The aesthetic interface stimuli on Chinese E-consumption behavior

An experimental study on influence of aesthetic interface in B2C E-retail website concerning first impression and behavioral intention

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Abstract

This study focused on exploring users' attributed affect, cognitive process and behavior on high aesthetic website interface which had been overlooked in B2C E-retail researches. Basing on literature review of Munsell's color harmony formula and Golden Section theory, this experiment conducted a 2×2 factorial design, in which there were two independent variables of aesthetical interface – layout balance (Golden Section layout vs. Symmetrical balance layout) and color harmony (color harmony vs. color disharmony), to investigate individual effect on three dependent variables, customers' perceived attractiveness, emotions and behavioral intention to use. During the experiment, through respondent-driven sampling technique, 150 Chinese participants made assessment on emotional reflection and users' behavioral intention of target website, and then gave responses to seven questions about its aesthetic quality. Ultimately, the results indicated that only the presence of layout balance significantly impacted on users' emotion, whereas the presence of color harmony had no significant influence on three dependent variables. Due to the results of this study are inconsistent with previous studies, further researches should continuously devote to author's research direction. Additionally, with respect to designing E-retail websites, the results suggested that website designer should adopt Golden Section layout rather than symmetrical balance layout. Besides that if E-retail websites are consisted of abound colorful images, designers should pay more attention on the structure rather than color scheme of interface frame.

Keywords: Aesthetical websites, Golden Section, Color harmony, Perceived attractiveness, Emotion, Behavioral intention

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Chapter 1 Introduction

The first chapter primarily introduces current situation and development of E-commerce in China, and points out that improving the aesthetic of E-retail websites help to enhance users' behavioral intention to use target websites. At the end of this Chapter, the research question and paper structure are exhibited.

1.1 China E-commerce

During the havoc of current financial crisis, E-commerce distinguishes itself from other industries due to its remarkable low-cost and high-efficiency. However, some negative factors constrain E-commerce development from birth, such as customer diversity, insecurity payment, and unguaranteed logistics… it is believed that an unprecedented opportunity is facing towards E-commerce, especially in China, the largest and fastest-growing market all over the world. According to IDC (International Data Corporation) white paper, the entire E-commerce transaction in China reached 195-billion Euro in 2008, which maintained a more than 20% growth compared with its 160-billion Euros in 2007. China presented sharp contrast against the worldwide macroeconomic downturn accompanied with market depression. Meanwhile, this white paper pointed out that China E-commerce in the coming 5 years will continue manage a remarkable rapid growth and estimated that by 2010, the total transactions will reach 322 billion Euros (Zhang, 2008). Nevertheless, the previous investigations of Chinese consumption behavior can be counted on the fingers of one hand in distinct contrast with its prosperous E-commerce market represented.

1.2 Importance of Aesthetic

The effectiveness of aesthetic was empirically supported by extensive researches. Intuitively, it is evident that beautiful things can induce individual's desire (Norman, 2004). So, the visual appeal can influence human attitude, and is major determinant of success of the market is obvious (Bloch, 1995). Therefore, the visual effect of products design is increasingly considered by industries in order to carter to the increasing needs of fastidious customers.

Although extensive researches in HCI (Human Computer Interaction) realm proved that the aesthetic quality of websites can impact its broadcasting and users' impression (Lindgaard, Fernandes, Dudek & Brown, 2006). However, two cloudy mysteries exist; firstly, previous researchers invariably applied subjective standards to define aesthetics rather than quantitative approaches, secondly, plenty of researches tried to find out the contextual clues to verify the relationship between aesthetics and user performances, scarcely they explored in depth on users' affective impression, perception, cognitive judgments towards aesthetic websites. Therefore, to fill in this gap, current study aims to develop scientific and quantitative approaches to identify aesthetic interface that effect user's emotions and behavioral intention in E-retail websites.

1.3 Research Question

The research question is whether an aesthetic E-retail website can significantly engender customers' perceived attractiveness, emotions and behavioral intention to use target E-retail websites.

1.4 Report Structure

In order to answer research question mentioned above, a serious of experiments were conducted to investigate the role of aesthetic website playing on customers' first impression, which subsequently impacted customers' perceived attractiveness, emotions and behavioral intention to use the website. Redefining the aesthetic of websites interface is prerequisite, which contributed to establish an exciting new path on scientifically designing E-retail website. The following chapters are organized, as follows:

Chapter 2 reviews literature of aesthetic analyses, introduces two core concepts of aesthetic interface (color harmony and layout balance), and the basic mechanisms of triggering emotion. Then, the research approach to investigate hypotheses and research model are presented. In Chapter 3, research method plays the core role, following by an experimental design. The results of current experiment are presented in Chapter 4, using SPSS as data analysis. Finally, Chapter 5 summarizes the findings and limitations of this study, furthermore some practical suggestions for website designers and recommendations for further researchers devoting into relevant issues are offered.

Chapter 2 Theoretical Background

Chapter two primarily basic principles of aesthetic interface are introduced for constructing a scientific and quantitative definition of aesthetic websites via two core concepts (color harmony and layout balance). Subsequently, based on previous empirical studies of aesthetic reviews, a basic mechanism of triggering emotion is proposed to capture users' affective impression, cognitive judgments and behavior, when they faced aesthetic interfaces. Finally, six hypotheses and corresponding research model are proposed.

2.1 Objective Aesthetic of E-retail Website

Aesthetics is an extremely subjective concept, which is difficult to be explained and objectively explored in quantifiable ways. As a result, most of the pervious researches focused on qualitative description and summarizing and did not utilize any quantitative or mathematical modeling approach. For instance, Gilboa and Rafaeli (2003) operationally defined aesthetic as beauty, tidiness, and order. Then, Lavie and Tractinsky (2004) termed "classical aesthetics" and "expressive aesthetics" to classify aesthetics websites. The "classical aesthetics" emphasize orderly, clear and following design rules, which are advocated by numerous usability experts; whereas, the "expressive aesthetics" dimension refers to break design in line with design creativity and originality. Consequently, majority of human-factor design were qualitative, and the effectiveness of many design techniques were left to debate because there were no methods to provide numerical analysis or credible comparison between different design proposals. In this paper, via quantitative mathematical modeling approach, an objectively and scientifically defined aesthetic will be promoted, which relates to the perception of harmony appearance, physical beauty and balance (Locher, Stappers & Overbeeke, 1998).

The attendant issue is how to defined harmony and balance appearance in website interface. Website design was born accompanied with the popularization of Internet; this web-oriented art plays itself nothing less than the inheritance and innovation of traditional art which construct on two basic elements, composition and color. Historically, this "two elements" were demonstrated by many researches, one example, balance layout and color harmony were strong predictors in the overall appeal of website according to the results of experiment operated by Lindgaard, Fernandes, Dudek and Brown (2006). In the next section, balance layout and color harmony principles are presented to explore what balanced website interface is.

2.1.1 Balance Ratio of Layout

It is a common knowledge that the spatial relationships of the elements in a space should provide certain degree of balance. Website interface is no more than a kind of two-dimensional space. As any objects retain a sort of balance distribution, the elements of website should balance each other adheres to principles. Generally speaking, there are two kinds of visual balance: symmetrical balance and asymmetrical balance.

Symmetrical Balance

Symmetrical balance (SB) refers to that the compositional elements locate equally basing on certain reference axis, which manifest elements are almost the same in position and proportion, even mirror-reflects each other to some extent. However, several definitions of symmetry exist. Ismail and Kadir (2004) defined that symmetry refers to axial duplication or unit on one side of the centerline is exactly replicated on the other side. For instance, vertical symmetry is balanced arrangement of elements about vertical axis, and of course, horizontal symmetry is about horizontal axis. Radial symmetry consists of equivalent elements balanced interest at central point. However, the Greeks clarify symmetry in different way, in which each element must be related to every other element.

Asymmetrical Balance -- *Golden Section principle*

Asymmetrical balance achieved through arranging dissimilar elements, such as allocating many elements of smaller weight to balance one large element, which is more versatile, unlike symmetrical balance. Asymmetrical balance is applied much more often on the website design. The well-known Golden Section (GS) principle is a kind of asymmetrical-balanced ratio which was proved can best support many layout designs and ultimately is considered to achieve aesthetically pleasing (Ngo & Ch'ng, 2001) and preferred (Benjafield & McFarlane, 1997).

The GS has a central value of 1.618. According to Fechner (1997) who firstly examined GS in a psychological perspective, individuals have a preference for rectangles (Fig. 1) with ratio of 1:1.618 for their width to height. The GS since has a significant impact on art and architecture in the history because of this core ratio. The artists of Renaissance used GS to design architecture (Fig. 2), sculpture, and their paintings (Fig. 3).

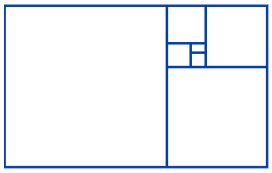


Fig. 1 Golden Rectangle

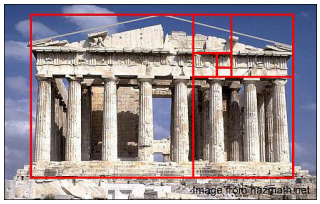


Fig. 2 Parthenon in Athens, Greece

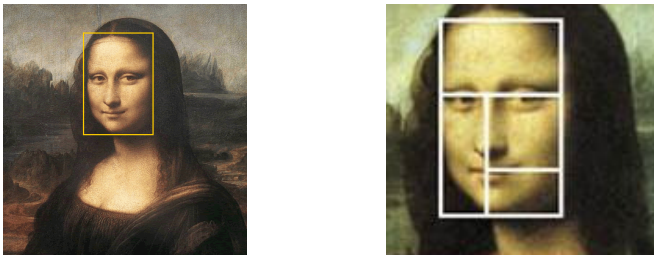
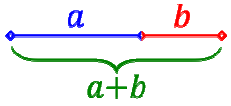


Fig. 3 Facial analyze of Mona Lisa

For example, as for the famous painting ---- the Mona Lisa, GS is perfectly applied to her face, the ratio of the length from head to chin divided by the width of head satisfied GS. Beside this, the ratio of the distance from forehead to eyes divided by the distance from eyes to chin, the ratio of the width of her left face divided by the width of right face all met GS. Furthermore, it is worth mentioning that most of computer monitors content GS too, for example, popular 1280 × 800 sized screen is manufactured approximately approaching to the ratio of 1.618.

Ancient Greek mathematicians first studied what is golden ratio in geometry. The golden section satisfies that the ratio of the sum to the larger equals the ratio of the larger to the smaller. And this specific ratio can be calculated, the value approximate 1.618 (Fig. 4).



$$\frac{a+b}{a} = \frac{a}{b} = \varphi \qquad \varphi = \frac{1+\sqrt{5}}{2} \approx 1.6180339887\ldots$$

Fig. 4 Calculation of Golden Section ratio

Nowadays, designers all over the world regardless execute this ratio to make artistic creation rather than simply relying on some pompous artistic notion, suffice it to say that this divine proportion gives people logical guideline to produce appealing layouts. Although GS layout is confirmed by artists and designers, the empirical evidence for the effectiveness of GS on website design is not overwhelming. Some investigators have found empirical evidences for users' preference of GS (Benjafield & McFarlane, 1997), or at least 'least disliked ratio' (McManus & Weatherby, 1997), while some empirical study proved that the effectiveness of GS always hover between success and failure. Schaik and Ling (2003) examined whether GS is useful to balance the navigation and content areas of web pages. 98 participants attended and completed an information retrieval task in one of five different ratio screens, as follows: 18.2:81.8, 23.2:76.8, 28.2:71.8, 33.2:66.8 and 38.2:61.8 (GS). The results indicated that the effect of screen ratio on task performance (speed and efficiency) and subjective outcomes (display quality and preferred screen width) was statistically significant. Unfortunately, the GS produced inferior results on speed, accuracy and display quality, which compared to other ratios. As author mentioned before, nothing but balance proportion of layout is not absolutely guarantee for successful website design. The factor of harmony color also should be taken into account.

2.1.2 Color Harmony

In order to create triumphant website, besides balanced management of elements in principle, color harmony is another dominant factor, strongly impacting human emotions and behaviors. Plenty of studies have investigated color effect on human emotions, and how to influence customers' decision to buy certain products (Ou, Luo, Woodcock & Wright, 2003). Moreover, color not only immediate influence individuals' emotions, but also "power on" users' overall satisfaction after operating certain system (Watzman, 2003). For instance, Nakarada-Kordic and Lobb (2005) proved perceived attractiveness had statistically significant effect on search perseverance after comparing six color-variant website-designs.

However, absolutely defining color harmony is always a problem in aesthetics research. In 1975, Judd and Wyszecki proposed that color harmony means two or more juxtaposed colors produce pleasing effect. Afterwards, the keyword 'pleasing effect' was widely adopted as the operational definition of color harmony. In general point of view, the alleged 'pleasing effect' remains sort of subjective perception.

This study aims to figure out quantitative approach to define color harmony. To define color harmony in quantitative approach, the characteristics of colors need to be analyzed. For example, Morriss and Dunlap (1987) defined color harmony as the suitability of juxtaposed colors, which influence by characteristics of individual colors (i.e., hue, brightness/value, and saturation/chroma), based on the study of Morriss and Dunlap (1987). For the study purpose, it is worth to firstly introduce three basic color concepts: hue, chroma and value.

(1) Harmonious Color Set of Hue difference

Hue refers to a property of colors determined by the dominant wavelength of the visible light.

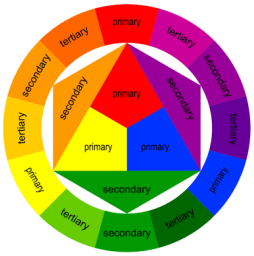


Fig. 5 RYB Color Wheel

Standard RYB (Red, Yellow, and Blue) color wheel (Fig. 5) is primarily utilized to exhibit hue value of different color in art or art lectures, particularly in painting theory. 'Red, yellow and blue' is a set of primary colors in the RYB color model. The three secondary colors (green, orange and purple) are created by mixing two of primary colors. Another six tertiary colors are created by mixing its two neighbor colors (one primary color with another secondary color).

(1.1) Analogous Color Scheme

In line with highest harmonious coefficient, analogous color scheme introduces colors adjacent to each other in the color wheel, like the combination of green-yellow, green and blue-green (Fig. 6). The analogous colors compose adaptive system and can create serene, comfortable and harmonious interface for website. However, audiences feel monotonous, vague and dull to website dominated by analogous color scheme.

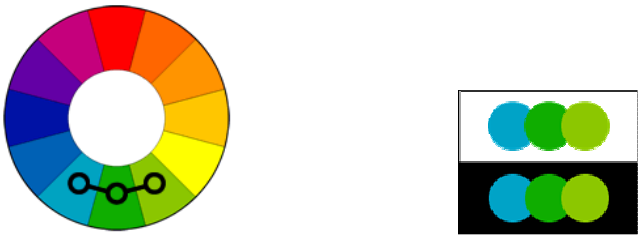


Fig. 6 Analogous color scheme

(1.2) Triadic Color Scheme

The second-highest harmonious scheme is triadic color scheme, in which each color evenly located on the color wheel with triangular balance, for instance, triangular location of orange, green and purple on the color wheel (Fig. 7). Triadic colors have variegated appear and characterized by variation on color, they are lively, but own the nature of unified, elegant and harmonious. Therefore, Triadic colors are widely adopted even in pale or unsaturated tone.

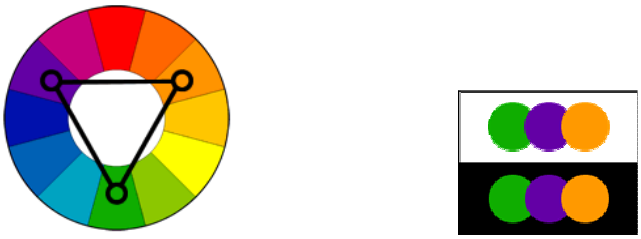


Fig. 7 Triadic color scheme

(1.3) Split-complementary Color Scheme

Split-complementary color scheme is a slightly scaled-down compared with triadic color scheme. It locates at third place which is variation on complementary color scheme. Adjacent choices surrounding complementary color make design less harmony than triadic color association，for instance, red-purple, red-orange and green (Fig. 8).

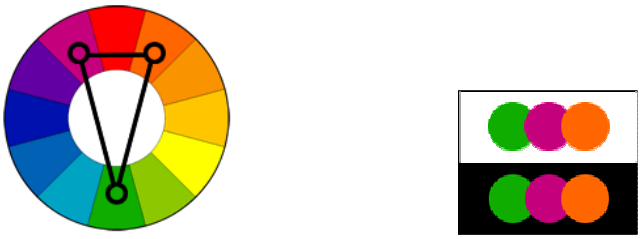


Fig. 8 Split-complementary color scheme

(1.4) Square Color Scheme

Square color scheme locates at the fourth place, which comprise four colors that quartering allocated on the color wheel and also could be viewed as two complementary-pairs, for instance, the set of red, yellow, green and blue (Fig. 9). Using this scheme, website manifest themselves powerfully, lively and exciting to audiences, can better attract users' attention.

Fig. 9 Square color scheme

(1.5) Rectangle Color Scheme

Rectangle color scheme can be treated as the derivative of square color scheme, providing strong contrast and offering plenty of possibilities to make variation, such as the combination of red, orange, green and blue (Fig. 10). The effect of Rectangle color scheme is so strong, easily causes visual fatigue.

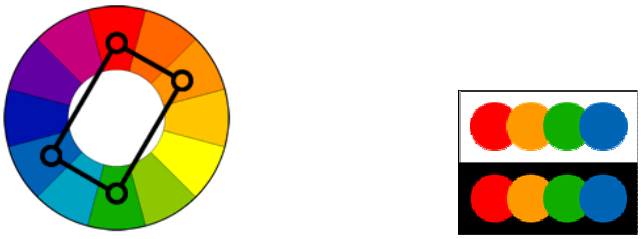


Fig. 10 Rectangle color scheme

(1.6) Complementary Color Scheme

The least-harmonious color scheme of all is complementary color scheme. Complementary color refers to colors locate opposite and mirror each other on the color wheel, for example, pair of red and green (Fig. 11). The effect of complementary color scheme is extremely violent, eye-opening and powerful. If designers cannot handle it properly, it is easily to produce vulgar, instability, disharmony and even bad feelings.

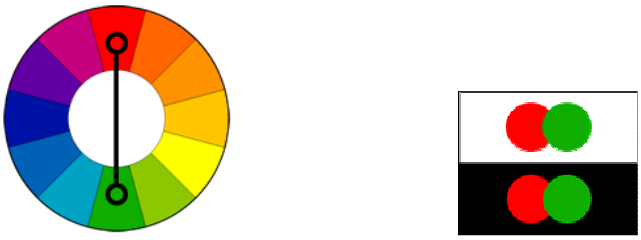


Fig. 11 Complementary color scheme

However, website design is not mere a simply addition of above-mentioned color scheme, comprehensive arrangement and integrated application of all approaches can eventually achieve integral harmony.

(2) Chroma

Chroma represents the color purity. Birren(1969) confirmed a linear relationship between Chroma and color purity. Technically, the more other colors were added, the lower scales of Chroma achieved.

(3) Value

The third parameter, value, refers to color's lightness or darkness (Birren, 1969). Dark colors have low value, while and light colors provide higher value. The method to modify the value of color is simply adding white, black or grey into target. Specially, adding white into pure color can make target lighter, which is termed tint (Fig. 12); adding black get target darker that is termed shade (Fig. 13); and adding gray could achieve different tone (Fig. 14).

Fig. 12 Tints - adding white

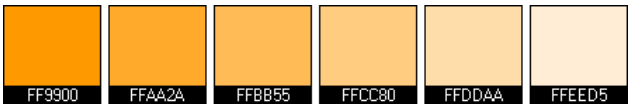


Fig. 13 Shades - adding black

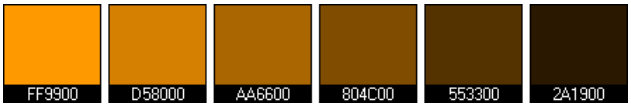
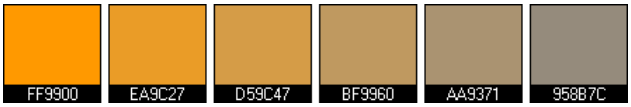


Fig. 14 Tones - adding gray



It is worth mentioning a case to theoretically form extreme harmony color scheme ---- Monochromatic color scheme, which refers to apply different values (tints and shades) of sole color, that shape effective, soothing and authoritative expression (Simmons, 2006). Several approaches can accomplish Monochromic harmonious color combinations. First arrangement, by combining black and white; black and gray; medium gray and light gray; or via mixing of black, white and gray; black, dark gray and light gray, audiences feel generous, dignified, elegant and very contemporary, on the other side, it is easy to produce sober sense of monotony. Second method is that "zero hue" color combine with prominent color, for instance, black contrast with red, gray contrast with purple, or contrast of black, white and yellow, contrast of white, gray and blue. Audiences probably feel lively and generous towards website interface based upon such combination. The third scheme relates to, two or more equal-hue colors combined together, varying merely chroma or value, for instance, combined blue with light blue (blue plus white), or combined green with light green (green plus white) and dark green (green plus black), etc. Equal-hue combination construes an atmosphere of sensory unity, quiet, elegant and steady, but also is easily to produce monotonous, rigid ills. Final unit is that white, black or grey combine with equal-hue colors, for example, combination of white, deep blue and light blue, or combination of black, orange and brown.

(4) Adjusting Size of Colors

Color size can significantly remodel the visual gravity of frame. Ismail and Kadir (2004) defined balance as the distribution of optical weight in pictures, which means the perception of two or more objects appear same weight. In detail, optical weight relates three variables: color, shape and size of objects. Therefore, the harmonious combination can be achieved via changing size or location of color block. When color has relatively large area and locates in the visual center, its color weight is heavier. Ismail and Kadir (2004) proved that the dark colors, unusual shapes, and large objects are heavier than light colors, regular shapes and small objects. Thus, balance in screen design refers to provide an equal weight of elements.

After above basic introduction of how to achieve color harmony through adjusting hue, chroma, value and area of colors, a scientific approach ---- Munsell's color balance principle is adduced to define the color harmony mathematically.

(5) Munsell's Color Balance Principle

Albert Munsell in 1898 firstly executed a mathematical method to quantify the concept of color harmony ---- this is Munsell's color model (Birren, 1969). The Munsell's color model specifies that colors based on three dimensions: Hue, Value and Chroma.

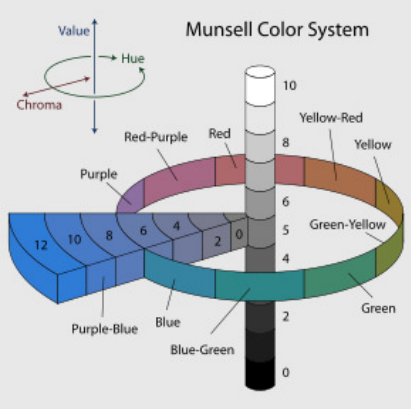


Fig. 15 Munsell's Color System

Hue

Munsell identified visible colors with ten milestones on circle (Fig. 15), including five "simple hues" — red, yellow, green, blue, purple; and five "compound hues" — yellow-red, green-yellow, blue-green, purple-blue, red-purple, which were compounded by five "simple Hues".

Value

Value (or lightness) of color was measured on the central pole which originates from gray with neutral value of zero-hue. In his model (Fig. 15), pure black located at the basal end with value of zero, and pure white flied at the peak end with value of ten. Take "red" as an example, the value scales of "maroon" was located lower because it is darker, whereas the value scale of "pink" was located higher so it is lighter.

Chroma

Chroma referred to color's strength or weakness that measured on the horizontal paths (shown in Fig. 15) counting from the neutral pole to the equator. Weak colors had low Chroma, while strong colors had high Chroma. For instance, red and blue-green opposite located on color circle, blue-green occupied middle value, red was twice as strong as blue-green.

In order to achieving color harmony, colors should be adjusted on their chroma, value and the size. Because no matter combines what hues of colors are, color harmony can be achieved through

adjusting the characteristics of colors, thus, hue of color does not be taken into account in Munsell's color harmony formula (Birren, 1969). In detail, to achieve possible balanced on two color blocks, color occupying large area should use relative weaker color (the score of chroma × value is small), instead of strong color application in Munsell's theory. To produce a balanced or harmonious color design, the value of $\text{Chroma}_1 \times \text{Value}_1 \times \text{Area (size)}_1$ should be equal to the value of $\text{Chroma}_2 \times \text{Value}_2 \times \text{Area (size)}_2$ (Fig. 16).

$$\text{Chroma}_1 \times \text{Value}_1 \times \text{Area (size)}_1 = \text{Chroma}_2 \times \text{Value}_2 \times \text{Area (size)}_2$$

Fig. 16 Munsell's color harmony formula

For instance, intense yellow and intense blue have equal Chroma, but the Value scale of yellow is definitely higher than blue. Therefore, Munsell theorized that in image consisting of yellow and blue, in order to achieve color balance the area of blue need to be larger to counteract the greater lightness of yellow. Abundant empirical experiments confirmed that the color schemes created upon Munsell theory always stand in line with perceived harmony of website interface. However, the study on Chinese Internet consumers is scanty. In this research, based on the methods of harmony combinations and Munsell's color harmony formula, the distinct of color harmony and disharmony conditions were explored on Chinese Internet consumers' behavior.

2.2 Effects of Aesthetic

Basing on previous researches of aesthetics, the possible causal effect of aesthetic interface could be roughly divided into five categories.

2.2.1 Aesthetics and Usability

In the research field of HCI, usability always emphasized its prominence. Abundant researches devoted into investigating the effect of aesthetic on objective aspects of usability and exploring that aesthetic or perceived aesthetic take effect on perceived usability.

When performance of websites is involved, efficiency, effectiveness and reliability are regularly examined as objective factors, specifically, in order to test how quickly, accurately and consistently users search functional needs from a website, the concept of "ease of use" is widely concerned in HCI researches (Van der Heijden, 2003). A recent study of Cawthon and Moere (2007) explored the relationship between perceived aesthetics and usability, three independent variables (color, typography and layout balance) and four outcomes (the speed of completing tasks, accuracy rate, task abandonment, and latency of erroneous response), reflecting the efficiency and effectiveness of target website, were tested in this experiment. The findings showed that only "latency in task abandonment" and "erroneous response time" relevant to users' perceived aesthetic, others are not significant.

However, the visual appeal of interface not only plays a role in usability, but also in perceived usability, which is validated by plentiful empirical studies. When system with high quality of aesthetic, users will perceive the usability is high. For instance, Kurosu and Kashimara (1995) investigated the relationship between users' perceived attractiveness and perceived usability via evaluating aesthetically appealing of ATM (automated teller machine). The results indicated that users' perceived usability is strongly affected by visual appeal rather than inherent usability. Similarly, Tractinsky, Katz and Ikar (2000) confirmed that the ATM with high aesthetic interface was perceived more usable, in condition that all ATM are in the same level of functionality.

A parallel and guided experiment appeared in 2006, Ben-Bassat, Meyer, & Tractinsky conducted a laboratory experiment with sample size of 150 engineering undergraduate students to assess the reference value of perceived usability, inherent usability and aesthetic. In their study, four versions of data-entry application 2(aesthetics: high vs. low) $\times$ 2(usability: high vs. low) were employed. All participants were randomly divided into four versions and were asked to rate the level on usability and aesthetic of each version. All data of this experiment were gathered via three measurements: objective performance, subjective preference, and auction bids. It is worth mentioning here that the results indicated the systems' inherent usability affected perceived usability as well as perceived aesthetics. Similarly, the systems' aesthetics affected perceived aesthetics and perceived usability. And both the inherent usability and aesthetics of interface have significant effect on users' performance, whereas perceived usability did not have any effect in each condition.

In 2008, Ilmberger, Schrepp and Held accomplished an empirical study to explore the cognitive processes underlying the high correlations between aesthetic impression and perceived usability of a user interface. Four online shops were tested varying color schemes and usability levels. These four interfaces were tested twice before and after an interaction period. By comparing these two mean scores of mood (before and after exploring interface), the results indicated that the users' mood can initially be influenced by aesthetic qualities. A high aesthetic interface can decrease bad experienced usability, and a good aesthetic impression can amplify the experience of good usability.

2.2.2 Aesthetics and Overall Satisfaction

It is already adequately proved that aesthetics could affect overall satisfaction of the system. Vilnai-Yavetz and Rafaeli (2005) investigated the effects of the aesthetics and professionalism of virtual services on customer feelings of pleasantness. In their study, a virtual services cape screen was modified to four versions: 2(aesthetic: good vs. poor) × 2(professionalism: high vs. low). 137 participants were randomly assigned into four versions and requested to master mouse to click on their screens. After all experimental interactions were done, a range of questions were promoted. The results indicated that both the effectiveness of the aesthetics and professionalism of virtual services positively and significantly influence customer feelings of satisfaction, and approach toward service interactions. Recently, Mahlke (2008) conducted a series of measurements to test the effect of aesthetic and usability on users' preference. He created four different versions of visual aesthetics for portable audio player interface 2 aesthetic levels (high aesthetic: high symmetry layout, low color combination and round shape vs. low aesthetic: low symmetry layout, high color differences and square shape) × 2 usability levels (high usability vs. low usability). In the experiment, all 48 participants tested two of the simulations with five short tasks. Before task accomplishment, participants firstly rated the visual aesthetics of the version. During tasks completing, heart rate, dermal activity as psychological measures and EMG (electromyography) to assess facial expression were applied. After completing all tasks, participants figured out scales to express their subjective feelings. When all tasks were finished, usability of system was rated, and finally the two system versions were ranked. The results showed that the variations of usability and aesthetics had the predicted impact on the perception of both types of qualities (perceived usability and perceived attractive). The results of the subjective feelings questionnaire revealed that the system of high usability and high aesthetic was experienced as most satisfying while the system of low usability and low attractiveness was most annoying. Finally, based on statistics analysis, no statistical interactive effect between usability and aesthetics, thus, both factors contribute to these emotions additively.

2.2.3 Aesthetics and Perceived Information Quality

Amount of the experiments evidenced how the aesthetic influence users' perceived information quality of website, and indicated aesthetic quality of website design is radically important, must be taken into account by interfaces designers. For instance, McKnight, Chounhury and Kacmar (2002) found that consumers' perception of website quality was a strong predictor of trusting beliefs in the retailer and of consumers' intention to buy from certain website. Lavie and Tractinsky (2004) guided an online survey of 125 engineering students to explore users' perceptions of aesthetic quality on websites. The results revealed that the interface with higher level of aesthetic can positively influence users' perceived information quality of target website.

Similarly, a recent study of Robins and Holmes (2008) explored the extent on people make credibility judgment when they first view target website. Using self-report technology, 20 graduate students judged credibility of 42 websites at first glance. Robins and Holmes compared the credibility judgments of higher-aesthetic websites with the lower aesthetic websites. Results manifested websites with high quality of aesthetic website had positive effect on users' credibility judgment.

2.2.4 Aesthetics and Time Stay On Websites

In previous studies of HCI, it is widely mentioned that website with higher aesthetical interface could make users spend more time on the website. However, no empirical studies directly measured this issue. The researchers of HCI could use homepages as stimuli to determine whether viewers willing to spend time exploring a site in the future.

2.2.5 Aesthetics and Likeliness of Revisiting the Website

The empirical study related the likeliness of revisiting target website caused by the aesthetic is almost blank. Based the majority of studies mentioned above, the effectiveness of aesthetic has a positive relationship with users' subjective perceptions of websites, such as user's perceived usefulness, user's perceived ease of use, user's enjoyment, overall satisfaction and user's perceived information quality of a site. Moreover, in terms of Technology Acceptance Model (TAM), the user's subjective perceptions are antecedents of user's behavioral intention and subsequent behavior (Hassanein & Head, 2007). Thus, the further research should concentrate on investigating the relationship between subjective perceptions of a web site and the likelihood of returning to a site in the future.

2.3 Explanation of Aesthetic Interface Trigger Users' Emotion

Although ubiquity and popularity of Internet applications has generated a large body of researches in HCI regarding the importance of website visual aesthetics, paucity of research on exploring the effectiveness of website interface features on the cognitive process. In general, two explanations exist in the context of E-retail website (Tractinsky & Lowengart, 2007), which could be explained how phenomenon of aesthetics may affect users' decision making in particular. Firstly, many researchers believe halo effect exists as a cognitive bias whereby the perception of a particular trait is influenced by the perception of the former traits in a sequence of interpretations. In E-retail website, the halo effect carries over first impressions of products or shopping environments to consumer evaluations of other attributes of these products or environments. However, due to the characteristics and causes of halo effect is more complicated; there little research to quantify the impact of halo effect.

The second explained that aesthetics affect users' perceptions, which influences users' subsequent evaluations of other attributes and attitudes towards the system. According to previous studies, focusing on the impact of aesthetic interface on first impression and users' overall satisfaction, aesthetics may elicit users' emotions that stimulate users have affect-based initial impressions before stimuli exposed (Ilmberger, Schrepp, Held, 2008), in turn, might induce users' judgment and behavior towards the system (Ben-Bassat, Meyer, & Tractinsky, 2006; Porat & Tractinsky, 2006). For instance, the previous study of Vilnai-Yavetz and Rafaeli (2005) proved that users' feeling of pleasantness was significantly higher when virtual services cape was more aesthetic. The pleasantness obtained from aesthetical interface directly reflects in that high-grade visual appealing might induce behavioral intention to use the website and users' overall satisfaction. Although this issue is crucial, the empirical studies of this direction are inadequate. Therefore, the current study devotes into proving high-aesthetic website trigger positive emotion and elicits pleasant feelings during the shopping procedure.

2.4 Research Hypothesizes

Based on the assumption of the traditional Stimulus-Organism-Response (S-O-R) paradigm which could be applied in a Web environment (Eroglu, Machleit & Davis, 2001), the aesthetical interface (layout balance and color harmony) could act as stimuli affecting cognitive and emotional states during online shopping episode. In SOR, "stimuli" refers to the atmospheric cues were operationalized, such as website interface; "organism" means users' emotional reactions; and "response" represents users' approach or avoidance behaviors after stimuli exposed. The empirical evidences supported that the relationship between pleasure (whether individuals perceive the environment as being enjoyable or not) and several approach behaviors, such as staying longer in the store, impulse purchase and affiliation with the store's personnel (Turley & Milliman, 2000; Yalch & Spangeberg, 2000).

Based on psychology theories and empirical evidences revealed in HCI, six relevant hypotheses and corresponding research model (Fig. 17) are proposed, as follows:

Hypothese1: The presence of golden section layout has a more positively influence on perceived attractiveness than the presence of symmetrical balance layout.
Hypothese2: The presence of color harmony has a more positively influence on perceived attractiveness than the presence of color disharmony.
Hypothese3: The presence of golden section layout has a more positively influence on users' emotion than the presence of symmetrical balance layout.
Hypothese4: The presence of color harmony has a more positively influence on users' emotion than the presence of color disharmony.
Hypothese5: The presence of golden section layout has a more positively influence on users' behavioral intention to use the website than the presence of symmetrical balance layout.
Hypothese6: The presence of color harmony has a more positively influence on users' users' behavioral intention to use the website than the presence of color disharmony.

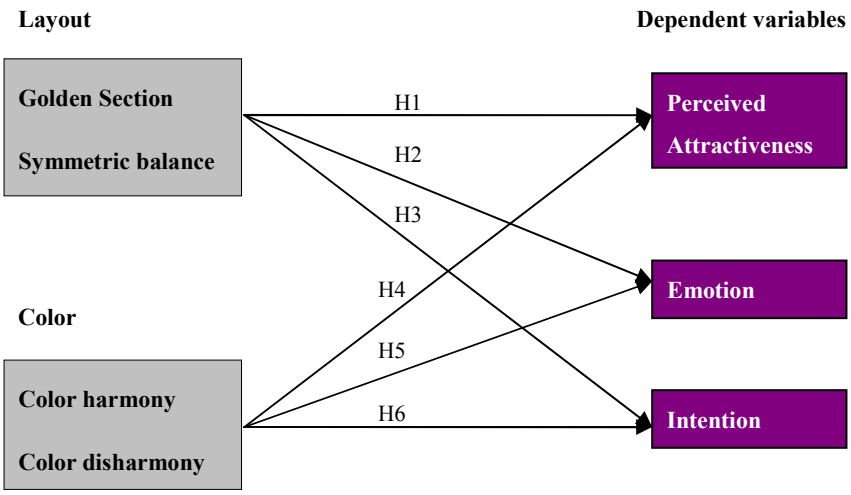


Fig. 17 Research model

Chapter 3 Research Methodology

3.1 Research Design

The purpose of this experiment is to prove attractive E-retail website can trigger Chinese E-consumers' good first impression, emotions and subsequent behavioral intention to use target website. According to above argumentation, two essential concepts would be discussed as research variables: one is color harmony versus disharmony based on Munsell's color harmony formula; another is layout balance based on GS theory against symmetrical balance.

Brady and Phillips (2003) introduced a valuable reference for this study. They investigated the role of aesthetics plays in website usability. In their study, the original website and three variations, modified on color, balance, or combination of above two, were employed to test the impact of color and balance on user satisfaction, aesthetic appeal and perceived usability. However, they ignored the aesthetic can be influenced by numbers of factors; any discord may lead to the failure of design. In their experiments, the sample interface was not expert in aspect of aesthetics. Researchers only create a concept website interface far away from real life. As for the Homepage of E-retail website, abundant product images also play a central role and should be taken into account. Researchers cannot simply ignore these factors and execute experiment on an optional sample interface. This study will explore the viability of Brady and Phillips's framework in the field of investigating on users' perceived attractiveness, emotions and willingness for website interface, through modifying an existing E-retail experimental website layout was created.

The current experiment conducted a 2(layout balance: Golden Section layout vs. symmetrical balance layout) × 2(color balance: color harmony vs. color disharmony) array-structure design to analyze two independent variables, layout balance and color harmony which influence three dependent variables: emotional factors of customers' perceived attractiveness, emotions, and behavioral intention to use the target website.

Independent variables: layout balance (Golden Section layout vs. symmetrical balance layout)
color balance (color harmony vs. color disharmony)

Dependent variables: perceived attractiveness, users' emotion, users' behavioral intention to use

3.2 Operationalization of Independent Variables

The current study selected a popular Chinese E-retail website ---- “Eachnet” (www.eachnet.com) as template for this experiment (Fig. 18).

Fig. 18 Original Eachnet website (homepage)

The original ‘Eachnet’ web page is redesigned, as follows:
Firstly, parallel identity of the sample-interface is created, in order to avoid the brand dispute with ‘Eachnet’. Secondly, several icons of digital products and popular dresses are added, in order to avoid the deviation of individual preferences. Finally, frames of homepage are modified on layout and color aspects for research purpose (Fig. 19).

Fig. 19 The variant website

3.2.1 Layout balance

For research purpose, the layout of original 'Eachnet' web homepage was changed into Golden Section layout (GSL) and Symmetrical Balance layout (SBL). The reason why author applied the symmetrical balance to play the role against the golden section layout rather than a random proportion layout is that symmetrical balance layout is proved as perfectly appropriate for user interface (Mullet & Sano, 1995). In website design, GSL and SBL which are optical balance layouts are widely used. By comparing GSL and SBL, the value of GSL could be powerfully confirmed.

Golden Section Layout

To be in line with Golden Section principle, which means the overall layout ration of two parties should approximately approach 1:1.618, the website is reformed as: two blocks lead by yellow bars on the right side of the webpage is in the scale of 8.6cm/13.1cm, which is equal to 0.66, approximate to 1:1.618. Meanwhile, two green blocks on the left side identified by a 0.5cm gap, almost have a ratio of 1:1.618 too. Finally, consider of the entire left party against the entire right side, obviously, the overall ration of these two color blocks, green and yellow, is closed to 1:1.618 as well. To sum up, the layout factor of the condition one closely adheres to the principles of Golden Section principle. (Fig. 20 & 22)

Symmetrical Balance Layout

The practical layout arrangement is very simple in symmetric balance layout, every blocks is equally disposed (Fig. 21 & 23). And the color scheme arrangement is the same as in condition one.

3.2.2 Color harmony

As regards the color harmony aspect, basing on Munselll's color harmony formula, if two color blocks requires to performance in balance, they should be equal on the products of Chroma × Value × Area.

Color harmony

In order to create the most harmony scheme in experiment, yellow and yellow-green were selected basing on Analogous color scheme. This was proved by the study of Polzella and Montgomery (1993) which certificated the combination of green and yellow was judged as one of the best harmonious combination. The current green (Hue_1 = 100, $Chroma_1$ = 90%, $Value_1$ = 53%, $Area_1 \approx$ 0.0088 ㎡) has product of 41.976; while the current yellow (Hue_2 = 50, $Chroma_2$ = 90%, $Value_2$ = 99%, $Area_2 \approx$ 0.0047 ㎡) possesses product of 41.877. It is obvious that the current combination of green and yellow approach the perfectly balance ratio situation.

Color disharmony

Basing on the study of Wright, Mosser-Wooley and Wooley (1997), in which the results of study indicated the combination of cyan and yellow is the worst combination on white background, we purposely arrange the cyan-yellow combination to make sample unharmonious, which can be demonstrated by Munselll's formula too, the current cyan (Hue_1 = 180, $Chroma_1$ = 96%, $Value_1$ = 98%, $Area_1 \approx$ 0.0088 ㎡, with product of 82.79) and the current yellow (Hue_2 = 60, $Chroma_2$ = 95%, $Value_2$ = 72%, $Area_2 \approx$ 0.0047 ㎡, with product of 32.148) are totally unequal.

The following 2 × 2 array-structure union was used, in terms of the discussion in 3.2.1 and 3.2.2,
Condition 1: Color harmony with Golden Section layout version (Fig 20);
Condition 2: Color harmony with symmetrical balance layout version (Fig 21);
Condition 3: Color disharmony with Golden Section layout version (Fig 22);
Condition 4: Color disharmony with symmetrical balance layout version (Fig 23).

Fig. 20 Condition 1: Color harmony with Golden Section layout version

Fig. 21 Condition 2: Color harmony with symmetrical balance layout version

Fig. 22 Condition 3: Color disharmony with Golden Section layout version

Fig. 23 Condition 4: Color disharmony with symmetrical balance layout version

3.3 Operationalization of Dependent Variables

3.3.1 Perceived Attractiveness

In order to investigate users' perceived attractiveness of the interface on the graphic design perspective, seven questions are asked on a 9-point scale (from "1" negative to "9" positive) based on previous studies (Lindgaard, Fernandes, Dudek & Brown, 2006; Vilnai-Yavetz & Rafaeli, 2006).

'Base on the website you observed, answer the following questions:

I judge this web page to be'

Negative	----------→									Positive
Complex	1	2	3	4	5	6	7	8	9	Simple
Boring	1	2	3	4	5	6	7	8	9	Interesting
Confusing	1	2	3	4	5	6	7	8	9	Clear
Bad layout	1	2	3	4	5	6	7	8	9	Good layout
Bad use of color	1	2	3	4	5	6	7	8	9	Good use of color
Ugly	1	2	3	4	5	6	7	8	9	Beautiful
Messy	1	2	3	4	5	6	7	8	9	Orderly

3.3.2 Users' emotion

The second dependent variable is users' emotion. To test user's first impression or feeling once the participants face website variant, Layered Emotion Measurement Tool (LEM tool) is adopted to evaluate emotional experience, LEM tool constructed on Pleasure-Arousal-Dominance (PAD) Emotional State model, which measures emotion on three dimensions of valence, arousal and dominance, which is developed by Mehrabian and Russell in 1974.

Recently, Capota, van Hout and van der Greest (2007) utilized the LEM tool to measure emotion during interaction on websites. By registering user experience emotions in combination with gathering specific data, they explained the way that user interacted with website; such as how they move the mouse and click. However, making participants relate word-describing of emotion is difficult. In this study, more direct approach was adopted, in which four feeling description were represented as images instead of texts, because participants' "feeling" is an instant experience (Beedie, Terry & Lane, 2005) within few seconds, the image can reflect what they truly felt inside more efficiently than the texts in such few seconds. Thus, the graphic questions in terms of LEMtool was ranging from 1 to 9 with the following equivalences, "1" is the most negative emotion, "9" is the most positive emotion and "5" means natural, as follows:

'Please answer the following four questions with emotional scales you felt on the website.'

1	----------→	9
	1 2 3 4 5 6 7 8 9	
	1 2 3 4 5 6 7 8 9	
	1 2 3 4 5 6 7 8 9	
	1 2 3 4 5 6 7 8 9	

3.3.3 Users' behavioral intention to use

To test what extent users would consume in target website, a 9-point Likert scales (1= absolutely not, 9= definitely will) is used, as follows:

'Will you choose this e-retail website, if you intend to buy something online?'

Absolutely not	1 2 3 4 5 6 7 8 9	Definitely will

3.4 Participants

3.4.1 Participants recruiting

Current study targeted at Chinese E-consumers, a target group with huge contrast on region, age, and education background. It is difficult that recruiting hundreds of Chinese in different city. In view of these facts, the respondent-driven sampling technique was appointed, which is a variation of chain-referral sampling methods accomplishing asymptotically unbiased estimates. Based on the study of Matthew, Salganik and Heckathorn (2004), the sampling procedure (Fig. 24) was framed as follow.

At the first stage, 24 participants were chosen in author's social network, purposely and impartially assigned into the four conditions mentioned in Chapter two; meanwhile, e-mails including the experiment details will reach them before experiment. In the second stage, these 24 participants forwarded these E-mails to two of their family members, two colleagues, and two friends (one male and one female in each pair) to invite them join into the study. Afterwards all involving participants on the second stage continuously extend the sample size (two family members, two colleagues, and two friends) of this experiment to make the samples size as large as rolling snowball.

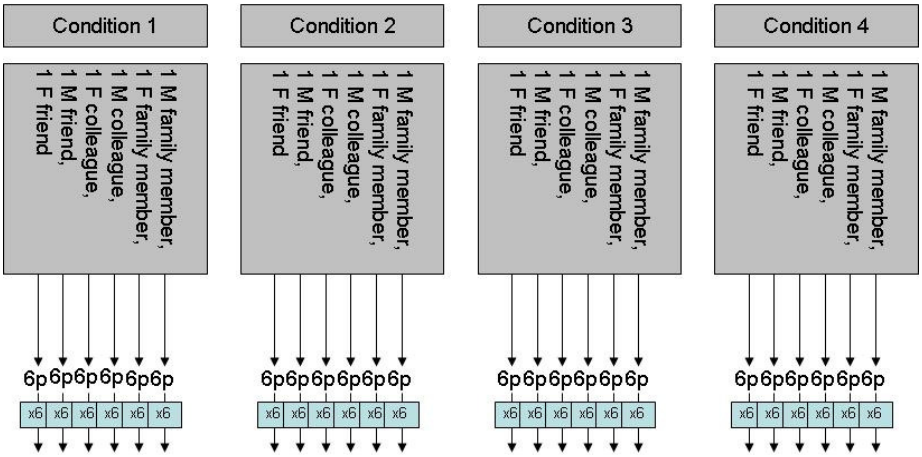


Fig. 24 Chinese respondents-driven sampling models

3.4.2 Personal characteristic of Chinese participants

China clearly distinguished itself from other countries, as Internet is a latecomer to the China market. In September of 1987, CANET (Chinese Academic Network) in Beijing Institute of Computer Application Technology established China first Internet E-mail node, and on 14th of September issued China's first e-mail: "Across the Great Wall we can reach every corner in the world", which formed a prelude to Chinese use the Internet. Afterwards, this latecomer cause a unique Internet phenomenon in China, official survey shows that the age of China Internet users is unbalanced, most of the users are youth between 18 to 24 years old; in the current 162 million Internet users, social freshmen under 25-year old occupy half (51.2%), users below 30-year old even reached tremendously percentage of 70.6%. The majority of the elderly, whose learn prime-time is before the Reform and Opening-up policy in 1979, have lost their desire and ability to accept Internet. Therefore, the unique phenomenon in China, age factor will be investigated during the experiments in this paper. In addition to the exceptive impact of age, there is a great difference in the structure and hierarchy of China education system. Table 1 showed the age and education stages for Chinese education system.

Table 1

China education system

Age	Education
6-12	Primary
12-15	Junior middle school
15-18	Senior high school/Vocational school
18-22	University/College

(http://en.wikipedia.org/wiki/Education_in_the_People's_Republic_of_China)

All Chinese students in Senior high school (15-18 years old), college and university (18-22 years old) have to accomplish the basic course of computer. The first generation taking the National Computer Examination in China was in 1994, which means that the first generation who took the exam is already above 30 years old in 2009. Therefore, in data analysis, all participants are divided into two groups (young group: under 30 years old, old group: older than 30 years).

3.4.3 Demographic of participants

The last count showed that 150 participants (75 male, 75 female) attended online investigation, who were obtained via respondent-driven sampling technique. Table 2 specified the demographic characteristics of participants. Most of them (80%) are younger than 30 years old, and 82.6% participants have higher education experience (college, bachelor, master or doctor). 49.4% participants spend over thirty hours online per week. Approaching one third (30%) of the participants have more than thirty times experience of online shopping.

Table 2

Demographic of respondents

	Characteristics	C1	C2	C3	C4	Total
Gender	Male	42.2%	56.5%	63.0%	40.6%	50%
	Female	57.8%	43.5%	37.0%	59.4%	50%
Age	under 20 years old	20.0%	6.5%	14.8%	12.5%	13.3%
	20-29 years old	66.7%	82.6%	59.3%	50.0%	66.7%
	30-39 years old	8.9%	6.5%	14.8%	25.0%	12.7%
	40-49 years old	0	2.2%	3.7%	0	1.3%
	over 50 years old	4.4%	2.2%	7.4%	12.5%	6.0%
Education	Junior middle school	2.2%	0	3.7%	3.1%	2.0%
	Vocational school	4.4%	0	3.7%	3.1%	2.7%
	Senior high school	6.7%	2.2%	37.0%	15.6%	12.7%
	College	31.1%	8.7%	3.7%	31.2%	19.3%
	Bachelor degree	35.6%	56.5%	37.0%	34.4%	42.0%
	Master degree	15.6%	32.6%	14.8%	9.4%	19.3%
	Doctor degree	4.4%	0	0	3.1%	2.0%
Time	less than 1 hour	2.2%	2.2%	11.1%	3.1%	4.0%
	1-5 hours	20.0%	10.9%	0	12.5%	12.0%
	6-10 hours	11.1%	17.4%	11.1%	9.4%	12.7%
	11-20 hours	17.8%	15.2%	18.5%	15.6%	16.7%
	Over 20 hours	13.3%	13.0%	11.1%	6.2%	11.3%
	Over 30 hours	35.6%	41.3%	48.1%	53.1%	43.3%
Experience	Never	22.2%	10.9%	48.1%	21.9%	23.3%
	1-5 times	20.0%	26.1%	22.2%	21.9%	22.7%
	6-10 times	13.3%	23.9%	7.4%	12.5%	15.3%
	11-20 times	6.7%	4.3%	7.4%	6.2%	6.0%
	Over 20 times	4.4%	2.2%	0	6.2%	3.3%
	Over 30 times	33.3%	32.6%	14.8%	31.2%	29.3%
	Total	45 (p)	46 (p)	27 (p)	32 (p)	150 (p)

3.5 Procedures

Before participants started the online survey, all participants received e-mails presenting the survey instructions, and including only one link of four conditions. From now, the sample snowball started its rolling. Once the participants entered the testing website, a general introduction would be presented with the following introduction: “Welcome to E-retail homepage survey. The survey is estimated to take about 10 minutes and you can quit at anytime if the survey is inconvenient or makes you uncomfortable. Please remember that the focus of this study is the homepage — not you, so I hope you can be objective, impartial and provide your valuable advice. (In order to ensure the impartiality of the experimental data, please do not repeat this test.)”. Then a group of demographic questions (about gender, age, education, time online per week and online shopping experience) would be exhibited to gather references data of participate.

Next to the online survey stage, all participants provided response to twelve questions. Then, four emotional questions would be answered about the first impression once the participants facing experiment variant. Followed by four graphical questions, all participants should make choices on what percentage they possibly consume on target website. Then, in the last seven questions, all participants should evaluate website interface on the graphic design perspective, which indicated the users’ perceived attractiveness (Lindgaard, Fernandes, Dudek & Brown, 2006).

Finally, participants need to forward the invitation email to six potential participants (two family members, two colleagues, and two friends), invite them to join this survey as well. ‘Please forward this e-mail to two of your family members, two of your colleagues, and two of your friends. Sincerely thank you for your cooperation.’

Chapter 4 Data Analysis and Results

Analysis of the collected data is conducted using SPSS. The following paragraphs present the data analysis and casual results including two-sample T-Test, correlation, linear regression and Two-way ANOVA.

4.1 Description Statistics

Table 4 reveals the Means (M) and Standard Deviations (SD) of four versions of aesthetic-variant stimulus. In Table 3, Condition 1 has the remarkable highest Mean scores on three dependent variables among all conditions, while Condition 4 has the second highest Mean scores.

Table 3

Means (M) and Standard Deviations (SD) on dependent variables

Condition (Number)	PA	Emotion	Intention to use
	M (SD)	M (SD)	M (SD)
Condition 1 (45)	39.07 (10.17)	23.00 (6.21)	5.24 (1.20)
Condition 2 (46)	33.20 (11.54)	20.09 (5.82)	4.63 (2.15)
Condition 3 (27)	35.26 (10.23)	20.93(6.58)	4.78 (2.39)
Condition 4 (32)	37.72 (6.53)	21.16 (6.31)	5.03 (2.16)

4.2 The effectiveness of independent variables on dependent variables

To investigate the effectiveness of layout balance and color harmony on users' perceive attractiveness, emotion and behavioral intention to use the website, a series of two sample T-tests are conducted. According to the data in Table 4 and 5, only the Mean scores of website with GS on users' emotion ($M = 22.22$, $SD = 6.38$) is statistically significantly ($t = 1.68$, $df = 148$, $p = 0.024$, $p < 0.05$) higher than website with SBL ($M = 20.53$, $SD = 6.01$). Thus, H3 is supported.

H1 and H5 are not supported. In respect that the Mean scores of website with GSL on users' perceived attractiveness ($M = 37.64$, $SD = 10.29$) is insignificantly ($t = 1.54$, $df = 147$, $p = 0.063 > 0.05$) higher than website with SBL ($M = 35.08$, $SD = 9.97$). Additionally, GS does not have significant impact on behavioral intention to use target website ($t = 0.78$, $df = 148$, $p = 0.218 > 0.05$).

However, Two sample T-tests showed different Mean scores on website in harmonious color scheme with disharmonious color scheme, reveal no statistically significantly difference on users' perceived attractiveness ($t = -0.27$, $df = 147$, $p = 0.394 > 0.05$), emotion ($t = 0.46$, $df = 148$, $p = 0.325 > 0.05$) and behavioral intention to use the website($t = 0.05$, $df = 148$, $p = 0.479 > 0.05$). Thus, H2, H4, H6 are thus not supported.

Table 4

Means and Standard Deviations of independent variables on dependent variables

Variable		PA	Emotion	Behavioral Intention
		M (SD)	M (SD)	M (SD)
Layout	**C1+3**	37.64 (10.29)	22.22 (6.38)	5.07 (2.14)
	C2+4	35.08 (9.97)	20.53 (6.01)	4.79 (2.15)
Color	**C1+2**	36.13 (11.21)	21.53 (6.16)	4.93 (2.09)
	C3+4	36.59 (8.44)	21.05 (6.37)	4.92 (2.25)

Table 5

Two sample T-tests on dependent variables

Variable	PA			Emotion			Behavioral Intention		
	F	t	P	F	t	P	F	t	P
Layout (C1+3 vs. C2+4)	0.23	1.54	0.063	0.64	1.68	0.048	0.13	0.79	0.218
Color (C1+2 vs. C3+4)	3.11	- 0.27	0.394	0.01	0.46	0.325	1.27	0.05	0.479

Basing on the output a series of ANOVA test, layout and color have interactive effect on users' perceived attractiveness ($F = 6.17$, $p = 0.014 < 0.05$, $R^2 = 614.96$), but they have no effect on users' emotion ($F = 2.31$, $p = 0.131 > 0.05$, $R^2 = 88.03$) and behavior intention ($F = 1.45$, $p = 0.231 > 0.05$, $R^2 = 6.70$).

4.3 Correlation between Dependent Variables

The internal-correlation of three dependent variables, a series of Pearson Correlations is conducted. The data of Table 6 indicates that all independent variables have statistically significant correlation between each other and the correlations were all smaller than 0.8 (Emory & Cooper, 1991).

Table 6

Pearson Correlation and linear regression (N = 149)

Independent variable	Dependent variable	Correlation	β	R^2	p
Users' perceived attractiveness	Users' emotion	.692**	0.42	0.48	.00
Users' perceived attractiveness	Users' behavioral intention	.616**	2.94	0.38	.00
Users' emotion	Users' behavioral intention	.640**	0.22	0.41	.00

**. Correlation is significant at the 0.01 level (2-tailed).

The output of linear regression analysis results indicate that users' perceived attractiveness has a positive impact on users' emotion ($F = 135.39$, $R^2 = 0.48$, $\beta = 0.42$, $p = 0.00 < 0.05$) and users' behavioral intention ($F = 89.86$, $R^2 = 0.38$, $\beta = 2.94$, $p = 0.00 < 0.05$). Furthermore, there is a positive linear relationship between users' emotion and users' behavioral intention ($F = 102.73$, $R^2 = 0.41$, $\beta = 0.22$, $p = 0.00 < 0.05$).

4.4 The influence of personal characteristics

To deeply testify whether five interactive effects (gander, age, education, online time per week, and experience of online shopping) influence the links between dependent variables (layout balance and color harmony) on three dependent variables, a series of analysis of variance are conducted.

4.4.1 Users' perceived attractiveness

Table 7 reveals the output of a series of ANOVA tests of five interactive effects influencing linking between layout balance and three dependent variables. The factors of online time per week has statically significant interactive effect with the effect of layout balance on users' perceived attractiveness ($F = 6.23$, $Mean^2 = 543.59$, $p = 0.000 < 0.05$), users' emotion ($F = 7.96$, $Mean^2 = 248.46$, $p = 0.000 < 0.05$) and behavioral intention ($F = 6.21$, $Mean^2 = 24.82$, $p = 0.00 < 0.05$).

Table 7

ANOVA output for layout balance and dependent variables

Dependent variables	Source	df	Mean Square	F	Sig.
Attractiveness	layout * Gender	1	184.790	1.824	.179
	layout * Age	4	109.702	1.122	.349
	layout * Education	6	20.527	.211	.973
	layout * Time	5	543.592	6.234	.000
	layout * Experience	5	49.656	.465	.801
Emotion	layout * Gender	1	6.171	.163	.687
	layout * Age	4	162.388	4.792	.001
	layout * Education	6	62.080	1.696	.126
	layout * Time	5	248.455	7.962	.000
	layout * Experience	5	57.537	1.521	.187
Intention	layout * Gender	1	.012	.003	.959
	layout * Age	4	9.112	2.055	.090
	layout * Education	6	6.930	1.609	.149
	layout * Time	5	24.821	6.209	.000
	layout * Experience	5	5.411	1.160	.332

The output of ANOVA test (Table 8) indicates that the factor of age has a statically significant interactive effect with the effect of layout balance on users' emotion ($F = 4.79$, $Mean^2 = 162.39$, $p = 0.001 < 0.05$).

Basing on the age of the first generation of Chinese computer learners, all participants were divided into two groups. The participants below 40-year old is ascribed to young group, while the participants above 40-year old is ascribed to old group. Because the sample size of old group are extreme small ($N = 11$), therefore we conducted a nonparametric test. Table 9 showed that the mean ranks of old group are larger than the mean ranks of young group on three aspects.

Results of Table 8 indicate that although the average ranks of old group is larger than young group on users' perceived attractiveness (MR old = 104.09 > MR young = 72.68), emotion (MR old = 94.91 > MR young = 73.96) and behavior intention (MR old = 79.14 > MR young = 75.21). The results of Table 9 suggest that there is a statistically significant difference between the underlying distributions of the perceived attractiveness scores of young group and the perceived attractiveness scores of old group ($z = -2.33$, $p = 0.02 < 0.05$), other two are insignificant.

Table 8

Nonparametric test output (1) for age (layout as independent variable on dependent variables)

	N		Mean Rank		Sum of Ranks	
	Young	Old	Young	Old	Young	Old
Attractiveness	138	11	72.68	104.09	10030.00	1145.00
Emotion	139	11	73.96	94.91	10281.00	1044.00
Intention	139	11	75.21	79.14	10454.50	870.50

Table 9

Nonparametric test output (2)

	PA	Emotion	Behavioral Intention
Mann-Whitney U	439.00	551.00	724.50
Wilcoxon W	10030.00	10281.00	10454.50
Z	-2.33	-1.56	-.30
Asymp. Sig. (2-tailed)	.020	.12	.77

a. Grouping Variable: Young Or Old

4.4.2 The Influence of Education on Users' Behavioral Intention

In order to explore the interactive effects between five personal factors and color harmony as regards three dependent variables, the same ANOVA tests are performed. The output of Table 10 indicates that the factor of education has a statically significant interactive effect with the effect of color harmony on users' behavioral intention ($F = 2.16$, $Mean^2 = 9.06$, $p = 0.05$).

Table 10

ANOVA output for color harmony and dependent variables

Dependent variables	Source	df	Mean Square	F	Sig.
Attractiveness	color * Gender	1	228.667	2.228	.138
	color * Age	4	72.639	.727	.575
	color * Education	6	192.123	2.157	.051
	color * Time	5	78.746	.749	.588
	color * Experience	5	81.424	.759	.581
Emotion	color * Gender	1	.001	.000	.997
	color * Age	4	2.269	.058	.994
	color * Education	6	49.762	1.330	.248
	color * Time	5	21.529	.537	.748
	color * Experience	5	8.096	.199	.963
Intention	color * Gender	1	2.366	.514	.475
	color * Age	4	10.324	2.341	.058
	color * Education	6	9.056	2.162	.050
	color * Time	5	10.198	2.242	.054
	color * Experience	5	3.559	.746	.590

Due to the great difference between the education system of China and western education system, thus, all participants are re-categorized into two groups (university vs. non-university). According to the results in Table 11, all Mean scores of three dependents variables for non-university group are higher than university group. To compare university with non-university groups, a series of two-sample T-Tests are conducted (Table 12). The results indicate that only the Mean of perceived attractiveness ($M = 42.96$, $SD = 11.26$) and intention ($M = 5.85$, $SD = 2.75$) for non-university group is statistical significantly higher (PA: $t = 3.83$, $DF = 147$, $p = 0.00 < 0.05$; Intention: $t = 2.44$, $DF = 148$, $p = 0.008 < 0.05$) than university group (PA: $M = 34.91$, $SD = 9.39$; Intention: $M = 4.734$, $SD = 1.955$). Whereas, the Mean score of emotion for non-university group ($M = 21.96$, $SD = 8.63$) is higher than university group ($M = 21.21$, $SD = 5.64$), but the difference between two groups is insignificant ($t = 0.56$, $DF = 148$, $p = 0.289$).

Table 11

Mean scores, standard deviations, number and Two-sample T-Test

(university group vs. non-university group on dependent variables)

	Non-university	University			
	M (SD), N	M (SD), N	t	df	Sig.
Attractiveness	42.96 (11.26), 26	34.91 (9.39), 123	3.83	147	.000
Emotion	21.96 (8.63), 26	21.21 (5.64), 124	.56	148	.289
Intention	5.85 (2.75), 26	4.73 (1.96), 124	2.44	148	.008

For the purpose of understanding why non-university group has higher Mean scores on three dependent variables than university group, demographic analysis of non-university group and the university group is performed (Table 12). Most of non-university participants are under 20 years old (38.5%) and over 50 years old (26.9%), while participants in university group are almost around 20-29 years old (76.6%). University group spent more time online and have more online shopping experience than no-university group. Instead of attractive appearance of Web interface, the university group more directly focuses on the images of products, which may provide the reason why the Mean scores on three dependent variables for university group are lower than non-university group.

Table 12

Demographic of non-university group vs. university group

Characteristics		Non-university	University
Gender	Male	38.5%	52.4%
	Female	61.5%	47.6%
Age	under 20 years old	38.5%	8.1%
	20-29 years old	19.2%	76.6%
	30-39 years old	11.5%	12.9%
	40-49 years old	3.8%	.8%
	over 50 years old	26.9%	1.6%
Time	less than 1 hour	15.4%	1.6%
	1-5 hours	23.1%	9.7%
	6-10 hours	3.8%	14.5%
	11-20 hours	34.6%	12.9%
	Over 20 hours	11.5%	11.3%
	Over 30 hours	11.5%	50.0%
Experience	Never	69.2%	13.7%
	1-5 times	23.1%	22.6%
	6-10 times	7.7%	16.9%
	11-20 times	0	7.3%
	Over 20 times	0	4.0%
	Over 30 times	0	35.5%

Chapter 5 Discussion and Recommendations

5.1 Findings

This study explored the effectiveness of harmony website interface on users' first impression and users' subsequent behavior. For this purpose, an empirical experiment is conducted by using a scientific and quantitative approach to redefine the aesthetic of websites interface, in which two variations of aesthetical interface – layout balance (GSL vs. SBL) and color harmony (color harmony vs. color disharmony) are used to investigate individual effects on three dependent variables, customers' perceived attractiveness, emotions and behavioral intention to use the website. The results of this study demonstrate that only layout balance variable has statically significant influence on users' emotion, and there is a huge gap between aesthetic and users' perceived attractiveness. Common users are not the expert on aesthetic, cannot distinguish GS layout with symmetrical layout on the aspect of attractiveness, but they have significant emotional bias upon these two layouts. As for behavioral intention, negative influence appeared in the experiment either. While the results show that the factor of color harmony does not have any effect on three dependent variables.

It is very interest that the findings of this study are contrary to the historical Chinese aesthetic. Participants reflected higher scores of perceived attractiveness and more positive emotion on website interface with GS instead of website interface with SBL.

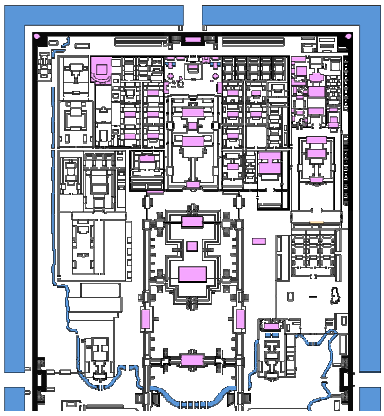


Fig. 25 Forbidden City ichnography

However, symmetrical composition has dominated ancient China architectural design, layout design, and pattern design for centuries. Its proper and dignity give Chinese a sense of permanence in a long age of change (Fig. 25). As for Chinese, fully aesthetic recognition of symmetric significantly reflected in the design of its national emblem (Fig. 26). Besides, one important element in the emblem design, the Tiananmen Square is also constructed basing on symmetrical design (Fig. 27).

Fig. 26 National Emblem

Fig. 27 Tiananmen Square in Beijing

Times have changed and so does the way esthetic presents itself to us, the Chinese contemporary design are no longer rigidly adhere to the absolute symmetry, the emergence of asymmetrical balance layout is rising up recently. In modern design, it is very hard to find absolute symmetry, which is replaced by asymmetrical balance (Fig. 28).

Fig. 28 Modern home decoration in China

Based on the exploring of five interactive effects (gander, age, education, online time per week, and experience of online shopping) with layout balance on dependent variables, the results reveal that the factor of time spent online has significant interactive effect on three dependent variables, which means users who had more experience online, are more possible use websites toward balance layout interface. And the factor of age has significant interactive effect on users' emotion. The Mean ranks of old group are larger than young group on three dependent variables. The outputs of a series of two-sample T-Tests indicate that only the Mean rank of perceived attractiveness has a statistical significant difference between two groups.

Furthermore, the results of this study inconsistent with previous studies (Brady & Phillips, 2003). The effectiveness of color harmony does not have significant influence on dependent variables. Users seemed refuse to pay attention on designer-perceived color harmony website, which could spring from that the sample website is an E-retail website, full of colorful products broadcasting images. Therefore, as regards the website design in the future, designer should lay main emphasis on layout structure rather than selective colors against the background of colorful image as the dominant factor

However, several interactive effects might cause bias. First, according to the analysis of interactive effect, the factor of time spends online significantly interactively impact the links between layout balance and three dependent variables. Second, the factor of age significantly interactively impacts the relationship between the effect of layout balance and users' emotion. All participants were divided into two groups (young group: below 40-year old; old group: above 40-year old) based on the age of the first generation of Chinese computer learners. Results indicate that although the average ranks of old group is larger than young group on three dependent variables. Third, the factor of education significantly interactive influences the relationship between color harmony and users' behavioral intention. By re-categorizing all participants into university group and non-university group, non-university group had high Mean scores of three dependent variables than university group. The outputs of a series of two-sample T-Tests indicate that only the Mean scores of perceived attractiveness and behavioral intention have statistical significant difference between non-university group and university group.

5.2 Limitations

There are several limitations in current study. First, because the respondent-driven sampling technique is executed in experiment, participants cannot be fully controlled. Part of participants might share one computer, which means they might talk and influence each other, that might bias results of this study. Second, majority of factors possibly effects on users' emotion in real life shopping experience. But, a pre-text of users' emotions is missed in this study. Thus, the results could not confirm the prediction that the effectiveness of aesthetic interface has positively influence on users' emotion. Third, only 11 participants are older than 40 years old in current experiment, a Non-parametric test has to be conducted for comparing young group and old group. Finally, contrast to the population of China, the sample size of this study nevertheless is limited, which may make generalization difficult.

5.3 Contributions

Despite these limitations, the study has several contributions to website designers and researchers interesting with this issue.

For practiced design

In summary, two suggestions are offered to practical website designers. First, users prefer website interface with GSL than with SBL. Thus, we suggest website designer apply Golden Section layout for homepage design. Second, if E-retail Website includes lots of colorful product images, then designers should concentrate on the structure of website rather than the color scheme of interface frame.

For further research

Finally, there are two suggestions for researches who are interested with this issue in the future. First of all, due to a pre-test of emotion did not be conducted before exposed stimuli, the correlation between users' emotion and use intention cannot be proved in this study. The further research could follow this direction and replicate this experiment.

Secondly, although the respondent-driven sampling technique is very useful and a cheap approach to obtain Chinese participants, another advice here that future researchers should carefully broadcast questionnaire. Hotmail is not so popular in China. This broadcasting approach could block the channel somewhere, MSN is possibly another option. By MSN, participants can guide next generation, which might be a brilliant idea and crucial for keeping sample size grow up.

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Appendix – A: E-mail

Title: I need your help.

Dear Friends:
This is my friends' graduate thesis test, which is an investigation the emotional reaction of Chinese customers on homepage of E-retail Website. The survey is estimated to take under 10 minutes and you are free to quit at anytime if this survey is inconvenient or makes you uncomfortable. I will gather your name and some personal information, but it wouldn't be used for any commercial purpose.

If you are interested in participating, please go to the link below:
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.26/WebForm/
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.27/WebForm/
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.28/WebForm/
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.29/WebForm/

Due to the sampling size is crucial for the results of the survey, please forward this e-mail to two of your family members, two of your colleagues, and two of your friends (total three male and three female) to invite them join this survey. And if it is possible, please use MSN to notice your people to broad cast it.

Thank you for your help.
Ivy Hong

标题: 我想请你帮个忙。

您好:

这是我朋友研究生毕业论文的测试, 它是关于调查中国顾客对于网络零售网站主页情绪反应的研究。这项调查估计需要 10 分钟。在调查进行的过程中，如果令您感到任何的不适, 您可以随时退出本次调查。在问卷中, 您会被要求填写姓名和一些个人信息, 但它不会用于任何商业目的。 (为了确保实验数据的公正性, 请不要重复参与测试。)
如果您有兴趣参加, 请访问以下链接:
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.26/WebForm/
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.27/WebForm/
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.28/WebForm/
http://practice.gw.utwente.nl/misc/enquete/Home/enquete.29/WebForm/

因为参与人数对于调查的准确性十分重要, 请转发次邮件给 2 位您的家长, 2 位同事, 和 2 位朋友(共 3 男,3 女), 并且在 MSN 上提醒您的朋友们，确保他们会参与此项调查并会邀请他们的朋友。

非常感谢您的协助。
你的朋友

Appendix – B: Online questionnaire

Welcome to E-retail homepage survey!

The survey is estimated to take about 10 minutes and you can quit at anytime if the survey is inconvenient or makes you uncomfortable.

Please remember that the focus of this study is the homepages——not you, so I hope you can be objective, impartial and provide your valuable advice.

(In order to ensure the impartiality of the experimental data, please do not repeat this test.)

1.	Gender	Male	Female					
2.	Age	Under 20	21-29	30-39	40-49	above 50		
3.	Education	Under Secondary school	Secondary school	Vocational school	High school	College	Bachelor	Master	Doctor

4.	How many hours pre week you spend online?	Less than 1hour	1-5 hours	6-10 hours	11-20 hours	Over 20 hours	Over 30 hours
5.	How often did you buy something online?	Never	1-5 times	6-10 times	11-20 times	Over 20 times	Over 30 times

Please observe the website 1-2 minutes, then answer the following questions.

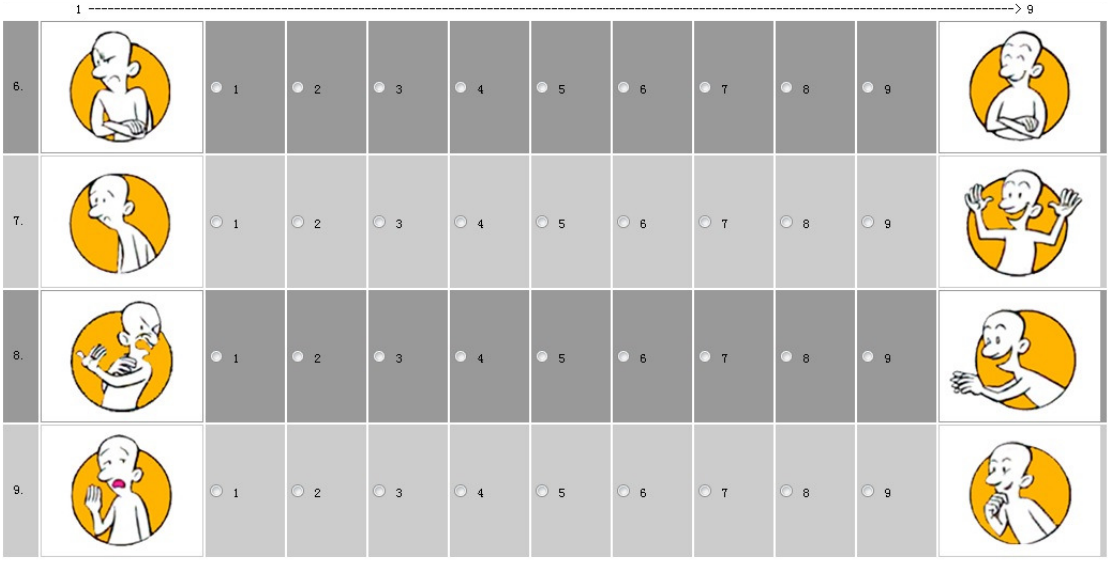
Link: http://practice.gw.utwente.nl/misc/enquete/Home/enquete.26/WebForm/

Link:http://practice.gw.utwente.nl/misc/enquete/Home/enquete.27/WebForm/

Link:http://practice.gw.utwente.nl/misc/enquete/Home/enquete.28/WebForm/

Link:http://practice.gw.utwente.nl/misc/enquete/Home/enquete.29/WebForm/

Please answer the following four questions with emotional scales you felt on the website.



Will you choose this e-retail website, if you intend to buy something online?

Base on the website you observed, answer the following questions: I judge this web page to be

1 ----------> 9

11.	Complex	1	2	3	4	5	6	7	8	9	Simple
12.	Boring	1	2	3	4	5	6	7	8	9	Interesting
13.	Confusing	1	2	3	4	5	6	7	8	9	Clear
14.	Bad layout	1	2	3	4	5	6	7	8	9	Good layout
15.	Bad color	1	2	3	4	5	6	7	8	9	Good color
16.	Ugly	1	2	3	4	5	6	7	8	9	Beautiful
17.	Messy	1	2	3	4	5	6	7	8	9	Orderly

Please forward this e-mail to two of your family members, colleagues, and friends. **Sincerely thank you for your cooperation.**

submit

Please confirm you completed all the questions before submit.

欢迎参于网络零售主页问卷调查!

本次问卷调查是关于调查中国顾客对于网络零售网站主页情绪反应的研究。调查时间大约需要花费10分钟。如果以下调查让您产生任何的不适,您随时可以推出文卷调查。

本次测试只是网站外观不针对个人,因此希望您可以客观,公正的提出您的宝贵意见。

(为了确保实验数据的公正性,请不要重复参与测试。)

1.	性别	男	女						
2.	年龄	20岁以下	21-29岁	30-39岁	40-49岁	50岁以上			
3.	学历	中学以下	中学	中专	高中	大专	本科	研究生	博士

4.	请问你每周上网的时间是多少?	少于1小时	1-5小时	6-10小时	11-20小时	大于20小时	大于30小时
5.	请问你网络购物过几次?	没有	1-5次	6-10次	11-20次	大于20次	大于30次

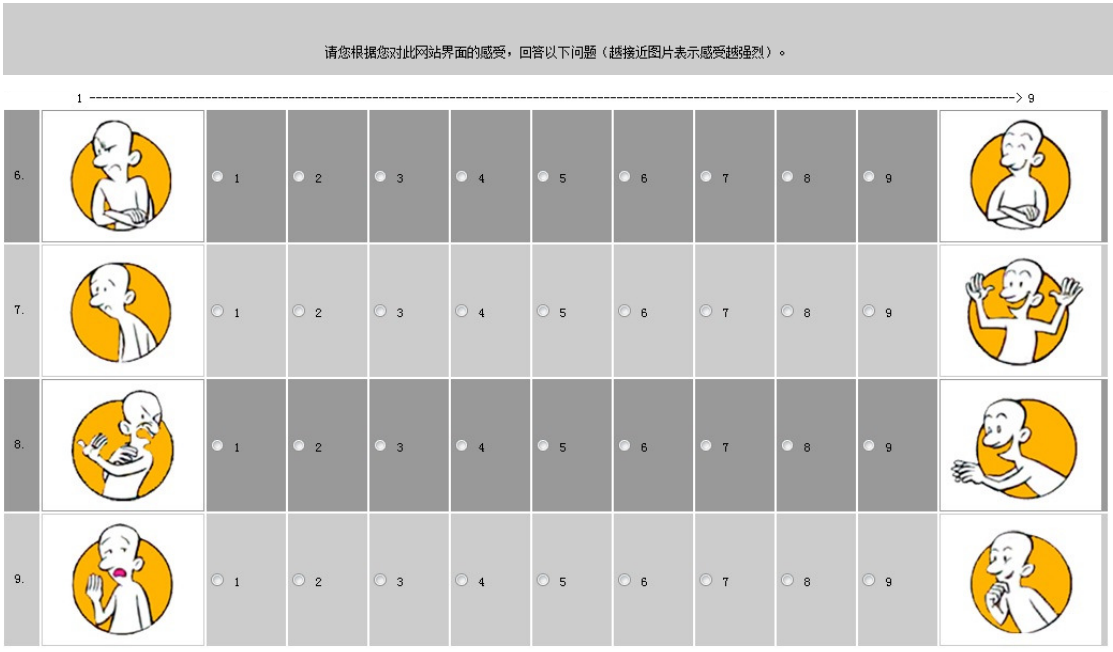
请观察以下网站界面1-2分钟, 回答之后的问题。

Link: http://practice.gw.utwente.nl/misc/enquete/Home/enquete.26/WebForm/

Link:http://practice.gw.utwente.nl/misc/enquete/Home/enquete.27/WebForm/

Link:http://practice.gw.utwente.nl/misc/enquete/Home/enquete.28/WebForm/

Link:http://practice.gw.utwente.nl/misc/enquete/Home/enquete.29/WebForm/



假如您有在网上购买物品的意向， 您在此网站购物的可能性是：

1 ----------> 9

10.	绝对不会	1	2	3	4	5 中立	6	7	8	9	一定会

根据您所看到的网站界面，回答以下问题。

1 ----------> 9

11.	我认为此网站界面非常复杂。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面非常简洁。
12.	我认为此网站界面非常呆板。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面非常活泼。
13.	我认为此网站界面非常混乱。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面非常清晰。
14.	我认为此网站界面的布局非常差。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面的布局非常好。
15.	我认为此网站界面的颜色非常差。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面的颜色非常好。
16.	我认为此网站界面非常丑陋。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面非常漂亮。
17.	我认为此网站界面非常杂乱。	1	2	3	4	5 中立	6	7	8	9	我认为此网站界面非常整齐。

请把此邮件转发给您的2位家长，2位朋友，2位同事（男/女各1位），邀请他们也来参与此项调查。 由衷地感谢您的合作。

提交

请在您“提交”之前确认您已经完成所有的问题。