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THE PARADOX OF SIMPLICITY: EFFECTS OF USER INTERFACE DESIGN ON PERCEPTIONS AND PREFERENCE OF INTERACTIVE SYSTEMS

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Abstract

This ongoing research project is concerned with people's perceptions regarding simplicity and complexity of user interface (UI) design of interactive systems. Human-computer interaction (HCI) experts suggest that simplicity is a key factor in enhancing system usability. According to this view, simplicity enables users to achieve their goals efficiently and effectively, and by that to enhance their satisfaction.

Recent voices in the HCI community, however, have observed that people actually prefer complex interfaces to simpler ones (e.g., Norman, 2007). We refer to the gap between the observed behavior and the advocated design guidelines as the paradox of simplicity*: whereas simplicity supposedly enhances performance and helps users achieve their goals, people actually seem to prefer complex designs.*

In this paper we propose a theoretical framework for the study of the simplicity paradox. Our model suggests that simplicity and complexity are potent signifiers that carry direct and indirect meaning and determine people's choice of a system. The analysis relates to four main system attributes: functionality, usability, aesthetics and symbolism. We suggest that individual, cultural and context variables serve as moderators in determining people's preference of complex or simple interfaces.

Keywords: User Interface design, simplicity, complexity, paradox of simplicity, individual differences

1. INTRODUCTION

HCI experts advocate designing simple user interfaces for interactive systems as a means to enhance system usability, because it filters the necessary from redundant functionality (e.g., Nielsen, 1993). This enables users to achieve their goals efficiently and effectively, and by that enhances their satisfaction. Recent voices in the HCI community however, have questioned the claim that simplicity should be a paramount design criterion. They have observed that although complex UIs might delay users in performing their tasks, people actually prefer them to simpler ones (Norman, 2007). In this paper we try to unravel this *paradox of simplicity*: whereas simplicity supposedly enhances performance and helps users achieve their goals, people actually prefer complex designs.

The Paradox of Simplicity can be seen as the opposite of the "Paradox of Choice" (Schwartz et al., 2002, Schwarz, 2004). Rational choice theories assume that more alternatives lead to greater satisfaction because consumers can either improve their situation by choosing a better alternative or remain with their initial choice (see Scott, 2000). However, recent research argues that the presence of many alternatives leads to excessive scrutiny of options and inflates expectations of future satisfaction. Later, if the chosen alternative fails to deliver the expected benefit, self blame may arise. Thus, the Paradox of Choice suggests that abundance of choice actually lessens satisfaction.

The *paradox of simplicity* works the other way around, in the sense that people seem to prefer UIs that appear to offer more choice (Norman, 2007), despite the apparent mental load that accompany the operation of such systems. Systems with more features allow people a wider range of options from which to choose, yet the abundance of features may lead to excessive mental load and additional cognitive strain. Eventually excessive number of controls or features may result in reduced satisfaction (Rust et al., 2006).

In this paper we study what meaning simplicity carries in the eyes of users and consumers, how it affects people's preferences, and the mediating factors that are involved in the process. In doing so we try to understand why in many cases people choose systems that appear too complicated to operate. We start with a qualitative perspective in order to collect as much information on the meaning of simplicity to decision makers. After identifying the main constructs we propose a model that portrays the relationships between simplicity and choice. Finally we outline a research program to test our model in a series of studies.

2. POSSIBLE RESOLUTIONS OF THE PARADOX OF SIMPLICITY

One possible resolution of the paradox may emerge from examining what is meant by the term "simplicity". A common interpretation of applying the rule of simplicity to interactive system design relates to minimizing the number of UI controls. Mollerup (2006) represents this approach by suggesting that 'as a broad rule more parts or elements mean less simplicity'. From this perspective, in a perfect user - system interaction, the user has to press one button in order to complete a task (e.g. Nielsen, 1999). We relate to this ideal solution as the One-Button Design (OBD). In contrast to the OBD approach, the One Button for One Action (OBOA) approach states that simplicity is achieved by minimizing the number of operations triggered by each control (Norman, 1988; Thomas and Richards, 2009). This approach requires the use of many buttons in the system's interface, leading to apparent perception of UI complexity. Thus, one potential resolution to the paradox lies in how people interpret "simplicity". If, for people, simplicity is represented by the OBOA principle, then their observed behaviour (preferring apparently complex, multi-button interfaces) may be consistent with recommendations for simplicity.

A second possible explanation for the simplicity paradox is that users are reluctant to give up functionality for the sake of usability. Norman (2007) demonstrates this in the South Korean consumer electronics market: There, complex, feature-laden electronics and SUVs sell better than simpler ones. Complexity is favoured because it is assumed that complex designs are more capable than simple ones. This may be a wise strategy because by choosing complex UIs, users try to ensure that they get all the functionality they may need in the future (Spolsky, 2006; Porter, 2007).

The third possible explanation to the Paradox of Simplicity lies in the specific characteristics of the decision makers: whether they are acting as a "users" or as "consumers" (Coates, 2003). In their role as users, people are mostly driven by utilitarian motivations. As consumers, people are mainly driven by hedonic motivations (Hassenzahl, 2003). Individual differences and cultural differences also influence choice. For example, some users are stimulated and attracted by new and apparently complex technologies (Yi et al., 2006). Others have a hard time using interactive products and are apprehensive of the apparent complexities of interactive devices (Compeau et. al, 1995). In some cultures minimalism (an approach resembling the OBD) is considered to be the ultimate sophistication (Karvonen, 2000), whereas in other cultures sophistication is manifested in rich, dense visual designs (Wroblewski, 2006). Thus, role, individual and cultural differences may affect choice in a way that whereas some people favour complexity, others prefer simplicity. The paradox can then be explained in terms of the characteristics of the sampled population from which conclusions are drawn.

In the remainder of this paper we describe a qualitative study that was done to assess the factors involved in the simplicity paradox. We then develop the theoretical model and propose a research program for testing it.

3. STUDY 1 – A QUALITATIVE PERSPECTIVE

Qualitative research methodologies enable a wide perspective on the research question and encourage diverse information to be included in the analysis (Strauss & Corbin, 1994). We have started our research by employing a qualitative study and using its results for an initial model building.

3.1 Method

Participants. Participants' age ranged from 5 to 70 years-old To increase the heterogeneity of the sample, participants were addressed in several places and contexts: 1. Friends, family and colleagues; 2. People waiting for a family member in a physiotherapy clinic; 3. Parents waiting for their children during a school activity; 4. Friends of friends. At the onset of the interview we ensured that all participants had enough time for a one hour interview.

Sample. In total sixteen participants took part in the study. This sample was heterogeneous in terms of age (median age: 35; range 5-70); gender (62.5% female); profession (law, finance, computer sciences, engineering, design etc.). All participants had at least some experience with interactive systems.

Tools. Semi-structured interviews were used in order to study user preference regarding interactive systems. Interviews were structured to the extent that the same set of UI illustrations was presented to all participants. However, the participants were encouraged to say whatever they thought about the illustration they saw. They were not tipped off regarding the functionality of the designs. In the second part of the interview they were asked about their strategies of scrutinising systems.

3.2 Data Analysis

The data analysis was based on the qualitative methodology of Grounded Theory (Strauss & Corbin, 1990). It started with open coding (Strauss, 1987): interviews were segmented into 'units of analysis', paragraphs or sentences that form an idea. These units were sorted to categories. Thirty five categories were identified, for example: UI simplicity, UI complexity, aesthetics, usability, OBD, OBOA, icons, controls shapes, symmetry etc. In the second coding level of the analysis (Hutchinson, 1988), axial coding, we merged those categories that seemed to address similar topics creating a range within the same parameter. For example: the trade-off between UI functionality and usability, simplicity-complexity continuum and the effect on aesthetics perceptions, one button design versus one button for one action design, etc. This level of coding reduced the number of categories to seventeen. In the third level of coding (Hutchinson, 1988), the selective coding, we sorted these seventeen categories into themes. We identified eight main themes: usability, functionality, aesthetics, symbolism, and attitude towards technology, IT as a social status, maximizers and satisfiers and the attitude towards the design.

3.3 Results

From the eight core themes, four were related to system attributes: usability, functionality, aesthetics and symbolism; Example for statements that defined the themes are (translated from Hebrew): "complex UIs are sometimes easier to use because you know exactly what each button is supposed to do. It looks more complicated but it is easier to control" (usability); "when I buy an electronic system I'd like it to have many buttons because it says to me that there are many functions" (functionality); "simple design is spacious, aesthetic, nice to look at" (aesthetics); "a single button?! No, it looks very plain, it doesn't stimulate me intellectually, unless it is designated for kids" (symbolism). Four additional themes were related to individual differences: attitude towards technology, IT as a social status, maximizers and satisfiers and the attitude towards the design. Example for statements that defined the categories is: "If I get the system as a present I'd like it to be as innovative as possible, even if it is very difficult to use. If the system comes with a manual, its good enough for me" (attitude towards technology); "I check a few models before I choose, maybe three or four and then I select the most complex" (maximizers) versus "I listen to what the salesman say and if its in within my budget I usually buy it, I do not spend too much time looking for better options" (satisfiers); "I will never buy a system if it is not nice to look at, even if I need it... That is my defect" (attitude towards the design); "Innovative design is important for me in order to show off, it shows I know how to use it, you are cool, you are smart, if you understand it, you can understand anything" (IT as a social status).

4. ESTABLISHING THE RESEARCH MODEL

The themes that were identified in the qualitative study used as a basis for a model that explains how simplicity and complexity of a design influence preference of a system. Because the HCI literature uses slightly different terms than we phrased, and because some of the themes had several aspects in our opinion, we revised them into eight constructs: 'Attitude towards technology' was revised into: `Personal innovativeness in the domain of IT` (Agarwal and Prasad, (1998 and 'Computer Self Efficacy' (Compeau and Higgins, 1995) because attitude towards technology entangles the confidence one's ability to manipulate unfamiliar systems as well as the motivation to do so; 'Attitude Toward a Design' was split to a personality trait known as the

‘Centrality of Visual Product Aesthetics’ (Bloch, 2003) and to the system’s attribute ‘The Perceived Aesthetics of the Design’ because attitude towards a design depends on both how important aesthetics is to a person and in the beauty of the design; Finally, ‘IT as a Social Status’ was split into ‘Symbolism in the Design’ and ‘Social Comparison Orientation’ (Gibbons and Buunk, 1999) because UIs present icons that provoke semiotic meaning (Hugo, 2005), triggering deciphering the symbolism of the design (Rafaeli and Vilnai-Yavetz, 2004) and that symbolism affects preferences of people who are motivated by status. Two more constructs were added to the model based on HCI Literature because of their moderating affect: role (consumer vs. user) and cultural differences. Role may affect how consumers and users rate the importance of system attributes. Cultural context may affect the perception of symbolism and aesthetics in the UI (Tractinsky, 1997; Wroblewski, 2006). Finally, we hypothesized about the relationships between the model’s constructs based on cues from the qualitative study and, to a larger degree, on the HCI literature.

4.1 Categories related to system attributes

Functionality and Usability. The Technology Acceptance Model postulates that perceived usefulness (PU) and perceived ease-of-use (PEOU) are important determinants of how and when to use an interactive system. PU is "the degree to which a person believes that using a particular system would enhance his or her job performance", and PEOU is "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989, p.320). Nielsen (1993) refers to PEOU as a dimension of usability and to PU as utility (p. 26). We relate to functionality as the utility gained from a system. Usability is the ways to access this functionality (Hassenzahl, 2003). We suggest simplicity imposes a tension between perceived functionality and perceived usability: because simple UIs are supposed to filter redundant functionality, they may require that some features are removed (Thompson et al., 2005), but since simplicity may require the reduction of visible controls, it may complicate use because single buttons will trigger different operations (Norman, 1988; Thomas and Richards, 2009).

Aesthetics. Lately there is growing evidence that evaluations of interactive systems are highly influenced by system's visual appearance. Researchers have shown that users are likely to perceive a system as more usable if they find it aesthetically pleasing both before (Tractinsky, 1997) and after (Tractinsky et al., 2000) the interaction. Consumers increasingly make brand choices based upon aesthetic values and distinctiveness of visual design (Bloch, 2003). In many cases, aesthetics becomes a major differentiating factor between IT products. Simplicity and complexity have aesthetic implications (Karvonen, 2000; Mollerup, 2006). In some cultures such as South Asian cultures it is complexity and dense visual activity that are considered aesthetic (Wroblewski, 2006). In other cultures such as Scandinavian culture minimalism is perceived as the ultimate beauty (Karvonen, 2000). Thus, the simplicity - complexity factor has aesthetic implications and may consequently influence other perceived aspects of the system.

Symbolism. Symbolism is the meaning or associations the artifact elicits. It is a general term for all instances where experience is mediated rather than direct; where an object, action, word, picture, or complex behaviour is understood to mean not only itself but also some other ideas or feelings (Levy, 1959). UIs trigger semiotic meaning because they display a variety of signifiers: controls carrying pictograms, modules opened with an icon, etc (Hugo, 2005). It is reasonable to assume that the UI represent the system as a whole (Barr, Biddle and Noble, 2003). As such, simple designs can represent an innovative system that is automated so that it requires only little interaction with the user. They may also represent a lean, incapable system that offers little functionality.

4.2 Categories related to individual differences

Maximizers versus Satisfiers. Maximizers aim at maximizing their outcomes. They feel compelled to examine all the alternatives (Schwartz et al., 2002), because for them the potential for regret is ever present. They are hypothesized to favour complex UIs because complex, feature-laden UIs appear to provide all the functionality they may need in the future. Satisfiers, on the other hand, are looking for something that will cross the threshold of acceptability as good enough (Schwartz et al., 2002). Satisfiers are expected to settle for a good enough alternative. We therefore expect satisfiers to appreciate simple designs as more appealing than complex designs, because the good-enough functionality is augmented by better usability.

Computer Self Efficacy (CSE). Computer self efficacy refers to individuals' beliefs about their abilities to competently use computers (Compeau and Higgins, 1995). People with high CSE may adopt a new technology despite perception of its complexity (Yi et al, 2006). Accordingly, they are expected to rate functionality as relatively more important than usability. Conversely, people who are low in CSE are expected to rate usability as more important than functionality because they do not have confidence in their ability to handle complex systems, and are thus expected to prefer simple designs.

Personal Innovativeness in the Domain of IT (PIIT). Personal innovativeness is a predisposed tendency toward adopting an innovation (Rogers, 1995). Individuals with higher level of personal innovativeness are expected to be more inclined to embrace new technologies (Agarwal and Prasad, 1998) and thus rate functionality as more important than usability because for them the exploration of the system is more rewarding (Limayem et al., 2000; Lee et al., 2007). We therefore expect individuals with high levels of IT innovativeness to prefer complex designs.

Centrality of Visual Product Aesthetics (CVPA). CVPA is a construct that assesses the importance of visual aesthetics for a particular individual in his or her relationship with products (Bloch, 2003). People who have high CVPA scores are expected to have greater than average concern for visual aesthetics independent of product category or setting. Relative to people low in CVPA, people high in CVPA are expected to weigh the aesthetics of the UI as more important. Because simplicity and complexity are also aesthetic notions we expect people high in CVPA to prefer simple designs if they consider simplicity to be aesthetic, or to prefer complex designs if they consider complexity to be associated with beauty.

Social Comparison Orientation (SCO). Every individual has the drive to evaluate his or her opinions and abilities to some extent (Festinger, 1954). The extent to which people do so varies from one individual to the next (Gibbons and Buunk, 1999). We hypothesize that people high in SCO shall prefer systems that appear to be complex in order to gain the status of IT experts.

4.3. Role and Cultural differences

Role (Users versus Consumers). What satisfies the consumer might not satisfy the user and vice versa (Coates, 2003). People are more open to hedonic considerations in their role as consumers. In this capacity they may consider shopping for stimulation and adventure (Arnold and Reynolds, 2003). Thus aesthetics and symbolism should be more important to consumers than to users (Hassenzahl, 2003) Functionality and usability that are closley related to use, should be more important to users than to consumers.

Cultural differences. Complexity and simplicity may have different connotations in Western culture context and Eastern culture context (Cha et al., 2005; Porter, 2007; Karvonen, 2000; Wroblewski, 2006; Norman, 2007). A simple UI may be considered as desirable in one cultural context but as incapable in another cultural context. Because studying cultural differences requires thorough investigation that is beyond the scope of this proposal (e.g., studies in different countries), it is only suggested here as a potentially important future research.

4.4. The Research Model

Our model (see Figure 1) states that the simplicity – complexity continuum influences people's perceptions of main UI attributes: usability, functionality, aesthetics and symbolism of a UI. The importance of these attributes and their manifestation in the design influence the degree to which the person prefers the design or chooses it from a set of alternative designs. The moderating variables -- role (consumer vs. user), individual differences and cultural differences -- moderate two relationships: (1) the effect of design simplicity on the perceived product attributes, and (2) the effect of importance on people's preferences.

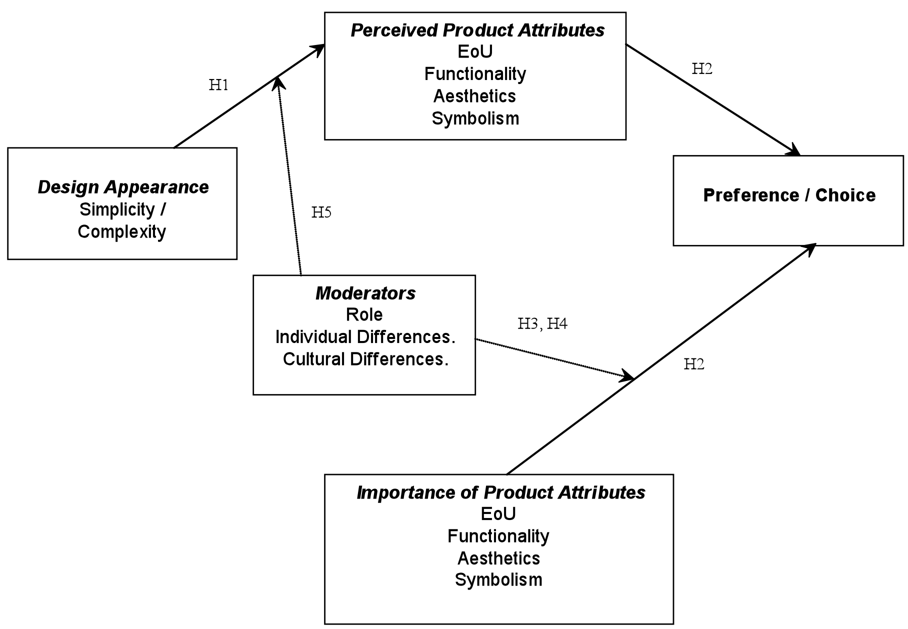

Figure 1: *The research model. Hypothesis numbers are marked on the lines that depict the relationships between the model's constructs.*

5. FUTURE STUDIES – TESTING THE RESEARCH MODEL

In this section we articulate the research hypotheses that derive from the model and describe in general terms how we plan to test them. Please note that due to space limitation, the hypotheses are presented in general terms. In our work we further refine each of these hypotheses.

5.1 Study 1 – How Simplicity Influences the Perceived Attributes of a System

H1: *Simplicity in a UI increases the perceived usability, aesthetics and positive symbolic value of the product, and decreases its perceived functionality.*

The model suggests that simplicity influences how system attributes are perceived. In order to test this hypothesis, we will present 20 illustrations of UI designs to 100 participants. In a pilot study we have already had participants rate the illustrations on the simplicity-complexity continuum. In this experiment, participants will evaluate the designs on the four product attributes: usability, functionality, aesthetics and symbolism. Each construct will be reflected by three statements that have to be rated on a Likert scale (rang 1-7). We believe that designs that were rated as simple will be rated higher on usability, aesthetics and symbolism statements. UIs that were rated as complex will be rated higher on functionality statements.

5.2 Study 2 – How Simplicity Influences the Importance of System Attributes

H2: *Preference of a product is a multiplicative function of the sum of each attribute's presence in the product and the importance of that attribute.*

This study will be comprised of three stages. In Stage 1, participants will rate the importance of various attributes of an IT consumer product (including usability, functionality, aesthetics and symbolism). In Stage 2, we will concentrate on people's preferences. Participants will rate their preferences of 30 interactive systems UIs (the stimuli), which will vary according to the levels of the four focal product attributes. A conjoint analysis will be used to derive the importance of each attribute from the participants' ratings of the stimuli. In Stage 3, we will concentrate on people's choice. Participants will rank-order the importance of each of the four attributes (usability, functionality, aesthetics and symbolism) in determining their choice of an IT consumer product. We expect ratings gained at the third stage to match preferences from stages 1 and 2.

5.3 Study 3 – The Moderating Effect of Role on Perceived Product Attributes

H3: *Perceived Ease of Use is most important for users, and Perceived functionality and Aesthetics are more important for consumers.*

The third set of hypotheses deals with the moderating effect of the individual's role (consumer or user) on the importance of the product attributes. We shall follow the procedure of study 2, but participants will be randomly assigned into two groups: One group ("users") will be told that they have to use the product to achieve some goal. The other group ("consumers") will be told they are shopping for a product for which they will have to pay. The "users" will be asked to speculate about the market price of each machine. The consumers will be asked to provide a price tag for each product. We expect that Perceived EoU would be most important for users, perceived functionality would be most important for consumers and aesthetics would be more important for consumers than for users.

5.4 Study 4 – Moderators of Choice

H4: *Individual Differences will moderate the importance of different UI attributes.*
H5: *Individual Differences will moderate how each attribute is perceived.*

The final set of hypotheses deals with the moderating effect of individual differences on perceived product attributes and their importance. The model suggests that individual differences serve as moderators of how simple design influences perceptions of product attributes as well as of the importance of each attribute in evaluating products and making decisions about them. In order to test these hypotheses, we will repeat the procedure of Studies 1 and 2. We will refine our measures and stimuli if necessary. In addition, we will incorporate five measurement scales of the traits identified in Section 4.2, which will serve as the measures for the hypothesized moderating variables.

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