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시각 디자인 요소와 감성 요소간의 상관 관계에** 대한 연구

- 가상 은행의 고객 인터페이스를 이용하여 -

김 진 우, 문 재 윤*

Effect of Visual Design Factors on the Emotional Usability of Customer Interfaces

- Trustworthiness of Cyber Banking System Inetrfaces -

본 논문의 목적은 고객의 특정 감성을 유발할 수 있는 전자 상거래 시스템 사용자 인터페이스의 설계 방안 모색에 있다. 이를 위해 가상 은행 시스템의 사용자 인터페이스에 대해 모두 네 단계에 걸친 실증 연구를 수행하였다. 제 1단계 실증 연구는 가상 은행과 관련된 제반 감성 요소를 충실하게 측정할 수 있는 감성 어휘들을 추출하는데 목적이 있었다. 제2단계의 실증 연구는 사용자 관점에서 중요하게 지각되는 시각적인 디자인 요소 파악이 주 목적이었다. 제3단계 실증 연구에서는 감성 요소와 디자인 요소 간의 상관 관계를 파악하였고, 최종적으로 제4단계의 실증 연구에서는 실험용 가상 은행 인터페이스를 개발하여 감성 요소와 디자인 요소 간의 상관 관계를 검증하였다. 본 연구 결과 사용자 인터페이스 내의 특정 시각 디자인 요소의 조작을 통해서 신뢰감과 같은 고객의 감성 유발에 영향을 미칠 수 있다는 사실이 입증되었다. 본 논문은 끝으로 이러한 연구 결과의 일반적인 전자 상거래 시스템 고객 인터페이스 구축 과정에의 적용 가능성을 타진한다.

* 서울 서대문구 신촌동 연세대학교 상경대학 경영학과

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1. INTRODUCTION

The importance of subjective feeling or emotion has been analyzed in numerous studies [e.g., Lazarus, 1991; Frijda, 1986], including several on the role of emotions in cognitive processes [Norman, 1981; Ortony, Clore, and Collins, 1988]. Prior studies found that emotions play an important role in problem solving [Feist, 1994] and decision making [Barnes and Thagard, 1996; Picard, 1995] by providing information on the emotional desirability of the options available, thereby reducing and limiting reasoning to only those that induce positive feelings.

The importance of emotion has also been emphasized in the design of physical products [Hofmeester, Kemp, and Blankendaal, 1996; Lee and Nagamachi, 1996; Nagamachi, 1995]. Logan, Augaitis and Renk [1994] maintained that emotional elements should be considered in the design of product categories that are closely related to the end user [Hofmeester, et. al. 1996]. In order to achieve this goal, Lee and Nagamachi [1996] proposed a design methodology that has been used to develop various physical products ranging from sports cars to coffee pots.

Emotion should play as important a role in the design of computer interfaces as in that of physical products [Nielsen, 1994; Picard, 1995]. People do not regard the computer as a medium for interaction with other human beings, but rather respond directly to the computer itself. In other words, people behave as if the computer were a social actor, even though they know that the machine does not actually possess human feelings [Nass, Steuer, and Tauber, 1994]. For example, it is not unusual to hear someone yelling at a computer as if it might feel sorry and change its behavior [Picard, 1996]. The feelings that are aroused in interacting with a system is especially important for systems that are used on a discretionary basis, such as home computing, games, and electronic commerce [Virzi, 1991]. This is because people will discontinue use of systems which arouse unpleasant feelings.

Electronic commerce can be defined as the delivery of information, products/services, or payments via telephone lines, computer networks or any other means [Kalakota and Whinston, 1997]. It includes a wide range of applications such as electronic document interchange, cyber shopping, and cyber banking [Kalakota and Whinston, 1996]. In this paper, we use the term 'customer interface' to refer to the user interface of such electronic commerce systems [Kim and Moon, 1997]. The purpose is to shift the perspective from the user of a computer system to the customer of commercial transactions. In real world commerce, the emotions and impressions evoked by the sales agent or commercial institution as a whole influence the overall satisfaction of the customer. The same applies to interaction with electronic commerce systems, where emotions evoked by the customer interface may affect the overall satisfaction of the user.

However, not much research has been conducted regarding the emotional usability of the user interface in general, let alone the customer interface of electronic commerce systems. Prior research on human computer interaction has focused on the cognitive usability of the system. The issues of most interest were those of ease of use, efficiency,

learnability, and error handling. These cognitive factors are definitely of extreme importance in human computer interaction. However, the feelings of users interacting with the computer system are of equal importance, because the users' emotions interact with cognition in the process of achieving a given goal [Barnes and Thagard, 1996]. For example, no matter how easy the use of the cyber banking system may be, people will not use the system as intended if they feel insecure about the reliability of the system.

The main objective of this research is to pave the way for the design of customer interfaces that can generate a target feeling while interacting with electronic commerce systems. This paper especially focuses on the effect of the visual design factors of interfaces, such as clipart and background colors, on the feelings elicited. Although in actual interaction with electronic commerce systems factors other than these visual design factors, namely the functionality and content of the system, will influence the feelings evoked in the customers, the scope of the present study is limited to the impact of the visual aspect of the systems. The rationale for doing so is based on the design methodology proposed by Lee and Nagamachi [1996] for the design of emotive physical products via manipulation of only their visual appearance. The visual appearance of electronic commerce system is important for another reason. Electronic commerce systems are by nature closely related to the marketing efforts of the firm. The importance of visual appearances in promotional activities and store layout have been proven in many studies [Baker and Churcill, 1977; Bellizzi, Crowley, and Hasty, 1983; Chaiken, 1979; Dion, 1978]. The user interacts with the system via the customer interface, which can be considered as the physical appearance of the electronic commerce systems. Hence, the visual appearance, determined by the interface, of an electronic commerce system will play as important a role in customer interaction with the system as other technological factors. Therefore, in this paper the focus is on determining how the visual interface of an electronic commerce system will affect the customer's feelings.

To achieve this objective, four related empirical studies were conducted. The first study constructed a questionnaire that includes the affective terms that are important in the cyber banking domain. The second study identified the visual design factors that are important in customer interfaces of cyber banking systems. The third study determined the important feelings that customers experience when interacting with cyber banking systems, and established the causal relations between the emotional factors and the design factors. The final study evaluated two different customer interfaces of cyber banking systems to verify the causal relations between the two factors.

2. EMOTIONS

The concept of emotional usability derives in part from the following concepts of emotions and their functions. After a brief overview of the nature and functions of emotions in relation to human computer interaction, emotion elicitation procedures will be discussed.

2.1 Definition of Emotion

It is hard to define emotion precisely [Picard,

1996], but it can be considered as a multifaceted phenomenon which encompasses a diversity of processes such as appraisal, facial expressions, bodily responses, feeling states, action tendencies, and coping strategies [Philippot, 1993]. There are two views of emotion—the basic category view which maintains that emotions are constituted of a fixed set of discrete categories [Gross and Levenson, 1995; Philippot, 1993], and the multidimensional view which proposes that emotions are differentiated along no more than two to four bipolar dimensions to constitute an emotion space [Frijda, 1987; Gehm and Scherer, 1988; Osgood, Suci and Tannenbaum, 1957; Russell, 1979; Russell, 1980]. The basic rationale behind the design of emotion-generating interfaces is based on the multidimensional view, which has been used successfully as a basis of design methodologies for physical products [Nagamachi, 1995; Lee and Nagamachi, 1996].

The emotion space is defined as a region of some unknown dimensionality that is determined by the nature of the situation to which the person is exposed [Frijda, 1987]. The emotion space can be constructed in terms of the major emotional dimensions, represented by emotional scales. Each emotional scale, defined by a pair of polar (opposite in meaning) adjectives such as 'happy - not happy', is assumed to represent a straight line function that passes through the origin of this space. To define the emotion space with maximum efficiency, the minimum number of orthogonal dimensions or scales which exhausts the dimensionality of the space needs to be determined.

The emotions that are identified as the orthogonal dimensions may not be the basic emotions of joy, sadness, amusement, interest, relief, pleasure, or anger [Ekman, 1992], but the non-basic, domain-specific emotions derived from these basic emotions [Averill, 1994]. These non-basic emotions are especially important with relation to the characteristics of task, such as the feelings of trustworthiness or sophistication when performing financial transactions.

2.2 Function of Emotion

Although rational thought and emotion are often depicted as being locked in an eternal battle, there is typically more cooperation than strife [Barnes and Thagard, 1996]. Recent research into the nature of emotion shows ample evidence with regard to this proposition. Neurobiological studies of frontal lobe patients show that practical and social decision making is closely related to the region of the brain connecting the emotional and cognitive centers [Damasio, Tranei, and Damasio, 1990]. Relying solely on the cognitive resources results in a never ending cost-benefit analysis of numerous options, impeding the decision maker from coming to a practicable conclusion. Emotions provide information on the emotional desirability of the options available, and thereby reduce and limit reasoning to those that induce positive feelings [Barnes and Thagard, 1996; Schwarz and Clore, 1981].

It is especially important to take the informative function of emotions into account when designing human computer interfaces. The interface may elicit a variety of emotions ranging from the basic affective feelings such as joy or fear, to non-basic feelings such as

trustworthiness or sophistication. Studies indicate that the various types of feelings all influence judgment and decision making in a similar manner [Schwarz and Clore, 1981]. Therefore, the feelings evoked by the human computer interface can also affect the quality of decision making in using the computer system. For example, the emotions induced from the customer interfaces can enhance the quality of the customers' experience by triggering informative emotions that can aid decision making in using electronic commerce systems.

2.3 Emotion Elicitation Procedures

Scientific research of emotion depends on the reliability of the procedures of emotion elicitation used in the laboratory. Research on the elicitation of emotions under laboratory conditions indicate that stimuli can be constructed to elicit certain target emotions [Gross and Levenson, 1995]. A large variety of emotion eliciting procedures, such as films, slides, and role playing, have been used in these experiments [Gross and Levenson, 1995; Philippot, 1993].

Of the diverse procedures available, films were found to be the most effective in eliciting universally common target emotions among different subjects in the laboratory [Gross and Levenson, 1995]. This was attributed to the fact that films have a relatively high degree of ecological validity, in so far as emotions are often evoked by dynamic visual and auditory stimuli that are external to the individual [Philippot, 1993]. Computer interfaces can basically be considered as a collection of snap shots that are composed of diverse visual and auditory stimuli designed to directly engage the user into the interaction [Laurel, 1993]. Accordingly, human computer interfaces also have the potential to elicit universally common emotions in their users, justifying the attempt to design the customer interface to elicit certain target emotions.

2.4 Emotion Measurement Techniques

Research about the nature of emotions is not possible without the means to measure the elicited emotions. Emotions are displayed in a person' facial expression and voice tone, and cause certain motor behaviors and physiological responses. Among the many available measurement techniques, self reports are most commonly used as the measures of emotion under laboratory conditions because of the ease of data collection [Gross and Levenson, 1995; Levenson, 1994; Schwarz and Clore, 1981].

There are three types of self report measures of emotions, the Differential Emotions Scale (DES), the Semantic Differential (SD) scale [Osgood et. al., 1957], and the free labeling method [Philippot, 1993]. The DES measures the intensity of an elicited emotion, whereas the SD scale pairs polar emotion terms and measures the intensity and direction of an emotion. Free labeling methods require that subjects simply jot down what they are feeling at the time of the experiment. Of the three, this research employed the SD scale for its association with the multidimensional approach to emotions, the view adopted in the design of emotion-generating interfaces.

3. EMPIRICAL STUDIES

Four empirical studies were designed to

determine the structure of the emotion space of customers interacting with cyber banking systems and the effect of visual design factors upon it. The first study was conducted to determine the structure of the emotion space and to develop the questionnaire based on the results. The second study focused on determining the *visual design factors* of a cyber banking system interface from the customer's perspective. In the third study, the *emotional factors* were determined and the causal relations between the emotional and design factors of the interface were established. The final study verified the interrelations between the design factors and the emotional factors.

3.1 Study 1

The purpose of the first study was to develop the self report questionnaire to be used for measuring the emotions elicited by cyber banking interfaces. The resulting questionnaire consisted of the differential scales that best represent the dimensions of the emotion space for cyber banking systems.

3.1.1 Materials

Questionnaire. Since the purpose of this first study was to select the differential scales that are appropriate for emotion measurement, a comprehensive search was made of all relevant pools of emotion terms. A survey of employees and customers of a financial institution was conducted in which they were asked to freely label the emotions that they associated with cyber banking systems. Emotion terms were also gathered from pamphlets and research papers about cyber banking systems [Kalakota and Whinston, 1996]. Finally, dictionaries and thesauruses were consulted to include multiple terms for the same emotion or feeling. This was done to ensure that all possible modes of expressing a certain emotion were provided in the initial questionnaire. For example, the emotion of happiness can be expressed through the terms 'Pleased, overjoyed, contented, satisfied' and many other terms. Each of these terms is appropriate in a particular situation and not in others. It is therefore necessary to include all possible terms that express the same basic emotion since it is not known a priori which is most suitable for cyber banking systems. Determining which of these multiple terms is most relevant in the context of interacting with cyber banking systems is the goal of this first study. A total of 318 terms were selected and arranged in the form of bipolar 7-point Likert scales, a sample of which is shown below in .

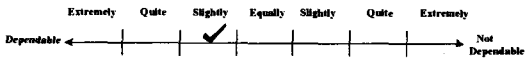

Figure 1. Emotive Differential Scale

Slide Material. Among the various cyber banking systems currently available, eight interfaces were selected as the experiment material. Especial care was taken in the selection process to ensure that most of the different types of interfaces were represented in this sample. They ranged from simple text-based interfaces to three dimensional virtual reality interfaces. The most representative screen of each interface was prepared to be shown as static slides, with the exception of those interfaces in which the animation effects constituted a major component of the interface. Figure 2 shows a sample of the cyber banking

interfaces used in the first study.

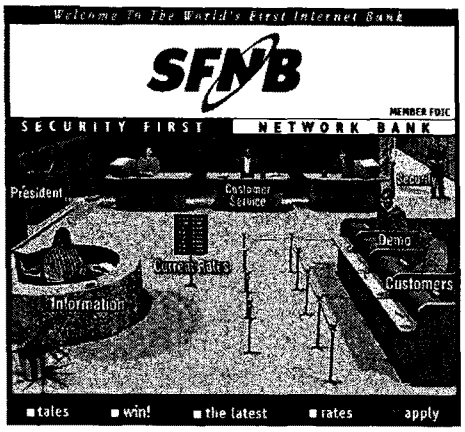

Figure 2. Example of Cyber Banking Interface

3.1.2 Procedure

The study was conducted in three group sessions of 5 to 10 subjects, each lasting approximately 3 hours. Twenty five subjects participated in the study. They came from diverse backgrounds such as cyber banking system developers, bank personnel, and cyber banking system customers. The ages of the subjects ranged from the late teens to the early forties, the portion of the population that accounts for most of the Internet users, i.e. potential customers of cyber banking systems.

The subjects were given the standard instructions for semantic differential questionnaires and were especially cautioned to mark their *'first impressions, the immediate 'feelings''* about the interfaces shown [Osgood et. al., 1957]. After everybody had understood the nature of the task, subjects were shown one slide at a time and asked to describe the intensity and direction of the feelings elicited by the interface on the emotive scales. The slides were shown on a 43 inch color monitor.

The order of the interfaces was counter-balanced for each of the three group sessions, and subjects were given one of five different versions of the self-report questionnaire so as to prevent an ordering effect. Each version of the questionnaire presented the emotive scales in random order so that no two versions were the same. The subjects were given 5 minutes after each slide to relax and empty their minds of the previous slide in order to avoid carrying over the feelings from the previous interface to the evaluation of the next.

3.1.3 Results and Discussion

Each slot on the 7 point scale was assigned a number from 1 to 7 starting from the left. A total of 200 self-questionnaires (8 slides × 25 subjects), each consisting of 318 scales were coded according to the assigned numbers. The variables in this data set were the 318 emotive differential scales.

Since the important emotional factors related to the interfaces of cyber banking systems is not known a priori, cluster analysis was used to reduce the redundant scales through the grouping of closely related ones. The two methods of cluster analysis employed in this study were Complete cluster analysis and Ward' cluster analysis. A total of fifteen clusters were determined through Complete cluster analysis, of which five were discarded due to significant discrepancies with the results of Ward' cluster analysis. A few emotive differential scales that were most appropriate for measuring the feelings elicited by cyber banking system interfaces were selected from each of the remaining 10 clusters. This was done by a group of cyber banking system designers, who were presumed to have a richer vocabulary for describing the emotive aspects of the cyber banking systems.

Forty bipolar emotive differential scales, shown in , were selected to be included in the final self report questionnaire. Although the initial set of 318 scales consisted of various basic emotion terms (e.g., frustrating, happy, comforting), most of these were filtered out as a result of cluster analysis in the first study. This implies that both the cyber banking system designers and the subjects deemed most of the basic emotions to be irrelevant in the domain of cyber banking. The remaining terms shown in are representative of the non-basic, domain specific terms of the emotions that are considered important in interacting with cyber banking systems, such as the terms related to trustworthiness (e.g., dependable, reliable).

Table 1. The Final Set of Selected Emotive Differential Scales

Awkward	Not Awkward	Dignified	Not Dignified
Balanced	Not Balanced	Dull	Not Dull
Boring	Not Boring	Elegant	Not Elegant
Charming	Not Charming	Epochal	Not Epochal
Childish	Not Childish	Exciting	Not Exciting
Cluttered	Not Cluttered	Exhilarating	Not Exhilarating
Common	Not Common	Exquisite	Not Exquisite
Consistent	Not Consistent	Familiar	Not Familiar
Countrified	Not Countrified	In Vogue	Not In Vogue
Dependable	Not Dependable	Liberal	Not Liberal
Likable	Not Likable	Sedate	Not Sedate
Luring	Not Luring	Simple	Not Simple
Luxurious	Not Luxurious	Slick	Not Slick
Obscure	Not Obscure	Spacious	Not Spacious
Opulent	Not Opulent	Splendid	Not Splendid
Progressive	Not Progressive	Tasteful	Not Tasteful
Realistic	Not Realistic	Unadorned	Not Unadorne
Refreshing	Not Refreshing	Uniform	Not Uniform
Reliable	Not Reliable	Vibrant	Not Vibrant
Rustic	Not Rustic	Witty	Not Witty

3.2 Study 2

The purpose of the second study was to identify the important visual design factors of a cyber banking system interface from a customer's perspective. The customer's perspective is important because how s/he perceives the interface will influence the emotions evoked by that particular interface.

3.2.1 Materials and Procedure

Slide Material. An extensive search was made of the existing cyber banking interfaces to ensure that most of the different designs were accounted for in the final set of slide samples. Twenty six cyber banking interfaces, ranging from simple text-base to virtual-reality interfaces, were selected from the currently available ones for the second study.

Procedure. The study was conducted in two group sessions of thirty subjects intotal. The subjects consisted of users, designers and managers of varying age and sex in order to reflect the variety of cyber banking system users. In order to determine the important design factors from the customer's perspective, each group session consisted of two phases.

The procedure for the first phase was the same as the first study. Subjects were shown the twenty six interfaces in sequence and were asked to indicate the elicited feelings on the forty emotive scales that had been constructed as a result of the first study. After the subjects had finished marking the self report questionnaires, the interfaces were hidden from view, and the subjects were asked to draw what they could remember of the interface. These free recall tests were done at random intervals for a few selected interfaces. Subjects

were expected to remember the features that they paid most attention to, either consciously or unconsciously, in judging the direction and intensity of the feelings elicited by the particular interface. Thus, the factors recalled by subjects were assumed to have been those that elicited the emotions. Since these assumptions have not been verified, the second phase of the study was conducted to complement the first phase study. The sorting method, proven to be a sound data-gathering technique for investigating a variety of cognitive and perceptual phenomena [Rosenberg, 1982], was employed in the second phase. The subjects were given the 26 interfaces at once and asked to sort them based on the similarity of their visual aspects. After the subjects finished sorting the interfaces, the experimenter asked the subjects to explain the criteria employed in grouping the interfaces [Chi, Feltovich, and Glaser, 1981]. These criteria were translated into the corresponding design factors.

3.2.2 Results and Discussion

A group of cyber banking system designers analyzed the 236 drawings of the interfaces. Figure 3 shows a sample of the subject's drawing in the free recall test. The drawing is that of the cyber banking interface shown in Figure 2.

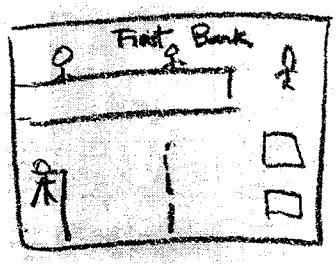

Figure 3. Extracting the Design FactorsFigure

The drawings were closely analyzed by interface designers of cyber banking systems in an attempt to identify which visual features were recalled the most. For example, a comparison of and reveals that the subject took notice of the size and text format of the title (e.g., "First Bank" in Figure 3), and the format and size of the clipart incorporated in the interface (e.g., figures of people and the interior of the bank in Figure 3). Common features noticed by a majority of the subjects for each interface were labeled as design factors.

Results of the second phase of the study were used to supplement those of the first phase. The subjects grouped interfaces of cyber banking systems based on similar visual design traits. The explanations provided by the subjects made it possible to identify additional features of the interface that were not captured in the drawings. For example, many subjects grouped the interfaces according to the impressions given by the color layout of the interface, which were not clearly discernible from the drawings. Finally, fourteen design factors in total were identified based on the content analysis of subjects' explanations and drawings. These fourteen factors were classified into the four design categories (title, menu, main clipart[1)], and color) shown in by the designers of the cyber banking systems.

3.3 Study 3

The third study had two purposes: first to determine the major dimensions of the emotion space of customers interacting with cyber banking systems, and second to establish the relations between the emotive dimensions and design factors of a cyber banking interface.

Table 2. Design Factors of Cyber Banking Interfaces A Customers PerspectiveTable

Categories	Design Factors	Values
Title	Format	Bar, Clipart, Text, Not Applicable (*)
	Graphics	Included, Not Included
	Position	Top, Middle, Bottom, Not Applicable
Menu	Format	Square, Oblong quadrilateral, Not Applicable
	Size	Over 1/16, Over 1/32, Over 1/64, Not Applicable
	Content	Numbers & text within a box, Symbols & text, Graphic & text
Main Clipart	Motion	None, Simple animation, Diverse animation effects
	Format	3 Dimensional, Human forms, Animal/Logo, Miscellaneous, None
	Size	Over ½ total screen size, ¼, 1/16, Not Applicable
Color	Color Tone	Cool hue, Warm hue, Not Applicable
	Main color	Primary Colors, Pastel Colors, Not Applicable
	Background	White over ½, White under ½, Color, Not Applicable
	Brightness	High, Medium, Low
	Symmetry	Symmetric color tone, Use of multiple colors, Single tone with emphasis on a particular factor, None of the above

(*)Not Applicable values signify that the particular interface does not have a clearly discernible feature that can be classified as the particular design factor.

3.3.1 Materials and Procedure

Questionnaire. The self report questionnaire used consisted of the forty representative emotive differential scales constructed from the results of the first study. Five different versions of the questionnaire were made to prevent an ordering effect.

Slide Material. Twelve cyber banking interfaces were selected from the twenty six slides used in the second study. The criteria applied in selecting the interfaces was based on the fourteen design factors from the second study. A group of cyber banking systems designers made a checklist of the fourteen design factor values and evaluated the twenty six interfaces to identify the value of design factors pertaining to each of the interfaces. After an interface was selected, the values of the design factors were checked, and the interface that had the least number of design features in common with those already selected was chosen next. This process was continued until the selected interfaces could account for all possible values of the fourteen design factors. The final set of stimuli consisted of the minimum number of interfaces covering all possible combinations of the fourteen design factors.

Procedure. The procedure employed was identical to that of the first study. Three separate sessions were conducted with 123 subjects in total. The subjects had diverse backgrounds, ranging from undergraduate students to interface designers of cyber banking systems. The interfaces were projected on a 43-inch color screen. The subjects were shown one interface at a time, and were given approximately five minutes to mark the intensity and direction of the feelings evoked

by each interface on the questionnaire. The order of the interfaces was randomized for each session to eliminate ordering effects. Each subject had to provide judgments for each of the 480 questions (40 emotive differential scales ×12 cyber banking interfaces) on the self report questionnaire. At the end of the experiment, subjects were asked for feedback regarding the experiment in general, and in particular, the pertinence of each of the forty emotive scales in the context of cyber banking systems.

3.3.2 Results and Discussion

Structure of the Emotion Space. A maximum likelihood factor analysis, using promax rotation, was performed on 1417 observations (12 interfaces×123 respondents, with 59 observations eliminated because of missing values). The seven factor solution displayed in , accounting for 80.6% of the variance, was retained (other factors accounted for less than 10% of the variance).

The emotive differential scales have been reordered in descending order of factor loadings for each consecutive factor in order to facilitate interpretation. The highest loading scales for the first factor are of those that measured the attractiveness - unattractiveness of the cyber banking interfaces. The second factor reflects the symmetry - asymmetry of the interfaces, whereas the third factor is a dimension for the sophistication - or lack thereof of the interfaces. The fourth factor reflects an emotion that can be crucial for effective customer interaction with cyber banking interfaces — trustworthiness - untrustworthiness. Factors 5, 6, and 7 each reflect awkwardness, elegance, and simplicity, respectively. Each of these factors reflects one of the emotions that can influence the effective interaction with the interfaces of cyber banking systems. The emotive scales that pertain to each factor group were selected based on the factor loadings. The final composition of emotive scales that represent each dimension of the emotion space are shown inside bordered areas.

Interrelation between Emotive and Design Factors. In order to determine the interrelation between the emotional and design factors of the cyber banking interfaces, the factor scores were computed for each of the 1417 observations. The redundancy of the emotive scales thus being reduced, the analysis was performed to determine the relationship between the main emotional responses, represented by the seven factors, and the fourteen design factors. Multivariate analysis of variance (MANOVA) was conducted with the factor scores as dependent variables and the design factors as independent variables[2]

The purpose of these analyses was to determine which design factors are responsible for causing a particular emotion, i.e. the existence of a significant effect of each design factor on the extent of emotion elicited by an interface.

The multivariate analysis of variance for the fourteen design factors was conducted to determine whether or not the elicitation of emotions was influenced by differences in the design factors. The results indicate that the aggregate effect of the fourteen design factors upon the extent of attractiveness, sophistication, and simplicity were found to be insignificant by the Wilks' Lambda Criterion. In other words, only the feelings related to the symmetry ($F=124.55$, $p<0.0001$), trustworthiness ($F=189.93$, $p<0.0001$), awkwardness ($F=99.95$, $p<0.0001$), and

3. Table 3. Rotated Factor Pattern of the SD Ratings of all Cyber Banking Interfaces

SD Scales (Emotion Term)	Factor Structure (Factor Loadings)							Commun-ality
	Attractivenes	Symmetry	Sophisticatior	Trustworthiness	Awkwardness	Elegance	Simplicity	
exciting (*)	0.81809	-0.01252	-0.17808	0.11544	-0.09545	-0.01906	0.02626	0.75834
epochal	0.80383	0.03405	-0.28248	0.10857	-0.04104	0.05302	-0.05701	0.77625
vibrant	0.80237	0.00641	-0.15544	0.13949	-0.07413	0.08364	-0.07649	0.75942
witty	0.79870	0.04996	-0.03205	0.07711	-0.05465	0.04108	-0.07672	0.69231
exhilarating	0.77327	0.16177	-0.20228	0.12240	-0.09578	0.09116	-0.01132	0.78436
in vogue	0.76954	0.05082	-0.34539	0.12052	-0.07151	0.03160	-0.07227	0.76193
refreshing	0.76693	0.20133	-0.29092	0.14129	-0.09434	0.01809	-0.07185	0.77863
luring	0.76624	0.10293	-0.27621	0.13880	-0.13096	0.06838	-0.05948	0.73559
luxurious	0.73968	0.07396	-0.13996	0.14164	-0.11388	0.02237	-0.10604	0.74204
progressive	0.72547	0.06525	-0.33053	0.10143	-0.00313	0.08245	-0.04170	0.67768
splendid	0.72305	0.13695	-0.30727	0.18063	-0.12898	0.10726	-0.07603	0.77228
charming	0.68518	0.09174	-0.09783	0.12561	-0.05504	-0.12068	-0.05851	0.59528
exquisite	0.66334	0.11721	-0.22901	0.23948	-0.00103	0.19916	-0.01903	0.61601
elegant	0.66065	0.18390	-0.23007	0.25680	-0.07431	0.33442	-0.00490	0.73026
likable	0.63601	0.23480	-0.26573	0.37875	-0.09764	-0.00221	0.00973	0.72448
liberal	0.61335	0.01378	-0.21648	0.10808	-0.12055	0.02204	-0.09341	0.51551
opulent	0.61261	0.12744	-0.41023	0.16659	-0.01197	0.20139	-0.06860	0.65478
familiar	0.52320	0.28007	0.04268	0.35600	-0.21186	0.07127	-0.01275	0.59180
spacious	0.50757	0.25127	-0.15365	0.28561	-0.02193	0.28109	0.06284	0.58902
sedate	-0.46461	0.13601	0.42272	0.06908	0.03462	0.17906	0.09568	0.48332
boring	-0.50682	-0.07964	0.34964	-0.23906	0.19534	-0.00546	0.03806	0.56288
dull	-0.54370	-0.09337	0.38085	-0.09191	0.40330	-0.06590	0.08985	0.75073
simple	0.07765	0.80780	0.01757	-0.00806	-0.03762	0.00604	0.03362	0.67633
consistent	0.04348	0.79425	0.03724	0.11114	-0.08548	-0.00760	-0.04459	0.66535
balanced	0.07291	0.63951	-0.03118	0.38610	-0.07659	0.05187	0.19289	0.63635
dignified	-0.11799	0.51784	0.06203	0.34403	-0.04137	0.19749	0.34523	0.59797
slick	0.38817	0.49010	-0.23860	0.18779	-0.07951	0.13364	0.03780	0.64283
childish	-0.36151	-0.09756	0.61175	-0.27078	0.15787	-0.09220	-0.04208	0.64389
countrified	-0.23780	0.04886	0.60914	0.00347	-0.00383	0.00334	0.05841	0.44606
rustic	-0.56066	-0.07458	0.58411	-0.17733	0.12017	-0.04732	0.03047	0.79209
common	-0.26859	0.13719	0.50609	0.08802	-0.01693	-0.14956	0.24666	0.47428
cluttered	-0.24046	-0.33912	0.43629	-0.21988	0.18433	-0.11091	-0.00326	0.62087
dependable	0.27244	0.34312	-0.10241	0.60644	-0.13392	0.02886	0.05534	0.59749
reliable	0.37652	0.46103	-0.07160	0.48750	-0.15978	0.11262	0.04807	0.66467
realistic	0.42044	0.19864	-0.02453	0.48348	-0.17731	0.05799	-0.04120	0.49815
uniform	0.42097	0.38680	-0.17294	0.45411	-0.05663	0.10351	-0.04047	0.63459
awkward	-0.31128	-0.24333	0.37211	-0.21475	0.56062	-0.06134	-0.00061	0.67209
obscure	-0.06669	-0.41712	-0.05453	-0.23509	0.47101	0.02113	0.00681	0.46909
tasteful	0.45822	0.29554	-0.26637	0.36022	-0.07734	0.49209	0.02837	0.75110
simple	-0.35737	0.31428	0.35903	0.03241	0.04183	0.00196	0.62867	0.75443
Variance explained	430.217	100.784	110.138	70.257	30.209	20.466	20.477	860.31(**)

(*) The emotion terms are polar scales of the form exciting - not exciting.

(**) Total Weighted Communality

elegance ($F=2097.99$, $p<0.0001$) are differentiated by the value of the design factors. shows the F value and level of significance for the effect of each individual design factor on the four significantly affected feelings.

Table 4. MANOVA - Significance of Effect of Design Factor by Wilks Lambda Criterion

Design Factor		Symmetry	Trustworthiness	Awkwardness	Elegance
Title Format	F	10.9481	144.5138	104.3950	1616.594
	P	0.0001	0.0001	0.0001	0.0001
Title Graphics	F	9.5360	22.8201	27.7462	68.5738
	P	0.0021	0.0001	0.0001	0.0001
Title Position	F	130.3425	73.0068	15.4220	1961.625
	P	0.0001	0.0001	0.0001	0.0001
Menu Content	F	7.2635	127.3922	52.6411	3393.561
	P	0.0007	0.0001	0.0001	0.0001
Menu Format	F	269.8087	127.6528	85.9121	173.3878
	P	0.0001	0.0001	0.0001	0.0001
Menu Size	F	5.1433	147.9287	74.6255	1822.160
	P	0.0060	0.0001	0.0001	0.0001
Clipart Format	F	74.1751	213.0398	105.1357	3231.750
	P	0.0001	0.0001	0.0001	0.0001
Clipart Size	F	127.9058	148.1831	92.3706	1491.414
	P	0.0001	0.0001	0.0001	0.0001
Clipart Motion	F	23.5395	17.0056	13.9921	1425.670
	P	0.0001	0.0001	0.0001	0.0001
Color Tone	F	260.2860	401.6664	132.0877	3081.625
	P	0.0001	0.0001	0.0001	0.0001
Main Color	F	207.5473	214.0998	105.1424	1595.062
	P	0.0001	0.0001	0.0001	0.0001
Background	F	109.8717	190.5048	130.7450	948.1789
	P	0.0001	0.0001	0.0001	0.0001
Brightness	F	188.5107	78.7095	32.5429	129.1040
	P	0.0001	0.0001	0.0001	0.0001
Symmetry	F	183.8625	277.6272	143.5426	2885.521
	P	0.0001	0.0001	0.0001	0.0001

The results in indicate that the extent of feelings related to symmetry, trustworthiness, awkwardness, and elegance will be significantly affected by the value of each of the fourteen design factors of the cyber banking system interface. However, it is not enough to simply state that a particular design factor will significantly affect the extent of feelings elicited. For each of the seven emotional factors, further ANOVA tests were conducted to determine exactly which design factor was most significant in the elicitation of the emotions, as well as the value of the particular design factor that evoked the greatest extent of the feeling. Due to space limitations, we will present the detailed analysis for only one of the seven emotional factors — the trustworthiness - untrustworthiness of cyber banking interfaces. The trustworthiness factor is analyzed in full detail due to its especial importance in electronic commerce systems, and its close relationship to marketing and promotion in general [Handy, 1995]. In marketing, factors such as the communicator's physical appearance have been found to have a considerable influence on the feeling of trustworthiness and the final decision to buy [Baker and Churchill, 1977; Chaiken, 1979; Dion and Stein, 1978; Mills and Aronson, 1965; Patzer, 1985]. In the case of an electronic commerce system, where the transactions are not directly visible and feedback is not immediate, the factor of trust plays an even more important role. Therefore, in the following sections we will focus on the effect of the design factors of the visual interface on the extent of trustworthiness evoked.

Trustworthiness in cyber banking interfaces. The design factors that were most important in deciding the trustworthiness - untrustworthiness was determined to be those related to the categories of main clipart and overall color layout. This was determined based on the amount of variance of the dependent variable — the trustworthiness factor — that was

explained by the design factors in the MANOVA test. The two design categories together accounted for 72.6% of the total variance. The right most column in displays the effect of each factor on the extent of trustworthiness, represented by the factor scores, for all possible values of each design factor in the two categories.

Table 5. Interrelations between Design Factor Values and Trustworthiness (Factor Scores(*))

Design Category	Design Factor	Value	Factor Score
Clipart	Format	3 Dimensional	0.40569
		Human Forms	-0.13473
		Animal or Logo Types	0.06157
		Not Applicable	-0.23168
	Size	Over ½ total screen size	0.26373
		Over ¼ total screen size	-0.11193
		Over 1/16 total screen size	0.06157
		Not Applicable	-0.23168
	Motion	None	-0.00124
		Simple Animation	-0.07898
		Diverse Animation Effects	0.17474
Color	Color Tone	Cool Tone	0.27994
		Warm Tone	0.20110
		Not Applicable	-0.36018
	Main Color	Primary Colors	0.04136
		Pastel Colors	0.14511
		Not Applicable	-0.39696
	Background	Over ¼ blank(white)	-0.35763
		Under ½ blank(white)	0.00226
		Color background	-0.34765
		Not Applicable	0.20857
	Brightness	High	-0.18657
		Medium	0.06839
		Low	0.18926
	Symmetry	Symmetric color tones	0.17937
		Use of multiple colors	0.07321
		Single tone/emphasis	0.12263
		Not Applicable	-0.75269

(*) A positive valence indicates trustworthiness, whereas a negative valence is a sign of relative untrus tworthiness.

The results from the main clipart category indicate that an interface that would enhance the user's feeling of trustworthiness toward the cyber banking system must be designed using three dimensional (factor score = 0.40569), dynamic (factor score = 0.17474) clipart that covers ½ of the total screen size (factor score = 0.26373). On the other hand, an interface with no clipart (factor score = -0.23168) would arouse a feeling of untrustworthiness in the customer.

The color layout of the interface is also apparently important in enhancing the extent of trustworthiness which the customer of the cyber banking system feels. According to the results in , the preferable tone of color for the interface should be cool (factor score = 0.27994) rather than warm, and its main color should be a moderate pastel color (factor score = 0.14511). At the same time, the colors used in the interface should be of low brightness (factor score = 0.18926), and the colors should be used symmetrically (factor score = 0.17937). On the other hand, the interface that has a bright (factor score = -0.18657) color background (factor score = -0.34765), and uses an asymmetrical color scheme (factor score = -0.75269), will induce a feeling of untrustworthiness in the cyber banking system.

The results of the above MANOVA test reveal that each of the design factors relating to the use of clipart and color have a main effect upon the trustworthiness of an interface. Further ANOVA tests were conducted to determine the existence of interaction effects between the three design factors for the main clipart (Form × Size × Motion) and the five design factors for the color of the interface (Tone × Main Color × Background × Brightness × Symmetry). The ANOVA tests

were limited to interaction within the two design categories under the assumption that design factors pertaining to the same category would have a higher probability of interacting to affect the extent of trustworthiness. In other words, the value of a particular design factor would influence the likely selection of the value of the design factors in the same category to a greater extent than of those in a different category. The results for those design factors having a significant interaction effect in the design category for clipart are displayed in Table 6.

Table 6. ANOVA - Interaction Effect of Clipart Design Factors on Trustworthiness

Design Factor / Interaction Effect	Clipart (*)			Factor Score
	Form	Size	Motion	
Clipart Form × Motion	3 D	-	None	0.514 (H)
(F=6.10, p=0.0136)	None	-	None	-0.231 (L)
Clipart Size ×Motion	-	Over ½	None	0.514 (H)
(F=41.12, p<0.0001)	-	None	None	-0.231 (L)

(*) For each interaction effect, the F statistic and significance level is shown in parentheses; the combination of design factor values that results in the highest factor score (H), i.e. the greatest extent of trustworthiness, is presented in the first row; the combination of design factor values that results in the lowest factor score (L), i.e. the lowest extent of trustworthiness, is presented in the second row.

The above results indicate that, with regard to the design factors for the main clipart of a cyber banking system interface, there exists a significant interaction effect between the size and form of the clipart and the amount of animation effects used. The trustworthiness elicited by an interface was significantly greater when the clipart was in three dimensional form and when there were no animation effects (mean trustworthiness factor score = 0.514). The trustworthiness of an interface was also maximized when the clipart was over ½ the size of the overall screen with no animation effects (mean factor score = 0.514). On the other hand, the trustworthiness was significantly lower when the interface included no clipart (mean trustworthiness factor score = - 0.231).

Table 7. ANOVA - Interaction Effect of Background Design Factors on Trustworthiness

Design Factor / Interaction Effect	Color (*)				Factor Score
	Tone	Main	Back-ground	Brigh-tness	
Color Tone ×Main	Cool	Pastel	-	-	0.279 (H)
(F=7.86, p<0.001)	Not App.	Not App.	-	-	-0.753 (L)
Color Tone×Brightness	Cool	-	-	Low	0.279 (H)
(F=24.61, p<0.0001)	Not App.	-	-	High	-0.500 (L)
Main ×Background	-	Pastel	Color	-	0.270 (H)
(F=26.18, p<0.0001)	-	Not App.	Color	-	-0.753 (L)
Main ×Brightness	-	Pastel	-	Low	0.189 (H)
(F=91.43, p<0.0001)	-	Not App.	-	High	-0.753 (L)
Background × Brightness	-	-	Color	Low	0.270 (H)
(F=53.24, p<0.0001)	-	-	Color	High	-0.753 (L)

(*) For each interaction effect, the F statistic and significance level is shown in parentheses; the combination of design factor values that results in the highest factor score (H), i.e. the greatest extent of trustworthiness, is presented in the first row; the combination of design factor values that results in the lowest factor score (L), i.e. the lowest extent of trustworthiness, is presented in the second row.

In the case of the overall color of the user interface, the interaction effects between the color tone and brightness, the main color and the background color, the main color and the brightness of the overall background, and the background tone and brightness of the overall background were each found to be statistically significant. The results shown in indicate that the colors constituting the customer interface

must be chosen so as to give the interface a consistent look in general. The combination of cool color tones with pastel colors as the main color resulted in an increased intensity of trustworthiness (mean factor score = 0.279). When using a cool color tone, pastel color, or a color background, maintaining the brightness of the color at a low level was most effective in enhancing the trustworthiness of the interface (mean factor score = 0.279; 0.189; 0.270). Finally, there was a significant interaction effect between the main color of the interface and the background, with the greatest extent of trustworthiness being evoked by a cyber banking system that used mainly pastel colors and had a color background (factor score = 0.270).

3.4 Study 4

The purpose of the last study was to verify the causal relations between the design factors and the emotional factors. This study focuses on the interrelations between trustworthiness and the design factors related to color and main clipart in order to verify the causal relations identified in Study 3.

3.4.1 Materials

Questionnaire. The self report questionnaire that was used in this study was identical to that of the third study, except for the elimination of eight differential scales from the original questionnaire. The eight emotive scales were 'in vogue, exquisite, liberal, opulent, spacious, sedate, countrified, and common'.

These scales were omitted because the subjects in the third study expressed difficulties in thinking of cyber banking systems in those terms. The remaining thirty two scales included in the final self-report questionnaire were those most appropriate for measuring the domain-specific emotions aroused when interacting with cyber banking systems, in terms of both relevance and clarity of meaning.

Slide Material. Two cyber banking systems were built to verify the causal relations between the two design categories — color and main clipart — and trustworthiness. The two systems were constructed from a prototype cyber banking system provided by an industrial developer, so as to reflect the industry standard with respect to the types of functions provided. The underlying system structure and functionality of the prototype was retained, manipulating only the *visual* design factors in , , and . The factor scores in , and 7 served as a guideline as to which design factor to manipulate. Interface I was designed with those design features that enhanced trustworthiness, whereas Interface II was designed with those that elicited untrustwor- thiness in the customer. The final prototypes of the two cyber banking systems had the same content and functions, differing only with regard to the visual interfaces.

The choice of design factor values was based on both the main effects (Table 5) and the interaction effects between the design factors (and Table 7) upon the extent of trustworthiness. The design factors shown in the tables are the ones that were manipulated. For each design factor, the values shown to have the highest positive factor score (H) in the interaction effect are the ones that were used in designing Interface I, whereas the values inducing the negative factor score (L) as a result of the interaction were used to design

Interface II. In the absence of an interaction effect, results of the main effect were consulted. The final design of Interface I and Interface II are shown in -A and -B.

Figure 4. Manipulation of Trustworthiness in Interface Design

Interface I was incorporated with a 3-dimensional clipart related to banking institutions that covered ½ of the total screen size. The second set of design factors manipulated were those related to the color scheme of the interface. Interface I was designed in a cool color tone, using mainly pastel colors. The background of the interface was of a pastel color, and the brightness was designed to be low so as to maximize the trustworthiness evoked.

The design factors that were manipulated in the design of Interface II were the same as that of Interface I. Accordingly, the final design contained no clipart. The colors used were mostly bright, primary colors such as blue, yellow, and red. Interface II was also designed to have a bright color background in order to minimize the extent of trustworthiness evoked.

3.4.2 Procedure

The procedure employed was similar to that of the third study. Two group sessions of a total of 55 subjects were conducted. Subjects were students enrolled in an *Internet & Electronic Commerce* course and the study was conducted as part of the course work. Each subject had to provide judgments for each of the 64 items (32 emotive differential scales (2 cyber banking system interfaces) on the self report questionnaire.

3.4.3 Results and Discussion

Comparison of Individual Emotive Scales Related to Trustworthiness. Each slot on the 7 point scale was assigned a number from 1 to 7 starting from the left. A total of 110 observations (2 interfaces ×55 subjects) were coded according to the assigned numbers. The variables in this data set were the 32 emotive differential scales. The observations were divided into two sets — Interface I and Interface II, and the mean scores were calculated for all 32 scales.

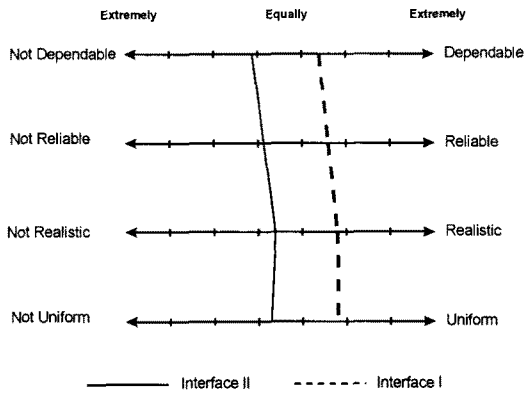

Figure 5. Interface I vs. Interface II (Trustworthiness Scales)

Figure 5 shows the direction and average intensity of four emotive scales related to trustworthiness, based on the structure of the emotion space in Table 3 - 'dependable - not dependable', 'reliable - not reliable', 'realistic - not realistic', and 'uniform - not uniform', The

results shown are the average extent of each emotion the subjects indicated for each interface. As can be seen the extent of trustworthiness evoked by Interface I was indicated to be consistently greater than Interface II. shows the average scores of the four emotive differential scales, and the results of the ANOVA test. Results in Table 8 indicate that Interface I evoked a significantly greater extent of trustworthiness in comparison with Interface II across all the four related scales.

Table 8. ANOVA - Extent of Trustworthiness Evoked (Interface I vs. Interface II)

Emotive Scale	Dependable	Reliable	Realistic	Uniform
Interface I	4.47273	4.61818	4.85454	4.87273
Interface II	2.92727	3.14545	3.43636	3.30909
F Value	18.87	15.82	12.14	12.38
P Value	0.0001	0.0001	0.0001	0.0001

(*) The values are the mean factor scores for each interface. A positive valence indicates a greater extent of the trustworthiness factor, whereas a negative valence I1ndicates a lesser extent of the factor.

Comparison of Factor Scores. Factor scores of the two interfaces were computed for each of the seven emotive factors in , using the scoring coefficients derived from the data in the third study. This was done under the assumption that the structure of the emotion space is similar to that established in the third study, since the composition of the subject pool and the nature of the task were similar to that of the third study. ANOVA tests reveal that the design factors manipulated in the development of the interfaces have a significant impact on the extent of trustworthiness elicited. Interface I (factor score = 0.36185) evoked a greater amount of trustworthiness compared to Interface II (factor score = -0.88069; F=50.32, p=0.0001).

Although the focus in the design of the two interfaces was on manipulating the extent of trustworthiness evoked, the ANOVA tests revealed that the difference in the intensity and direction of the feelings related to the attractiveness, symmetry, awkwardness, and elegance factors were also statistically significant. shows the difference in the extent of the emotions elicited by each interface. Interface I was rated as evoking a greater extent of symmetry (factor scores : 0.52708 > -0.24310) and elegance (factor scores : 0.31555 > -0.27916), and a lesser extent of awkwardness (factor scores : -0.33913 < 0.86852) when compared to Interface II[3]. Apparently the manipulation of the design factors had induced these differences.

Table 9. ANOVA - Difference in Emotions elicited by Interfaces

Emotive Factor	Attractiveness	Trustworthiness	Symmetry	Awkwardness	Elegance
Interface I	0.12887(*)	0.36185	0.52708	-0.33913	0.31555
Interface II	-0.56492	-0.88069	-0.2431 0	0.86852	-0.2791 6
F Value	39.73	50.32	34.76	63.75	26.00
P Value	0.0001	0.0001	0.0001	0.0001	0.0001

(*) The values are the mean factor scores for each interface. A positive valence indicates a greater extent of the particular emotive factor, whereas a negative valence indicates a lesser extent of the factor.

It is interesting to note that with the exception of the attractiveness factor, the emotions significantly affected by the manipulation of the design factors are indeed those that were shown to be influenced by the choice of design factor values in the third study. in the section of study 3 presents the main effect of each individual design factor on the four emotional dimensions — symmetry,

trustworthiness, awkwardness, and elegance. Almost all the design factors that had been manipulated to control the extent of trustworthiness in study 4 also had a significant effect upon the extent of symmetry, awkwardness and elegance[4]. For example, the format of clipart turned out to have a significant impact on symmetry (F=74.175), awkwardness (F=105.13), elegance (F=3231.75), as well as trustworthiness (F=213.03).

Therefore, it is highly probable that the manipulation of these factors in the design of the two interfaces resulted in the significant statistical differences shown in Table 9.

The average factor scores for the design features were computed from the results of the third study in order to support the proposition that the design factors manipulated in Interface I and Interface II also influenced the other three emotional factors. The mean factor scores for the design features are shown in Table 10.

Table 10. ANOVA - Interrelations between Design Factor Values and Attractiveness, Symmetry, Awkwardness and Elegance (Factor Scores)(*)

Design Factor	Value	Symmetry	Awkwardness	Elegance
	3 Dimensional (I)	0.1382	-0.2522	0.5244
Clipart - Form	Not Applicable (II)	-0.0604	0.2369	-0.1183
	Over ½ screen (I)	0.1199	-0.1739	0.2883
Clipart - Size	Not Applicable (II)	-0.0604	0.2369	-0.1183
	Cool tone (I)	0.1479	-0.1597	0.2022
Color - Tone	Not Applicable (II)	-0.3389	0.2342	-0.3131
	Pastel (I)	0.2163	-0.1207	-0.0050
Color - Main	Primary (II)	-0.0936	-0.0178	0.2420
	Low (I)	0.4842	-0.1322	0.0307
Color - Brightness	High (II)	-0.3133	0.1360	-0.0772
	Consistent (I)	0.2210	-0.1205	0.0407
Color - Symmetry	Not Applicable (II)	-0.6450	0.6097	-0.6683

(*) A positive valence indicates that the extent of the particular emotion is high, whereas a negative valence indicates that the elicited emotion is of the opposite nature (unattractiveness, etc.). (I) is the design factor value for Interface I, (II) for that of Interface II.

In the case of the symmetry factor, the design features that were incorporated in the implementation of Interface I elicited a greater extent of the feeling as compared to the features used in the design of Interface II. For example, a 3-dimensional clipart, incorporated in the design of Interface I, elicited a greater extent of symmetry (0.1382), as compared to an interface with no clipart (-0.0604), as in Interface II.

The opposite is true for the awkwardness factor. For example, use of colors of low brightness (-0.1322) elicited a lesser extent of awkwardness, compared to those high in brightness (0.1360). For the elegance factor, with the exception of the effect of the main color on the extent of elegance perceived (pastel = -0.0050 < primary = 0.2420), the effect of the design factors was consistent with that of the

results shown in . Therefore, results in Table 10 confirmed the argument that the design factors manipulated in Interface I and II influenced the feelings of symmetry, awkwardness, and elegance, as well as those of trustworthiness.

4. CONCLUSION AND DISCUSSION

Electronic commerce systems may replace the traditional institutions of today as the preferred medium of commercial transactions [Gasmori, 1995]. Many firms have already implemented some form of home shopping system in order to reap the benefits of electronic commerce, namely lower costs, customer service enhancement, and reduced time to market. However, the key to the success of electronic commerce systems lies in a wide adoption of such technologies by the customer [Bloch et. al., 1996]. It is therefore essential to attract the casual navigator on the World Wide Web, a potential customer of any electronic commerce system. Whether or not the casual navigator will become a loyal customer of a particular cyber shopping mall or cyber bank may depend on the first impression of the interface. Therefore, the emotions aroused by the interface of electronic commerce systems must be systematically incorporated into the design of customer interfaces.

The central question addressed by this paper was that of the possibility of designing customer interfaces which can involve the users emotionally and thus enhance the quality of the decisions made while interacting with electronic commerce systems. The results indicate that it is possible to design customer interfaces of cyber banking systems that will elicit target emotions, in particular trustworthiness. One might argue that graphic designers naturally consider the elicitation of 'good' feelings in designing customer interfaces. What this paper contributes is the identification of the combination of the design factors that will elicit a greater extent of the particular feeling in the customers. Although some of the results of this study merely verify common design know how, such as in the result indicating that balanced color tones invoke a greater extent of trustworthiness as compared to unbalanced color tones, some of the causal relations between the design and emotional factors are not in accord with what designers would intuitively be inclined to think. For instance, the results indicate that a clipart that covers over ½ of the total interface induces a greater extent of trustworthiness than those of other sizes. However, the importance of empirical studies for verifying the interrelation between the various design factors and the emotional factors becomes even more apparent when we consider the interaction effect between multiple design factors. For example, an animated clipart in and of itself might induce a greater extent of positive feelings, but when the size of the clipart is taken into joint consideration, a clipart that covers over ½ of total screen size should not have any animation in order to maximize the trustworthiness. The results of this research add new insight as to what constitutes a good design and how to combine the diverse design factors in order to achieve the best overall effect.

However, these results are not immediately applicable to the actual design of customer interfaces because of the following limitations.

First, subjects in this research were asked to indicate the immediate feelings evoked by a couple of slides of each cyber banking system interface. Therefore, the emotions indicated were the result of passive exposure to the visual interface, not the actual usage of the cyber banking system. This was done so as to isolate the effect of the visual design factors from such confounding factors as navigation aids, information content and data transmission speed that might influence the emotions elicited during the actual usage of the electronic commerce system. Finally, not all of the cyber banking systems selected as the test materials were based on the world wide web. Some of them were text-based, while others were based on proprietary video-text software. Use of static slides enabled subjects to focus only on the visual appearance of the cyber banking systems without having to pay attention to the operational details of each system. Otherwise, the operational characteristics of the systems would have influenced the feelings induced by the interfaces. In spite of the fact that the study was not conducted in a natural usage situation, the use of snap shots of the interface in determining the relation between the design factors and emotional factors is justified by the results of a study conducted by the University of Minnesota, which indicate that it takes a mere eight seconds for a user to decide whether or not to continue to browse the corresponding web site. In other words, if a site does not capture a casual Web surfer's interest within eight seconds, the user will be off to another site with a click of the mouse. Given the current traffic on the Internet, customers can not see much more than a couple of pages within eight seconds.

However, performing financial transactions is not simply a mechanical process of purchasing merchandise/services, but a complex process of emotional engagement and interaction with people. Therefore, other factors, such as the functionality and information content of the system, should be considered, as well as the visual appearance of the system, in order to fully understand the emotional factors of the cyber banking systems. For example, the security level of electronic payments and data transmission (such as SSL and public key encryption) will influence the feelings of trustworthiness induced by the system. Another possible influential factor is the level of technology underlying the design of the cyber banking system interface. Results from the study indicate that three dimensional clipart and diverse animation effects, both of which are based on new technologies, evoke a high level of trustworthiness. Future studies should investigate the emotional usability of the customer interface when subjects are actually using the system, taking into account the technological and social factors, as well as the visual design factors.

The second limitation of this research lies in the failure to make a comprehensive analysis of the interaction among the fourteen design factors and of that among the seven emotional factors. Analyses of the design factors were restricted to the interaction within the same design category. Therefore, it was difficult to determine the ideal combination of design factors that may enhance the trustworthiness of a cyber banking system interface. In the case of the emotional factors, analysis was limited to the feeling of trustworthiness, with no consideration given to the complex interrelations

that may exist between the myriad of emotions evoked by the interface. The verification of the causal relations in the fourth experiment was focused only on the trustworthiness, and no further experiments were conducted for other factors, such as simplicity and attractiveness. Based on research on interpersonal trust [Rempel, Holmes, and Zanna, 1985], it is possible to speculate the existence of a close association between trustworthiness and the feelings related to attractiveness, simplicity, elegance, and symmetry. Since this research could not perform a comprehensive analysis of interaction effects, it could not fully account for emergent or "gestalt" interface features that depend on the entire set of design factors rather than individual factors. It is left to future studies to determine the complex interrelations between the design factors and emotional factors, a task requiring a modified classification scheme of design factors and an alternative technique for measuring emotions.

The third limitation is related to the pool of participants used in our empirical studies. Even though their age, sex, and occupations were varied in order to account for the diverse customers in electronic commerce, they were homogeneous with respect to their socio-cultural backgrounds, i.e. ethnography and nationality. It is hard to assume that people with different soci-cultural backgrounds would feel the same emotion to the interfaces. Future studies should consider the difference of emotional factors resulting from diverse cultures and nations, which is important in building electronic commerce systems high in international usability [Galdo and Nielson, 1996] .

The final limitation of this research stems from the assumptions on which the experimental procedures and analyses were based. The research made the assumption that emotions elicited by a particular customer interface are determined by those design features that command the customer's attention, a proposition based on theories in human cognition and emotion [Barnes and Thagard, 1996; Damasio et. al., 1990; Feist, 1994; Frijda, 1987; Levenson, 1994]. The second assumption made in the research was that the factor structure determined in the third study would be preserved for the fourth study due to similarities in the composition of the subject pool and experimental task. Future studies should verify the validity of such assumptions and search for other experimental methods that do not require such assumptions.

Despite these limitations, the results of this research have interesting implications for the future of human computer interaction, especially in the area of electronic commerce systems. They demonstrate that it is possible to elicit target emotions in a majority of subjects, thus making it possible to design emotive interfaces for widespread use. Furthermore, the possibility of generalizing the findings to include all electronic commerce system interfaces was raised by a similar study that was conducted with a different system of electronic commerce (e.g., cyber shopping malls). In this study, subjects were asked to buy several items and allowed to traverse in the real web shopping site at their will. Preliminary results from the research reveal that similar emotive factors can be identified in cyber shopping malls, an indication that it is possible to develop common emotive factors for electronic commerce systems. Furthermore, connections can be established between other design factors

in addition to the visual factors and emotions elicited by the interface, thereby enabling an explicit method of dealing with the emotional usability of customer interfaces. Interfaces thus designed will be able to appeal to the individual customer's emotions and make the experience of interacting with the computer system, whether it be to shop, to deposit money in a bank account, or to play a game, an emotionally engaging experience, a mimesis of the actual world [Laurel, 1993].

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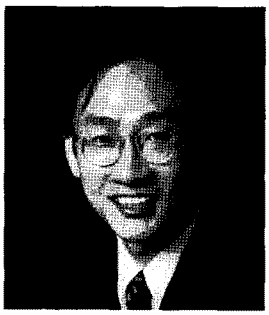
◆ 저자소개 ◆



공동저자 김진우는 연세대학교 경영학과 조교수로 재직중이다. 그는 연세대학교 경영학과를 졸업하고, UCLA에서 경영학 석사 학위를 취득하였다. 그 후 Carnegie Mellon University에서 이학 석사 및 경영학 박사 학위를 취득하였다. 그의 주요 관심분야는 인간과 컴퓨터의 상호작용 (Human Computer Interaction, HCI)로서 현재 사이버 공간에서의 사용자의 인지과정 및 고객 인터페이스 (Customer Interface)에 대한 연구를 수행 중 이다.

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