

# Text vs visual metaphor in mobile interfaces for novice user interaction

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**Abstract.** This paper explores the effectiveness, efficiency and ease of use of two alternative interface interactions in a mobile tablet application. More specifically, the study employs a navigation task which novice users were required to complete by means of two types of main menu button, one utilizing text and the other utilizing a visual metaphor. Furthermore, little evidence exists on the effect of the use of metaphor on users of various ages and levels of computer experience. Our results show that young users prefer buttons that display a visual metaphor in the form of an icon, in contrast to older participants, who preferred the button that employed text. They also show that the users' performance is dependent upon age.

**Keywords.** Mobile tablet, visual metaphor, interface, interaction design, novice user.

## Introduction

The rapid growth of mobile and wireless technologies combined with contextual computing has contributed to an increase in new mobile applications and services. Currently mobile devices typically utilise direct user interfaces, such as touch-screens, where interactions are performed directly by controlling graphical elements or by means of controls located on the interface. These new forms of mobile communication are fast becoming indispensable in contemporary society. The term 'mobility' is closely related to 'ubiquitous' computing [1], and 'nomadic computing' [2, 3]. Weiser introduced the term 'ubiquitous computing' or 'ubicomp' and argued that in order to become ubiquitous, computers need to be seamlessly integrated into everyday life and to provide useful services [1].

With the increase in the use of new technologies and of use of the Internet at home, there is an exponential growth in numbers of novice users, that is, in ordinary people who lack skills in computer science and who are drawn from a wide range of backgrounds. They thus face difficulties in operating computers. Such ordinary people, however, are now the main target of the market, which produces new applications very rapidly. Not all users perceive technology as beneficial and helpful. According to Hassenzahl [4], there is no guarantee that users will actually perceive and appreciate the product in the way designers desire it to be perceived and appreciated. For example, a product with a specific screen layout intended to be clear and simple will not necessarily be perceived as such.

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In such cases, it is necessary to find ways of giving the user clues as to how something works. In the case of mobile interfaces, a common solution to this problem is to employ metaphors. Not all metaphors are created equal or are equally useful. It is therefore important to understand why metaphors work, in order to judge the usefulness of the metaphor that one is currently investigating. Yet there has been little investigation into the influence of mobile device interaction style on the operating task performance of inexperienced users. Furthermore, there is little discussion in the research literature on mobile computing that deals with intergenerational interaction experiences, in which older users employ mobile tablet information applications alongside younger users, perhaps in a family environment.

The research reported in this paper is the first phase of a larger study which explores the possible effects of mobile computing on the design interface process of inexperienced users for intergeneration use. Two alternative interactions for supporting “main menu” navigation, deriving from a study of users, are presented and evaluated here. Our experiment had two main goals, namely:

- to investigate the influence of two types interactions navigation buttons on the operating task performance of inexperienced users and
- to examine whether age plays any role in time completion tasks.

## 1. Mobile applications for intergenerational use

Mobile devices, such as tablets, offer new ways of using technology, since the tablet provides access from any location at any time. We deal with an application under the theme of first aid provision. The application follows design principles that cater for interaction with inexperienced users and was developed and presented in a previous study. During a pilot test, we noticed that some older users had difficulty in understanding the metaphor of a home icon used on the navigation button in the main menu (Figure 1). Their past experiences may not have enabled them to understand the meaning of this well-known metaphor.



Figure 1. Two alternatives interactions involving different main menu button.

Cultural differences may make basic metaphors used in an interface design incomprehensible to some users. Icons present particular problems because images that may be comprehensible in one culture may be unknown in another [5]. The cultural environment of the user is made up from their ethnicity, their range of experience, which is related to their socioeconomic background. However, cultural differences may also be defined by age. These differences should become apparent during requirements gathering. The perceptual abilities of users vary, which means that they therefore have different needs in regard to what should be visualized [6]. Novice users feel frustrated, insecure and even frightened, when they have to deal with a system whose behavior is incomprehensible, mysterious and intimidating [7]. One of the main goals of a mobile interface is to relate device functions and operations to elements of interaction that are performed well [8]. We therefore set up a study to compare the effectiveness of the use of text button and of icon button in main menu navigation. Recent work by researchers such as Hsu and Blackwell suggests that novices with poor prior experience of a domain may perform even worse when given an explanatory metaphor [9,10]. The concept of a user-interface metaphor that serves to explain a point must be something familiar to the user, because it is the user who must ultimately understand and interact with the system.

## **2. Background**

### *2.1. Metaphors*

Metaphor can function as a means for understanding abstract digital concepts. The most famous example, the metaphor of the desktop, has proved successful over the past thirty years, in particular in that it helped users to adapt to early computer systems. However, one of the most prominent problems in the use of metaphor in interfaces is the general lack of understanding of the fundamental concept itself. The fact that metaphors are subject to interpretation is, of course, of primary importance in any consideration of user-interface metaphor [11].

The word 'metaphor' derives from the Greek *μεταφορά* (metaphora), which literally means 'transferring' or 'conveying'. Aristotle's definition of metaphor is still highly applicable today. He wrote that a "metaphor consists in giving the thing a name that belongs to something else" [12]. According to The Oxford Encyclopedia English Dictionary (1998), a metaphor is "the application of a name or descriptive term or phrase to an object or action to which it is imaginatively but not literally applicable"[13].

Lakoff and Johnson's view of metaphor has largely dominated the field since the 1980s. They argue that "...the way we think, what we experience, and what we do every day is very much a matter of metaphor." In their book *Metaphors We Live By*, they present numerous linguistic metaphors and group them into larger, more inclusive categories of conceptual metaphors [14]. In their view, the nature of metaphor is perceived in association with people's conceptual system. Lakoff argued that the "metaphor is the main mechanism, through which we comprehend abstract concepts and perform abstract reasoning"[15].

Expressing a view similar to that of Lakoff and Johnson, the authors of *The Handbook of Human- Computer Interaction* state that "metaphors allow the transference or mapping of knowledge from a source domain (familiar area of

knowledge) to a target domain (unfamiliar area or situation), enabling humans to use specific prior knowledge and experience for understanding and behaving in situations that are novel or unfamiliar.”[16]. Hackos and Redish point out that the term ‘metaphor’ describes the overall concept used to organize all the objects and the actions in a coherent whole [5].

## *2.2. Visual Metaphors*

Visual metaphors have to be considered in the context of interface design mainly in regard to the communication of mental models to aid in the understanding of complex software. Visual metaphors, although frequently encountered in everyday life and hardly novel are less well-studied than verbal metaphors. Early research into human-computer interaction suggested that the use of mental models enable people to interact with complex software [17]. In Blackwell’s view, a metaphor is a channel of visual communication by means of which the designer achieves the rapid transfer of an effective mental model to the mind of the user [10]. Because mental models employ a strong visual component, it is only natural to consider the possibility of using visual images or pictorial metaphors to represent or support mental models in computer displays [18]. In addition, research in advertising has investigated the ability of visual metaphors to persuade through association. Forceville, who has analysed pictorial metaphor on billboards and in advertising in general, defines a visual metaphor as the replacement of an expected visual element by an unexpected one [19]. Visual interface metaphors draw heavily on culturally specific knowledge and practices.

## *2.3. Interface Metaphors*

The concept of a user-interface metaphor is very familiar in the field of human-computer interaction and is often utilized in the process of user-interface design. Metaphors provide analogues from the user’s real world that can be employed in the virtual world constructed in the interface. The function of the metaphor employed in the interface is to convey to the user instantaneously knowledge on how to interact with the interface. In fact, of course, the concept of metaphor contains a consciously committed error, in that the two things which, in terms of the metaphor, are identical, are in fact not identical. Some researchers have claimed that user interface metaphors should closely match the way a user conceptualises a specific task [20]. Closer examination of user-interface metaphors reveals that such metaphors can often both create and solve serious problems of use [21].

User-interface metaphor functions slightly differently from literary metaphor, as is evident, for example, in the sentence, “The seeds of his great ideas were planted in his youth.” Metaphorical interface objects, such as “buttons” work differently from their literary equivalent, for example Gaver points out that interface metaphors allow one to create relations between attributes of function and attributes of appearance for interface objects by means of a conceptual mapping between the functional attributes of the computer and some everyday analogue [22]. Neale and Carroll go so far as to claim that computing metaphors are inevitable as overarching design strategies [16].

#### *2.4. Limitations of Metaphors*

It can be hard to find the appropriate metaphor. According to Cooper “metaphors rely on associations perceived in similar ways by both the designer and the user. If the user doesn’t have the same cultural background as the designer, it is easy for metaphors to fail. Even in the same or similar cultures, there can be significant misunderstanding. Does a picture of an airplane mean check flight arrival information or make airline reservations?” [23]. In many cases the metaphor fails to explain all of the functionality of the interface, leading designers to abandon or stretch the metaphor and creating confusion in users.

In our study, older participants failed to understand the metaphor of “home”, which may be unfamiliar to them because some of them, at least, have used only mobile phones, rather than computers as well. Jonas Löwgren has pointed out one problem inherent in metaphors, that they sometimes simultaneously convey both too little and too much [24]. Norman claims that metaphor is both useful and harmful and in fact believes that metaphors do more harm than good in use [25]. One of the basic lessons of Eco’s semiotics is that you have to build a model of your reader if you want some text to be incisive [26].

### **3. Methodology**

As we wished to compare these two types of interfaces, we employed a laboratory experiment centred on closed tasks. The purpose of the experiment was to examine the effectiveness and ease of use in these two types of interactions in relation to the question as to whether the ‘main menu’ button should employ text or an icon. 36 individuals (20 women, 16 men) took part in the study. Participants ranged from 15 to 74 years in age, and were randomly assigned to two groups, the sole criterion being that they were to be equally distributed among three age groups. In first group (text button) participants were aged between 15-34 (n = 6), 35-54 (n = 6), 55-74 (n = 6) years of age, respectively, while in the second group (icon button) participants were aged between 15-34 (n = 6), 35-54 (n = 6), 55-74 (n = 6) years of age. All participants were mobile computing novices. Participation was voluntary.

Menu navigation is one of the most common interactions between user and mobile device. We required each participant to complete a mobile device task consisting of nine steps, in a specific order (Figure 2). The user was required to find the item “drowning” on the main menu. In order to complete the task the users had to perform nine steps.

#### *3.1. Experimental design variables*

In order to evaluate task effectiveness, we measured the percentage of steps successfully solved within the set time limit. To evaluate efficiency, we recorded the time needed to process the task. In order to measure ease of use, we asked participants to rate each of the following statements on a 5-point Likert scale (1=strongly disagree, 5=strongly agree): (a) ‘It was easy to complete the task.’ (b) ‘I felt lost in the menu.’ (c) ‘It was easy for me to remember how to perform.’ (d) ‘I did not know where to go next.’ (e) ‘I was satisfied with my performance’ (f) ‘I did not know how to reach a specific function.’

Steps	Tasks	Text button N=18	Icon button N=18
Step 1	Turn mobile device on	94.4%	100%
Step 2	Find the icon for the 'first aid' application	100%	100%
Step 3	Select the icon and go to first screen	83.3%	94.4%
Step 4	Select information for "drowning" via the main menu.	100%	100%
Step 5	Go to screen with "drowning".	94.4%	100%
Step 6	Go to next screen(menu depth: four levels)	88.8%	83.3%
Step 7	Return to application main menu	88.8%	66.6%
Step 8	Exit of the application	100%	100%
Step 9	Turn of the mobile device	83.3%	94.4%

**Figure 2.** Specific user navigation steps and users effectiveness.

## 4. Results

Clear differences emerged between the users' performance in relation to the interaction style and age groups. Table 1 shows the mean time for the task in seconds. The results showed that older adults displayed a significantly lower mobile computing performance and also reported less ease of use when interacting with icon button. Members of the younger group performed better in their interaction with icon buttons.

**Table 1.** Mean task completion time (seconds) and SD, for text button and icon button.

Interaction style	Age group	Mean task completion time (seconds)	SD
Text button	15-34	84.2	(SD=7.0)
	35-54	96.7	(SD=9.2)
	55-74	127.7	(SD= 5.1)
Icon button	15-34	75.3	(SD=2.7)
	35-54	134.5	(SD=6.2)
	55-74	167.2	(SD=8.7)

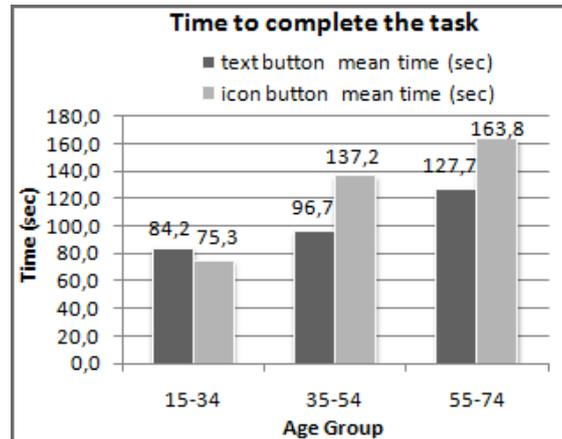
### 4.1. Menu Navigation Task

The results arising from the menu navigation task show that not all users make incorrect steps and that the elder participants employing the text button interaction style executed more steps correctly than those employing the icon navigation button. Incorrect steps taken by the participants are shown in Figure 2.

### 4.2. Task Completion Time

We recorded the total amount of time required for completing each mobile device task, starting from turning the device on to turning it off. The mean amount of time required by participants from each age group is shown in Figure 3. An analysis of the data shows a large increase in time across age groups. More specifically, there was a significant difference in operating time between age groups. This observation was

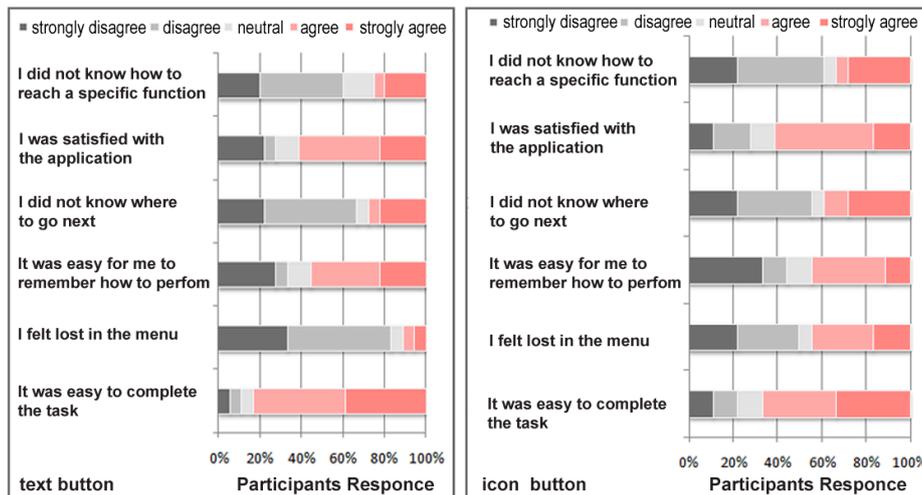
confirmed by an analysis of the time data, which revealed that age was indeed a significant factor.



**Figure 3.** The interaction effect of age and interaction style on operating time and mean task completion time (seconds).

#### 4.3. Users' ease of use rating

After completing the tasks, participants rated the perceived ease of use of the mobile application. Ratings mirrored the outcomes in terms of measurement of performance for text and icon button interfaces. The results are given in Figure 4.



**Figure 4.** Participants ratings on ease of use for text and icon button interaction.

Participants were asked informally what the most important factor was in learning how to use the mobile device. In their view, being shown through easy, interesting applications was the most important factor, followed by help of other family members.

Some users told us that they had never used a computer before and that they liked this approach of a mobile tablet application, preferring the touch screen over other environments. Another factor that participants commented on was the ease of use of the menus. Menus are usually complicated and act as barrier between user and interface, which, of course, impacts on user interactivity.

## 5. Selecting a visual metaphor

In choosing a visual metaphor the designer should take into account various obvious criteria, such as comprehensibility, culture, prior knowledge on the part of the user, general conventions and actual context.

- The first and most decisive feature of a good visual metaphor in the context of the interface must be its *comprehensibility*. If a metaphor is not comprehensible to its users, then it is no metaphor at all [27].
- Different *cultures* have different conceptual frameworks, especially in regard to such abstract ideas as time [28].
- It is important to use the first metaphor that comes to mind for the user in the *actual context* [29]. What may work in one medium or domain may not in another.

## 6. Conclusions –Future work

The choice between the visual metaphor of a navigation button and the visual metaphor of a text button depends on the particular situation. When choosing metaphors, designers should take into account both the degree of prior knowledge on the part of users and the nature of domains familiar to them and use all this as a basis for the design of tools to aid learning on the part of new users. In the view of Stagger and Norcio, in the design of applications to aid new users in the process of learning, designers need to consider both users' experience and the tasks to be completed [30]. One important question is the degree of comprehension of these interfaces elements by users from various cultures, since visual metaphors are usually deeply rooted in the culture from which they derive and are thus difficult to interpret for the novice user.

This paper reports on our experience of an empirical method for comparing two alternative interface button interactions whose aim is to allow novice users to handle a mobile tablet application easily and effectively. The results demonstrate that young users prefer the button that displays a visual metaphor in the form of an icon, in contrast to older participants, who prefer a button that employs text. From the results, it is clear that the mean values and standard deviations are susceptible to changes in the scores of the evaluators because of the small size of the samples.

Thus the overall results of this study support the use of this intergenerational application. The results of this study will, we hope, provide useful guidance and reference for future investigation into the performance of users inexperienced in mobile computing and thus make artifacts easier for intergenerational use.

The next phase involves a full evaluation by novice users, with this time subjects drawn from a larger sample of users of various ages. We wish also to identify which

interface icons are most likely to meet the needs of the novices we are investigating, for which we intend to design and develop a fully-functional prototype and then to evaluate this empirically and analytically.

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