

The Correlation between Visual Complexity and User Trust in On-line Shopping: Implications for Design

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Abstract. Perceived visual aesthetics of a web site positively affects a user's credibility assessment of the site and less visual complex web page is associated with more favorable attitudes toward the page. Here we further investigate whether the visual complexity of a web site affects its aesthetic preference and as a consequence is associated with the users' credibility. Two experiments with on-line payment scenario were conducted. Experiment 1 shows users trust pages with higher text-based complexity more. Experiment 2 shows perceived image-based complexity is negatively correlated with credibility. Our results show text-based complexity and image-based complexity have different effects on the credibility of on-line shopping site. Designers can decrease image-based complexity of a web site to increase users' aesthetic preference and trust. This work can serve as the fundament to develop an automatic evaluation tools to predict the users' trust and preference of a web page based on the visual complexity computation.

Keywords: Credibility, Aesthetics, Complexity, E-commerce, Visual Design.

1 Introduction

Literature has shown beautiful web sites are often perceived as more trust [1] and more usable [1-6]. For example, User's credibility on a web site can be influenced by the first impression of its aesthetics [7]. Balance, harmony, contrast and dominance, are the major aesthetic elements underlies credibility of a web site [7]. Fogg and colleagues [8] asked 2,684 participants to rank the degree of credibility and collected the reasons behind their ranks. They found that when people evaluate the credibility of a web site, the design look is mentioned more often (46.1%) than any other features, such as information design/structure (28.5%), information focus (25.1%), company motive (15.5%), usefulness of information (14.8%), accuracy of information (14.3%) and so on. Robins and Holmes [9] compared 20 web sites which have identical contents but two levels (low and high) of aesthetics and suggested that the level of the aesthetics of a web page is highly correlated with the degree of the judgments of credibility of the page and, as a consequence, it affects the user's willingness to stay in the current page or move on to another web page. They also found that before any type of complex conscious cognitive analysis occurs, credibility judgments are

already made based on the perceived visual design elements, such as the combination of colors, layout, overall aesthetic treatment, fonts, use of bulleted lists, or presentation of tabular data. These findings show the critical role of aesthetics and design in the credibility of a web site.

Trust is particularly an important issue in e-commerce. Ang and Lee [10] claimed that “If the web site does not let a consumer to believe that the merchant is trustworthy, no purchase decision will be made”. The level of trust of online shoppers towards the web sites is one of critical factors affecting the consumers' online purchase decision [10-12]. To build a trustworthy web site has become the primary key for online shops. All successful web pages should make people feel confident, joyful, or arouse some positive emotion [8]. The visual design is not just about “what is communicated but rather about how information is communicated” [13, 14]. However, how to design a beautiful on-line shopping web site which arouses users' positive emotions and credibility during the interaction is not easy for designer.

Wang and Emurian [15] suggests that the trust between on-line shoppers and shops can be influence by the visual design of e-commerce interface. Alsudani and Casey [7] used a more theoretical and systematical framework to investigate how visual elements of a web site influence its credibility and offers some guidelines about affective design factors on credibility which helped web page designers to evaluate the design factors on the credibility. Wang & Emurian [15] have also proposed 14 design features which can induce user trust. They created a web site following these features so as to demonstrate how designers can apply these design features on the web site, particularly when they want to increase the user trust. However, although these 14 design features, such as the use of three-dimensional and half-screen size clipart, the symmetric use of moderate pastel color of low brightness and cool tone and so on, could become the constraints limiting visual design space, designers still do not know whether their design match the guidelines without user testing. While design process should allow web site designers more space to express their ideas, creativity and personal styles or allow a company to express their traditional value and identity via the details, aesthetics and the styles of visual designs, it should be accelerated by more efficient and effective evaluation tools or process.

Studies have also shown that the visual complexity is highly correlated with the visual aesthetics [16, 17, see 18 for a review]. For example, Michailidou, Harper and Bechhofer [16] found the correlation between visual complexity and aesthetics and layout. In a series studies, Tuch and colleagues [18-20] show that users prefer web sites with lower visual complexity. They [18] found the less complex web design is associated with psychophysiological responses, such as lower experienced arousal, more positive valence appraisal, higher heart rate and lower facial muscle tension and with cognitive responses, such as shorter visual search time and higher recognition rate after one week. This study shows that the visual complexity has effects on human emotion and cognition. More recently, they found less complex web page results in higher emotion, fewer eye movements and larger finger pulse amplitude [19].

Moreover, Researchers have proposed several ways to calculate visual complexity based on the text and images occupied in the space [21, 22], on the boundary [21, 23], on the number of colors used in the web page [22], or on the number of leaves resulting from a quadtree decomposition of the image [24]. For example, Zheng and colleagues [24] found that web sites that have higher number of leaves calculated by

the quadtree decomposition of the image often are perceived as unprofessional and complicated. More recently, also based on the computation of spatial distribution of the resulting leaves of the quadtree decomposition, Reinecke and colleagues [25] found the perceived complexity is highly correlated to the calculated visual complexity and the visual complexity negatively affect the visual aesthetic preference. Therefore, there is a chance for us to evaluate the visual complexity and aesthetics by calculating the visual complexity on the web page.

Based on the abundant evidence has showed that aesthetics play an important role in credibility [1, 7-9, 26, 27] and aesthetics is affected by the visual complexity [16-20], here we aim to further investigate whether the visual complexity of a web site affects its aesthetic preference and, as a consequence, influence the users' credibility. We found the credibility and text-based complexity is positively correlated and credibility and image-based complexity is negatively correlated. The results of this study can further be applied to develop an automatic evaluation tool based on the computation of visual complexity [25]. The automatic evaluation tool can help designers to assess the level of visual complexity of visual designs and then predict the level of the credibility earlier in the iterative design cycle to reduce the cost of user testing.

2 Experiment 1

In Experiment 1 the correlations between variables, such as calculated complexity, user perceived complexity, and trust in an on-line shopping web page were investigated. The major factor which affected the visual complexity in the Experiment 1 is the amount of text using in the page. Therefore, the visual complex in Experiment 1 is the text-based complexity.

2.1 Method

A real life scenario was created to simulate the payment activity in an on-line web page. Participants were provided experimental tokens to pay the product on the experimental web page. They were asked to select one of the five experimental pages to pay and finish the buying. However, they were informed in advance that four of the five web pages are scams. If participants paid in the scam web site, the tokens would be taken away. Only one of the web sites rewarded the product on the web site. The scam and the reward web sites were randomly assigned. This design motivated participants to choose an interface that they trusted most. Participant's selection time and score (1 to 100) of the perceived visual complexity and credibility were collected and analyzed. After all the stimuli were shown, participants were also interviewed to understand the possible different strategies and decision reasons underlying their choice.

Participants. Twenty participants, including 13 males and 7 females, were recruited from the community of National Cheng Kung University. They were asked to pick a web page to finish a simulated shopping and evaluate the credibility, preference, and perceived visual complexity. Adult participants aged over 20 were chosen. The female average age is about 21.7 and the male average age is about 22.3.

Apparatus. ACER Aspire S3-391 was used to run the samples during the experiments, products picture were downloaded from Apple.com. Adobe Photoshop CS5 and Adobe Illustrator CS5 were used for Web page design preparation. The score of the perceived visual complexity and credibility of a web page was evaluated on paper sheets.

Stimuli. We designed five on-line shopping web pages having different amount of text information (see figure 1). All design features of the web page were based on the trust-inducing features proposed by Wang and Emurian [15]. Five levels of the text-based complexities of the created web pages were adjusted by the Quadtree decomposition method. The computation code is provided by Reinecke and colleagues [25].



Fig. 1. The experimental web pages of Experiment 1. The calculated visual complexity score by the Quadtree decomposition method [25] is: (a) 2.23, (b) 3.70, (c) 5.99, (d) 7.90, (e) 9.88, respectively.

Procedure. The 5 levels of text-based complexities were arranged in a counterbalanced manner. First, a sample web site picture was shown to allow participants familiar with the experiment. After providing the introductions, participants started the experiment. Participants had unlimited time to examine sample web pages until they selected the sample page that they trusted most to finish the buying. The score of the credibility and the perceived visual complexity were then collected by paper sheets. First, participants ranked the sample web pages and then gave each of them a score of the visual complexity and a score of the credibility. Participants were also asked their subjective reasons underlying the choice.

2.2 Results and Discussion

First of all, the calculated visual complexity is positively related with users' perceived complexity ($R^2=0.59$, $p < .001$). This result validates that the visual complexity of Experiment 1 was successfully calculated by the program of Reinecke and colleagues [25]. Figure 2 shows that the calculated text-based visual complexity of a web page is positively related with users' credibility ($R^2=0.363$, $p < .001$). Figure 3 illustrated that the correlation between credibility and perceived complexity is also positively correlated ($R^2=0.501$, $p < .001$). This result indicates that the more text information on an on-line shopping web page, the more trust from the users. Although the more text information increases the complexity of a web page, but it provides user more useful information about the web page and, as a consequence, more trust toward the web page.

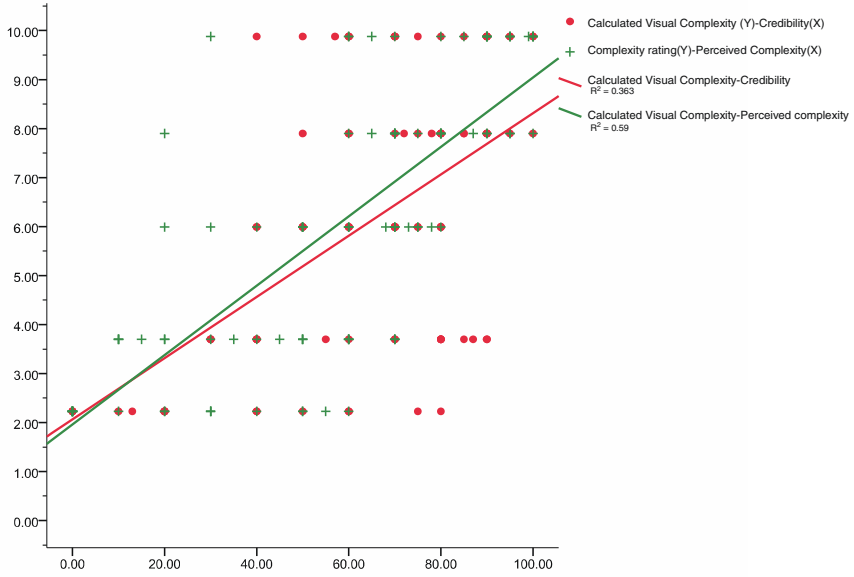


Fig. 2. Experiment 1. The calculated visual complexity is correlated with the credibility (red line, $R^2=0.363$, $p < .001$), and with the perceived complexity (green line, $R^2=0.59$, $p < .001$).

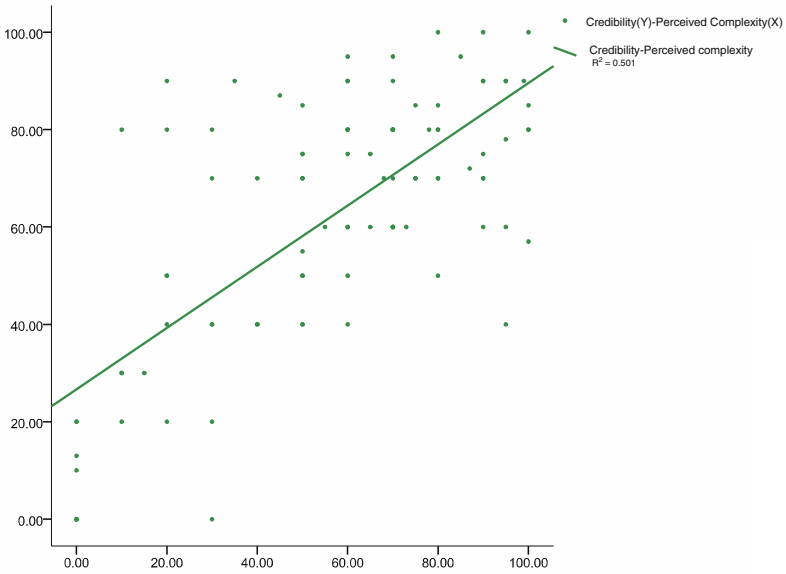


Fig. 3. Experiment 1. The correlation between credibility and perceived complexity (green line) ($R^2=0.501$, $p < .001$).

3 Experiment 2

3.1 Method

The five different complex web pages in the Experiment 1 were majorly manipulated by different amount of text information. To investigate the correlation between image complexity and credibility, the 5 levels of image-based complexities were manipulated by adjusting the image elements used in the web pages in the Experiment 2. The different levels of image-based complexities were evaluated by the Quadtree decomposition method used in [25] (see Figure 4).

Except for the 5 experimental web pages, the other settings in the method of the Experiment 2 were kept the same as Experiment 1. The 20 participants in the Experiment 2 were also the same as the Experiment 1.



Fig. 4. The experimental web pages of Experiment 2. The calculated visual complexity score is: (a) 2.68, (b) 4.15, (c) 5.42, (d) 6.66, (e) 5.49, respectively. Comparing to Experiment 1, the lower score here is because the calculated visual complexity score by Quadtree decomposition method used in [25] is hard to increase only by adding images in the web page.

3.2 Results and Discussion

First, the visual calculated visual complexity is positively related to user perceived complexity ($R^2=0.333$, $p<.001$). Again, this result validates the codes of the computation of visual complexity used in this Experiment. Figure 5 shows that calculated visual complexity of a web page is negatively related with user perception of credibility ($R^2=0.053$, $p<.05$). This indicates that the amount of image content in an on-line shopping web page has an effect on the credibility of the page. The users' attitudes toward the trust of a web page increase as the decrease of the level of its image complexity. Moreover, visual complexity score of a web page is negatively correlated with the aesthetic preference ($R^2=0.093$, $p=.002$). This result is consistent with the previous findings of Tuch and colleagues [18-20].

Figure 6 shows that the correlation between variables. The correlation between credibility and aesthetic preference is positive ($R^2=0.671$, $p<.001$), while the correlation between aesthetic preference and perceived complexity, and the correlation between credibility and perceived complexity is negative ($R^2=0.161$, $p<.001$, $R^2=0.099$, $p=.001$, respectively). These results show that the image complexity reduces the users' aesthetic preference and credibility judgment.

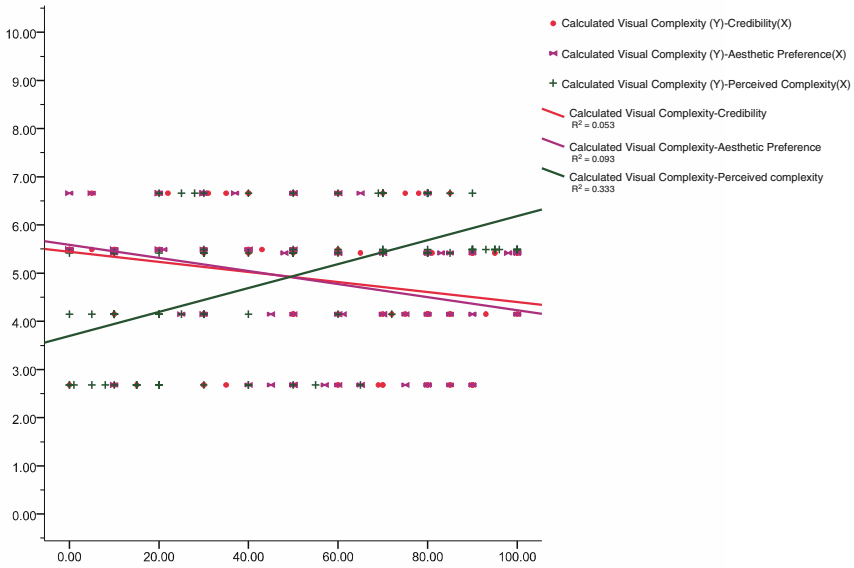


Fig. 5. The calculated visual complexity is negatively correlated with the credibility (orange line, $R^2=0.053$, $p < .05$), and with the aesthetic preference (purple line, $R^2=0.093$, $p = .002$), and positively correlated with the perceived complexity (green line, $R^2=0.333$, $p < .001$)

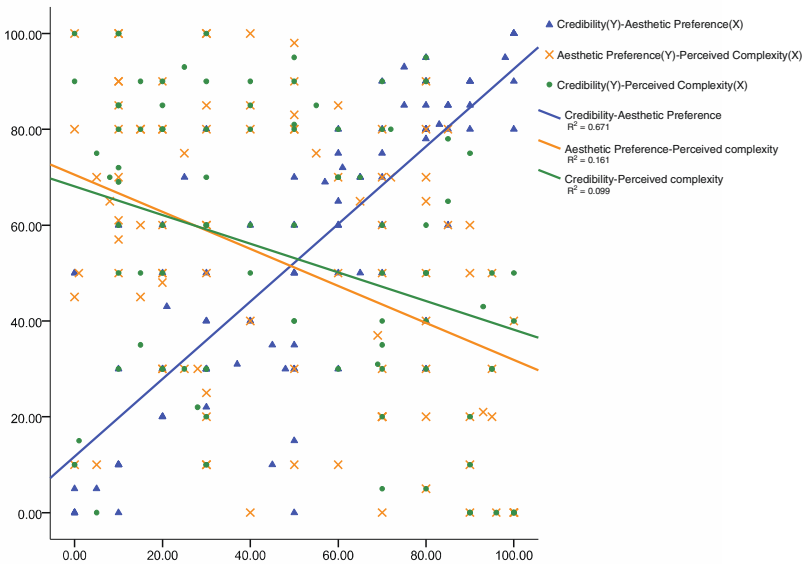


Fig. 6. Experiment 2. The correlation between variables, such as credibility and aesthetic preference (blue line, $R^2=0.671$, $p < .001$), aesthetic preference and perceived complexity (yellow line, $R^2=0.161$, $p < .001$), and credibility and perceived complexity (green line, $R^2=0.099$, $p = .001$).

4 General Discussion

The present two experiments investigate the correlation between visual complexity of a web page and user's credibility perception. The results of the both experiments show the perceived complexity is highly correlated to the calculated complexity which is based on the number of leaves by the quadtree decomposition of an image [24, 25]. This result validates the methodology of the computation of the visual complexity used in previous work [24, 25]. However, when we prepared the visual materials for the Experiment 2, the image-based complexity is not easy to increase by only adding the image elements without increasing the text information. Therefore, the computational model used in [25] seems to be more appropriated to calculate text complexity rather than image complexity. More investigation of the complexity computation is needed in the future.

Our main finding was that the credibility perception is highly correlated with the visual complexity of the on-line shopping web page. The results of Experiment 1 show that the amount of text information is positively correlated with the credibility perception. In Experiment 1 the visual complexity of the stimuli was increased by adding related shopping information in the page (see figure 1). This result indicates that the more related shopping information in an on-line shopping web site, the more trust the users may have. Moreover, the more text information web sites in the Experiment 1 look more similar to the popular on-line shopping site in Taiwan, according to the participants' answers in our interviews. In Fogg and colleagues study [8], information focus and usefulness of information is mentioned 25.1% and 14.8% respectively when evaluating the credibility of a web page. Focus and useful text information seems a factor to increase the trust. The future study can focus on understanding how the relevant level of the text information (e.g. the degree of focus and usefulness) affects the credibility perception.

Experiment 2 shows that the amount of image elements is negatively correlated with the aesthetic preference. The negative correlation between visual complexity and aesthetic preference is in line with the previous works by Tuch and colleagues [18-20] which shows that the lower visual complex web page gains the more positive emotion and aesthetic judgment from the users. The evidence of Experiment 2 also shows that the credibility perception is positively correlated with the aesthetic preference. This finding is in line with previous results [1, 7-9, 26, 27] showing that aesthetics play an important role in the credibility perception. People trust a more beautiful on-line shopping web site more than less beautiful one. More interestingly, we found for the first time that the visual complexity is negatively correlated with the credibility perception. Experiment 2 correlates the visual complexity and credibility: image-based visual complexity decreases the aesthetic preference and, as a consequence, is negatively associated with the credibility perception.

The different results of visual complexity on the credibility in the Experiment 1 and Experiment 2 show that the text-based complexity and image-based complexity have different effects on the credibility perception. The text-based complexity may provide more related shopping information which allows people feel confident toward a on-line shopping web site. It seems that a web site having more useful and focus information is a more trustworthy web site [8]. The image-based complexity may confuse the user when searching useful information and result in less trust.

The reasons underlying the difference effects between text-based complexity and image-based complexity on the credibility is interesting for further study in the future.

Recent study [25] shows a possible way to predict the aesthetic preference of a web page based on the computation of its visual complexity, because the high correlation between visual complexity and aesthetic preference [1, 7-9, 26, 27]. The present study further establishing the relationship between visual complexity and credibility provides the fundament to develop an automatic evaluation tool to predicts user preference and trust. This tool can help designers to check visual layout earlier in the design cycle and reduce cost of iterative user testing. This work strongly suggests that the image-based complexity is the major factor which influence user's preference and trust. This work also provides the web page designers flexible guidelines to increase the trust of a web page by adjusting visual design elements while maintaining the content information.

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