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ABSTRACT

The hedonic role of icons has been undermined in contemporary human computer interaction research, though users have specifically mentioned the importance of icons while performing aesthetic evaluation of user interfaces. Previous research has also neglected factors like aesthetics and pleasurable interaction while comparing efficiency of same interface elements. In this regard, current study investigates how different types of icons in mobile applications affect the aesthetics and pleasurable interactions of semi-literate users. This study also investigates the extent to which aesthetics and pleasurable interactions affect satisfaction with the process. The study addresses these issues from the theoretical perspectives of metaphor and aesthetics. Significant differences were observed for aesthetics and pleasurable interactions between two different types of icon sets, namely metaphoric and idiomatic. This study suggests that for higher evaluation of aesthetics and pleasurable interaction for semi-literate users, specific icon types are preferred.

Keywords

Metaphoric icon, Idiomatic icon, Classical aesthetics, Expressive aesthetics, Pleasurable interaction, Satisfaction with the process.

INTRODUCTION

The hedonic role of icons has been also undermined in the contemporary HCI research (Lee and Koubek 2010). Often users specifically mention the presence of icons as main reason for favorable aesthetic evaluation of interfaces (e.g. Reinecke and Bernstein 2011). There are almost no empirical studies that consider aesthetic evaluations and pleasurable interactions while simultaneously looking at the hedonic roles and users' satisfaction with the process (Tractinsky et al. 2000; van der Heijden 2003). Additionally, these studies are rare for ICT development targeted at semi-literate users. Since aesthetic evaluation and visual appeal can significantly contribute to a system's acceptance (Schenkman and Jonsson 2000), there is a need for studies exploring ICT development amongst semi-literate users of developing countries. In our study, we address this issue by testing the hedonic roles of two different types of icons, metaphoric and idiomatic. These icon types have been

showed to perform inconsistently in different contexts (Blackwell 2006). In this study, we test the hedonic role of icons in context of semi-literate users in India. 'Semi-literate' users are those who have basic literacy but cannot read and write fluently (Findlater et al. 2009, Medhi et al. 2011). They typically have one to six years of formal education.

Aesthetic design is an integral part of effective interaction design as it clearly represents the need of users' aesthetic requirements (Alben 1996). Appreciation of aesthetics and beauty is hard-wired into human genetic setup and thus aesthetic feeling fulfills an adaptive biological function (Schenkman and Jonsson 2000). Classical aesthetic dimension pertains to aesthetic notions that presided from visual clarity aspects (cleanliness, clarity and symmetry). This notion emphasizes orderly and clear design. Expressive aesthetic dimension is represented by the more subjective design attributes like creativity, originality, sophistication, etc. These factors seem to capture users' perception of the creativity and originality of the design.

Therefore, there is also a requirement for the exploration of the relationship between different interface elements, aesthetic evaluation and satisfaction of semi-literate users. Our study addresses this requirement in terms of interface icons. Specifically by examining the key concepts from the theory of metaphor, aesthetic evaluation and icon types, we try to answer the following research questions:

RQ1: *How do different types of icons in mobile applications affect classical aesthetics, expressive aesthetics and pleasurable interactions of semi-literate users of India?*

RQ2: *To what extent do aesthetic dimensions and pleasurable interactions affect semi-literate users' satisfaction with the process?*

THEORETICAL FOUNDATION

Metaphoric and Idiomatic Icon

An icon can be defined as a graphical representation of concepts that symbolize system action (Ware 2000). The reason for the increased popularity of icons comes from the fact that graphical symbols are often considered as language independent, potentially universal means of communication (McDougall et al.

2000; Schroder and Ziefle 2008). A lot of research strongly recommends icon based graphical user interface for different semi-literate communities of developing countries (Grisedale et al. 1997; Parikh et al. 2003; Thatcher et al. 2005). Previous researches which have looked at icon designs concentrated either on functional efficiencies or on the effect of culture in their perceptions and recognitions (Chanwimaiueng and Kasemsan 2011; Gatsou et al. 2011). To the best of our knowledge, there was no empirical study which addresses the hedonic role of icons in the context of semi-literate users. Therefore, there is a requirement to judge the hedonic role of icons in the context of semi-literate users' satisfaction with the process. Our current study tries to address this issue in terms of two icon types, namely metaphoric and idiomatic.

Metaphoric icons are those which use relatively familiar visual metaphors that indicate a direct or implied relationship with the function that it represents (Markus 1998). These icons use a typical object to represent a general class of objects (Wang et al. 2007). On the other hand, the idiomatic icons are like visual idioms (Cooper et al. 2007) which have no intuitive connection between the icon and the referent (Wang et al. 2007). They are generally made up of unfamiliar geometric shapes, lines, arrows, etc. Metaphoric icon adopts an analogical learning process, based on the user's prior knowledge whereas idiomatic icon adopts a procedural learning process (learning while using) based on users' conscious effort of relating the function with the corresponding icon form and then memorization (Cooper et al. 2007).

Aesthetics

The concept of aesthetics is quite complex. Previous researches define 'aesthetics' in many different ways. It is defined as 'beauty in appearance' (Lavie and Tractinsky 2004), 'visual appeal' (Lindgaard and Dudek 2003), 'a response' or 'a judgment' (Hassenzahl 2004a), a 'property of objects' (Porteous 1996) or 'a process' (Langer 1967). To develop a precise understanding, we adopt the classical and the expressive aesthetic model by Lavie and Tractinsky (2004), as this model provides a holistic measure of both the aesthetic dimensions as well as pleasurable interactions.

According to Lindgaard et al. (2011), classical aesthetics can be seen as closely usability related and readily measurable, independent of any observer. Classical aesthetics provides a design with 'order' and 'harmony'. It portrays a mathematical view of aesthetics, which Hassenzahl (2004a; 2004b) mentioned as 'normative values'. Expressive aesthetics captures mostly the subjective experience of users. It measures the extent to which the impression of beauty is observer dependent. In his study Hassenzahl (2004a; 2004b) referred it as 'experiential values'.

According to Schenkman and Jonsson (2000), while considering aesthetic evaluation meaning-function relationship cannot be undermined. Meaning is important in the design of interactive system elements (in our case icons). Specific to aesthetics, meaningfulness and function in context of icons for example, metaphoric icon set is expected to be aesthetically favored by the participants for classical dimension. The participants were expected to acquire more meaning and hint from metaphoric icon set as metaphoric icon were expected to function based on their previous knowledge. Based on above arguments, we hypothesize -

H1: Evaluation of classical aesthetics will be higher for participants who used mobile interfaces comprised of

metaphoric icons than those who used interfaces comprised of idiomatic icons.

Due to its very nature idiomatic icons are expected to provide more scope to depict expressive aesthetic qualities as they are not restricted only to contextual visual metaphors. As idiomatic icons hardly depict any obvious relationship between representation and referent, it provides ample scope of simplification and abstraction. While designing an idiomatic icon a designer gets more freedom for showing creativity, originality and sophistication. As a consequence, users were expected to identify more creativity, originality and sophistication in idiomatic icons. Based on above arguments, we hypothesize-

H2: Evaluation of expressive aesthetics will be higher for participants who used mobile interfaces comprised of idiomatic icons than those who used interfaces comprised of metaphoric icons.

PLEASURABLE INTERACTION

Pleasurable interactions can be defined as the emotional and hedonic benefits associated with the use of a system. The relationship between aesthetics and pleasurable interaction is well established (Sheppard 1987). Aesthetically superior system provides a more pleasurable interaction which implies a feeling of confidence during the use of the system. Karvonen (2000) also considered 'pleasure' as an aesthetic notion. Therefore, it is important to look into the pleasurable interaction that two different types of icons offer, while going over their aesthetic evaluation.

According to the researchers (van der Heijden 2003), aesthetic appearance strongly contributes to the pleasure which some users took in their product. A pleasurable interaction due to the design's higher aesthetic qualities is capable of improving users' moods and their overall evaluation of the system. As an aesthetic evaluation and pleasure share causal relationship, while considering different aesthetic dimensions, it is also quite essential to measure the pleasurable interaction that different icon style offers (Tractinsky et al. 2000). Based on the above argument and theory of metaphor and cognitive representation, we hypothesize-

H3: Pleasurable interaction will be higher for participants who used mobile interfaces comprised of metaphoric icons than those who used interfaces comprised of idiomatic icons.

PERCEIVED EASE OF USE

'Perceived ease of use' of a system is defined as the extent to which a person believes that using a technology will be free of effort (Venkatesh 2000). This particular construct is the reflection of an individual assessment of the effort required in the process of using any system (Davis 1989). In absence of context or background, subject tends to make evaluation of perceived ease of use based on prior experience with the system. In lack of prior experience with the system, subject mostly relies on the context or the background information. In absence of both the contextual knowledge as well as prior experience, subject mostly relies only on the information offered by the stimuli for the evaluation of perceived ease of use (Venkatesh 2000).

Based on the theory of metaphor and cognitive representation (Carroll and Thomas 1982; Carroll and Mark 1999), it can be assumed that metaphoric icon set will provide more contextual

information regarding system's functions in comparison to idiomatic icon set. Therefore, we can expect a significant difference in perceived ease of use scores between the users of metaphoric and idiomatic icon set. Thus, we hypothesize that-

H4: Perceived ease of use will be higher for participants who used mobile interfaces comprised of metaphoric icons than those who used interfaces comprised of idiomatic icons.

USER SATISFACTION

In a given situation, 'satisfaction' is a person's feelings or attitudes toward a variety of factors affecting the situation (Wixom and Todd 2005). According to Ivanov and Schneider (2010), satisfaction with the process taps directly into one's evaluative affect with respect to the process, which is inclusive of both tools and procedures. Increased user satisfaction will lead to a higher intention to use, which will subsequently affect the actual usages of the system (Petter et al. 2008). According to Wixom and Todd (2005), user satisfaction enumerates system and information design attributes and it is a potentially useful diagnostic tool for system testing. User satisfaction is closely related to object-based beliefs and attitudes (Petter et al. 2008). Thus the measures of user satisfaction provide a useful base for identifying and examining the object (icon) based belief and attitudes towards the information quality characteristics of that system. Previous research suggests a correlation between the aesthetic quality of an interface and users satisfaction with the system (deAngeli et al. 2006). Pleasurable interaction has also been shown to be intrinsically connected to users satisfaction (Lindgaard and Dudek 2003; Tractinsky and Zmiri 2006). Therefore, together with pleasurable interaction, two different dimensions of aesthetics are expected to contribute considerably to the satisfaction with the process. Based on that, we hypothesize that

H5: Participants' satisfaction with the process can be explained by their evaluation of classical aesthetics, expressive aesthetics and pleasurable interaction.

METHODOLOGY

Participants

We recruited 56 semi-literate participants, 15 were females and the rest males, with the help of a non-profit organization from six different villages in the Indian state of Maharashtra. Participants have three common background traits: *semi-literacy, low level of formal education* (maximum educational level of up to seventh grade schooling) and *complete inexperience with personal computers*. In order to minimize bias, participants were distributed equally among two different experimental groups based on their age, gender, level of formal education and experience with mobile phones.

Instruments

We designed several versions of icons which represent six different functions of the application. Metaphoric icons were developed by considering different visual images of objects and actions, which metaphorically represent the concept of the function suggested by eight representative users. Idiomatic icons were developed by forming guidelines based on visual idioms with agriculture as the domain of interest. Both idiomatic and metaphoric icons and their representativeness were checked and validated by a team of four judges which includes two visual designers and two information system researchers(Cohen's

kappa was 0.83(Cohen 1960). Table 1 shows the final version of metaphoric and idiomatic icons.

Table 1. Final Version of Metaphoric and Idiomatic Icons
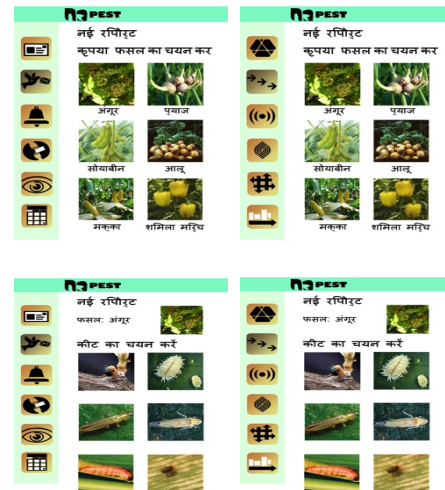
Figure 1. Interface Screens for New Report Feature Comprising Metaphoric and Idiomatic Icon

Experiment Design

Our experiment employed a between subject single factorial design. Out of fifty-six participants, twenty eight participants were assigned to metaphoric icon based interface while the other twenty eight were assigned to idiomatic icon based interface. Through a role based scenario participants were told to complete three different tasks, like report a recent pest problem on his farm and find recommendations provided by the system, etc. All the participants were given a brief introduction to the application by the moderator. During the introductory stage, participants were shortly exposed to both types of icons as part of the menu of the application. Random assignment was done. Predefined field setting was used.. Finally, the participants were required to fill a post-test questionnaire, which included a manipulation check and measurement of other dependent variables. The entire experiment took 30 to 35 minutes for each participant to complete.

Measurements

To measure classical and expressive aesthetics, we adopted the scale developed by Lavie and Tractinsky (2004). For classical aesthetics all five items were retained but for expressive aesthetics the item, 'use of special effect', was removed for its irrelevance to icon design. For pleasurable interaction we used the three item scale used by Lavie and Tractinsky (2004). For satisfaction with the process, we adopted the four item measurement scale used by Wixom and Todd (2005). Perceived

ease of use was measured through a four- item scale adopted from the study done by Venkatesh (2000).

RESULTS

To test H1, H2, H3 and H4, we conducted between subjects single factorial ANOVA. To test H5 we estimated a multiple regression model with 'satisfaction with the process' as dependent variable and 'classical aesthetics', 'expressive aesthetics' and 'pleasurable interaction' as predictor variables. The result revealed that means classical aesthetic score was significantly higher for participants who used metaphoric icon based interfaces than those who used idiomatic icon based ones (P<0.05), (H1: Supported). Result also showed that mean expressive aesthetic score was significantly higher for participants who used metaphoric icon base interfaces than those who used idiomatic icon based interfaces (P <0.05), H2⊗Not Supported). Results indicate that 'mean pleasurable interaction' is significantly higher for participants who used metaphoric icon based interfaces than who used idiomatic icon based interfaces (P <0.05), (H3: Supported). Perceived ease of use score is significantly higher for participants who used metaphoric icon based interfaces than those who used idiomatic icon based interfaces (P <0.05), (H4: Supported). Hypothesis five (H5) predicted that the 'satisfaction with the process' can be explained significantly based on the 'classical aesthetics', 'expressive aesthetics' and 'pleasurable interaction'. H5 was tested by estimating a multiple regression model with 'satisfaction with the process' as dependent variable and 'classical aesthetics', 'expressive aesthetics' and 'pleasurable interaction' as predictor variables. The results provide partial support for H5. While there is a significant effect of 'classical aesthetics' (P<0.05) and 'pleasurable interaction' (P<0.05) on participants' 'satisfaction with the process' we found no effect of 'expressive aesthetics' (P>0.05). Model accounted for 18.8% to 23.3% (R^2) of the variance in the dependent variable, 'satisfaction with the processes'.

The result of our study also suggests a relationship between visual metaphor and judgments of classical aesthetics for semi-literate communities of India. Though we are not completely denying the effect of affective response, the same explanations remain applicable for the support of H3 as well as H4. We found no support for our hypothesis two (H2). Our result reveals the counterintuitive phenomenon. In order to investigate this finding we looked at the 'categorical model' proposed by Whitfield and Slatter (1979, 1983). 'Categorical model' conceives aesthetics in terms of information processing demands, where the visual stimuli are judged in the context of the function to which they are assigned. Such phenomenon is known to 'human decision making' (Kahneman et al. 1982) in which 'representativeness' (familiarity) or lack of it proved an effective prediction of preference in studies of aesthetics.

According to Lindgaard et al. (2011), maximum novelty is sometimes assumed to be non-categorical and therefore difficult to categorize. Novel stimuli would thus have positive value to the extent that they contribute to internal category elaboration and differentiation (Whitfield 1983). In our research context, this might be supplemented by the fact that semi-literate community members have significant limitations regarding some crucial cognitive and metacognitive skills (Medhi et al. 2010).

For hypothesis four, participants judged the perceived ease of use of the application assigned to them before they actually use the application. Therefore, the participants have to judge the

perceived ease of use of the system based on the 'face value' of interface i.e. aesthetics. The menu icons set can be considered as significant part of the façade of the application which the participants experience first and it is what cues participants about the functionality of the system.

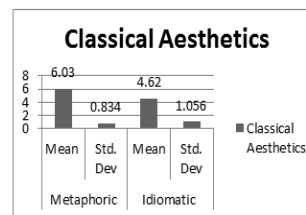| Table 2: Multiple Regression Analysis Test Results					
H5	**Overall Partially Supported**	**B**	**T**	**P**	**Hypothesis Support**
Classical Aesthetics		0.360	2.282	0.027	Supported
Expressive Aesthetics		0.049	0.303	0.763	Not Supported
Pleasurable Interaction		0.319	0.319	0.025	Supported

Figure 2. Descriptive statistics of classical expressive aesthetics
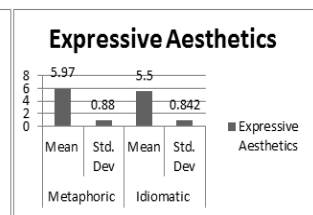
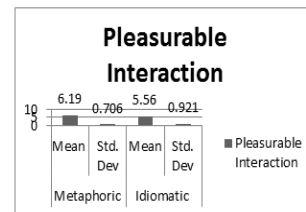Figure 3. Descriptive statistics of aesthetics

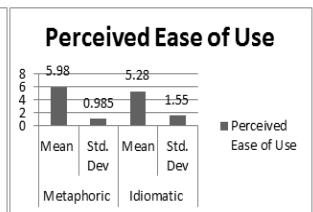Figure 4. Descriptive statistics of pleasurable perceived interaction

Figure 5. Descriptive statistics of ease of use

It also influences how the participants further interact with the application. We believe that comparative familiarity with the visuals used in the icons, which represent the system functions plays quite an important role as per the theory of metaphor.

THEORETICAL AND PRACTICAL IMPLICATIONS

Our study has following major theoretical implications. Firstly, it tries to find a relationship between the theory of 'metaphor' (Carroll and Thomas 1982) and 'classical and expressive aesthetic model' (Lavie and Tractinsky 2004) manifested through icon types. Secondly, it clearly identifies the possible effect of different kinds of aesthetics and pleasurable interaction on users' satisfaction with the process. This study also indirectly contributes to the debate of 'aesthetics-usability relationship' in terms of icon types specifically for semi-literate users of rural India.

Practically, we tested the relevance of aesthetics with semi-literate community members in a daily life usage context. The result of our study suggests a particular type of icons for more favorable aesthetic evaluation and pleasurable interactions. By identifying the aesthetic evaluation of two different types of icons it reflects the aesthetic preference of semi-literate users of rural India. Product managers can now specifically target interface design elements (icons) to ensure satisfaction of the

semi-literate target users. Finally, our findings are helpful for interface designers to find better icon design strategy to ensure more aesthetically pleasing experience with the end users.

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