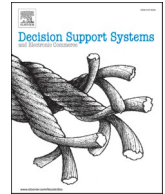


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Authors	Han,Yu; Zhang,Ziqiong; Ou,Carol X. J.; Zhang,Zili
Published in	Decision Support Systems
DOI	10.1016/j.dss.2025.114496
Publication Date	2025-09
Document Version	publishersversion
Link	https://research.tilburguniversity.edu/en/publications/aaa1207c-d535-4e5d-a822-e4d361ab18ff
Citation	Han, Y, Zhang, Z, Ou, C X J & Zhang, Z 2025, 'The more aesthetic, the better? The impact of photo aesthetics on perceived review helpfulness', Decision Support Systems, vol. 196, 114496. https://doi.org/10.1016/j.dss.2025.114496
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The more aesthetic, the better? The impact of photo aesthetics on perceived review helpfulness

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ARTICLE INFO

Keywords:

Photo aesthetics
Perceived review helpfulness
Pleasure
Perceived effort
Perceived authenticity

ABSTRACT

Review helpfulness is crucial for assessing the quality of online reviews and mitigating information overload. Although numerous studies have explored the impact of textual and reviewer characteristics on review helpfulness, the role of photo aesthetics remains important but underexplored. This study addresses this gap by investigating the impact of photo aesthetics on perceived review helpfulness and its underlying mediating effects. The hotel review data from TripAdvisor.com exhibit an inverted U-shaped effect of photo aesthetics on perceived review helpfulness, in which review text length moderates this relationship. To further validate this causal relationship and explore the underlying mediating effects, an experimental study is conducted. The experimental results confirm the causal impact of photo aesthetics on perceived review helpfulness and reveal that perceived pleasure, reviewer effort and review authenticity mediate the relationship. These novel insights challenge the notion that “the more aesthetic, the better” for review photos, offering new theoretical and practical implications.

1. Introduction

Online reviews help consumers reduce the uncertainty and risks associated with online shopping and have become one of the most trusted sources of information in their daily online shopping experiences [1]. Photos and text are both essential components of online reviews, which jointly influence consumers' perceptions of review helpfulness. Photos complement textual reviews by providing visual cues of travel experience [2]. It is often believed that “a photo is worth a thousand words,” [3] with photos being more vivid, attention-grabbing, and easier to understand [4]. However, most relevant studies have focused on how the textual content of online reviews [5–8] and reviewer-related characteristics [9–12] affect review helpfulness while overlooking the nuanced impact of review photos in this process. Therefore, this study focuses on the effect of review photo characteristics.

Visual aesthetics can influence readers' first impressions within 100 milliseconds [13], thus serving as a critical dimension for evaluating photo quality [14]. It is often assumed that higher aesthetics are better, and existing studies have suggested a positive linear relationship between photo aesthetics and review helpfulness [15–17]. However, according to optimal stimulation level (OSL) theory [18], individuals

typically prefer a moderate level of environmental stimulation [19,20]. When stimulation surpasses this optimal level, further increases in aesthetic appeal may yield diminishing returns [21]. The nuanced effects of photo aesthetics are overlooked in the typical assumption of a simple linear relationship, so the comprehensive and diverse influences between photo aesthetics and perceived review helpfulness need to be explored further. Specifically, we argue that while photo aesthetics can enhance review helpfulness [15–17], excessively high aesthetics may trigger a disconfirmation effect [22]. This may stem from overly polished photos being perceived as inauthentic, as imperfect images are often considered more realistic [23]. As a result, the perceived falsity resulting from excessively high aesthetics can diminish readers' perceptions of review helpfulness. Based on these possibilities, we suggest an inverted U-shaped relationship between photo aesthetics and perceived review helpfulness. Our work challenges the notion that “the more aesthetic, the better” by comprehensively considering the positive, negative, and nonlinear effects of photo aesthetics on perceived review helpfulness.

Current research on photo aesthetics in the consumer review process remains limited, lacking causal validation and exploration of underlying mechanisms [15–17]. To fill this gap, we draw on stimulus-organism-

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<https://doi.org/10.1016/j.dss.2025.114496>

Received 28 July 2024; Received in revised form 20 June 2025; Accepted 20 June 2025

Available online 22 June 2025

0167-9236/© 2025 Elsevier B.V. All rights reserved, including those for text and data mining, AI training, and similar technologies.

response (SOR) theory [24] to explain the causal impact of photo aesthetics on the voting of review helpfulness. As environmental stimuli, photo aesthetics (S) influence readers' organism (O), including their affective and cognitive states, thereby impacting their behavioral response (R) in helpfulness voting. Existing research has shown that visual aesthetics can enhance users' positive affective states in context of online shopping [25]. Visual aesthetics also guide individuals through cognitive processes. For instance, visual aesthetics in product design enhance consumers' perceptions of producers' efforts [26], while aesthetic imperfections in avatar endorsers influence users' perceptions of brand authenticity [23]. Though conducted in different contexts, these studies provide fragmented evidence that suggests individuals' affective and cognitive states may mediate the relationship between photo aesthetics and perceived review helpfulness. Our work provides new insights into the underlying mechanisms, contributing to a deeper understanding of photo aesthetics in helpfulness voting.

Furthermore, we argue that the impact of photo aesthetics on perceived review helpfulness may vary depending on review text length. According to cognitive overload theory, the brain's limited capacity can be overwhelmed by excessive information [27]. In the context of online reviews, review length serves as a key indicator of cognitive overload [28]. Long reviews often contain a large amount of information and a lack of structure, which increase cognitive load for readers and deplete their limited cognitive resources [29]. This leads to a reduction in cognitive resources allocated to photo aesthetics and weakens the reader's processing path for photo aesthetics. Therefore, it is necessary to explore the impact of photo aesthetics on perceived review helpfulness at different text lengths to capture the boundary conditions of the aesthetics effect.

The identified gaps lead to the following research questions: **RQ1:** Beyond a simple linear relationship, how do photo aesthetics exert a nuanced effect on perceived review helpfulness? **RQ2:** What are the underlying mediators behind this effect? **RQ3:** What role does review text length play in influencing the impact of photo aesthetics on perceived review helpfulness?

To address the research questions and fill gaps in the literature, this study uses a mixed-methods approach combining secondary and experimental data. First, we analyzed user reviews from [TripAdvisor.com](https://www.tripadvisor.com) (referred to as "Study 1"), which validated the inverted U-shaped effect of photo aesthetics on perceived review helpfulness and highlighted the moderating role of text length. Building upon the observational analysis in Study 1, we conducted an experiment (referred to as "Study 2") to confirm causal relationships and explore underlying mechanisms. In Study 2, we verified the causal effects and examined the mediating roles of pleasure, perceived reviewer effort, and perceived review authenticity.

This study offers four important contributions. First, we propose and test the nonlinear relationship between photo aesthetics and perceived review helpfulness, identifying an optimal level of photo aesthetics. Our findings suggest that exceeding this optimal level can negatively affect perceived review helpfulness, contributing to a better understanding of this dynamic. Second, we not only uncover this phenomenon but also identify its underlying mediating effects, highlighting the mediating roles of pleasure, perceived reviewer effort, and perceived review authenticity, thus filling a gap in both research and practice. Third, drawing on cognitive overload theory, we examine the combined effects of review text and photos on perceived review helpfulness, while verifying the moderating role of text length, thereby enriching theoretical insights in this area. Finally, we employ a mixed-method approach, using secondary data analysis to identify initial patterns and experimental methods to verify causal relationships and mediating effects, offering valuable insights for future research.

2. Literature review

2.1. Factors affecting online review helpfulness

With the rapid growth of social media, the proliferation of online reviews has led to information overload, which impedes effective information processing [30]. To aid consumers in effectively finding helpful reviews, many online review platforms, such as [TripAdvisor.com](https://www.tripadvisor.com) and [Booking.com](https://www.booking.com), have adopted helpfulness voting systems [31]. Helpfulness, measured by the number of helpful votes, is the most common metric used by consumers to evaluate online reviews [5,32]. It reflects the overall quality of online reviews [33], contributing to the trust in online reviews and facilitating information processing, especially under high information load [34]. Online review helpfulness enables consumers to quickly identify the most useful information, guiding their purchasing decisions [35,36]. Therefore, it is essential to explore the antecedents of review helpfulness.

Recent studies have investigated the determinants of review helpfulness from two perspectives: reviewer-related factors and review-related factors. First, reviewer characteristics impact review helpfulness, including reviewer personality traits [9], level of identity disclosure [10,11,37], reviewer experience [34,38], expert label [39,40], reviewer popularity [12], and engagement [41]. Second, review content consists of three main parts: review text, ratings and review photos, and most existing studies focus on the features of the first two parts. Numerous studies have confirmed that text length [1,5,42–44], readability [37,45], ratings [1,6,7], emotional expressions [8,46,47], and the similarity between review title and content [48] are all predictors of review helpfulness. However, few studies have explored the factors related to the photos included in reviews.

2.2. Visual aesthetics of review photos

Visual aesthetics play a significant role in shaping various psychological and behavioral responses. For instance, studies have shown that aesthetics of product recommendations on social media [49] and mobile app design aesthetics [50] can significantly enhance users' positive affect. Visual aesthetics are found to influence users' overall impressions of web pages through processes such as automatic perception, initial perceptual confirmation, and impression formation [51]. Additionally, visual product aesthetics have been shown to affect consumers' price sensitivity [52]. Moreover, visual aesthetics can boost download intentions [50] and enhance perceptions of ease of use and usefulness [53]. Given that visual aesthetics have such a profound impact across different contexts, it is crucial to explore their role in online reviews, particularly relate to review photos.

Review photos are a key component in online reviews and play a prominent role in consumers' judgments and decisions related to online reviews [30]. Photos convey objective information like color attributes [54] and image composition [55]. Research in online reviews has explored the impact of factors such as the presence of photos [56,57], the content displayed in photos [2,58], the provision of size references in photos [59], and the integration of text, photos, and videos [60] on review helpfulness. Despite the established importance of photos, the role of visual aesthetics in review photos remains underexplored.

Visual aesthetics are commonly used to assess the quality of photos [14]. The specific content presented in photos, such as the types of photographic elements, can also help potential consumers evaluate products/services [61]. Existing studies have explored the impact of photo aesthetics on review ratings and purchase intentions. For example, the aesthetics of customer-generated images (CGIs) is identified to influence product rating dynamics [22]. Similarly, the aesthetic appeal of product recommendations was found to be positively associated with product affection and the urge to buy impulsively [49]. However, despite the significance of photo, there is limited research on how photo aesthetics affect the online review helpfulness. Although

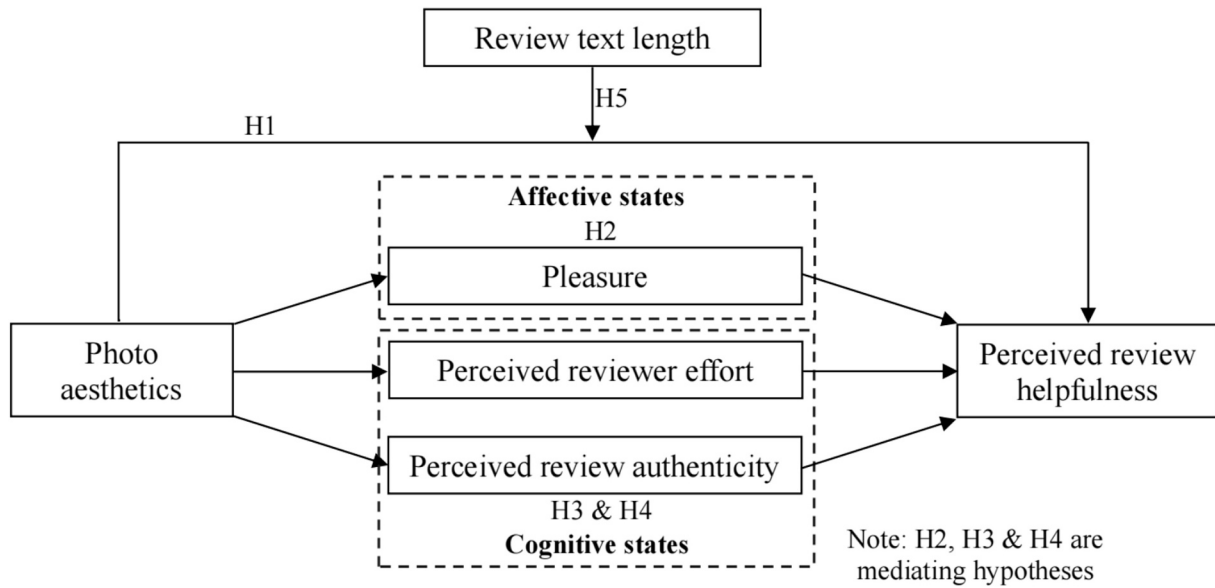


Fig. 1. Research model.

some studies have shown a positive correlation between the photo aesthetics and review helpfulness [15–17], they only address the positive linear relationship, and no underlying mechanisms are explored. As a result, we will conduct a more comprehensive and in-depth investigation to fill this gap.

2.3. Stimulus-organism-response theory

This study examines how the aesthetics of review photos influence readers' helpfulness voting behavior through SOR theory [24]. This framework posits that external stimuli (S) trigger changes in an individual's organism (O), leading to a behavioral response (R). Here, S represents external stimuli, such as photo aesthetics in this research; O serves as a mediating variable representing the individual's state change after receiving the stimulus, such as affective and cognitive processes; and R reflects the resulting behavior, such as helpfulness voting in the current research. The SOR theory in general has been widely used in the study of user behavior in online review contexts [62–64].

We make use of the SOR framework to explain the causal relationships and mediating effects that influence readers' helpfulness voting behaviors. First, when readers browse online reviews, they encounter stimuli like photo aesthetics. Second, aesthetic stimuli trigger readers' internal states, expressed through affective and cognitive elements [65]. The affective state refers to readers' feelings (e.g., pleasure), while the cognitive state involves perceptions and thoughts about the product/service. Readers evaluate review helpfulness from two perspectives: the review and the reviewer's characteristics [33]. Accordingly, we focus on two cognitive processes: perceived review authenticity (reflecting readers' cognition of the review) and perceived reviewer effort (reflecting readers' cognition of the reviewer). Finally, these internal states drive behavioral responses, such as voting on review helpfulness.

3. Research model and hypothesis development

In this paper, grounded on the theoretical tenets of SOR framework [24], we argue that aesthetic stimuli (S) of review photos influence readers' organism (O), which in turn causally affects their helpfulness voting behavior (R). First, according to optimal stimulation level theory [18], we propose an inverted U-shaped effect of photo aesthetics on helpfulness voting (H1) to address RQ1. Second, we propose the underlying mediating effects, emphasizing readers' organism, which encompasses both affective and cognitive states, to address RQ2.

Specifically, the affective state focuses on the reader's perceived pleasure (H2), while the cognitive states include perception of reviewer effort (H3) and review authenticity (H4). Finally, based on cognitive overload theory [27], we propose a moderating role for the review text length (H5) to address RQ3. Fig. 1 illustrates the research model.

3.1. The inverted U-shaped relationship between photo aesthetics and perceived review helpfulness

Based on SOR theory, we argue that photo aesthetic stimuli (S) causally affect voting behavior of review helpfulness (R). We employ optimal stimulation level (OSL) theory [18] to further explore the specific relationship between the two. According to the OSL theory, individuals generally prefer moderate levels of environmental stimulation [19,20], as excessive stimulation may have a negative effect once it surpasses optimal levels [21]. This theory applies to how environmental stimulation shapes exploratory consumer behavior [18]. In the context of online reviews, OSL theory can be applied to justify the inverted U-shaped relationship between photo aesthetic stimuli and readers' helpfulness voting behavior.

We argue that review photos with moderate aesthetics are likely to receive most helpfulness votes. Numerous studies have validated the positive effects of aesthetics, such as eliciting pleasant feelings [25,66], promoting online word of mouth (WOM) engagement [67], and increasing booking intentions [68]. The aesthetic quality of review photos serves as a key cue for evaluating review value and enhances readers' perception of helpfulness [15]. Therefore, improving the aesthetics of review photos to the optimal level will enhance readers' perception of the review helpfulness and promote their voting behavior. However, when the aesthetics of photos exceed the optimal level, excessive aesthetics can impose negative effects, such as triggering the disconfirmation effect [22]. To attract attention, more users are enhancing the aesthetics of photos through editing [69]. Studies have shown that overly perfect images can be perceived as unrealistic [23], while amateur photography is often seen as more authentic [70], with authenticity increasing helpfulness votes [71]. Therefore, we argue that the aesthetics of review photos are not simply "the more aesthetic, the better," as excessive aesthetics may lead to negative effects.

In summary, consistent with OSL theory, which posits that moderate levels of stimulation yield the best effects, we hypothesize that, compared to photos with lower or higher aesthetics, moderately aesthetic photos are perceived as more helpful. Therefore, we propose

the following hypothesis:

H1. There is an inverted U-shaped effect of photo aesthetics on perceived review helpfulness.

3.2. The mediating role of pleasure

According to SOR theory, affective states are a key component of the organism (O) [65]. Many studies have emphasized the significant impact of aesthetic stimuli on pleasure [25,66]. We argue that photo aesthetics serve as an external stimulus (S) that triggers reader's pleasure (O), influencing their helpfulness-voting behavior (R).

Lorenzo-Romero et al. [13] have pointed out that visual information activates brain areas related to affect, thereby triggering affective responses. For example, studies have shown that aesthetics of product recommendations on social media [49] and design aesthetics of mobile applications [50] can significantly enhance users' positive affective states. In another context, after aesthetic stimulation from food, the most critical factor related to customer affect to be focused on is pleasure [72]. Studies across various contexts have further emphasized the positive correlation between aesthetics and pleasure. Specifically, the aesthetics of web-store design [66], cafe merchandise design [25] and online food delivery apps [73] are all found to enhance users' pleasure. Based on these studies, we suggest that photo aesthetics of reviews can also evoke readers' pleasure.

Further, we argue that the stronger the reader's pleasure, the more likely they are to vote for the review helpfulness. It has been shown that affective states significantly influence individuals' judgments and decisions [74,75]. Positive affective states are typically associated with more favorable evaluations and behaviors. For example, individuals in a positive affective state tend to evaluate their surroundings more favorably and make more productive decisions [76]; customers in a pleasant state usually give higher product evaluations and are more willing to accept promotions [77]. Pleasure has been identified with the most significant effect on positive WOM [78]. People are more likely to give positive reviews when in a pleasant state and negative reviews when in an unpleasant state [79]. Therefore, in an online review environment, readers are more likely to rate reviews as helpful when they are in a pleasant state. The following hypothesis is proposed:

H2. Reader's pleasure mediates the relationship between photo aesthetics and perceived review helpfulness. Specifically, higher photo aesthetics enhance the reader's pleasure, which increases their tendency to vote the review as helpful.

3.3. The mediating role of perceived reviewer effort

The cognitive state of organism in SOR theory [65] covers perception, evaluation and reasoning. In the context of online reviews, we propose that perceived reviewer effort (referring to the effort the reviewer invests in posting a review) is an integral part of the reader's perception, evaluation, and reasoning process, as it provides cues about the reviewer's credibility, relevance, and expertise. Previous research has demonstrated that readers assess the reviewer's effort, thereby inferring the helpfulness of the review [36].

In this study, first, we argue that when readers recognize the aesthetics of photos in a review, they infer the effort put in by the reviewer. This is because consumers often associate aesthetic elements with the effort or skill that producers invest in product design and creation [21]. User-generated photos are seen as the result of a productive activity, with reviewers acting as producers. Photos with higher aesthetics are typically regarded as higher quality [14], with clear foreground-background separation, appropriate brightness and contrast, and pleasing colors [80]. Similarly, aesthetic elements in product design significantly enhance consumers' perceptions of producers' efforts [26]. In the context of our study, producing and posting such aesthetic photos on online review platforms generally requires more time and labor from

reviewers. As a result, readers are likely to perceive reviewers who post highly aesthetic photos as having invested more effort.

Second, readers are more likely to find reviews helpful if they believe the reviewer has expended more effort in the post. Consumers often rely on perceived effort to assess the value and quality of a product or service [81], and helpfulness is a key indicator of a review's quality and value [33]. When readers perceive that a reviewer invested more effort, they tend to view the review as thoughtful and valuable, and thus rate its helpfulness higher [36,82,83]. Based on above analysis, we propose the following hypothesis:

H3. Perceived reviewer effort mediates the relationship between photo aesthetics and perceived review helpfulness. Specifically, the higher the aesthetics of review photos, the greater the perceived reviewer effort, thereby increasing their tendency to vote the review as helpful.

3.4. The mediating role of perceived review authenticity

Perceived authenticity is crucial in assessing user-generated content (UGC) [84] and reflects whether readers view the information as genuine, trustworthy, and free from manipulation [85]. In the online review context, we argue perceived authenticity of a review is also an integral part of reader's perception, evaluation and reasoning process, i.e., the cognitive process of organism in SOR theory. Research has shown that consumers are becoming increasingly skeptical about the authenticity of online information [86], partly due to businesses attempting to mislead consumers by fabricating false reviews [87] or manipulating existing ones [88]. Consequently, authenticity has become a key factor for readers when evaluating review helpfulness [85]. In this research, we propose it as a cognitive mediator in the relationship between photo aesthetics and perceived review helpfulness.

The previous discussion highlighted the positive impact of photo aesthetics on perceived review helpfulness by enhancing reader's pleasure and perceived reviewer effort. However, some studies have suggested that overly aesthetic designs may have adverse effects. For example, consumers tend to rate products with better aesthetic designs lower in performance [89]. We argue that review photos are not necessarily better when they are highly aesthetic because excessively high aesthetic quality can lead to a disconfirmation effect [22]. On social media, users often enhance the photo aesthetics through postprocessing, such as photo editing and tone settings, to cater to viewers, thereby creating a "false beauty" [69]. Photos taken with snapshots are often considered more credible than professional studio shots [70]. Similarly, Pantti and Bakker [90] noted that overly high technical quality can reduce authenticity, while amateur photos are seen as more intimate and real. Lv et al. [23] reported that minor imperfections in celebrity endorsements can increase perceived authenticity. Therefore, while moderate aesthetics can enhance perceived authenticity [91], excessively high aesthetic quality can have detrimental effects.

Furthermore, the relationship between authenticity and helpfulness has been supported in prior research [92]. Lie et al. [71] reported that perceived authenticity in online review text positively impacts perceived helpfulness. When readers perceive photos as highly authentic, they are more likely to trust the review content [93]. In our study, we hypothesize that moderate aesthetics enhance authenticity perception, while excessively high aesthetics reduce authenticity and, in turn, helpfulness voting. The following hypothesis is proposed:

H4. Perceived review authenticity mediates the relationship between photo aesthetics and perceived review helpfulness. Specifically, there is an inverted U-shaped relationship between photo aesthetics and perceived review authenticity, and perceived review authenticity positively influences helpfulness.

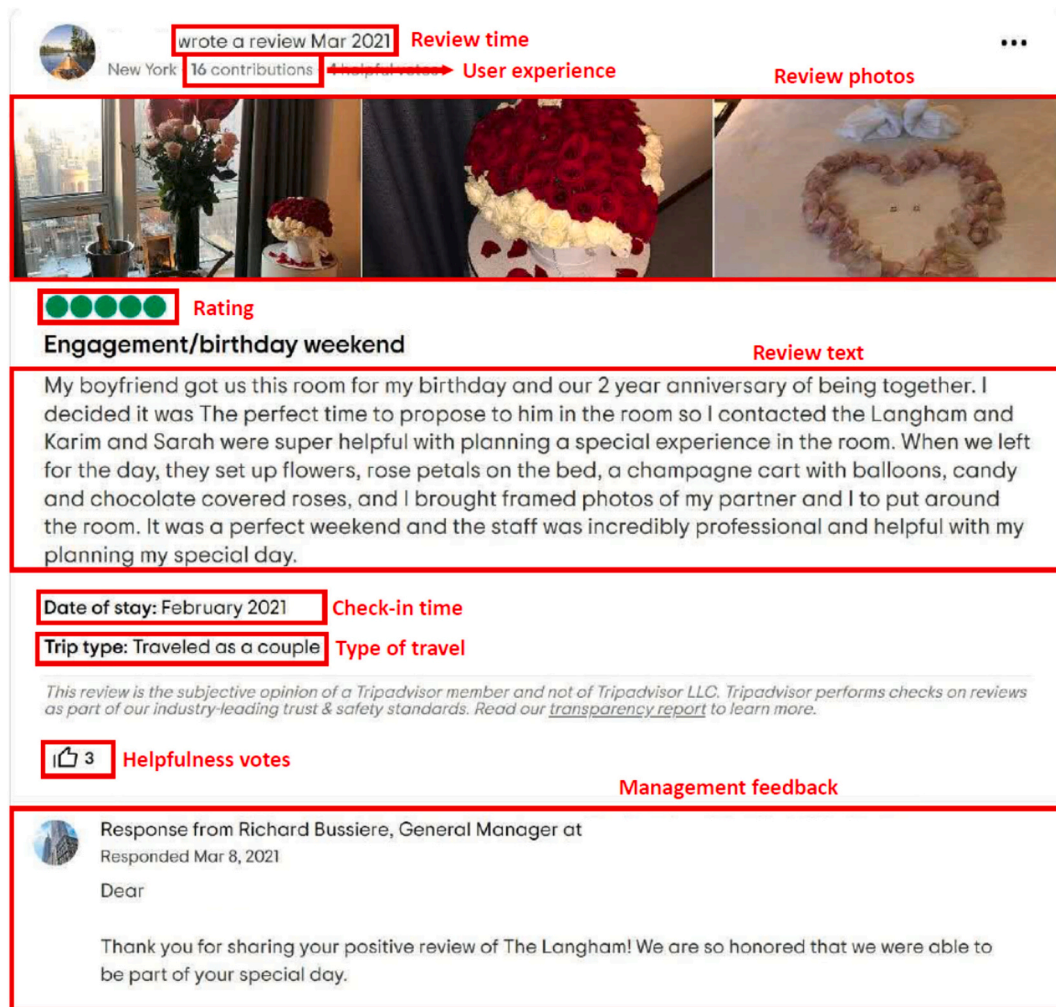


Fig. 2. Illustration of a review example.

3.5. The moderating role of review text length

Previous hypotheses suggest that the effect of photo aesthetics on perceived review helpfulness is influenced by individuals' cognitive processes. According to cognitive overload theory, the human brain has a limited capacity to process information and cannot efficiently handle all incoming information, which may lead to information overload [27]. This theory has been widely applied in studies of online environments, particularly regarding individuals' processing of information from online platforms [94–97]. Consequently, readers with varying levels of cognitive load may evaluate review helpfulness differently.

In online WOM environments, review text length has been recognized as a key indicator of cognitive overload [28]. Studies have shown that long texts are characterized by a large amount of information and unclear structure, both of which increase cognitive load and make it harder for individuals to process information effectively [27]. First, longer reviews often contain more detailed descriptions of product attributes, requiring readers to exert more cognitive effort to process while browsing [98]. Consequently, long texts can increase cognitive load, reducing the reader's willingness to process the information [99]. Second, longer reviews often suffer from unclear structure, reflecting the writer's difficulty in expressing ideas concisely [28]. Linguistic studies have highlighted that longer texts typically feature more complex structures, making them harder for readers to comprehend [100]. Thus, poorly structured long reviews can increase reader's cognitive load [29]. Given that cognitive resources are limited, long texts occupy more

cognitive resources and inevitably reduce the cognitive resources allocated to photo aesthetics, thus weakening readers' processing paths related to photo aesthetics. Based on the above analysis, we hypothesize that the influence of photo aesthetics on helpfulness voting diminishes when reviews are longer. We propose the following hypothesis:

H5. Review text length weakens the impact of photo aesthetics on perceived review helpfulness. Specifically, the longer the review text is, the flatter the effect of photo aesthetics on perceived review helpfulness.

4. Study 1: Online secondary data analysis

We first conducted an initial phenomenon analysis using 56,671 user reviews from [TripAdvisor.com](https://www.tripadvisor.com). Online secondary data were used to identify: the inverted U-shaped relationship between photo aesthetics and perceived review helpfulness (H1) and the moderating role of review text length (H5).

4.1. Data collection

User review data from hotels in New York, USA, were obtained from the mainstream online travel agency [TripAdvisor.com](https://www.tripadvisor.com) as the research sample for this study. We designed a web crawler program using Python to obtain user review data from [TripAdvisor.com](https://www.tripadvisor.com), including information such as helpfulness votes, review ratings, review text, review photos, review time, check-in time, management feedback, travel type, user experience, and hotel ID. Fig. 2 illustrates this information based on a

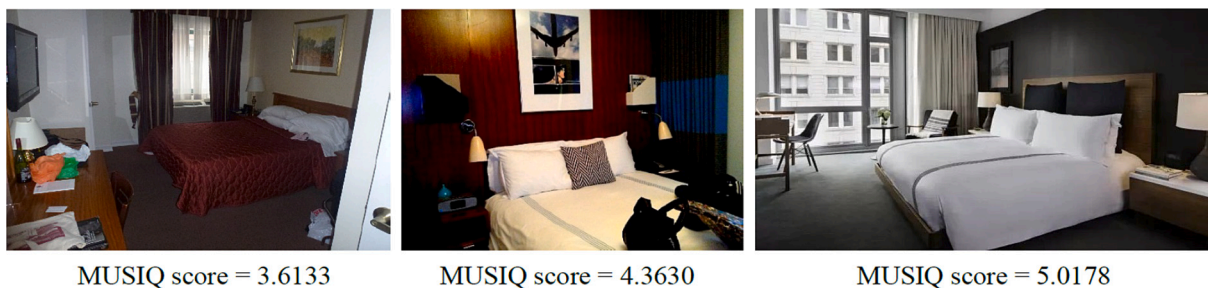


Fig. 3. Examples of MUSIQ scores of reviews' photo aesthetics from [TripAdvisor.com](https://www.tripadvisor.com).

Table 1

Variable definitions.

Variable	Definition
Dependent variable	
<i>Helpfulness</i>	The number of helpfulness votes received for each review
Independent variable	
<i>Aesthetics</i>	The average aesthetic score of all review photos included in each review
Moderating variable	
<i>RevLength</i>	Text length of each review
Control variables	
<i>Emotion</i>	Difference between the proportion of positive and negative emotion-related words in a review
<i>Rating</i>	Overall review rating of each review (value of 1, 2, 3, 4, or 5)
<i>Readability</i>	The Gunning FOG index of each review
<i>RevPicNum</i>	The number of review photos of each review
<i>HaveResponse</i>	Dummy variable: 1 = review received a management response; otherwise, 0
<i>Interval</i>	The interval between hotel stay and posting of review (days)
<i>ReviewerExp</i>	Experience value of the user account
<i>TripType</i>	A categorical variable; trip type, including other, business, couple, family, friends and alone

review example. We selected reviews that contained at least one review photo and removed those with missing values. The final dataset consists of 56,671 user reviews of New York hotels, spanning from October 2003 to January 2023.

4.2. Research variables

4.2.1. Dependent variable

The dependent variable Review Helpfulness (*Helpfulness*) indicates the number of helpfulness votes received for the review, which is a common measure of review helpfulness [8,101]. Fig. 2 shows an example of helpfulness voting on [TripAdvisor.com](https://www.tripadvisor.com), where the example review received three helpfulness votes.

4.2.2. Independent variable

In our work, the independent variable Photo Aesthetics (*Aesthetics*) reflected the average aesthetics score of all review photos contained in each review. The specific procedure for this variable was as follows: First, we downloaded the review photos for each review. Second, we used the multiscale image quality transformer (MUSIQ) to calculate the aesthetics score for each photo. Third, we aggregated the data to the review level by using the average aesthetics score of all the photos in each review as a measurement for the independent variable.

We chose MUSIQ to calculate photo aesthetics for several reasons. Advanced image quality assessment (IQA) methods can be categorized into two main types. The first category is based on convolutional neural network (CNN) deep learning models, such as the deep bilinear convolutional neural network (DBCNN) [102] and the hyper network image quality assessment (HyperIQA) [103]. The second category is based on

transformer deep learning models, such as MUSIQ [104]. In batch training, the performance of CNN-based deep learning models is often constrained by fixed shape requirements, leading to input images being resized and cropped to a fixed shape, which can result in a decline in image quality. However, MUSIQ can handle full-size image inputs with different resolutions, sizes, and aspect ratios, capturing image quality at various granularities [104]. Image quality consists of two aspects: technical quality [105] and aesthetic quality [106]. This study focuses on aesthetic quality. MUSIQ demonstrates significant advantages in predicting image aesthetics and achieves state-of-the-art performance on the AVA aesthetic quality dataset [106]. The MUSIQ used in this study is pre-trained on the AVA dataset, ensuring its outputs effectively represent the aesthetic quality of images. To better understand the practical application of the MUSIQ, we present three examples from [TripAdvisor.com](https://www.tripadvisor.com) in Fig. 3. These three photos depict guest rooms, with corresponding MUSIQ aesthetics scores of 3.6133, 4.3640, and 5.0178, respectively.

4.2.3. Moderating variable

Review length (*RevLength*) serves as our moderating variable. We measure it using the number of words in a review [5,107]. Longer reviews generally contain more detailed descriptions and deeper insights into the service experience. With increasing text length, readers must exert more cognitive resources to process and comprehend the review, which we interpret as an increase in cognitive load.

4.2.4. Control variables

We control important variables to account for the effects of other potential factors. Review emotions can be significantly correlated with review helpfulness [108]. Thus, we calculate the emotional polarity contained in the reviews via Eq. (1):

$$Emotion_{ij} = \left(PosWord_{ij} - NegWord_{ij} \right) / TotalWord_{ij} \quad (1)$$

where i denotes the hotel; j denotes the review; the number of positive emotion-related words in review j of hotel i is denoted as $PosWord_{ij}$; the number of negative emotion-related words in review j of hotel i is denoted as $NegWord_{ij}$; and the number of all words is denoted as $TotalWord_{ij}$. This means that the higher the $Emotion_{ij}$ is, the higher (lower) the positive emotion (negative emotion) expressed in the review. We used the linguistic inquiry and word count (LIWC) program to measure the degree of emotional expression in the reviews [109].

Review star ratings (*Rating*) and the readability of review text (*Readability*) affect review helpfulness [101]. We used the Gunning FOG index developed by Gunning [110] to measure the readability of review text. The FOG index is used to measure the years of education that a reader needs to have to easily read and understand a text. The larger the Gunning FOG index is, the worse the readability. Considering that more review photos can lead readers to find the review more helpful [16], we control the review photo quantity (*RevPicNum*). The type of trip (*TripType*) and the management response (*HaveResponse*) for the review are also factors that influence review helpfulness [111]. We also control for

Table 2
Descriptive statistics.

Variable	Obs.	Mean	Std. Dev	Min	Max	Skewness
Helpfulness	56,671	0.197	1.762	0	277	108.442
Aesthetics	56,671	4.422	0.418	2.611	6.247	0.060
RevLength	56,671	180.89	157.655	6	2920	3.004
Emotion	56,671	0.050	0.036	-0.182	0.333	0.905
Rating	56,671	4.236	1.064	1	5	-1.536
Readability	56,671	8.745	2.056	0	22.600	-1.673
RevPicNum	56,671	3.437	3.345	1	152	5.148
HaveResponse	56,671	0.640	0.480	0	1	-0.581
Interval	56,671	42.146	65.321	0	1457	4.502
ReviewerExp	56,671	299.516	1871.555	1	166281	47.998

the reviewer characteristic variable, specifically, the reviewer experience in writing reviews (*ReviewerExp*) [34]. Given the potential effects of time trends and hotel heterogeneity, we also add intervals between hotel stay and review posting (*Interval*), year–month fixed effects of the time to post reviews and hotel fixed effects [111].

Table 1 lists all the variables, and their descriptive statistics are presented in Table 2. We logarithmically transform *Helpfulness*, *RevLength*, *RevPicNum*, *Interval* and *ReviewerExp* because they have high standard deviation and skewness. For variables that contained zeroes, we add a value of 1 before applying the log transformation [112]. Correlation analysis has revealed that the highest correlation between variables is 0.488, indicating relatively low correlation among them. Furthermore, the variance inflation factors (VIFs) for all variables are below 1.62, indicating no multicollinearity in the econometric model.

4.3. Econometric specifications

We used ordinary least squares (OLS) regression to estimate the following econometric models. Eq. (2) is the estimation of the main effect, and Eq. (3) is the estimation of the moderating effect.

$$LgHelpfulness_{ij} = \beta_{10} + \beta_{11} \cdot Aesthetics_{ij} + \beta_{12} \cdot Aesthetics_{ij}^2 + \sum \lambda_{ij} \cdot Control_{ij} + Hotel_i + Time_{ym} + \varepsilon_1 \tag{2}$$

$$LgHelpfulness_{ij} = \beta_{20} + \beta_{21} \cdot Aesthetics_{ij} + \beta_{22} \cdot Aesthetics_{ij}^2 + \beta_{23} \cdot LgRevLength_{ij} + \beta_{24} \cdot Aesthetics_{ij} \times LgRevLength_{ij} + \beta_{25} \cdot Aesthetics_{ij}^2 \times LgRevLength_{ij} + \sum \lambda_{ij} \cdot Control_{ij} + Hotel_i + Time_{ym} + \varepsilon_2 \tag{3}$$

where *i* denotes the hotel, *j* denotes the review, *Control_{ij}* denotes control variables, *Hotel_i* denotes hotel fixed effects, *Time_{ym}* denotes the year–month fixed effects of the time to post reviews, and ε is the stochastic disturbance term. In Eq. (2), we focus mainly on β_{11} and β_{12} , expecting β_{11} to be significantly positive and β_{12} to be significantly negative; in Eq. (3), we focus mainly on β_{25} , and if β_{25} is significant, there is a moderating effect of review text length.

4.4. Results of the online secondary data analysis

4.4.1. Main results

Table 3 shows the results for three model specifications. Model 1 is the reference model, including all control variables and the moderating variable. Model 2 builds on Model 1 by adding *Aesthetics* and its quadratic term, while Model 3 further incorporates interaction terms.

Table 3
The OLS regression results of main effect and moderating effect.

DV: <i>LgHelpfulness</i>	Model 1	Model 2	Model 3
<i>Aesthetics</i>		0.0562*** (0.019)	0.3153** (0.126)
<i>Aesthetics</i> ²		-0.0066*** (0.002)	-0.0501*** (0.014)
<i>LgRevLength</i>	0.0311*** (0.002)	0.0312*** (0.002)	0.1968 (0.129)
<i>Aesthetics</i> × <i>LgRevLength</i>			-0.1356** (0.058)
<i>Aesthetics</i> ² × <i>LgRevLength</i>			0.0220*** (0.007)
Controls	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	56,671	56,671	56,671
Adj-R ²	0.2503	0.2504	0.2539
AIC	-84000.65	-84008.57	-84269.75
LR test (Model 1 as reference)	0	11.93 (<i>p</i> = 0.0026)	277.11 (<i>p</i> = 0.0000)

Notes: Standard errors are reported in parentheses; ****p* < 0.01, ***p* < 0.05, and **p* < 0.1.

Both Model 2 and Model 3 demonstrate an improvement over Model 1. Specifically, Model 2 has an Adjusted R² of 0.2504, while Model 3 achieves the R² of 0.2539, both exceeding that of Model 1 and the changes are statistically significant. The AIC values for Model 2 (-84,008.57) and Model 3 (-84,269.75) are lower than that of Model 1 (-84,000.65), further supporting their significantly enhanced performance. According to Anderson and Burnham [113], a $\Delta AIC > 10$ provides strong evidence against the model with the higher AIC; the 269-point drop in Model 3 thus strongly supports the inclusion of aesthetic-related variables. Additionally, we performed a Likelihood Ratio (LR) test using Model 1 as the reference. The results indicate that Model 2 and Model 3 fit significantly better than Model 1 (*p* < 0.01).

The results of Model 2 demonstrate the main effects: the coefficient between *Aesthetics* and *LgHelpfulness* is significantly positive ($\beta = 0.0562, p < 0.01$), whereas the coefficient of *Aesthetics*² is significantly negative ($\beta = -0.0066, p < 0.01$). This initially suggests an inverted U-

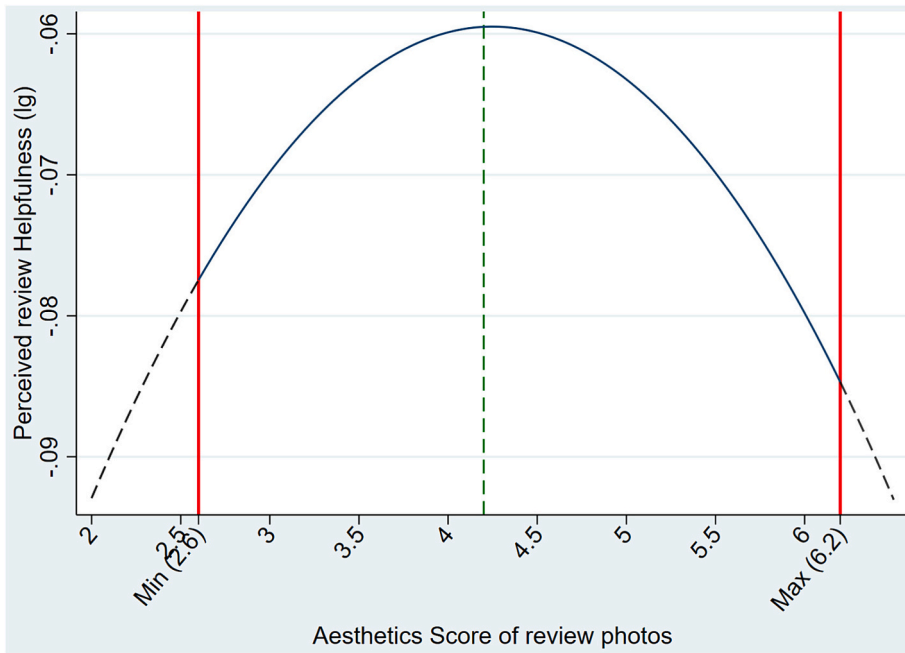


Fig. 4. The inverted U-shaped relationship between photo aesthetics and perceived review helpfulness.

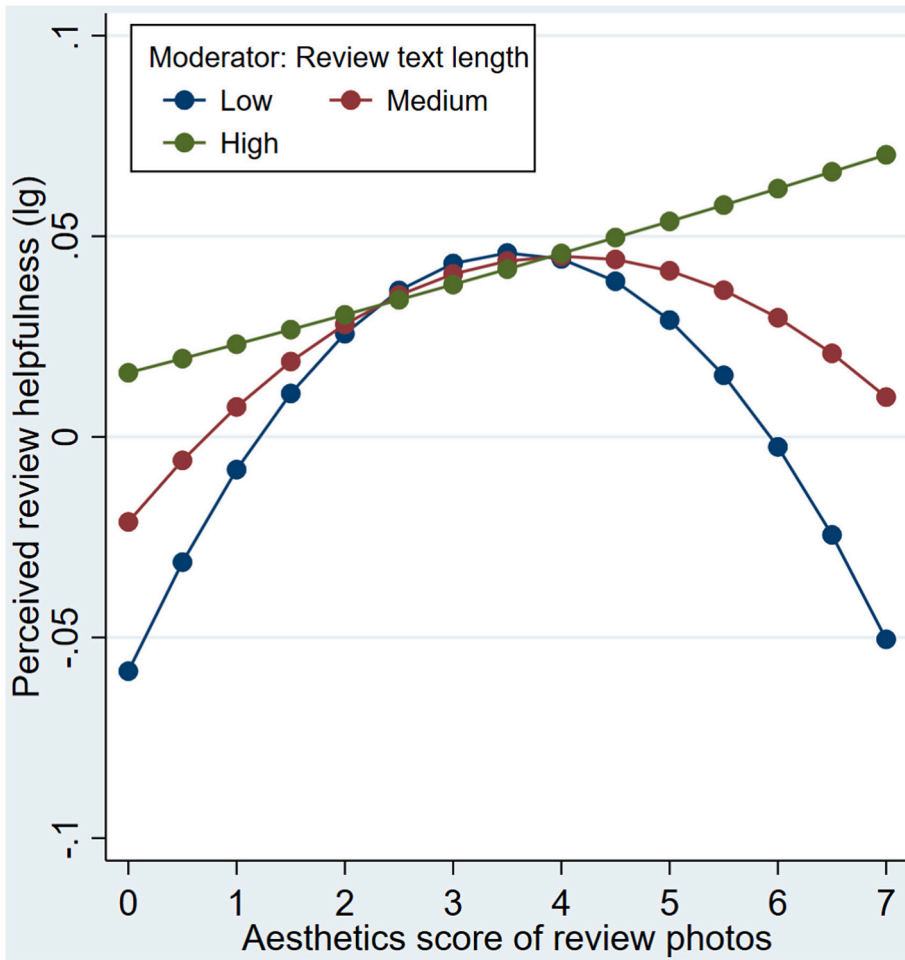


Fig. 5. The moderating effect of review text length.

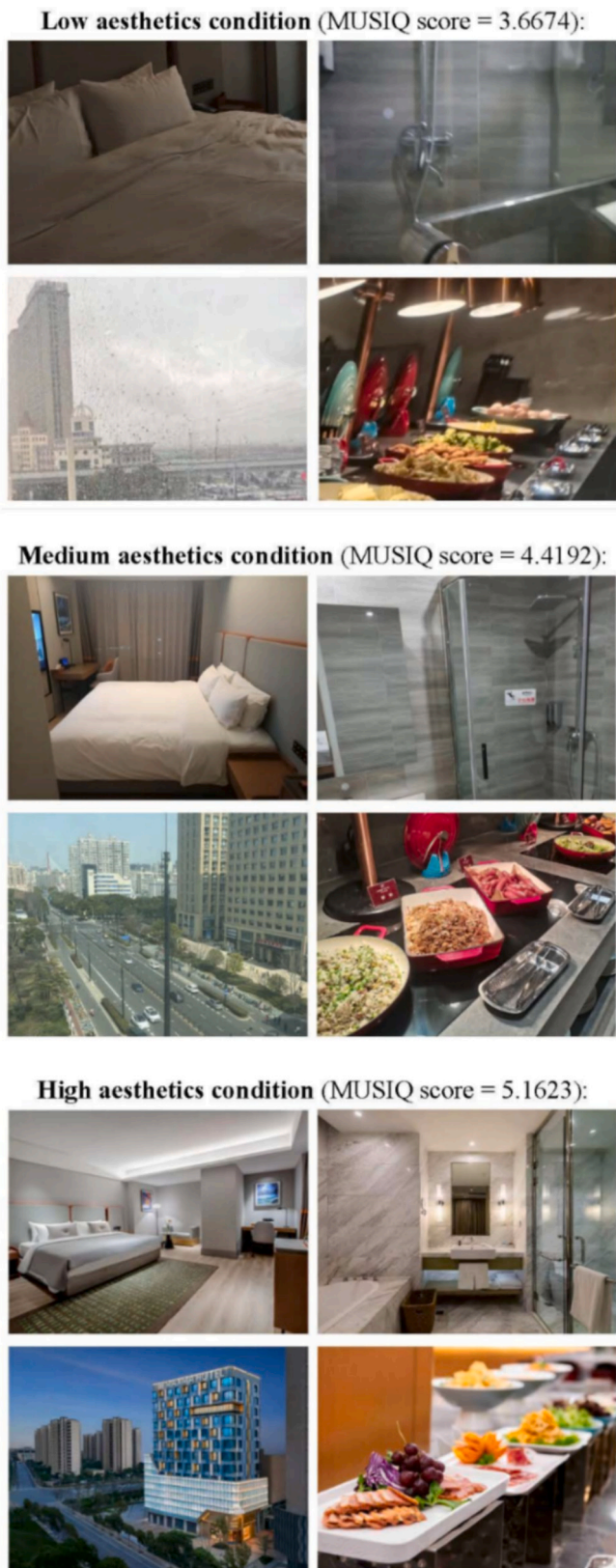


Fig. 6. Manipulation of review photo aesthetics.

shaped relationship between the aesthetics of review photos and perceived review helpfulness.

However, two conditions must be met before an inverted U-shaped relationship between variables can be established. These include the

following: 1) the estimated coefficient of the quadratic term of the independent variable must be negative and significant, and 2) the extreme point of the curve must lie within the range of the independent variable. The regression results in Table 3 already fulfilled the first condition. Next, following the method of Lind and Mehlum [114], we used the U test command in Stata 25.0 to test the second condition. The results show that the value at the extreme point is 4.2481, whereas the range of the independent variable is [2.6109, 6.2474]. The extreme point falls within the range of the independent variable and is significant at the 1% statistical level. Additionally, the slope of the independent variable is 0.0217 at the minimum value, which is significantly positive at the 1% level, and -0.0265 at the maximum value, which is significantly negative at the 1% level. On the basis of the above analysis, we confirm that photo aesthetics have an inverted U-shaped effect on perceived review helpfulness, so H1 is validated. We illustrate the inverted U-shaped relationship in Fig. 4.

As shown in Table 3, Model 3 presents the results of the moderating effect: the coefficient of $Aesthetics \times LgRevLength$ is significantly negative ($\beta = -0.1356, p < 0.05$), whereas the coefficient of $Aesthetics^2 \times LgRevLength$ is significantly positive ($\beta = 0.0220, p < 0.01$). This finding indicates that review text length plays a weakening moderating role in the relationship between photo aesthetics and perceived review helpfulness, thus confirming H5. Fig. 5 illustrates the relationship between photo aesthetics and perceived review helpfulness in different conditions of review text length. We used the 25th, 50th, and 75th percentiles of the review text length as proxies for low, medium, and high conditions, respectively. As shown in Fig. 5, the inverted U-shaped relationship between photo aesthetics and perceived review helpfulness becomes flatter as text length increases.

4.4.2. Robustness check

Alternative method for OLS: In our study, 88.39% of the values in the dependent variable (i.e., helpfulness votes of each review) are zero. Tobit regression is considered an appropriate method for handling samples with such limited dependent variable values [115]. The Tobit regression results (see Table A.1 in Appendix A) are consistent with the previous findings.

Alternative sample: Users write reviews as voluntary contributions; thus, they are not time bound. However, if much time elapses between a hotel stay and the related review posting, significant recall bias may occur, affecting the accuracy of the review. Therefore, we excluded reviews with a lengthy time gap for the robustness check. Table A.2 in Appendix A shows the OLS regression and Tobit regression results for reviews with time intervals within two months and three months. The results remain consistent with previous findings.

Alternative measure of Aesthetics: Due to the display limitations of the TripAdvisor website, only the first three photos are shown by default in the review interface unless viewers actively click on the details page to view additional photos. To account for this constraint, we used the average aesthetic score of the first three photos in each review as an alternative measure. Furthermore, we applied OLS and Tobit regression methods for estimation. As shown in Table A.3 of Appendix A, the results are consistent with previous findings, further reinforcing the robustness of our conclusions.

5. Study 2: Experimental study

Study 1 focuses on direct effects based on the available secondary data. Therefore, we designed an experiment (Study 2) aiming to address unresolved causality issues from Study 1, including validating the causal impact of the main findings (H1) and exploring the underlying mediating effects of photo aesthetics on perceived review helpfulness (H2-H4).

Table 4
Measurement items and Cronbach's alpha.

Constructs	Items	Cronbach's alpha
Perceived review helpfulness [36]	"How likely are you to click the 'Helpful Votes' button for the above review?"; 1 = "least likely" and 7 = "most likely" "How would you describe the above review?"; 1 = "not at all helpful" and 7 = "very helpful" "How would you describe the above review?"; 1 = "not at all useful" and 7 = "very useful"	0.7693
Pleasure [117]	"I feel joyful after reading the above review?"; 1 = "strongly disagree" and 7 = "strongly agree" "I feel pleasure after reading the above review?"; 1 = "strongly disagree" and 7 = "strongly agree" "I feel gratified after reading the above review?"; 1 = "strongly disagree" and 7 = "strongly agree"	0.8444
Perceived reviewer effort [118]	"In your opinion, how much effort had the reviewer put into writing this review?"; 1 = "very little" and 7 = "very much" "In your opinion, how much thought had the reviewer given to the above review when he/she wrote it?"; 1 = "very little" and 7 = "very much" "In your opinion, how much time did the reviewer spend writing this review?"; 1 = "very little" and 7 = "very much"	0.8479
Perceived review authenticity [84]	"The above review is genuine"; 1 = "strongly disagree" and 7 = "strongly agree" "The above review seems fake"; 1 = "strongly disagree" and 7 = "strongly agree", [reverse coded] "The above review is a paid advertisement"; 1 = "strongly disagree" and 7 = "strongly agree", [reverse coded]	0.8730

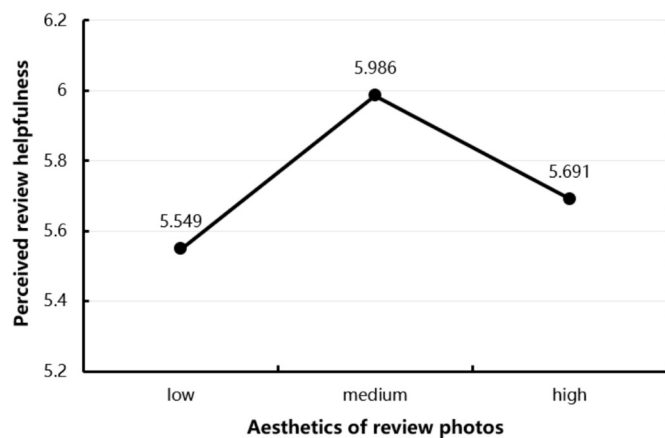


Fig. 7. The effect of photo aesthetics on perceived review helpfulness, Study 2.

5.1. Design and participants

We employed a single-factor (aesthetics of review photos: low vs. medium vs. high) between-subjects design for this study and collected 300 questionnaires through Credamo.com, a professional data platform [116]. After the filtering process, a total of 291 participants (50.86% male; $M_{age} = 28.78$) were included, with $N_{low} = 99$, $N_{medium} = 97$ and $N_{high} = 95$. The analysis of variance (ANOVA) results revealed no significant differences in gender ($F = 0.25, p > 0.7758$), age ($F = 1.39, p > 0.2496$), education level ($F = 1.97, p > 0.1411$) or online review

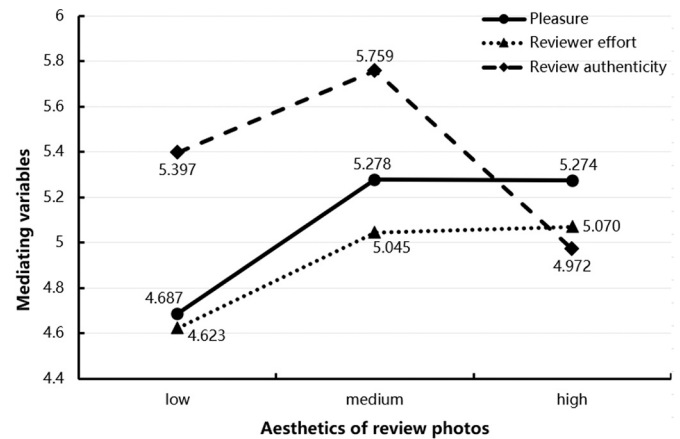


Fig. 8. The effect of photo aesthetics on mediating variables, Study 2.

Table 5
The impact of mediating variables on the dependent variable, Study 2.

DV: Helpfulness	Model 4
Pleasure	0.2334*** (0.036)
Effort	0.1891*** (0.034)
Authenticity	0.2545*** (0.032)
Education	0.0623 (0.042)
LgExperience	0.0522 (0.047)
LgAge	-0.0842 (0.131)
Gender	-0.0234 (0.064)
Observations	291
Adj-R ²	0.5169
AIC	461.7038

Notes: Standard errors are reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

experience ($F = 0.71, p > 0.4924$) across the three conditions.

The primary stimulus material for this experiment was an online review about a hotel. To control potential confounding factors, such as the hotel's quality, the reviewer's characteristics, and the timing of the review, we included detailed background descriptions in the experimental context. Descriptions of the hotel covered its name, overall rating, total number of reviews, city ranking, and price. Reviewer-related information covered nickname, location, total number of reviews written, and posting time. Additionally, the timing information was addressed with details about the check-in and review posting date (specific to the month).

The experimental procedure was designed as follows: First, participants were presented with background information about the hotel. Next, they were shown an online review about the hotel. This online review consisted of two parts. The first part included descriptions of the reviewer's characteristics, the hotel check-in date, and the review posting date. The second part was the main content of the review, which contained a star rating, review text, and four review photos. In three conditions, all the information was the same, except for the difference in the aesthetics scores of the four review photos. These manipulations ensured that participants read reviews from the same hotel, written by the same experienced reviewer, with the same stay duration and posting time, thus eliminating the confounding effects of hotel quality, reviewer characteristics, and review time on the experimental results. Fig. 6 shows the photo stimulus materials under three different aesthetic

Table 6
Bootstrap analysis of the mediating effect in Study 2.

Effect type	Mediators	Low vs. Medium			Medium vs. High		
		Effect	95% CI	p	Effect	95% CI	p
Total effect		0.4864	[0.2838, 0.6891]	0.0000	-0.2997	[-0.4994, -0.1000]	0.0035
Direct effect		0.1767	[0.3361, 0.2333]	0.0299	-0.1114	[-0.2697, 0.0468]	0.1665
Indirect effect	<i>Pleasure</i>	0.1213	[0.0444, 0.2247]	-	-0.0080	[-0.0897, 0.0671]	-
	<i>Reviewer effort</i>	0.0752	[0.0150, 0.1623]	-	0.0020	[-0.0463, 0.0505]	-
	<i>Review authenticity</i>	0.1132	[0.0395, 0.2128]	-	-0.1823	[-0.2977, -0.0931]	-

Table 7
Summary of studies.

Study	Method	Sample	Tests	Related hypotheses and key findings
Study 1	Secondary data analysis	56,671 online reviews of New York hotels on TripAdvisor.com	Ordinary least squares regression and Tobit regression with fixed effects	<ul style="list-style-type: none"> • Photo aesthetics have an inverted U-shaped effect on perceived review helpfulness, supporting H1. • Review text length moderates the effect of photo aesthetics on perceived review helpfulness, supporting H5.
Study 2	Experiment	291 participants on Credamo.com	ANOVA and mediation analysis using a bootstrap sampling approach	<ul style="list-style-type: none"> • Photo aesthetics have an inverted U-shaped effect on perceived review helpfulness, supporting H1. • Perceived pleasure, reviewer effort and review authenticity mediate the relationship between photo aesthetics and perceived review helpfulness, supporting H2, H3 and H4.

conditions. These photos are all extracted from real user reviews from the same hotel on the [TripAdvisor.com](https://www.tripadvisor.com). We ensured that the four photos depicted the same content, showing the hotel’s guest room, bathroom, building, and restaurant. We used MUSIQ to calculate the average aesthetic scores for the high, medium, and low groups: 5.1623, 4.4192, and 3.6674, respectively. Second, the participants were asked to answer questions about the dependent variable, mediating variables, and manipulation check. Finally, the participants reported their demographic data.

5.2. Measurement scales

The dependent variable, perceived review helpfulness, and the mediating variables, participants’ perceptions of pleasure, reviewer effort, and authenticity of reviews were collected by the survey questions. The measurement items for all variables were detailed in [Table 4](#). Reliability was evaluated using Cronbach’s alpha, with all scales achieving scores above 0.7693, indicating good reliability.

5.3. Results of the experimental analysis

5.3.1. Manipulation check

During the experiment, a question was used to test whether the manipulation of photo aesthetics had been successful (“Please evaluate the aesthetic level of the photos included in the review above”; 1 = “Least aesthetic,” and 7 = “Most aesthetic”). The one-way ANOVA results revealed that the participants significantly perceived a difference in photo aesthetics ($M_{high} = 5.663, M_{medium} = 4.918, M_{low} = 4.020, F_{(2, 288)} = 56.57, p = 0.000$). This result indicates the successful manipulation.

5.3.2. Hypothesis testing

5.3.2.1. *Perceived review helpfulness.* To test H1, we examined the impact of photo aesthetics on perceived review helpfulness. The ANOVA results revealed significant differences in perceived review helpfulness across three conditions ($F_{(2, 288)} = 8.90, p = 0.000$). As shown in [Fig. 7](#), an inverted U-shaped pattern was identified, with the medium condition rated the highest in perceived helpfulness, significantly higher than both the low condition ($M_{medium} = 5.986, M_{low} = 5.549, F_{(1, 194)} = 17.74, p = 0.000$) and the high condition ($M_{medium} = 5.986, M_{high} = 5.691, F_{(1, 190)} = 8.60, p = 0.004$). These results verify H1.

5.3.2.2. *Pleasure.* As the photo aesthetics improved, the participants’ pleasure also significantly increased ($M_{low} = 4.687, M_{medium} = 5.278, M_{high} = 5.274, F_{(2, 288)} = 10.66, p = 0.000$). Compared to the low-aesthetic condition, both the medium-aesthetic condition ($M_{low} = 4.687, M_{medium} = 5.278, F_{(1, 194)} = 13.85, p = 0.000$) and the high-aesthetic condition ($M_{low} = 4.687, M_{high} = 5.274, F_{(1, 192)} = 14.05, p = 0.000$) showed significantly higher pleasure levels. However, there was no significant difference in pleasure between the medium and high conditions ($M_{medium} = 5.278, M_{high} = 5.274, F_{(1, 190)} = 0.00, p = 0.971$).

5.3.2.3. *Perceived reviewer effort.* Participants’ perception of the reviewer effort was positively correlated with photo aesthetics ($M_{low} = 4.623, M_{medium} = 5.045, M_{high} = 5.070, F_{(2, 288)} = 5.56, p = 0.004$). Specifically, compared to the low condition, both the medium condition ($M_{low} = 4.623, M_{medium} = 5.045, F_{(1, 194)} = 7.70, p = 0.006$) and the high condition ($M_{low} = 4.623, M_{high} = 5.070, F_{(1, 192)} = 7.86, p = 0.006$) showed significantly higher perceived reviewer effort. However, there was no significant difference between the medium and high conditions ($M_{medium} = 5.045, M_{high} = 5.070, F_{(1, 190)} = 0.03, p = 0.858$).

5.3.2.4. *Perceived review authenticity.* Participants in the medium condition perceived significantly greater authenticity than those in the low ($M_{low} = 5.397, M_{medium} = 5.759, F_{(1, 194)} = 7.52, p = 0.007$) and high conditions ($M_{medium} = 5.759, M_{high} = 4.971, F_{(1, 190)} = 30.14, p = 0.000$). We also compared the low and high conditions, and found that participants in the high condition perceived significantly lower authenticity than those in the low condition ($M_{low} = 5.397, M_{high} = 4.971, F_{(1, 192)} = 6.84, p = 0.010$). This finding indicates that higher aesthetics are not always better; excessively high aesthetics can lead consumers to doubt the authenticity of the review.

[Fig. 8](#) shows the effects of photo aesthetics on the mediating variables, which include perceived pleasure, reviewer effort, and review authenticity. Overall, along the path from low to medium aesthetics, all three mediating variables significantly increased. However, when the aesthetics became excessively high, perceived review authenticity significantly decreased, while perceived pleasure and reviewer effort no longer played a role.

Additionally, we conducted a regression analysis of the mediating variables on the dependent variable, incorporating four control variables: participants’ gender (*Gender*), age (*Age*), education level (*Education*) and online review experience (*Experience*). As shown in [Table 5](#), our

regression analysis of the mediating variables (i.e., perceived pleasure, reviewer effort and review authenticity) and the dependent variable (i.e., perceived review helpfulness) reveals that both perceived pleasure ($\beta = 0.2334$, $p < 0.01$), reviewer effort ($\beta = 0.1891$, $p < 0.01$) and review authenticity ($\beta = 0.2545$, $p < 0.01$) have a significant positive impact on perceived review helpfulness. Based on the above results, H2, H3 and H4 are validated.

To validate the mediation effect, we employed the bootstrap sampling approach using PROCESS macro in SPSS [119–121]. We divided the sample into two groups: “Low vs. Medium” and “Medium vs. High”. We expected to find a positive effect of photo aesthetics on perceived helpfulness in the “Low vs. Medium” group and a negative effect in the “Medium vs. High” group. Using Model 4 in the PROCESS macro in SPSS 25.0, we set the bootstrap sample size to 5,000 and analyzed the mediating effects for both groups separately. As shown in Table 6, the results indicated the following:

For the “Low vs. Medium” group, photo aesthetics significantly positively impacted perceived review helpfulness (total effect = 0.4864, $p = 0.0000$), with pleasure, perceived reviewer effort and perceived review authenticity serving as significant mediators (95% CI excluded 0). Their mediating effects accounted for 24.94%, 15.46% and 23.27% of the total effect, respectively. At this point, the p -value for the direct effect of photo aesthetics on helpfulness increased ($p = 0.0299$), with a coefficient of 0.1767, accounting for 36.33% of the total effect. The direct effect of photo aesthetics on perceived review helpfulness was weakened but still remained significant after the inclusion of the three mediating variables: pleasure, perceived reviewer effort, and perceived review authenticity. This indicates that the three mediating variables play a partially mediating role on the left side of the U-shaped relationship.

For the “Medium vs. High” group, higher photo aesthetics led to lower perceived review helpfulness (total effect = -0.2997, $p = 0.0035$). Notably, pleasure and perceived reviewer effort ceased to be a significant mediator (95% CI included 0), whereas perceived review authenticity remained significant (95% CI excluded 0), accounting for 60.83% of the total effect. It is worth noting that at this point, the direct effect is no longer significant ($p = 0.1665$), indicating that perceived review authenticity plays a full mediating role.

Based on these findings, H2, H3, and H4 are further validated. Specifically, these findings indicate that perceived pleasure, reviewer effort and review authenticity are the partial mediators of the positive correlation between photo aesthetics and perceived review helpfulness, whereas perceived review authenticity is the full mediator of the negative correlation between the two.

6. Discussion and conclusion

We have conducted two studies, combining secondary data analysis and an experiment, to investigate the impact of the photo aesthetic on perceived review helpfulness and its underlying mediating mechanisms. Table 7 summarizes the information about the findings from these two studies.

First, RQ1 has been addressed by both Study 1 and Study 2. We have verified that the aesthetics of review photos have an inverted U-shaped effect on perceived review helpfulness. Previous studies emphasized the positive linear impact of photo aesthetics [15–17], but our findings provide a more comprehensive perspective on this topic. On the one hand, photo aesthetics do not always have a positive effect. When aesthetics are too high, they can actually decrease readers’ perceptions of review helpfulness. On the other hand, the relationship between photo aesthetics and perceived review helpfulness is not simply linear, because its marginal effects vary continuously.

Second, RQ2 has been answered by Study 2. Prior studies on the impact of photo aesthetics on review helpfulness have overlooked potential underlying mechanisms [15–17]. Our experimental findings in Study 2 indicate that moderate photo aesthetics lead readers to perceive

greater pleasure, reviewer effort, and review authenticity. Though with partial mediation effects, these three mediators can significantly enhance the perceived review helpfulness. However, excessively high aesthetics can cause readers to question the authenticity of reviews, which can fully mediate the effects of photo aesthetics on perceived review helpfulness. This discovery highlights the mediating roles of perceived pleasure, reviewer effort, and review authenticity in the relationship between photo aesthetics and perceived review helpfulness.

Finally, RQ3 has been addressed through Study 1. We examine the boundary conditions under which photo aesthetics affect perceived review helpfulness, specifically by considering review text length. An analysis of secondary data (Study 1) reveals that the impact of photo aesthetics on perceived review helpfulness varies with review text length. Specifically, review text length plays a weakening moderating role. In other words, for longer reviews, compared with shorter ones, the impact of photo aesthetics on perceived review helpfulness is weaker.

6.1. Theoretical implications

First, this study confirms that the relationship between photo aesthetics and helpfulness does not conform to the notion of “the more aesthetic, the better” and identifies the optimal level of aesthetic effect, which is novel. By combining the relevant literature exploring the antecedents of review helpfulness, we find that existing studies have focused on review text [5–8] and reviewer characteristics [9–12], with few studies exploring the aesthetic quality of photos. Although some studies have examined the impact of photo aesthetics on helpfulness [15–17], they have considered only a simple linear relationship and overlooked the underlying mechanisms. Drawing on SOR theory and OSL theory, our findings suggest that photo aesthetics exhibit an inverted U-shaped effect on perceived review helpfulness, implying that excessively high aesthetic quality may diminish helpfulness. Furthermore, through comprehensive data analysis, we estimate the optimal level of aesthetic quality. This finding not only provides new insights into the critical conditions for aesthetic effects but also plays a significant role in advancing the understanding and application of related research.

Second, further to the identified inverted U-shaped relationship between photo aesthetics and perceived review helpfulness, this research explains its underlying mediating effects, unveiling the critical roles of perceived pleasure, reviewer effort and review authenticity and thereby providing new insights into the field of online reviews. While previous studies have examined the impact of factors such as the number of review photos [30], photo aesthetics [15], and photo clarity [16] on review helpfulness, few have gone beyond the level of identifying phenomena to explore the underlying mechanisms. Based on SOR theory, our study validated that photo aesthetics influence perceived review helpfulness through readers’ affective (i.e., pleasure) and cognitive states (i.e., perceived reviewer effort and review authenticity). This provides a clearer explanation for the inverted U-shaped relationship and contributes to the existing body of literature.

Third, based on cognitive overload theory, this study examines the combined impact of review text and photos on perceived review helpfulness and validates the moderating effect of text length, contributing to related theoretical research. Existing studies have explored factors affecting helpfulness from a single perspective, either text [8,36] or photos [16,67], neglecting their coexistence in reviews. This paper finds that when the text is longer, the influence of photo aesthetics on perceived review helpfulness is weakened. This finding advances the application of cognitive overload theory and offers a fresh perspective on online review research.

Finally, we employ a mixed-method approach that combines secondary data analysis and experimental research, which offers significant insights for future scholars. At the beginning of our research, our preliminary analysis of secondary data reveals initial evidence of an inverted U-shaped relationship between photo aesthetics and perceived

review helpfulness. However, secondary data primarily demonstrate correlations between variables, limiting their ability to explore causal relationships. To address this limitation, experiments are designed to verify causal effects and underlying mediating effects. This mixed-method approach provides scholars with a more comprehensive understanding of the research topic and enhances the reliability of the findings.

6.2. Managerial implications

This study examines the impact of photo characteristics on perceived review helpfulness in terms of the aesthetic quality. Our findings provide practical recommendations for online review platforms and service industry managers, helping them enhance the perceived value of online reviews to potential consumers, thereby improving performance at a low cost.

From the perspective of online review platforms, filtering high-quality reviews is crucial for ensuring their long-term quality development. On the basis of our findings, we suggest that online review platforms consider photo aesthetics a key factor in review ranking. Currently, many platforms prioritize reviews with long texts and aesthetic photos, which make it easier for potential consumers to read and browse. We recommend modifying this ranking approach by placing reviews with moderately aesthetic photos at the top and avoiding overly lengthy texts. Additionally, according to our findings, photos with a MUSIQ aesthetics score of approximately 4.2 exhibit the optimal aesthetic effect. Thus, platforms can provide users with examples of moderately aesthetic photos on the website to guide them in uploading review photos of similar aesthetic quality.

For managers in the service industry, guiding consumers to take and upload photos that are both aesthetically appealing and authentic to their experience is key to improving review quality and service reputation. Some businesses seeking positive reviews often encourage customers to take highly aesthetic photos to attract potential consumers. However, according to our study, this may be counterproductive as it sacrifices authenticity when aesthetics is considered too high. Extreme aesthetic enhancements in photos might raise concerns. If photos are overly curated, reviews that create an unrealistic impression can lead to the erosion of consumer trust. In the age of online bookings, hotels may strategically optimize photo aesthetics in their online presence to appear more appealing, potentially influencing booking decisions, but not to the extreme. In addition, hotel managers can incentivize consumers to leave aesthetically pleasing reviews by offering upgrades, discounts, or perks, subtly encouraging them to frame their experiences positively.

Table A.1

Alternative method: The Tobit regression results of main effect and moderating effect.

DV: <i>LgHelpfulness</i>	Model 5	Model 6
<i>Aesthetics</i>	0.0562*** (0.019)	0.3153** (0.125)
<i>Aesthetics</i> ²	-0.0066*** (0.002)	-0.0501*** (0.014)
<i>LgRevLength</i>	0.0312*** (0.002)	0.1968 (0.128)
<i>Aesthetics</i> × <i>LgRevLength</i>		-0.1356** (0.058)
<i>Aesthetics</i> ² × <i>LgRevLength</i>		0.0220*** (0.007)
Controls	Yes	Yes
Hotel FE	Yes	Yes
Time FE	Yes	Yes
Observations	56,671	56,671
Log likelihood	42814.29	42946.88
<i>p</i> > chi2	0.0000	0.0000
AIC	-84006.57	-84267.75

Notes: Standard errors are reported in parentheses; ****p* < 0.01, ***p* < 0.05, and **p* < 0.1.

These measures can enhance the quality and value of customer reviews, thereby improving the hotel’s online reputation management.

6.3. Limitations and future research

This study has several limitations and opens up the future research opportunities. First, the data are exclusively from hotel reviews in New York, which may limit the generalizability of the results. Future research could expand the scope to include reviews from other regions and industries. Second, in the analysis of secondary data, although we control many potential variables, this approach can only establish correlations. To address this limitation, we employ randomized experiments to validate causality. Future research could adopt other rigorous methods to further strengthen the verification of causal relationships. Finally, while we examine the mediating roles of perceived pleasure, reviewer effort, and review authenticity, we are unable to explore all potential mediating variables. We made efforts to identify underlying drivers based on existing theories, and future research could investigate additional mediating variables to further enrich and refine these mechanisms.

CRedit authorship contribution statement

Yu Han: Writing – original draft, Visualization, Software, Methodology, Investigation, Data curation, Conceptualization. **Ziqiong Zhang:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization. **Carol X.J. Ou:** Writing – review & editing, Supervision, Conceptualization. **Zili Zhang:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Acknowledgments

This work was supported by the National Natural Science Foundation of China [grant numbers 72131005, 72121001, 72171062].

Appendix A

Table A.2

Alternative sample: The regression results of main effect and moderating effect.

DV: <i>LgHelpfulness</i>	OLS		Tobit	
	2 months Model 7	3 months Model 8	2 months Model 9	3 months Model 10
<i>Aesthetics</i>	0.3183** (0.138)	0.3148** (0.134)	0.3183** (0.137)	0.3148** (0.133)
<i>Aesthetics</i> ²	-0.0514*** (0.016)	-0.0508*** (0.015)	-0.0514*** (0.015)	-0.0508*** (0.015)
<i>LgRevLength</i>	0.1905 (0.141)	0.1869 (0.137)	0.1905 (0.140)	0.1869 (0.136)
<i>Aesthetics</i> × <i>LgRevLength</i>	-0.1361** (0.064)	-0.1339** (0.062)	-0.1361** (0.063)	-0.1339** (0.062)
<i>Aesthetics</i> ² × <i>LgRevLength</i>	0.0225*** (0.007)	0.0222*** (0.007)	0.0225*** (0.007)	0.0222*** (0.007)
Controls	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	49,220	51,519	49,220	51,519
Adj-R ²	0.2579	0.2562	-	-
Log likelihood	-	-	36446.77	38372.33
<i>p</i> > chi2	-	-	0.0000	0.0000
AIC	-71293.54	-75136.66	-71291.54	-75134.66

Notes: Standard errors are reported in parentheses; ****p* < 0.01, ***p* < 0.05, and **p* < 0.1.

Table A.3

Alternative measure of *Aesthetics*: The regression results of main effect and moderating effect.

DV: <i>LgHelpfulness</i>	OLS		Tobit	
	Model 11	Model 12	Model 13	Model 14
<i>Aesthetics</i>	0.0519*** (0.018)	0.2344* (0.122)	0.0519*** (0.018)	0.2344* (0.121)
<i>Aesthetics</i> ²	-0.0061*** (0.002)	-0.0404*** (0.014)	-0.0061*** (0.002)	-0.0404*** (0.014)
<i>LgRevLength</i>	0.0312*** (0.002)	0.1216 (0.124)	0.0312*** (0.002)	0.1216 (0.123)
<i>Aesthetics</i> × <i>LgRevLength</i>	-	-0.0986* (0.056)	-	-0.0986* (0.056)
<i>Aesthetics</i> ² × <i>LgRevLength</i>	-	0.0176*** (0.006)	-	0.0176*** (0.006)
Controls	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	56,671	56,671	56,671	56,671
Adj-R ²	0.2504	0.2537	-	-
Log likelihood	-	-	42813.57	42940.62
<i>p</i> > chi2	-	-	0.0000	0.0000
AIC	-84007.14	-84257.24	-84005.14	-84255.24

Notes: Standard errors are reported in parentheses; ****p* < 0.01, ***p* < 0.05, and **p* < 0.1.

Data availability

Data will be made available on request.

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