities but lack the technical savvy to intervene on it at a level deeper than that of message translation.

The program structure proposed here requires a different professional figure: a humanist with enough computing experience to design and implement anchor systems. This person might not have a deep knowledge of mathematics (they won’t have to design sophisticated algorithms), but will have to unite a fairly deep technical knowledge of programming with a profound knowledge of translation, semiotics, anthropology, and psychology. It is not too daring to assume that internationalization and localization should become a college major, offered jointly by the departments of cultural studies and computing science.
6 CONCLUSIONS

Localization is the adaptation of a program to a homogeneous (according to some relevant character) class of users; to—the name says it—a *locale*. But a locale doesn’t necessarily correspond to a linguistic community. A locale may have a cultural identity more specific than that represented by language or have characteristics that span a number of linguistic communities. This implies that localization must be more specific than the simple translation of an interface’s labels and messages: it must encompass the adaptation of all semiotic systems that make up an interface. This point of view on localization, which is essentially a cultural one, has important technical consequences for internationalization. The direct consequence of our new point of view is that a program should be customized at a much deeper level than it was done thus far, and in a more technically challenging way. While the localization of labels and messages can be carried out by translators with relatively little technical knowledge, manipulating files in relatively simple formats using user-friendly tools, changing the anchor system of a program requires an intervention of considerable technical sophistication. This, in turn, requires that a new professional figure, the internationalization expert, be brought in, with a broad background in languages, semiotics, anthropology, psychology, and computer science.

When one brings up the kind of considerations that we have done in this paper to professional meeting, one is met with a whole range of different reactions. A not uncommon is the *cui prodest* or even, quite more directly, the “why bother?” attitude. In its most articulated expression, this point of view holds that technology is a powerful force that unifies cultures so that a culture that uses computers and wireless telephones is *ipso facto* transformed into a different culture, one that is either well acquainted with the way interfaces work or that it better become so. In other words, this attitude entails that adaptation is a responsibility of the target culture, not of the designer. The argument, as such, has a few flaws. The argument is usually not carried out to its final consequences: if it is the culture that should adapt, why localize at all? Since most programs are developed in English, leave them in English and avoid the trouble of different alphabet, Unicode, etc.: let the user adapt. The argument is seldom taken to these extremes, and consequently it is left a bit hanging in the air: why should we adapt certain things but not others? How do we know, from the vantage point of our culture in which we develop programs, which aspects of an interface
will be important for an unknown target culture?

The issue of who should adapt to what is a complex one, and this is not the right forum to take it on. We should however at least be open to the opinion that technology should be at the service of human culture and not vice-versa. We see a lot of technology that, developed in an environment completely alien to that in which it is deployed, imposes certain habits and mental schemas. The question is one of humanism and of priorities: is technology a tool or an imposing culture? Those of us who believe that technology is a tool, that it should be placed at the service of human values, can’t but hope in a more adaptable and flexible way in which technology can be inserted in our lives and placed in the service of our values.

These considerations are becoming more pressing with the evolution of modern technology. If it is true that people who use a computer for work are more or less immersed in a western-style process of production and are therefore quite receptive to the office metaphor behind computer interfaces, it is also true that new devices, especially telephones, tablets and web pages, are entering in cultural milieus much more heterogeneous, into ways of life very different from those of the people who designed these artifacts. Whether technology will enter these culture by adapting to them, or whether it will destroy them trying to force them into a predefined mold, is a choice that computer scientists, as a social group, must make.

Madrid, May 2018

References

Barthes, R. (2015). *Mythologies*. Le Seuil, Paris.

Cooper, M. & Rejmer, P. (2001). Case study: localization of an accessibility evaluation. In *CHI ’01 Extended Abstracts on Human Factors in Computing Systems*, (pp. 141–2). New York:ACM Press.

Cyr, D. & Trevor-Smith, H. (2004). Localization of web design: An empirical comparison of german, japanese, and united states web site characteristics. *Journal of the American Society for Information Science and Technology*.

Deacon, T. (1998). *The symbolic species: the co-evolution of language and the brain*. W. W. Norton.
Dreyfus, H. (1992). *What computers still can’t do: a critique of artificial reason*. Cambridge, MA:The MIT Press.

Eco, U. (1979). *A theory of semiotics*. Bloomington:Indiana University Press.

Hall, B. (2002). Developing software with internationalization in mind. *Internationalization*.

Hodge, R. & Kress, G. (1988). *Social Semiotics*. Itacha: Cornell University Press.

Lakoff, G. & Johnson, M. (1980). *Metaphors we live by*. University of Chicago Press.

Lavendel, G. (1980). *A decade of research: Xerox Palo Alto research center: 1970-1980*. R.R. Bowker & Co.

Merleau-Ponty, M. (1964). *L’Œil et l’esprit*. Paris: Gallimard.

Roberts, C. W. (2008). *The Fifth Modality: On Languages That Shape Our Motivations and Cultures*. Brill Academic Publisher.

Sonnesson, G. (1999). Iconicity in the ecology of semiosis. In S. T. D. Martin, & B. Brogaard (Eds.), *Iconicity* (pp. 59–80). Aarhus:NSU Press.

Tufte, E. (2006). *The cognitive style of powerpoint: Pitching Out Corrupts Within* ((2nd Edition) ed.). Graphics Press.

Uren, E., Howard, R., & Perinotti, T. (1993). *Introduction to Software Internationalization and Localization*. New York:John Wiley and Sons.

Varnum, R. & Gibbons, C. T. (2001). *The Language of Comics: Word and Image*. University of Mississippi Press.

Wooffitt, R. (2005). *Conversation Analysis and Discourse Analysis: A Comparative and Critical Introduction*. Sage.