



# The Influence and Moderation of Perceived Visual UI Complexity on User Preference in Social Media Apps

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**Abstract.** This study focuses on investigating two key visual factors influencing user preference levels: perceived visual element density and visual structural clarity. An experimental design was implemented across four platforms—WeChat, Douyin, Weibo, and Xiaohongshu—to collect user feedback on interface visual design, with statistical analysis conducted using a two-factor ANOVA. Results indicate that visual structural clarity significantly enhances user preference, whereas visual element density exhibits no significant effect. However, an interaction effect between visual element density and structural clarity shows marginal significance, suggesting that improving structural clarity is crucial for enhancing user experience in high-density interfaces. Consequently, the study recommends prioritising structural clarity in interface design for functionally complex or information-dense interfaces. Concurrently, although high-density interfaces did not significantly negatively impact user preference, designers must still organise information rationally to prevent information overload from adversely affecting user experience. These findings provide empirical support for user experience design and interface optimisation, while offering theoretical foundations for future interface design practice.

**Keywords:** Visual Element Density, Structural Clarity, User Preferences, Interface Design, User Experience.

## 1 Introduction

With the deepening penetration of social media, the quality of user experience and interface design in social applications has become a key factor influencing user engagement and the dissemination effectiveness of mobile applications. On mainstream platforms such as WeChat, Douyin, and Xiaohongshu, users' average daily usage time has surpassed 2.5 hours. As a vital medium for human-computer interaction, the design quality of an application's visual user interface (UI) significantly impacts user behaviour [1].

Currently, many social applications suffer from severe issues such as crowded interface elements, chaotic colour schemes, and unclear functional divisions. These interface characteristics not only risk causing visual fatigue but may also increase cognitive load, thereby diminishing users' overall preference for the application [2]. Research

findings indicate that optimising interface structure and controlling visual complexity are key strategies for enhancing user experience [3].

Consequently, this study delves into the primary effects and interaction effects of two focal metrics—element density and structural clarity—on user preference, centring on the core question: ‘How does visual UI complexity influence users’ preference for social media applications?’

Methodologically, this study first clarified conceptual constructs and variable dimensions through literature analysis. Subsequently, employing a 2×2 between-subjects experimental design, it manipulated two factors—‘element density’ (high/low) and ‘structural clarity’ (high/low)—to create four simulated interface groups. A five-point Likert scale questionnaire measured users’ preference levels for each interface. The research subjects comprised application users, including those of WeChat, Douyin, Xiaohongshu, and others, yielding a total of 637 valid responses.

Research objectives encompass: Theoretical significance: to validate the main effects and interaction effects of the two primary dimensions of UI complexity (element density and structural clarity) on user application preferences. Practical significance: to provide quantitative evidence and actionable recommendations for enhancing social application interfaces, thereby further improving user retention and platform competitiveness.

## 2 Literature Review

In an era where social media permeates daily life, the visual user interface (UI) of applications has become the direct medium through which users access information. Its design quality decisively influences both the user experience and overall preference for the application. Research indicates that overly complex interface designs—characterised by cluttered elements, chaotic colour schemes, and disordered information organisation—significantly diminish users’ information processing efficiency and cognitive satisfaction. Conversely, minimalist and orderly UI designs enhance usability while rendering the interface more aesthetically pleasing [4].

From the perspective of optimizing the UI structure, existing research indicates that controlling visual complexity and optimizing the interface structure can effectively reduce cognitive load and increase the rate of comprehension. Excessively complex visual layouts can distract users and negatively influence the overall evaluation of the application [5]. Likewise, Souchet et al, who tracked users’ gaze with an eye tracker and showed that disordered information in interfaces not only increases cognitive load but situational decision making and preference formation [2].

Additionally, research on advertising communication and visual design indicates that design flaws such as colour conflicts and information overload can evoke negative emotional experiences, thereby affecting users’ receptiveness to brands or content [6]. This provides indirect evidence for the influence of interface complexity on user preferences within social media applications.

Although existing studies have laid a foundation for the topic, there is still a significant gap. On the one hand, a majority of studies have concentrated on the impact of

single dimension of UI complexity (e.g. element density or number of colours) on user experience and user preference, and insufficient research has been undertaken on the combined effect of “visual element density” and “visual structural clarity” that can really be considered as the double-side of one coin, thus making the overall influence of this for application preference unexplained. On the other hand, although interface design factor influences significantly users’ preferences, the investigation of whether and how individual differences (e.g., visual perceptual abilities) moderate the relationship between UI complexity and users’ preferences is still lacking. Therefore, the specific linkage between visual UI complexity and user preference within social media application awaits further empirical probe.

### 3 Research Methods

#### 3.1 Research Design

This study employed a 2 (visual element density: low/high)  $\times$  2 (visual structure clarity: low/high) between-subjects factorial experimental design. By manipulating the complexity of visual elements and the clarity of information structure in the interface [7,8], four experimental conditions were established. Each participant was exposed to one set of experimental materials and completed the corresponding evaluation questionnaire. This study was to investigate the main effects as well as the interaction between the two independent variables on the user app preference.

The participants were users of social media apps within mainland China. Participants were recruited via an online survey on the Chinese social media platforms WeChat, Sina Weibo and Xiaohongshu using convenience sampling method. Inclusion criteria were as follows: (i) aged 18 years or older; (ii) had used at least one mainstream social media application in the past month; (iii) had basic knowledge of the interface. A total of 637 valid samples were collected, which were equally divided into four experimental groups: WeChat group (189 cases), Douyin group (170 cases), Weibo group (164 cases) and Xiaohongshu group (114 cases). To ensure data quality, invalid data that failed the attention check or the response time was abnormally too short were removed. All participants gave written informed consent and completed the experiment, and the study was conducted in a manner that the privacy of the subjects and the anonymity of the data were strictly protected.

Based on theoretical analysis and literature review, this study proposes the following hypotheses:

H1: Higher visual element density correlates with lower user preference;

H2: Greater visual structural clarity correlates with higher user preference;

H3: Visual element density and visual structural clarity exhibit an interactive effect on user preference.

#### 3.2 Experimental Materials

**Experimental Stimulus Materials.** This study selected real interface screenshots from four mainstream social media apps (WeChat, Douyin, Xiaohongshu, and Weibo), each

representing a distinct combination of visual UI complexity. To eliminate interference from brand preferences and other factors, sensitive information and brand logos within the interfaces were uniformly processed (Table 1).

Each participant viewed and evaluated only one type of interface material to avoid conditioning effects and intergroup interference.

**Table 1.** Experimental conditions and examples of interface materials.

Experi- mental Conditions	Visual Ele- ment Density	Visual Struc- ture Clarity	Material Examples
Group 1	Low (reasona- ble)	High (reasona- ble)	WeChat Chat Interface (No re- dundant elements, clear func- tional boundaries)
Group 2	Low (reasona- ble)	Low(slightly blurred)	TikTok Recommendation Page (Elements are well-organized, with some features hidden)
Group 3	High (Slight Overload)	High (reasona- ble)	Xiaohongshu Homepage (Float- ing Tags & Multi-Color Cover, Clearly Defined Functional Sec- tions)
Group 4	High(Slight Overload)	Low(slightly blurred)	Weibo feed (floating ads & simi- lar buttons, blurred module boundaries)

**Questionnaire Measurement Tools.** The questionnaire consists of 18 questions across four sections:

- 1) Basic Information and App Usage Habits (4 questions)
- 2) Perception of Visual Element Density (4 questions, e.g., “Do interface elements feel crowded?”)
- 3) Perception of Visual Structure Clarity (3 questions + 1 attention check question)
- 4) User preference level (5 questions, e.g., “willingness to use this interface frequently”)

All questions utilize a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). Data quality was ensured by including one attention check item. All three core constructs exhibited good internal consistency (Cronbach’s  $\alpha > 0.75$ ). The instruments and variables (see Table 2) are consistent with these parts.

**Table 2.** Survey Questionnaire Tools.

Variable Type	Variable Name	Measurement Description	Analysis Method
Independent Variable	Visual Element Density	Material Manipulation (Low/High)	Group Comparison
Independent Variable	Visual Structural Clarity	Material Manipulation (Low/High)	Group Comparison
Dependent Variable	User Preference Level	Mean of 5 Likert 5-point Scale Items	Two-way ANOVA
Manipulated Variables	Perception of density of elements, perception of structural clarity	Average scores for each relevant item	One-way/Two-way ANOVA

### 3.3 Data Analysis Methods

This study employed SPSS 27.0 software for statistical analysis, comprising the following steps:

First, the collected questionnaire data underwent cleaning to exclude invalid samples characterised by excessively short response times, logical inconsistencies, or failure to pass attention detection. Subsequently, descriptive statistics presented the demographic characteristics of the research subjects alongside the mean and standard deviation of key variables.

Secondly, to validate the reliability, validity, and applicability of the measurement tools, Cronbach's alpha coefficients were calculated for the three core variables—visual element density, visual structural clarity, and user preference level. Structural validity was assessed using KMO scatter plots and Bartlett's sphericity test for task ecology. Results indicated that all variables demonstrated satisfactory reliability and validity, permitting subsequent statistical analysis.

Third, in order to test the effectiveness of the experimental material intervention, we used PVED and PEVSD as dependent variables. Perceived differences of subjects under four experimental conditions were compared by one-way ANOVA or two-way ANOVA to demonstrate the success of the intervention of the independent variable.

Finally, to test the research hypotheses, a 2×2 two-way ANOVA was conducted. Visual element density (low/high) and visual structural clarity (low/high) served as fixed factors, with user preference level as the dependent variable. Significant effects were further analyzed using post-hoc multiple comparisons (Bonferroni correction) to identify sources of variation, with effect size measures (Partial  $\eta^2$ ) reported to enhance interpretability.

All statistical tests employed two-tailed procedures with a significance level set at  $\alpha = 0.05$ .

## 4 Research Findings

### 4.1 Data Cleaning and Sample Description

After excluding responses that failed attention checks or contained anomalies, the valid sample comprised N=637 participants (WeChat: 189, Douyin: 170, Weibo: 164, Xiaohongshu: 114). Participants were randomly assigned to one condition within a 2×2 factorial design (Visual Element Density: Low/High × Visual Structural Clarity: Low/High), with each participant evaluating only one interface configuration.

In inferential analysis, user preference, perceived visual element density, and perceived visual structural clarity were quantified by averaging scores across corresponding items, with higher scores indicating more positive evaluations.

### 4.2 Descriptive Statistical Analysis

In order to further elaborate on the difference of the users’ attitude towards the social media application under different experimental conditions, this study performed descriptive statistics on the degree of user preference and the manipulative variables (perceived element density and perceived structural clarity). Results can be found in Table 3.

**Table 3.** Descriptive statistics for each condition of the experiment (Mean ± Standard Deviation).

Element Density	Structural Clarity	N	User Preference	Perceived Element Density	Perceived Structural Clarity
High	High	114	3.646 ± 1.121	3.154 ± 0.940	3.348 ± 0.478
High	Low	164	2.561 ± 1.063	2.716 ± 1.205	3.262 ± 0.537
Low	High	189	3.532 ± 1.202	3.057 ± 1.148	3.277 ± 0.542
Low	Low	170	2.764 ± 1.107	2.935 ± 1.035	2.939 ± 0.593

The mean values' trend presents a very clear trend for all the four conditions of the experiment: the users favored significantly higher interfaces when these were visually more structurally clear (Low Density  $\times$  High Structure:  $M=3.532$ ; High Density  $\times$  High Structure:  $M=3.646$ ), for any given density of visual elements. This confirms that simple, straightforward layouts and quick 'findability' for functions reduce cognitive load, which improves user friendliness as well as interface preference. At the same time, visual element density exerts a rather weak effect. When the structure is low, low density is better than high density ( $M=2.764$  vs.  $M=2.561$ ), but with high structure, high density is better than low density ( $M=3.646$  vs.  $M=3.532$ ). That implies that element density and preference do not linearly relate to each other in a predictable manner, and that this relationship is moderated by structural clarity. About checks on manipulation, the average estimate of clarity of the structure in the high-structure treatments was always above 3.2, and in the low-structure treatments nearly always below 3.0. This also confirms that subjective experiences of participants in the experiment turned out as intended by experimental design, thus confirming the manipulation. Participants also experienced a greater visual load in the high-density condition, but in the high-structure condition, the interface was more comprehensible. Overall trends were clear and consistent with theoretical expectations.

At the descriptive statistics level, even without inferential testing, a trend emerged showing structural clarity exerting a stronger influence on user preference than element density. The latter's impact was found to be context-dependent (i.e., subsequent interaction effect analysis), providing foundational data support for hypothesis testing.

### 4.3 Reliability and Validity Testing

For the questionnaire measurement tools, the reliability and construct validity the internal consistency reliability (Cronbach's  $\alpha$ ) and construct validity (KMO and Bartlett's sphericity test), of the three core scales of density perception of visual elements, clarity perception of visual structures, and user preference level were analyzed (Table 4).

The results of the reliability analysis indicated that the values of Cronbach's  $\alpha$  for all three scales on both platforms were above 0.70. In particular, the User Preference Scale had excellent internal consistency ( $\alpha > 0.90$ ) across all related studies. The Visual Element Density Perception Scale showed high reliability ( $\alpha \geq 0.81$ ). Although the Cronbach's  $\alpha$  of Perception Scale of the Clarity of Visual Structure was lower due to less items, it was still higher than 0.63, which could be considered as an acceptable level and hence the stability of the scale items was confirmed.

Concerning the validity test, the KMO values of the related scales on the four platforms were between 0.81 and 0.88, which could be accepted as "good" and "very good". Bartlett's sphericity test was positive for all the platforms ( $p < .001$ ), implying that the variables were sufficiently correlated with each other to be considered for further factor analysis and for the inferential procedure. Therefore, the instruments used in this study are valid and reliable on different platform and under different experimental manipulation, which will be further proved by data analysis, and employed to draw valid conclusion.

Taken together, the questionnaire had good content stability and model fit and the observed variables of the questionnaire truly represented what the participants perceived (which are psychological constructs such as “visual perception of interfaces” or “user attitudes”). This ensures a solid basis for the hypotheses testing to follow.”

**Table 4.** Table of cross-platform reliability and validity test results comparison.

APP	Variable Construct	Cronbach's $\alpha$	KMO	Bartlett's Sphericity Test $\chi^2(df)$	Significance
	Element Density Perception	0.891			
WeChat	Structural Clarity Perception	0.818	0.875	1127.248 (66)	<.001
	User Preference Level	0.947			
	Element Density Perception	0.876			
TikTok	Structural Clarity Perception	0.745	0.819	777.173 (66)	<.001
	User Preference Level	0.823			
	Element Density Perception	0.781			
Weibo	Structural Clarity Perception	0.635	0.869	969.502 (66)	<.001
	User Preference Level	0.778			
	Element Density Perception	0.810			
Xiaohongshu	Structural Clarity Perception	0.770	0.875	514.712 (66)	<.001
	User Preference Level	0.928			

#### 4.4 Manipulation Check

In order to check if the experimental materials could effectively lead the participants to notice the difference in visual complexity, this study carried out a  $2 \times 2$  ANOVA with “the perceived average density of visual elements” and “the perceived average clarity of visual structure” as dependent variables.

Results are as follows:

**Perceived Visual Element Density.** The main effect of density was non-significant,  $F = 0.702$ ,  $p = .402$ . Although the high-density condition obtained a slightly higher mean in visual load than the low-density condition, the difference was not statistically significant. The main effect of structural clarity was significant ( $F = 8.561$ ,  $p = .004$ ), reflecting that structural clarity had a significant effect on perceived visual load.

**Perceived Visual Structural Clarity.** The main effect of structural clarity was significant, ( $F = 27.88$ ,  $p < .001$ ). High structural clarity interfaces reduced perceived burden significantly, in line with experimental predictions.

**Interaction Effect** A significant interaction effect was also found between element density and structural clarity ( $F=8.218$ ,  $p = 0.004$ ), implying that the effect of structural clarity on perceived load was stronger in high-density environments.

In conclusion, the manipulations were successful, in that participants were guided to attend to differences between conditions, and that success was confirmed by the results of the manipulation check.

#### 4.5 Hypothesis Testing

In this study the  $2 \times 2$  ANOVA was used to investigate between-subjects effects of the density (low/high), the visual structural clarity (low/high) on user preference (dependent variable) to test hypotheses H1 to H3. The hypotheses are as follows:

H1: High-density interfaces lead to decreased user preference for the interface.

H2: High structural clarity interfaces enhance user preference.

H3: There exists an interaction effect between visual element density and structural clarity, meaning interfaces with high density and low structural clarity yield the worst user experience.

Based on the analysis results in Tables 3 and 4: First, the main effect of visual element density (H1) failed to reach significance ( $F(1, 633) = 0.702$ ,  $p = .402$ , Partial  $\eta^2 = .001$ ). This finding indicates that visual element density exerts a weak influence on user preference, thus failing to support H1. One possible reason could be that although dense information interfaces are information-rich, the orderly presented information and simple visual design then seem to have no more than a mild negative effect on user preference, which may be offset by other user interface dimensions.

Second, the main effect of visual-organizational clarity (H2) was significant,  $F(1, 633) = 8.561$ ,  $p = .004$ , Partial  $\eta^2 = .013$ , indicating that structural clarity significantly promoted users' preference, which supported H2. More specifically, high structural clear interfaces allow users to search information and functions more quickly on it, decrease the cognitive load and increase user preference significantly. This result is

consistent with relevant research on user experience, which suggests that structural clarity is a decisive element of interface design that contributes to the increase of user satisfaction and experience.

Finally, for the interaction effect (H3), a marginally significant interaction was observed between visual element density and structural clarity ( $F(1, 633) = 3.214, p = .074, \text{Partial } \eta^2 = .005$ ). While not reaching conventional significance ( $p < 0.05$ ), this finding indicates a potential interplay between the two variables. That is, in the high-density condition, low structural clarity interfaces might result in worse user experience while the negative effect of high-density interfaces can be well alleviated by high structural clarity. Although the interaction effect was not fully significant, in future study, increasing the sample size or modifying the experimental design could lead to further confirmation of this effect.

In summary, results show that visual structural clarity has an impact on user preference, but visual element density has no effect on user preference. In addition, the close to significant interaction of visual element density by structural clarity suggests that a high level of structural clarity can compensate for the detrimental effects of high-density interfaces to some degree. These findings give empirical support to interface design, with structural clarity being the key mediator in achieving a positive user experience.

#### 4.6 Simple Effects Analysis

According to Table 5, the two-factor ANOVA revealed a marginal significant interaction effect of Visual Element Density x Visual Structural Clarity ( $p = .074$ ), which is visually depicted. The interaction failed to reach traditional significance ( $p < .05$ ), but this tendency suggests that the effect of structural clarity on the user experience is especially strong for the high-density condition. To have a better understanding of this interaction, we conducted a simple effects analysis.

Comparing groups within conditions, we observed that the effect of structural clarity was rather small in the low-density condition. On the other hand, when under high-density conditions, users were very inclined to interfaces with high structural clarity than the low one. These result, shown in Table 6, indicates that the structural clarity has a more important function especially in the finding in information-laden interfaces

**Table 5.** Comparison of perceptual test results for manipulated variables between platforms.

Effect Type	F(1, 633)	p	Partial $\eta^2$
Main Effect of Element Density	0.702	.402	.001
Main Effect of Structural Clarity	8.561	.004	.013
Interaction Effect	3.214	.074	.005

**Table 6.** Comparison of the effect of manipulation and the interaction effect on different platforms.

Effect Type	F(1, 633)	p	Partial $\eta^2$
Main Effect of Element Density	22.372	<.001	.034
Main Effect of Structural Clarity	27.882	<.001	.042
Interaction Effect	8.218	.004	.013

## 5 Discussion

The aim of this research is to analyze the impact of the visual element density as well as the visual structural clarity on the level of users preference. The experimental results show that visual structural clarity has a significant effect on the level of user preferences, but visual element density has no significant effect on the level of user preferences. Firstly, although the high-density interfaces visually presented more information load, users mentally processed more levels of information in the visual display (the higher levels of levels of information = LOI) with good design informed the users, resulting in non-significant effects on user preferences). By contrast, structural clarity has a strong positive influence on user preference. Distinct interface layouts and a logical organization of information greatly contribute to increasing users' preference to the interface in accordance with findings from other research in user experience. This suggests that straightforward structural arrangement is influential in positively affecting user satisfaction and experience efficiency.

Although visual element density did not have a significant effect on user preference, a near-significant interaction between element density and structural clarity was found in this study. Therefore, we can expect that, in high-density interfaces, increments of structural clarity will have a great positive effect on the level of user preference. In high-density interfaces, insufficient visual information organization may overload users' cognition and then influence their preferences. Conversely, the negative effects of information overload can be remedied by good structural organisation of the interface in high-density screens [9].

These results provide essential guidelines for designing interfaces. Visual structural clarity Firstly, visual structural clarity should be emphasized, especially for multi-functional or information-intensive UI [10]. Clear interface layouts enable designers to lessen cognitive burden and improve user satisfaction and performance. Second, although high-density interfaces do not greatly influence users' favor, designers should pay more attention to present and organize information clearly when introduce more visual information in order to avoid visual overload. Finally, the finding of interaction effects also indicates that to maximize visual structural clarity is especially important

when high density interfaces are used in order to be able to effectively search for information and to realize a high quality user experience [11].

There are also limitations to this study. First, it was based on data from only four platforms and concentrated on two variables within interface design—the density of visual elements and structural clarity. Future studies can extend to more platforms and other aspects of interface design such as color, typography, and layout to validate the findings. Second, this study is based entirely on self-reported data. Future investigations may involve objective measure such as physiological responses, eye-tracking to evaluate more wholly the influence of visual design on cognitive load of users and their emotional responses. In addition, research and designs of longitudinal studies could be applied to investigate the effect and evolution of interface design for long-term use.

## 6 Conclusions

This paper is focused on analyzing the effect of visual element density and visual structural clarity on users' preference, especially on social platforms with information-dense layout. Through the processing of empirical data from four platforms (WeChat, Douyin, Weibo, Xiaohongshu), some key findings are generated. The visual structural clarity also exerts a positive effect on user preference, which indicates that users are willing to use a highly structured interface. Users find information and functions more quickly, and they can do so with less cognitive effort, resulting in a better experience. Concise structural design is also important, especially for an interface-based complex function or large quantity of information. On the other hand Visual Element Density did not reach statistical significance as a predictor of user preference, however this does not mean that high-density interfaces cannot be useful. Properly designed high-density displays that categorize the information and screen layout enable users to absorb the information without being overwhelmed, hence not necessarily decreasing preference.

Second, there was a marginally significant interaction effect of visual element density and structural clarity (which was more similar to an effect size description rather than an explanation). Users experience more positive effects on high density interfaces by an increase of structural clarity, while on low density interfaces the effects of structural clarity are rather weak. This result is highly informative for designers: increasing structural clarity is the most important factor in the improvement of user experience in the context of high-density interface design.

This research makes a contribution to establishing a theory and practice of interface design in the influence of visual complexity and structural clarity. Structural clarity should be foremost in a designer's mind so that potential users can make sense of, and use, an interface. Additionally, although high-density interfaces do not seem to dramatically influence user preference, anyone who is designing in a information-dense environment (particularly those who are creating sequences of designs like us) should be mindful that clarity of design and organization of information across screen (and beyond screen) is crucial to managing cognitive load.

Nonetheless, this study is not without limitations. First, as the study is based on data obtained from four platforms only, further studies could incorporate more platforms

and different types of applications. Second, the present research was concerned with two variables — visual component density and structural coherence — yet these, and other visual variables (color, font, contrast, and so on) may have an influence on user experience. Future studies should take into account the effects of these factors. Future studies could also consider combining physiological and eye-tracking methods to assess users' visual load and emotional reactions in a more objective and holistic manner.

In sum, the present study offers empirical evidence for the benefits of managing visual element density and structural complexity in interface design. Its suggestions for improving user performance by structural design of multifunctional and information richness interfaces are of high applicability.

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