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# Usability and Acceptance in Small-Screen Information Systems

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## Abstract

*The small screen sizes of mobile phones can create problems for users. There is a need for acceptable user interfaces that enable a better, more maximised use of the limited screen size while still providing high levels of usability. One method of maximising a limited display area is translucency. To examine the effect of translucency on interface usability we created a fully functioning simulation of a third generation mobile phone user interface, containing a translucent menu system. In this study translucency was implemented at 50% alpha, and two menu levels deep. Objective and subjective aspects of usability and acceptance were gathered. Within the focus of the research the study yielded interesting findings positively relating translucency to perceived usability and measures of acceptance of small screen information systems. This paper presents the results of this study, and presents avenues for continuing research arising from the findings.*

## Keywords

Usability, Acceptance, Small Screen

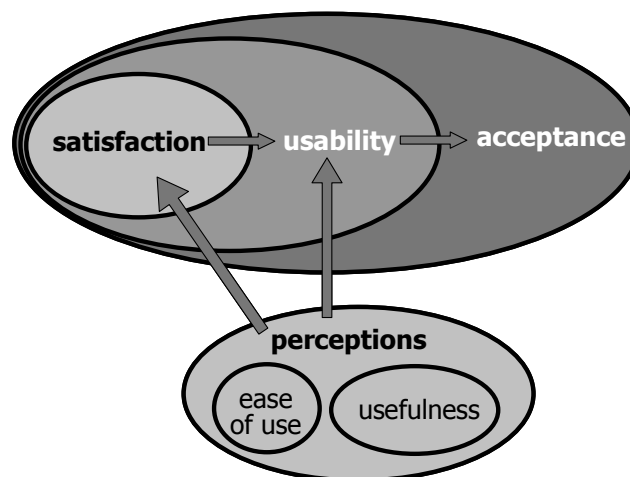
## 1. INTRODUCTION

The screen sizes of mobile phones can create problems for users – the small screen space can display relatively little data at a given time, resulting in difficulties in using the device for complex tasks. Yet these devices are becoming more and more pervasive, and with the advent of 3G phones the potential of these devices will be considerably expanded. There is a need for techniques that enable a better, more maximised use of the limited screen size while still providing for intuitive use. One means to help make the most of a limited display area is translucency; a method by which the user can (to some degree) visibly see through on-screen displayed ‘objects’ to those beneath them. Translucency provides concurrent access to multiple screen layers, and as such can help maximise display space limitations. However, it remains unclear how such translucency might affect the usability of the device’s user interface.

## 2. FROM USABILITY TO ACCEPTANCE

Interface usability and acceptance by users can be assessed using various metrics (Bawa 1994; Robinson and Fitter 1992). Purposeful and sentient usability emerges not only from the collection and analysis of quantitative measurement variables (Davis 1989; Van der Heijden 2001), but also from careful and deliberate consideration and inclusion of subjective qualitative criteria (Tractinsky et al. 2000). From an objective perspective, usability is measurable using quantifiable data such as user performance, error rates, or time taken to complete tasks, using positivist scientific methods embodied in closed system experimentation, and is an objective approach to usability evaluation. This approach comprises actual usability. On the other hand, and from an interpretive and subjective perspective, usability is measurable either quantitatively or qualitatively, but based on user perceptions, attitudes, and intentions towards aspects of the interface, including perceptions of ease-of-use, usefulness, and intentions towards usage and acceptance of the underlying system (Davis 1989). This comprises perceived or ‘apparent’ usability. Furthermore, for the purposes of usability measurement and data collection, actual and perceived usability may be treated as separate entities (Davis 1986; Davis et al. 1989; Van der Heijden 2001).

Subjective user perceptions towards an interface can directly mediate perceptions of system usability (Benbunan-Fich 2001; Tractinsky 1997). Indeed research has shown that user perceptions towards a system’s interface are strongly related to apparent usability and may significantly affect overall system acceptability (Hassenzahl et al. 2001; Schenkman and Jonsson 2000; Tractinsky 1997). Tractinsky (1997) found that aspects of an interface that lead to user opinions of increased perception in usability of the system can result in an increased user acceptance of the system. A major aspect of perceived usability, and therefore a predictor of acceptability is ‘ease-of-use’. Many argue that system use is affected by the system’s ‘perceived ease-of-use and perceived usefulness’, and that perceived ease-of-use has a positive effect on an individual’s attitudes and intentions toward using an information system (Davis et al., 1989; Hassenzahl and Wessler 2000; Mathieson and Kiel 1998; Van der Heijden 2001; Venkatesh and Davis 2000). Furthermore, Venkatesh and Davis (2000) affirm that much previous research has established that perceived ease of use is ‘an important factor influencing user acceptance and usage behavior of information technologies’ (figure 1).



**figure 1** Influence of perceptions on mediators of acceptance

Measuring perceived usability can be accomplished through the observation of actual users interacting with the interface and collecting objective and subjective data gauging the ease of use, and the users' satisfaction with that interface (Benbunan-Fich 2001; Chin et al. 1988; Nielsen 2001; Nielsen and Levy 1994). As such, perceived usability

is inextricably linked not only to user acceptance of a user interface's underlying system through mediation, but encompasses user satisfaction, and is itself mediated by it. Various tools exist to assist in measurement of perceived usability: amongst these is the Technology Acceptance Model (TAM) (Davis 1986; Davis 1989; Davis et al. 1989; Van der Heijden 2001). TAM has been extended by Al-Gahtani & King (1999) to include constructs such as compatibility, user characteristics, system rating and the end-user computing satisfaction (EUCS) construct as a surrogate for measures for acceptance. The Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Venkatesh et al. (2003) extends TAM to take into account several new constructs (Performance Expectancy, Effort Expectancy, and Social Influence) that bear significant influence on behavioral intention and ultimately usage of technologies. An extensive analysis of the applicability and usefulness of the TAM model is provided in Acton and Golden (2003).

The Theory of Reasoned Action [TRA] (Fishbein and Ajzen 1975) provides a theoretical basis for the link between attitude and behavior. Both TAM and TRA models suggest that satisfaction with a particular technology leads to usage. Other kernel theories are based on the Information Systems (IS) success research stream (DeLone & McLean 1992; DeLone & McLean 2003; Rai, Lang, & Welker 2002). Important determinants of IS success are identified as user satisfaction (Baroudi and Orlikowski 1988; Doll and Torkzadeh 1988), user-perceived benefits (Guimaraes et al. 1992), and self-efficacy (Edison & Geissler 2003). Several antecedents to perceived usefulness and perceived ease of use stem from the realm of cognitive absorption and involve temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity. In turn, these have as antecedents individual traits of playfulness and personal innovativeness (Agarwal and Karahanna 2000).

For this study usability was assessed using well-established methods for both objective and subjective measures (Davis 1989; Van der Heijden 2001). Objective measures of usability included data gauging user performance, error rates, and time taken to complete defined tasks. Subjective measures were based on the TAM model and included user perceptions of interface ease-of-use, in addition to feelings and impressions of satisfaction, enjoyment, and usefulness.

### **3. METHOD**

To examine the effect of translucency on user interface usability we created a fully functioning simulation of a prototype third generation mobile phone, containing a translucent menu system through which users could navigate and make menu selections (see Acton and Golden 2003). Where menus 'overlapped' one another on screen, users could see through the top-most menu (at 50% translucency) to a completely visible menu beneath.

In parallel we created a control interface, similar in all respects but lacking translucency, so that where menus overlapped the underlying menu(s) were at least partially obscured. Translucency was implemented two menus deep. Under controlled laboratory conditions seventy University students, randomly split into two groups, carried out blind usability tests on the design: individuals in one group carried out seven randomised yet well-defined tasks using the translucent prototype, those in the other group carried out the same tasks on the control version. These tasks were based on the most common tasks currently carried out on existing mobile phones, and included tasks related to third generation functionality.

For the tests each participant worked only with either the translucent or non-translucent interface, and was unaware of the existence of the other version. The pivotal question is 'Does menu translucency affect the usability and acceptance of a third generation mobile phone user interface?'

### **4. FINDINGS**

The study yielded interesting results. On a subjective level the presence of translucent menus had very substantial effects: the translucent interface was perceived to be more enjoyable and more attractive than the control version. Additionally for the translucent interface, navigation through nested menus was found to be easier, and the presence of translucency perceived to be useful. Yet the objective measures showed no real differences in terms of the time taken to complete tasks, or the number of errors made, between the translucent and non-translucent systems. Thus, from an objective viewpoint translucent menus did not enable users to complete tasks more quickly, or with fewer errors, yet subjectively translucency gave users the "feeling" of having a more usable interface. As a result of this discrepancy we further investigated the inter-connectedness between perceptions of ease-of-use, enjoyment, attractiveness, and usefulness. In so doing we found that user perceptions of the interface as enjoyable led directly to a higher perception of how easy it is to use. In addition, perceiving the translucent menu version to be more attractive led directly to an increased perception of its usefulness.

The key finding here is that user perceptions directly influence the usability rating achieved by a system's user interface. Such perceptions can be based on subjective items such as the extent to which the user interface is attractive

and enjoyable, rather than on objective measures such as task completion times. This particular study, at the solitary 50% translucency level implemented, shows that although translucent menus did not speed up or slow down user interactions with their mobile phone, designers may wish to include translucent menu systems in small-screen systems to increase enjoyment and attractiveness, as a means of achieving a better usability rating by users.

## 6. DISCUSSION AND CONCLUSIONS

Thus far, this research highlights a major challenge of applications with small screens in contrast with traditional large-screen information systems, namely the increased importance of maximization of the available screen area. The research presented here demonstrates the effectiveness of a new way to address this challenge through translucency of on-screen menus.

Following on from this initial study, which examined the effects of 50% translucency on displayed interface menus on a single, simulated mobile phone small screen system, many issues remain to be addressed before the overall effects of translucency can be assessed: first the possible differences in effects of varying translucency levels on actual and perceived usability, and thus their effects on user acceptance; second the possible usability implications of translucency implemented on other on-screen objects other than menu systems; third the possible effects of translucency on the usability of other applications for small screens, and fourth the possible influence of the translucency variable relative to varying screen size, such as the very small screen on a mobile phone compared with a larger sized screen on a personal digital assistant. These, and other 'next steps' pose a challenge to the researchers going forward, so that translucency can be bounded in its influence on aspects of usability and acceptance of small screen information systems.

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