How to win friends and influence people: definitions of user-friendliness in interactive computer systems

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The arrival of 'user-friendly' (UF) computing has important implications, both for computer sales and for the accessibility of information online. Yet despite the growing trend towards UF systems and the increasing use of 'UF' in the literature, the term has not yet been adequately defined nor have criteria for UF been conclusively established. This paper stresses the importance of UF for the state-of-the-art and reviews the literature around this subject.

The popular understanding of UF is outlined and some other definitions cited which suggest that the concept is more complex than it might appear. The author asserts that the idea of 'friendliness' is qualified by the word 'user' and that therefore UF systems must be able to recognize and accommodate the needs of different user groups. Published criteria for 'friendliness', 'ease of use', etc., are then discussed and a set of criteria for UF on which there is a consensus, is listed. The paper concludes by suggesting that a plausible definition of UF must take into account variations in the user population in terms of their individual characteristics and the tasks they wish to perform.

Introduction

It might be said that we currently know more about systems which are unfriendly than about the idea of user-friendliness (UF). As Gruenberger says, "It is not necessary to define user-hostility to anyone with more than six months experience in our field" [1]. The theme of user-hostility is very much in evidence in the information and computing literature of the last decade and more especially in recent years. The *Annual Review of Information Science and Technology* of 1984 found that a large number of papers and articles were devoted to criticizing existing systems and to identifying features which were characterized as alienating and difficult to use [2]. Smith asserts that, "The recent spate of literature advocating user-orientated, user-friendly, user-cordial (but not user-amicable) systems suggests that a growing number of systems designers are not content with the state of the art" [3].

I would suggest that there are two reasons why this situation has arisen. First, we don't really know what UF is. Burch claims that UF is "hopelessly undefinable" [4] and, as this paper will illustrate, stated and implicit definitions indicate that the concept is being interpreted in a variety of different ways. Second, there is no definitive listing of criteria for UF, although many suggestions have been put forward. Cuadra, commenting on the "promises and pitfalls" of early online systems, noted that many were badly designed due to the lack of a "body of principles that would tell anybody exactly what characteristics the ideal interface should have" [5]. A decade later, the situation was no better, as Ramsey and Atwood discovered when surveying the literature on "man-computer interface design guidance". They concluded that: "The interactive system designer is given little human factors guidance with respect to the most basic design decisions... . No guidelines have been found which are both extensive and sound" [6].

Why do we need to define 'user-friendly'?

All the indications are that if systems are not friendly then people will be reluctant to use them —friendliness is not merely an 'optional extra' but an essential component of system design. Hostile systems can frighten off actual or potential users. For, as Mann says: "Unlike many other tools, most people in our culture seem to regard computers as alien, mysterious and inherently difficult to use" [7]. Each time a user is confronted with confusing routines, garbled messages or incomprehensible instructions, that image of the computer

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as alien is reinforced. Regular users may be deterred from using the system's full capabilities and new users may give up altogether.

For computer manufacturers and software producers, then, UF is a very relevant issue and one which may make the difference between survival and extinction. The personal computer market's 'honeymoon period' is now over—some competitors will inevitably go to the wall unless they can find new customers. Creating systems which appeal to a wider range of users is one way of doing this. The relationship between UF and productivity cannot be over-emphasised.

UF also has significant implications for our access to the world's store of information. Computer terminals are appearing in an increasing number of public places—from banks and travel agents to public libraries and academic institutions. All kinds of people, including the computer illiterate and information specialists, are required to gain access to data via these channels. Whether the information sought is a bank statement or a bibliographic citation, users must be able to obtain it without feeling irritated, threatened or incompetent. As more and more information is stored on computer, it becomes increasingly important that the secrets of successful retrieval are not monopolized by a privileged few. The importance of UF is clear. But not until we have defined it and gained a better understanding of what it involves, can we hope to achieve it in our computer systems.

Where did the term 'user-friendly' originate?

In the early days of computing, the computer was a large, complex piece of machinery which was housed in special conditions and operated by trained personnel, usually mathematicians or engineers. Although this is still true for mainframes, the arrival of the micro brought 'the computer' into schools, offices and homes and offered 'hands-on' experience to ordinary members of the public with no special training or qualifications. Everyone became a potential computer user. In order to appeal to this sizeable new market, manufacturers began to design computers which were more amenable to non-specialists and the term UF was coined in this context.

Thus UF began as advertising jargon, but it soon became acceptable vocabulary in the language of the computer world. Terms such as 'UF', 'user-cordial' (even 'user-cuddly') started to appear in both popular and scholarly journals around 1980. For example, UF first appears in the *ACM Guide to Computing Literature* subject index in 1980 [8] and in the Permuterm subject index of the *Science Citation Index* in 1981 [9]. The term is now used widely, but—as we shall see—not always to signify the same thing.

How is 'user-friendly' commonly understood?

UF is commonly understood in three main ways. First, UF is often regarded as synonymous with 'easy to use' or 'comfortable'. The *Oxford English Dictionary* defines UF as "easy to use; designed with the needs of users in mind" [10]. Stevens says that "A composite definition which captures the spirit of the most common usage is: a system which helps a person to do a job in a natural way, that is easy to use and understand" [11]. Similarly, Selander defines 'user-cordial' as being concerned with "considerations which, if incorporated into system design, will result in users not being intimidated or frustrated in their interaction with the computer" [12].

Second, another common assumption about a UF system is that its primary aim is to serve the non-expert or novice. Many authors consider this to be the *raison d'être* of UF computers—for example, Burch defines UF as "not completely impossible for non-experts to use" [13], while Gruenberger says that: "The object is to get the work done with the least strain and annoyance to the user [who] is assumed to be intelligent but not skilled in the data processing field" [14]. Two dictionaries of computing support this view: "UF describes a terminal or computer which has input facilities specially designed for an uninformed user" [15] and "A system with which relatively untrained users can interact easily" [16].

Third, UF is sometimes taken literally i.e. in order to be UF a computer must exhibit the same qualities of friendliness we would expect to find in a friendly human. This approach depends on the theory that human–computer interaction is similar to inter-personal communication and that therefore the computer must display a pleasant 'personality'. This would be specially desirable where

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the computer is being used to obtain personal information, for example, where a terminal is used for medical diagnosis. The tendency to regard the computer as a friend has resulted, in some cases, in the anthropomorphization of the computer. The Macintosh personal computer is 'introduced' to the public via advertising, 'Hello' appears on the screen and it is said to be "so personable it can practically shake hands" [17]. Such a sales pitch for another piece of technology, say a washing machine, would seem faintly ridiculous, yet is acceptable (if gimmicky) because of the interactive nature of computing. Moreover, as Dwyer points out, the computer is not an inanimate object talking to you, but a reflection of the personality of the programmer [18].

Despite the popularity of the above definitions, on closer examination they become more problematical. For example, 'simplicity', 'comfort' and 'naturalness' may seem like desirable properties, but these concepts are subjective, depending on the abilities and preferences of individual users. The same may be said of 'friendliness'. Even in a human environment, it would be hard to say categorically what makes a person 'friendly' and, again, what appeals to one person may be off-putting to another. Moreover, we might question whether we want computers to imitate humans. Boden warns against 'specious friendliness', suggesting that users might prefer the computer to be impersonal. She also cautions that making computer environments 'too seductive and overly accommodating' may lead to isolation and social alienation in users [19].

The definition of UF as a system orientated towards novices is also too simplistic. Some systems are available to a variety of users with differing levels of expertise. For trained users, even for the untrained who are computer-literate, features designed to accommodate the uninformed may be unnecessary or, worse, tiresome. In an information retrieval system, for instance, the novice would probably prefer to select choices from a menu, while the expert would be happier with a command-driven system offering a powerful search language and the possibility of using Boolean operators to increase precision and recall. Even where a system is intended to be used exclusively by unskilled end-users, the absolute beginner will have need of facilities which may become superfluous as he, or she, becomes more familiar with the operation of the system.

It becomes clear that the popular definitions of UF are superficial and ignore the implications of diversity in the user population. In addition, because computers are used for a variety of functions, 'friendliness' may be related to the purpose of the system, rather than being an unchanging quality. We must be more flexible in our understanding of UF—systems may exhibit degrees of friendliness rather than being simply UF or user-hostile. Indeed, Matthews and Frye suggest that anyone familiar with even a few so-called UF systems will know that they are not "all created equal" [20]. They have devised a 'UF Index' which describes and rates degrees of UF, thus enabling users to predict system performance and their own chances of satisfaction during interaction. These range from the 'user-intimate' systems—still a fantasy for most users—to 'user-vicious' systems which "take great delight in inflicting cruel and unusual punishment on anyone foolish enough to use them" [21].

Some more sophisticated definitions of 'user-friendly'

Stevens takes a critical look at the 'working definition' of UF which, he says, consists of four elements, i.e. ease of use: naturalness; ease of understanding; helpfulness. Stevens makes the point that what constitutes ease of use depends on the user. He also points out that, while psychologists have found that the human capacity to handle information is quite limited, certain factors —such as good display and the 'chuncking' of material—can enable people to absorb greater quantities of information. Therefore, we should not necessarily aim to create the ultimate in simplicity if, by creating a more sophisticated but equally accessible system, users can learn to achieve better results. 'Naturalness' is objected to on the grounds that, "The obstacles to making communication with machines truly human-like appear fundamental". He then discusses some of the problems associated with natural language input. 'Ease of understanding' is also shown to be a complex issue. For example, the user may not have to understand the system fully in order to be able to use it effectively. Further, if the interface is made very simple to comprehend, the user may

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gain only an illusion of understanding the system. Stevens states that 'helpfulness' can be achieved in three ways—by building-in a helpful 'personality', by responding to user requests for help, and by the provision of helpful error messages. All these must be responsive to user type and level of expertise [22].

Some authors have suggested that UF is not a term which may be applied universally to describe certain kinds of systems, but that it is a relative concept; friendliness depending on what the computer is being used for. To quote Nesdore, "UF as a generic term is meaningless... . We can only say that System A is better than System B for the same job" [23] and Noerr, "A system is UF if it provides the right number of appropriate features and functions for the user to perform the current task" [24].

If UF is related to user task, then the type of operation for which the computer is being used will influence definitions of friendliness. For example, it has often been stated that data security is a necessary ingredient for a UF system. However, if an interactive terminal were intended for home usage, e.g. for 'online shopping', it would be less important to users whether others could tap into their files than if that terminal were designed for use by a government body to store and retrieve classified information.

To illustrate the point that peoples' understanding of UF may vary according to the different requirements of different areas of computing, a couple of definitions of UF which relate to the field of bibliographic information retrieval are presented.

A survey of the commercial retrieval services of Euronet Diane found that the kind of improvements which would encourage more use included more uniformity in retrieval languages, standardization of manuals and simpler logging on. Other helpful features mentioned were crossfile searching, simple billing and timely updating. All the above features were described as 'online friendliness' [25], although not all of them would be applicable outside this field. Dolan, on the other hand, considers that most commercial systems are elitist in terms of the academic/scholarly references which they offer: "Not until we have databases which are of, by and for the people, will present systems be truly UF" [26]. This definition is strictly limited to the arena of bibliographic information retrieval. Moreover, Dolan has shifted the emphasis of UF from the interactive process itself to the nature and quality of the information retrieved during that interaction.

In discussing UF we are not merely talking about 'ease of use' or 'friendliness' as desirable qualities *per se*, but about friendliness to the user. As information scientists begin to look more carefully at the implications of the concept of UF, many are now beginning to stress that it is dependent on the desires of individual users. Chafin writes that: "UF is an individual preference, not an inherent characteristic of a system. It is only appropriate to call a system UF if it meets the user's needs, matches his characteristics and fits the way he normally operates" [27]. For Trenner and Buxton, the crux of the problem is, "the assumption made by those who use UF as a self-explanatory term, that 'users' form a homogeneous group with a standard set of characteristics and that therefore what is friendly to one is friendly to all" [28].

A common assumption about UF systems, as was noted earlier, is that they are there to serve the non-expert. This idea was criticized on the grounds that systems may be used by a variety of users. If this fact is ignored, we risk creating a breed of computers which are hostile to experts. As Quirk comments in connection with UF, "Today's systems are novice-friendly rather than expert-friendly" [29].

'User-friendly' systems must facilitate interaction by all levels of user

Users will have different expectations of computer systems and approach their tasks in different ways according to personality, background, level of computer literacy and so on. A UF system must be able to cater for all categories of user and accommodate their requirements. Although more research is needed in order to ascertain the multifarious needs of computer users, it may be surmised that all users want the system to respond to their level of experience and to help them to interact as quickly, efficiently and painlessly as possible. The novice, for example, wants detailed explanations and instructions and continuous guidance and reassurance, while the expert wants to cut interaction to a minimum whilst still achieving optimum results.

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The capacity of the system to adapt to the user is especially important when a system is specifically designed to be used by a variety of users. An online public access catalogue, for example, must permit library staff, cataloguers and the general public to interact effectively. Regular/trained users must be able to capitalize on their expertise, suppressing unwanted information and using short-cuts in the dialogue; the first-time or occasional user must be provided with many levels of assistance; bibliographic information displayed must be appropriate to the needs of the individual user.

UF systems, then, must have flexible, adaptable interfaces. In order for a system to provide the level of interaction appropriate to the individual user, users must be given the opportunity of indicating their levels of expertise. Although it is unusual to encounter computer systems which are user-adaptive there are several technical ways in which this can be achieved. For example:

(1) When logging on to the system, the user indicates what level of sophistication is required, perhaps by selection from a menu. Interaction is then conducted at this level.

(2) When a user initially registers with a system which provides user IDs he, or she, tells the system provider or host what level of interaction is required and this is recorded so that, whenever that ID is keyed, interaction automatically takes place at the user's selected level. Users must be able to change their choice if they have difficulty, or if they become more proficient.

(3) A system can be programmed to respond automatically to the user's perceived level of sophistication. On a simple level, this can mean that when a user makes an elementary error, or repeats errors, the system responds by switching to a more explicit mode of interaction. Or, in a more complex system, Artificial Intelligence can be utilized to mimic a sympathetic relationship between computer and user.

Quantifying 'user-friendliness'

As we have seen, definitions of UF are not very useful if they refer vaguely to 'ease of use' or 'pleasant interaction'. Without more specific information, users are really unable to say if a system is 'easy to use', nor can they evaluate the friendliness of one system as compared with another. Noting this point, Wallace calls for a definition of UF which is both "functional and operational" [30]. Taking this idea to its logical conclusion, some writers have attempted to quantify UF, so that the friendliness of a system may be calculated mathematically.

Raduchel, for example, while recognizing that "No system can be UF except in the context of specific problems for specific users", puts forward the theory that UF may be defined using quantifiable terms. His equation for calculating UF is as follows:

$$F = P_0 \times p^n$$

where

F = System friendliness,
P_0 = Probability that user will find the set of steps to solve a problem
p = Probability that user can successfully execute each step,
n = Minimum possible number of steps in the solution.

As Raduchel points out, this equation reflects the necessity for balancing design goals, i.e. reducing the number of steps will increase the chance of users finding those steps, but, because those steps will be more complex, so the likelihood of successful execution decreases. Thus, "a system that is easy to learn may not be easy to use and every UF system faces a trade-off between those two goals" [31]. This accords with the observation made earlier in this paper that features designed to be friendly to the novice could become progressively less helpful as the user gains familiarity with the system.

Others, however, have criticized Raduchel on the grounds that UF may not be calculated numerically. "The meaning of the phrase is not locked up in some netherworld that can only be penetrated with the precisely made points of mathematics" [32] and "Users don't count keystrokes... whether it works is more important than the number of steps" [33].

Raduchel's equation may be useful for some computer applications, especially those involving fairly precise problem solving. However, his definition is based on the premise that users will find steps easier to perform if they are short and simple, which does not take into account other factors, such as how the system responds to user

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errors, or what kind of 'Help' is available.

In contrast with Raduchel's quantifiable definition of UF, Miller has put forward quantifiable criteria. His "operational criteria for human ease of use" all permit mathematical values to be assigned to a system. They are:

(1) Length of training time required for members of the subject population to reach some established performance criteria;

(2) Number of errors a sample of 'competent' users makes per unit of time, or per some number of operations performed;

(3) Number of exasperation responses (e.g. the 'Oh Damn!' response);

(4) Proportion of the human population that can learn to perform the task on the facility in a given time;

(5) Number of people who want to use the device;

(6) Habit formation rate, i.e. how quickly the user can learn to use the facility more or less automatically [34].

Where we are dealing with psychological factors based on human reactions to technology, quantification or verification can be difficult or inappropriate. For instance, we might stipulate that a system should respond in less than two seconds, and we can calculate precisely if this criterion is being met. But we might also say that 'pages' of screen information should be clearly formatted and well presented. Despite recommendations concerning legibility and layout for VDUs, the acceptability of presentation relies ultimately on the preferences of individual users.

Returning to Miller, all of the criteria cited above are clearly quantifiable, but human factors might complicate the calculations. Regarding his third criterion, for example, one would have to decide, when counting 'exasperation responses', whether to include utterances of boredom or non-comprehension.

Clearly then, UF is not a simple concept and simple definitions will not suffice. Measuring UF precisely presents us with problems; nonetheless it appears that the friendliness of a system is dependent on a number of factors, some of which may be verified or quantified, and it is these factors which require closer examination.

Criteria for 'user-friendliness'

As was noted in the introduction to this paper, there is as yet, no listing of the criteria for UF which could be regarded as both complete and authoritative. However, several authors have put forward suggestions for 'ease of use' or 'friendliness', while others have listed recommendations for systems designers, or have enumerated desirable features for user-orientated online systems.

Comparison of these recommendations reveals some contradictions—often due to the trade-off effect, i.e. some features can be achieved only at the expense of others. However, there are also many areas of agreement. What follows is a brief discussion of those areas of consensus on the criteria for UF in interactive systems based on a review of the literature on, and around, this subject.

(1) *System design must prioritize the needs of users* [35,36,39,42]. Often, in a system design, technical considerations predominate. UF systems must recognize human needs as paramount, starting at the design stage. For example, systems must be built in accordance with human ways of thinking, rather than expecting people to think like computers. In order to ensure that this requirement is met, suggestions include testing a system on potential users during the design process to assess their reactions and, once a system is in use, providing a channel for users to input their comments and suggestions. Features which do not satisfy users may then be redesigned or modified.

(2) *Different user levels must be accommodated* [35,37,41,42]. The user-computer interface must facilitate interaction by users with different backgrounds and levels of expertise, for example, by providing 'Help' instructions and messages which cater to the needs of different user groups. For retrieval systems, search strategies which accommodate user diversities should be available. This might mean the provision of menus, a simple set of commands and a complex command language within the same system.

(3) *The system should always respond to the user* [36,40,41]. Every user input should elicit some kind of response from the computer. Users may feel abandoned if the system simply carries out an instruction without indicating that it is doing so. Recommendations on system response time vary, but it is generally agreed that a delay of over two

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seconds is unfriendly to users; therefore, where input requires lengthy processing, the computer should reassure users with an 'interim response'.

(4) *Dialogue tone should be based on the principles of cordial interaction between humans* [35,37,39]. The computer should never criticize or threaten, and user–hostile messages like 'user error' and 'input rejected' should be avoided. Spurious intimacy or 'user-gossipy' [43] output may also irritate users. In UF systems, computer output should be factual, positive and polite.

(5) *Dialogue structure should be flexible* [35,36,40,41]. Users are not obliged to carry out a task in a predetermined sequence of steps, but are able to back-track, jump forwards, or terminate the dialogue at any stage. In command-driven systems, commands may be entered in any order.

(6) *The system provides user support and orientation* [35,36,37,40]. Throughout the interactive process, users should feel supported by the system and confident about how to continue the dialogue. In order to achieve this, the following suggestions have been made: unambiguous prompts should inform the user when, and what kind of input is required; the user should be able to ascertain, at any moment, what stage the dialogue has reached, or what mode the system is operating in; 'Help' which explains every feature and function, should be constantly available.

(7) *User errors should be handled intelligently and constructively* [37,38,40]. Minor input errors should be tolerated; the system should inform the user how it has interpreted the entry, or use interactive dialogue to clarify the user's intentions. Other errors should be correctly and unambiguously identified and possible remedies offered.

(8) *The user's data must be protected* [38,39,40, 41]. Private information and commercially available files should be accessible only by authorized personnel. The system should have built-in safeguards which prevent the user from 'accidentally' destroying files, e.g. by making the user double-check before deleting data, or by allowing him, or her, to recall files which were unintentionally deleted.

Conclusion

This paper has stressed the importance of UF in terms of both its relationship to productivity and its implications for wide-ranging access to computerized information. But, while the information world is united in its desire for systems to be more UF, it does not seem to be in agreement about what that might mean. Since the term has now moved on from the domain of sales literature and into scholarly publications, it is important that we should find an acceptable definition of it.

A number of definitions of UF have been discussed, taken from both popular and academic literature, and they are mostly found to be inadequate. Often, definitions are superficial because they fail to take account of diversities in the user population—UF relates specifically to the user—hence, satisfying individual needs and requirements is paramount. One of the aims of this paper has been to open up the debate around definitions of UF. It may be that we are not yet in a position to define it conclusively, but something along the following lines is suggested. A UF computer system allows users to perform desired tasks without frustration and provides a range of features and functions which help each individual user to optimize his, or her, efficiency.

Next, we must try to establish how systems may be designed so that user frustration is avoided, as well as identifying those features and functions which enable users to make the best use of the system's and their own capabilities. As the earlier discussion illustrates, we are beginning to gain a better understanding of the criteria for UF. However, the list of guidelines needs to be refined and verified and, where possible, quantified using practical experimentation on a variety of users. Work on this is in progress and will be reported in a later paper. Once a more authoritative set of criteria has been drawn up, designers will be in a better position to create interactive computer systems which are genuinely friendly to all users.

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