Quantifying the effects of online review content structures on hotel review helpfulness

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Abstract

Purpose – Drawing on attribution theory, the current paper aims to examine the effects of review content structures on online review helpfulness, focusing on three pertinent variables: review sidedness, information factuality, and emotional intensity at the beginning of a review. Moreover, the moderating roles of reviewer reputation and review sentiment are investigated.

Design/methodology/approach – The review sentiment of 144,982 online hotel reviews was computed at the sentence level by considering the presence of adverbs and negative terms. Then, the authors quantified the impact of variables that were pertinent to review content structures on online review helpfulness in terms of review sidedness, information factuality and emotional intensity at the beginning of a review. Zero-inflated negative binomial regression was employed to test the model.

Findings – The results reveal that review sidedness negatively affects online review helpfulness, and reviewer reputation moderates this effect. Information factuality positively affects online review helpfulness, and positive sentiment moderates this impact. A review that begins with a highly emotional statement is more likely to be perceived as less helpful.

Originality/value – Using attribution theory as a theoretical lens, this study contributes to the online customer review literature by investigating the impact of review content structures on online review helpfulness and by demonstrating the important moderating effects of reviewer reputation and review sentiment. The findings can help practitioners develop effective review appraisal mechanisms and guide consumers in producing helpful reviews.

Keywords Review content structures, Review sidedness, Information factuality, Emotional intensity, Review sentiment, Reviewer reputation, Online review helpfulness, Attribution theory, Text analytics

Paper type Research paper

1. Introduction

Online customer reviews have become an important source of information that consumers rely on to support their purchase decisions (Litvin *et al.*, 2008), particularly when purchasing tourism products (Ye *et al.*, 2011). For instance, a recent study by TripAdvisor reported that more than 81% of travelers always or frequently read online reviews before booking accommodation online, and over half of respondents (55%) browsed multiple reviews across

several pages (TripAdvisor and Ipsos MORI, 2019). Some studies have investigated online reviews' role in influencing consumer purchases of physical products (Wang *et al.*, 2020b), accommodation services (Lin and Xu, 2017; Sparks and Browning, 2011) and trips (Xiang and Gretzel, 2010). Noticeably, consumers tend to depend more on online reviews to minimize potential risks when buying services than when purchasing physical goods because experience goods' characteristics can only be ascertained upon consumption (Mudambi and Schuff, 2010).

Despite online customer reviews' various benefits, the overwhelming number of online reviews may cause problems for users, such as information overload (Frías *et al.*, 2008) and hesitance in decision-making due to the conflicting opinions presented in such reviews (Purnawirawan *et al.*, 2012). The influx of reviews available online and the anonymity of reviewers make identifying the most helpful online reviews difficult for consumers when evaluating a brand, product or service (Baek *et al.*, 2012; Shan, 2016). Therefore, research on identifying helpful online reviews greatly interests both researchers and practitioners (Fang *et al.*, 2016).

Researchers studying online customer reviews tend to shift their focus from directly observed factors to textual content-derived properties, such as sentiment and emotion, and various types of linguistic features (Fan, 2021). For instance, past studies have shown that review content and reviewer characteristics affect the perceived helpfulness of online customer reviews (Fang *et al.*, 2016; Liu and Park, 2015). Liu and Park (2015) found that reviews' qualitative textual aspects, such as review sentiment and readability, are the most influential factors that affect online review helpfulness.

However, past studies on review sentiment and its derivatives – information factuality (Filieri, 2015, 2016) and review sidedness (Chen, 2016) – as determinants of online review helpfulness have presented inconsistent findings. *Information factuality* refers to the degree of content in a review that is "*free from emotional* [emphasis added], subjective, and vacuous comments*" (Filieri, 2015, p. 1263). Meanwhile, *review sidedness* refers to whether one- or two-sided arguments are presented in review content (Chen, 2016). Some studies have reported that two-sided reviews – that is, reviews expressing both positive and negative emotions – are perceived as more credible or helpful by consumers (Cheung *et al.*, 2012; Filieri *et al.*, 2018b; Jensen *et al.*, 2013). In contrast, some researchers have argued that one-sided reviews – which express only positive or negative sentiment – could be more persuasive (Chen, 2016; März *et al.*, 2017; Pentina *et al.*, 2018; Schlosser, 2011). A third view has argued that emotion-free review text, or text rich in information factuality, can be more persuasive (Filieri, 2015, 2016).

Earlier studies' inconclusive findings have emphasized a need to understand review content structures in more detail (Fan, 2021). For instance, a review may contain both sentences that express strong emotions and sentences that do not contain emotional words or phrases. As a result, a review can simultaneously exhibit high degrees of review sentiment and information factuality. However, how a review's content structure that mixes emotion-rich and emotion-free sentences affects online review helpfulness remains unclear. Additionally, past studies' measurements of review sidedness as a binary variable of one- or two-sided reviews may not fully reflect the subtleties of the sentiments embedded in review content. In the current study, we incorporate natural language processing (NLP) to measure the magnitude of review sidedness as a continuous variable by quantifying the degree of co-presence for both positive and negative sentiments in a review.

This study aimed to investigate the effects of review content structures on online review helpfulness by quantifying the impact of review sidedness, information factuality and emotional intensity at the beginning of a review on online review helpfulness. Specifically, we focused on two overarching questions: (1) What is the role of review content structures in shaping online review helpfulness? (2) How do reviewer reputation and review sentiment moderate the effects of review content structures on online review helpfulness?

To answer these questions, we computed the sentiment scores of each sentence in a collection of 144,982 online hotel reviews. For this research, we used a new sentiment analysis method derived from NLP technology. Drawing on attribution theory (Kelley, 1973), we examined review content structures' (i.e. review sidedness, information factuality and emotional intensity at the beginning of a review) effects on online review helpfulness. Additionally, we examined review sentiments' (the degree of positive or negative sentiment in a review) and reviewer reputations' moderating effects on how review content structures influence online review helpfulness.

The remainder of this paper is organized as follows: After a systematic review of the earlier literature relevant to our study, we present our theoretical model and develop hypotheses for our empirical study. Then, we introduce our data collection, analysis methods and analysis results. Next, we discuss and explain the study's contributions. We finish with concluding remarks and a brief discussion of this study's limitations, as well as possible directions for future research.

2. Literature review and theoretical grounding

2.1 Online review helpfulness

Online review helpfulness refers to the perceived value of the information included in an online review (Li *et al.*, 2013); it also measures review diagnosticity – that is, the extent to which a review helps a reader make informed purchase decisions (Mudambi and Schuff, 2010). e-Commerce players have introduced online review helpfulness ratings on their platforms to convert review readers into buyers by assisting in consumers' information search and decision-making (Otterbacher, 2009). The time savings that result from decisions through e-commerce platforms lead to higher consumer satisfaction with those platforms (Kohli *et al.*, 2004), implying that online platforms with more helpful reviews offer consumers higher potential value (Mudambi and Schuff, 2010). As shown in Table 1, *online review helpfulness* is a multifaceted concept that is affected by different factors on the basis of both quantitative and qualitative measures (Huang *et al.*, 2015; Qazi *et al.*, 2016).

Online review helpfulness has commonly been examined from review, reviewer and product/service perspectives. Initially, researchers generally assessed online review helpfulness vis-à-vis reviews' fundamental quantitative factors, such as star ratings, review length, review age, total votes and reviewer rank (Forman *et al.*, 2008; Mudambi and Schuff, 2010; Pan and Zhang, 2011; Zhang *et al.*, 2010). Later studies considered qualitative measures alongside quantitative measures, such as review sentiment (Lee *et al.*, 2017; Ullah *et al.*, 2015), review extremity (Kuan *et al.*, 2015; Zhu *et al.*, 2014), readability (Fang *et al.*, 2016; Park and Nicolau, 2015) and review sidedness (Filieri *et al.*, 2018b; Pentina *et al.*, 2018).

Some scholars have also suggested that these measurements, directly collected from online platforms, are relatively simple and superficial clues (Qazi *et al.*, 2016). Otterbacher (2009) called for research on online reviews' written language to derive in-depth insights into readers' information processing in order to rate online review helpfulness. With advancements in NLP and text mining techniques, recent studies have extracted more versatile characteristics that are embedded in review content as possible determinants of online review helpfulness, such as discrete emotions (Ahmad and Laroche, 2015; Ren and Hong, 2019; Yin *et al.*, 2014a, 2017) and multiple types of linguistic features (Chua and Banerjee, 2016; Huang *et al.*, 2018; Shin *et al.*, 2019; Sun *et al.*, 2019). Additionally, several studies have investigated reviewer-related characteristics' effects on online review helpfulness, such as information disclosure (Forman *et al.*, 2008; Sun *et al.*, 2019; Willemsen *et al.*, 2011), reviewer experience (Filieri *et al.*, 2018b; Liang *et al.*, 2019; Park and Nicolau, 2015), reviewer expertise (Baek *et al.*, 2012; Chua and Banerjee, 2015; Filieri *et al.*, 2019) and reviewer online attractiveness (Li *et al.*, 2019; Liu and Park, 2015; Zhou and Guo, 2017).

Table 1.
Summary of key empirical studies on factors contributing to online review helpfulness

Factors and effects on online review helpfulness

Studies	Rating	Rating²	Review extremity	Review length	Readability	Available days	Review valence/sentiment	Objectivity/factuality	Total votes	Review sidedness	Emotion	Linguistic features	Total review count	Product type	Information disclosure	Reviewer experience	Reviewer expertise	Reviewer online attractiveness
Ghose and Ipeirotis (2007)	+		+															
Sen and Lerman (2007)							+							−				
Forman et al. (2008)	+														+			
Mudambi and Schuff (2010)	+			+					−					−				
Zhang et al. (2010)	×			+														
Ghose and Ipeirotis (2011)	+				+			+	+						+			
Pan and Zhang (2011)	+			+		+							−	−				
Schlosser (2011)										×								
Willemsen et al. (2011)	+			+			+								+			
Wu et al. (2011)	+			+					+									
Baek et al. (2012)	+	−		+			+		+				−	−			+	
Korfiatis et al. (2012)	+	+	+	+	×				−									
Yin et al. (2012)	+					+						+					+	
Scholz and Dorner (2013)	−			+		+		×	+								+	
Siering and Muntermann (2013)			−	+			−	+	+					−				
Yin et al. (2014a)	−		+	+	−	+												
Yin et al. (2014b)	+	+		+	−	+					×		−				+	+
Yin et al. (2014c)	−			+	−	+	−						−				+	+
Zhu et al. (2014)	−		+	+	−				−				−				+	+
Ahmad and Laroche (2015)	+	+		+							×							
Chua and Banerjee (2015)	−			+													+	

(continued)

Factors and effects on online review helpfulness

Studies	Rating	Rating[2]	Review extremity	Review length	Readability	Available days	Review valence/ sentiment	Objectivity/ factuality	Total votes	Review sidedness	Emotion	Linguistic features	Total review count	Product type	Information disclosure	Reviewer experience	Reviewer expertise	Reviewer online attractiveness
Einar et al. (2015)	+			+				+	+					–	+			
Huang et al. (2015)	+			+													+	
Kuan et al. (2015)			–	+			×										+	
Liu and Park (2015)	+			+											+			+
Park and Nicolau (2015)				+	+										+	+		
Quaschning et al. (2015)	+			+													+	
Ullah et al. (2015)	+	–		+			+											
Zhou and Guo (2015)	–			+		+	–								+	+	+	+
Agnihotri and Bhattacharya (2016)	+			+			+							+	+	+		
Chen (2016)			++	++	+	+				×			–	+			+	
Fang et al. (2016)			++	++	+	+										+	+	
Hlee et al. (2016)			–	++	+	+	×								+			
Hong et al. (2016)				++														
Lee and Choeh (2016)				+									–	+	+		+	
Qazi et al. (2016)									–			×						
Yin et al. (2016)	–		–	+								+						
Chua and Banerjee (2017)	+													+				
Gao et al. (2017)			+	++		++									+	++	+	
Guo and Zhou (2017)	–			++		++									+	++	+	+
Karimi and Wang (2017)	+		–	+			+				–				+			
Lee et al. (2017)			++	++													++	
Li et al. (2017)				++	+							+					++	

(continued)

Table 1.

Factors and effects on online review helpfulness

Studies	Rating	Rating²	Review extremity	Review length	Readability	Available days	Review valence/ sentiment	Objectivity/ factuality	Total votes	Review sidedness	Emotion	Linguistic features	Total review count	Product type	Information disclosure	Reviewer experience	Reviewer expertise	Reviewer online attractiveness
Liu and Li (2017)	+	+		+														
März et al (2017)		+	+	+		+	+			−	−	×	+			+		
Wang and Karimi (2017)	−			+		+						−						
Wu (2017)			+	+	−	−												
Yin et al. (2017)	+	+		+			+				+		−	×	+	+	+	
Zhou and Guo (2017)	−			+														+
Eslami et al. (2018)	−			+								+						
Filieri et al (2018b)										+						+		
Filieri et al. (2018c)	−	+		+	+										+		+	
Huang et al. (2018)												+						
Lu et al. (2018)	+		+	+									+				+	
Pentina et al. (2018)							+			−								
Risselada et al. (2018)			+	+	+		+					+					+	
Filieri et al. (2019)			+	+												+	+	
Li et al. (2019)	−			+ +	+ +	+						+					+	+
Liang et al. (2019)	−	+		+ +	+ +										+	+	+	
Liu et al. (2019)	−			+ +	+	+						+					+	
Ren and Hong (2019)	+	−		+ +	+	+					×	+		−			+	
Shin et al. (2019)												−						
Srivastava and Kalro (2019)	+			+	+	+	+								+	+	+	
Sun et al. (2019)	−					+ +						+			+		+	
Wang and Karimi (2019)	−	+		+		+						−			+			

(*continued*)

Factors and effects on online review helpfulness

Studies	Rating	Rating²	Review extremity	Review length	Readability	Available days	Review valence/ sentiment	Objectivity/ factuality	Total votes	Review sidedness	Emotion	Linguistic features	Total review count	Product type	Information disclosure	Reviewer experience	Reviewer expertise	Reviewer online attractiveness
Wang et al. (2019a)	−				+	+					×	+					+	+
Wang et al. (2019b)	+	+	+	+	+	+							−					
Yang et al. (2019)	+		+	−		−	+								+		+	
Zhou and Yang (2019)	−		+	+	+	+	−										+	
Chatterjee (2020)	+			−		−	−				×							
Chen and Farn (2020)			+								+						+	
Craciun et al. (2020)	+		+	+	+	+					×		−					
Fan and Zhang (2020)	−		+	+		+							−				+	
Hu (2020)											×	×						
Huang et al. (2020)			+	+		+					×		+					
Ismagilova et al. (2020)											×			+				
Wang et al. (2020a)	−					−										+	+	
Zhou et al. (2020)	+	+	+	+		−	−					+						
Zhu et al. (2020)	+	+	+	+		−							−					

Note(s): + indicates a positive effect, − indicates a negative effect and × indicates mixed findings

Table 1.

Review emotion is often used interchangeably with the term *review sentiment* in existing studies. Although a few studies have explored the impact of the emotions expressed in online reviews on review helpfulness, their findings have not been fully consistent. Several studies have found that *negative* emotions more strongly influence online review helpfulness than neutral or positive emotions. Specifically, Yin *et al.* (2014a) discerned two kinds of negative emotions in reviews: anxiety and anger. They also showed that anxiety positively influenced online review helpfulness. Similarly, Siering and Muntermann (2013) mapped the emotional words of 4,970 product reviews into several predefined categories using dictionaries. They found that reviews with negative emotions are perceived to be more helpful than reviews with positive emotions for experience goods.

Somewhat contradictorily, several studies have reported a beneficial effect of *positive* review emotions on online review helpfulness, or the "likelihood of [consumer's] acceptance of current agent advice," as conceptualized by Gershoff *et al.* (2003, p. 163). Compared with negative reviews, positive reviews more strongly influence this likelihood (Gershoff *et al.*, 2003). In the same vein, Doh and Hwang (2009) found that positive reviews positively affect potential customers' attitudes and purchase intentions.

While reviews expressing strong emotions have been found to be more helpful, research on information factuality has suggested that sentiment-free review text (i.e. with a neutral sentiment) can be even more helpful (Filieri *et al.*, 2018a). *Information factuality* is typically conceptualized similarly to *perceived objectiveness* (Filieri, 2015). Information factuality and strong sentiments can coexist in a review that includes both emotion-free sentences and sentences that express strong emotions. Therefore, a detailed review content structure that integrates *review emotion* and *information factuality* should be considered when examining online review helpfulness.

2.2 Attribution theory

Attribution theory is formally defined as dealing "with how the social perceiver uses information to arrive at causal explanations for events. It examines what information is gathered and how it is combined to form a causal judgment" (Fiske and Taylor, 1991, p. 23). The theory asserts that individuals construe the cause of a particular event or outcome with regard to certain factors in a particular way (Snead *et al.*, 2015). These causal inferences are called *attributions*, and they come in two main types: *dispositional* and *situational* (Heider, 1958). *Dispositional attribution* ascribes a behavior's cause to a person's internal characteristics (e.g. personal traits and motives). Meanwhile, *situational attribution* attributes a behavior's cause to situational or environmental features beyond a person's control.

Attribution theory has also been used to explain how consumers assess online review helpfulness. According to the logic of attribution theory (Kelley, 1973, 1987), readers evaluate online review helpfulness based on their causal inferences about the review's attributions, such as the reviewer's motivation to post the review (Sen and Lerman, 2007). In other words, consumers may attribute the reason for an online review to the reviewer's dispositional characteristics (e.g. self-serving or other non-product-related reasons), alongside or instead of the actual performance of the reviewed product or service (cf. Chen *et al.*, 2020; Lee and Youn, 2009). Such causal inference for online reviews is likely to influence readers' judgments about these reviews' helpfulness. Chen and Farn (2020) used attribution theory to explain how expressions of emotions in online reviews affect perceived review helpfulness through consumers' attributions about reviewers' cognitive efforts. Similarly, Sen and Lerman (2007) argued that review readers infer reviewers' motivations in order to determine whether to make a purchase.

The discounting principle of attribution theory indicates that the presence of other plausible reasons or causes may discount a certain cause's role in producing a given effect (Chen and Farn, 2020). For example, if a review reader suspects that an endorsement in an online review was motivated by a financial incentive from a company, that reader will perceive the reviewer as biased and the review content as unconvincing (cf. Kelley, 1973). Earlier research has applied the discounting principle to determine source characteristics' impact on online review helpfulness (Lee and Youn, 2009; Senecal and Nantel, 2004).

Supported by previous research on how review content and review sources influence online review helpfulness, we found attribution theory to offer an appropriate theoretical lens with which to analyze review content structures' impact on users' evaluation of online review helpfulness.

3. Research model and hypothesis development

3.1 Research model

In this study, we investigated how review content structures shape online review helpfulness. On the basis of earlier research, we focused on three factors that pertain to review content structure: (1) *review sidedness*, which refers to an online review's degree of two-sidedness (reflecting the review content's argumentation style used) (Chen, 2016); (2) *information factuality*, which pertains to the degree of content in an online review that is "free from emotional, subjective, and vacuous comments" (Filieri, 2015, p. 1263); and (3) *emotional intensity*, which is the degree of positive or negative emotions expressed at the beginning of an online review. A review can achieve high scores in all three attributes simultaneously if its content includes both emotion-free sentences and sentences that express strong positive and negative emotions. Based on these variables that are pertinent to review content structures, our research model included six relevant hypotheses. The proposed research model is depicted in Figure 1. We explain the rationale for our hypotheses in the next subsection.

3.2 Hypothesis development

A one-sided review expresses either positive or negative sentiment, whereas a two-sided review contains both positive and negative statements related to a service or product (Cheung *et al.*, 2012). In the current study, *review sidedness* was measured as the degree to which an online review contained both positive and negative sentiments. A one-sided review's sidedness score was 0. Some scholars have argued that an online review's inclusion of a two-sided argument enhances its perceived helpfulness since the review may be perceived as less biased (Cheung *et al.*, 2012; Filieri *et al.*, 2018b). On the contrary, other scholars have claimed
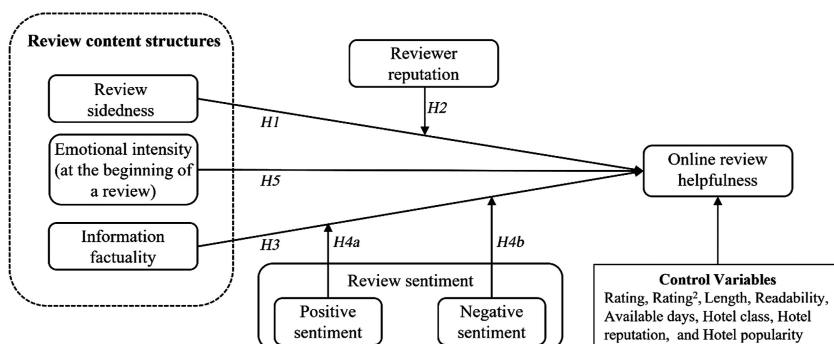

Figure 1.
Research model

that two-sided reviews are not always helpful and may even be less persuasive than one-sided reviews because they may contain ambiguous information and offer unclear suggestions (Chen, 2016; März *et al.*, 2017; Pentina *et al.*, 2018; Schlosser, 2011).

Whether positive or negative, one-sided reviews may be perceived as more informative because they are unequivocal (Forman *et al.*, 2008). Since a one-sided review either favors or opposes a purchase choice, it "eliminates or strengthens the position of the product with regards to the list of alternatives or items in a consideration set" (Korfiatis *et al.*, 2012, p. 207). Thus, two-sided reviews can be assumed to impair users' ability to make purchase decisions by complicating their decision-making. In other words, users are likely to consider one-sided reviews to be more helpful than two-sided reviews (Lee and Choeh, 2018; Pentina *et al.*, 2018; Purnawirawan *et al.*, 2012). Evaluating a service or product's actual performance is less demanding based on a one-sided review than based on a two-sided review. This difference is due to the greater mental effort needed to make causal inferences about a reviewer and their review as attribution theory has explained. Therefore, we postulate the following:

> *H1.* The degree of review sidedness is negatively associated with online review helpfulness.

Source credibility refers to readers' perceived credibility or trustworthiness of a message source, and it is typically measured as source expertise (Lu *et al.*, 2018; Pornpitakpan, 2004; Sussman and Siegal, 2003). Past studies have suggested that source credibility has a strong positive impact on message persuasiveness (Cheung *et al.*, 2009; Dou *et al.*, 2012; Hu *et al.*, 2008). A reviewer with a good reputation is deemed a credible message source. Reputable reviewers are considered less likely to engage in opportunistic behavior – such as writing fake reviews in exchange for payment from vendors or their rivals (Hu *et al.*, 2008). Therefore, they are perceived as more credible and trustworthy (Hu *et al.*, 2008).

In assessing an online review's trustworthiness by evaluating a reviewer's reputation, consumers attribute the review's cause to what attribution theory calls the reviewer's *dispositional characteristics* (Snead *et al.*, 2015). For example, if a novice user posts two-sided comments, review readers may doubt the reviewer's qualifications to provide meaningful evaluations. In comparison, when reading a two-sided review posted by a highly reputable reviewer, readers may attribute the reviewer's provision of both positive and negative comments to their experience and ability to comprehensively evaluate product or service performance. Thus, a two-sided review is more likely to be considered helpful if it is written by a more reputable (experienced) reviewer than if it is written by a reviewer with a poor reputation (e.g. a reviewer with no or very few accumulated helpfulness votes on TripAdvisor).

Furthermore, previous studies have indicated that reviewers with good reputations often also have the expertise required to write helpful online reviews (Chen, 2016; Ghose and Ipeirotis, 2011). These reviewers typically excel in expressing their thoughts and emotions, thereby producing appealing reviews (Chua and Banerjee, 2015). In other words, readers perceive online reviews by highly reputable reviewers as higher-quality, alleviating the negative effect of reviews' two-sidedness on perceived helpfulness. Therefore, we hypothesize the following:

> *H2.* Reviewer reputation positively moderates the effect of review sidedness on online review helpfulness.

Review content can be either emotional or factual (Filieri *et al.*, 2018a). A review may contain sentimental statements to reflect subjective experiences regarding a product or service; it may also contain emotion-free statements to reflect a more objective evaluation (cf. Filieri, 2015). However, purely emotional content reduces an online review's perceived objective value, or perceived information factuality, whereas fact-based, emotion-free information and

objective discussion of a reviewer's experience with a product or service could increase a review's diagnosticity (Filieri *et al.*, 2018a). Accordingly, earlier studies have conceptualized *information factuality* similarly to *perceived objectiveness* (Filieri, 2015). From an attribution theory perspective, a review's inclusion of factual information may serve as a useful cue triggering readers' situational attribution, encouraging readers to believe that a review's reported service experience derives from the reviewer's "situational" or personal experience. Consequently, these studies have concluded that a review's perceived information factuality is an important determinant of online review helpfulness (Filieri, 2015, 2016; Filieri *et al.*, 2018a). Therefore, we hypothesize the following:

H3. Information factuality is positively associated with online review helpfulness.

Combining factual information with emotional content may serve as a validation cue of review authenticity. Factual descriptions imply that comments derive from an authentic consumer with firsthand experience, rather than a commercial endorsement or slander. Such inferences are particularly essential because of online reviews' anonymous nature. As attribution theory has explained, readers may attribute objective, emotion-free information in an online review to the reviewer's good intention to present trustworthy facts and offer an objective evaluation; thus, these readers will believe that the review content reflects the actual performance of the product or service. Accordingly, we postulated that the simultaneous presence of objective information (measured by emotion-free content or information factuality) and subjective information (measured by content rich in emotion or review sentiment) would lead to high perceived helpfulness for a review. This relationship suggests a positive interaction effect of information factuality and review sentiment on online review helpfulness. Because a review can include either positive or negative sentiment, or both simultaneously, we hypothesized the following:

H4a. The interaction effect of positive sentiment and information factuality positively influences online review helpfulness.

H4b. The interaction effect of negative sentiment and information factuality positively influences online review helpfulness.

Psychologists have long acknowledged that first impressions matter (Digirolamo and Hintzman, 1997). In the news media context, a headline determines readers' first impression of an article and can influence how readers perceive the remainder of an article's content (Reis *et al.*, 2015). Readers of online customer reviews undergo similar information processing; thus, the beginning of a review may strongly affect how readers perceive the entire review. As per H3, we assumed that emotion-free, factual information at the beginning of a review would likely be more convincing to readers.

In line with attribution theory, we considered factual information to offer readers a cue on which to base their evaluation. This consideration was supported by earlier studies that have demonstrated the use of evidence-based (or factual) information to significantly alter people's attribution and evaluation (Hong and Park, 2012; Kim and Ferguson, 2018). And the fact-based descriptions may signal a reviewer's authenticity and credibility, making readers attribute a review to a product or service's actual performance. Accordingly, higher confidence in a review's accuracy increases a review's perceived helpfulness (Ismagilova *et al.*, 2020; Sen and Lerman, 2007). Therefore, we expected readers to consider online reviews that begin with a more objective, less emotional statement to be more helpful. Accordingly, we postulated the following:

H5. The emotional intensity at the beginning of a review is negatively associated with online review helpfulness.

4. Data and methodology

4.1 Data collection

To test our research model, we collected actual review data from TripAdvisor, the world's largest travel site. TripAdvisor allows prior hotel customers to evaluate and rate their experiences on a scale of one to five stars, together with a text review detailing their stay. At the time of this study's data collection, TripAdvisor had accumulated over 15 years of online customer reviews. Our unit of analysis was customers' individual reviews.

On TripAdvisor, readers of online reviews can also vote on whether they view a specific review as helpful. *Online review helpfulness* – this study's dependent variable – was, therefore, measured using the cumulative number of helpfulness votes. Such data were collected by crawling from TripAdvisor.com. The collected dataset comprised 144,982 reviews (written in English) of over 1,200 hotels in Germany, Finland and China that had been posted from June 2002 to February 2016. The hotels in our sample were full-service hotels with three stars (45%), above-average hotels with four stars (26%), mid-market economy hotels with two stars (11%), luxury hotels with five stars (3%), budget hotels with one star (2%) and hotels with no star information (13%). For each online review, we collected the customer's hotel rating, the review text and the helpfulness votes the review had received. Additionally, for each hotel, we computed the respective total number of reviews and the average customer rating.

4.2 Operationalization of variables

We adopted NLP to compute the variables that were pertinent to reviews' content structures by quantifying *review sidedness*, *information factuality*, and *emotional intensity at the beginning of the review*. Using the *R* "qdap" package to bridge between qualitative texts and statistical analysis (Rinker *et al.*, 2020), we first decomposed each review into a set of sentences. Then, we computed each sentence's sentiment score. In prior research, sentiment analysis has most often been conducted using lexicon-based methods, which cannot deal with negation and adverbs in a sentence. Instead, as demonstrated in Table 2, NLP can more precisely calculate the presence of negations and adverbs in a sentence (D'Andrea *et al.*, 2015). For instance, the phrase "not good" should be classified as a negative sentiment, rather than a positive sentiment, by capturing the presence of the negative term ("not" in this example). The strength of the sentiment derived from adverb use should also be considered. For example, the sentiment reflected by the term "very good" should not be deemed to have the same score as "good." Therefore, rather than using a lexicon-based method, we employed NLP to quantify magnitudes of review sidedness.

After computing the sentiments of each sentence in a review, we summed the positive and negative sentiment values of all sentences in each review to represent each review's score of positive or negative sentiment. A review's sidedness was the product of its *z*-score transformed values of positive and negative sentiment scores (See Table 3). Consequently, *review sidedness* was measured on a continuum; the lower end denoted no coexistence of positive and negative sentiments in the review's content, and the higher end indicated a high degree of two-sidedness. Absolute values for positive and negative sentiment scores and review sidedness were used in this analysis. Additionally, *information factuality* was operationalized as the proportion of emotion-free content in a review, represented by the

Table 2.
Examples of sentiment scores in a review sentence computed via the *R* qdap package

Sample sentence	Sentiment score	Sample sentence	Sentiment score
The hotel is very good	0.805	The hotel is not bad	0.447
The hotel is good	0.500	The hotel is bad	−0.500
The hotel is not good	−0.447	The hotel is very bad	−0.805

proportion of neutral sentences in each review. *Reviewer reputation* was operationalized as the quotient of the number of helpfulness votes that a TripAdvisor reviewer had received over the total number of online reviews that they had posted. *The emotional intensity at the beginning of a review* was measured as the sentiment score of the review's first sentence.

Following prior work on online review helpfulness (Mudambi and Schuff, 2010; Yin *et al.*, 2014a), we controlled for a series of review-related variables in our analysis – namely, *star ratings*, *star ratings' quadratic terms*, *review length*, *readability* and *available days*. *Star ratings' quadratic terms* were included to account for the nonlinear relationship between rating and helpfulness (Mudambi and Schuff, 2010). *Readability* was calculated using the automated readability index (Smith and Senter, 1967), a method of determining written material's difficulty (Fan, 2021; Korfiatis *et al.*, 2012). The operationalization of the variables used in this study is presented in Table 4.

The descriptive statistics for the dataset are summarized in Table 5. The *online review helpfulness* values ranged from 0 to 154, with a mean of 0.871. In our sample, the average rating of customer reviews was equal to 4.123, with an average review length of 125 words.

	Input: *review text with N sentences*
1	*separate review into sentences i = 1, 2, ..., N*
2	for *sentence i = 1, 2, ..., N* do
3	*sentiment$_i$ ← calculate sentiment score of sentence$_i$*
4	End
5	*positive sentiment score of review (pos)* $\leftarrow \sum_{i=1}^{N}$ if *sentiment > 0*
6	*negative sentiment score of review (neg)* $\leftarrow abs(\sum_{i=1}^{N}$ if *sentiment < 0)*
7	Outcome: *review sidedness ← z-score(pos) × z-score(neg)*
8	End

Table 3.
Algorithm: review
sidedness calculation

Variable	Definition and operationalization
Online review helpfulness	A review's number of helpfulness votes
Rating	The star rating of a review
Rating^2	The quadratic term of the star rating
Review length	The number of words in a review
Readability	Automated readability index
Available days	The number of days that had elapsed since a review was posted
Review sidedness	The degree to which both positive and negative sentiments were represented in a review
Information factuality	The proportion of neutral sentences in a review
Positive sentiment	A review's positive emotion score, calculated by aggregating sentences' positive emotion scores in a review
Negative sentiment	A review's negative emotion score, calculated by aggregating sentences' negative emotion scores in a review
Emotional intensity at the beginning of a review	The sentiment score of the first sentence in a review
Reviewer reputation	The number of helpfulness votes divided by the total number of reviews posted
Hotel class	The reviewed hotel's official class rating
Hotel popularity	The number of reviews a hotel had received
Hotel reputation	A hotel's average customer rating

Table 4.
Operationalization of
variables

Variable	Min.	Max.	Mean	Median	Std.
Online review helpfulness	0.000	154.000	0.871	0.000	1.984
Rating	1.000	5.000	4.123	4.000	0.955
Rating^2	1.000	25.000	17.911	16.000	6.920
Review length	1.000	2360.000	125.717	93.000	112.881
Readability	−13.873	201.338	6.834	6.417	3.531
Available days	1.000	4989.000	974.508	789.000	829.621
Review sidedness	0.000	184.906	1.014	0.000	3.135
Information factuality	0.000	0.923	0.276	0.267	0.193
Positive sentiment	0.000	32.722	2.660	2.348	1.771
Negative sentiment	−10.572	0.000	−0.349	0.000	0.623
Emotional intensity at the beginning of a review	−2.078	16.717	0.320	0.250	0.450
Reviewer reputation	0.000	132.667	0.810	0.580	1.212
Hotel class	1.000	5.000	3.945	4.000	0.796
Hotel popularity	1.000	5327.000	1079.332	863.000	976.585
Hotel reputation	1.000	5.000	4.138	4.182	0.391

Table 5.
Descriptive statistics

Furthermore, 48.5% of all analyzed reviews expressed negative emotions, and 97.5% of reviews contained at least one positive sentence.

5. Data analysis and results

To analyze this study's model, we used zero-inflated negative binomial regression, which can account for data that exhibit overdispersion and excess zeros (Greene, 1994, 2018). *Online review helpfulness* is a count variable that takes on only positive integer values, but a large number of reviews had not received votes. This approach was deemed appropriate because of the skewed distribution of the dependent variable (Liu and Park, 2015; März *et al.*, 2017). To test for multicollinearity, which affects regression analysis, we calculated variance inflation factor (VIF) values. All VIF values were below 3.5. Therefore, multicollinearity did not appear to be a concern for our analysis. Moreover, our analysis of this study's model indicated a good fit (log-likelihood = −163368.922). The results of our zero-inflated negative binomial regression analysis are presented in Table 6.

H1 postulated that the more two-sided a review, the less helpful its perception among review readers. A significant negative relationship between *review sidedness* and *online review helpfulness* was found ($\beta = -0.075$; $p < 0.001$). Thus, H1 was supported. Additionally, the interaction effect between *reviewer reputation* and *review sidedness* was significant ($\beta = 0.027$; $p < 0.001$). This finding indicates that reviewer reputation alleviates the negative influence of two-sidedness, thus supporting H2. As shown in Table 6, the relationship between *information factuality* and *online review helpfulness* was significantly positive ($\beta = 0.044$; $p < 0.001$), thereby supporting H3, H4a and H4b presuppose that both positive and negative sentiments positively moderate the impact of *information factuality* on *online review helpfulness*. We observed that reviews with positive sentiment alongside objective descriptions were perceived as more helpful ($\beta = 0.017$; $p < 0.001$), but we did not find a significant effect regarding the moderating role of negative sentiment in the relationship between *information factuality* and *online review helpfulness* ($\beta = -0.004$; $p = 0.456$). Thus, H4a was supported, but H4b was not. H5 posited that the emotional intensity at the beginning of a review is negatively associated with online review helpfulness; a review beginning with a fact-based description may lead to a better first expression about the reviewer's reliability. The results of our analysis show that *the emotional intensity at the beginning of a review* is negatively associated with *online review helpfulness* ($\beta = -0.014$; $p < 0.01$), thus supporting H5. The results of our hypothesis testing are summarized in Table 7.

	Model 1	Model 2	Model 3	Model 4
Negative binomial Independent variables		*Coefficients (std. error)*		
(Intercept)	−0.566 (0.006)***	−0.566 (0.006)***	−0.564 (0.006)***	−0.564 (0.006)***
Review sidedness	−0.042 (0.006)***	−0.071 (0.008)***	−0.045 (0.006)***	−0.075 (0.008)***
Information factuality	0.038 (0.005)***	0.039 (0.005)***	0.043 (0.005)***	0.044 (0.005)***
Emotional intensity at the beginning of a review	−0.014 (0.005)**	−0.014 (0.005)**	−0.014 (0.005)**	−0.014 (0.005)**
Reviewer reputation	0.348 (0.006)***	0.347 (0.006)***	0.348 (0.006)***	0.347 (0.006)***
Positive sentiment	0.037 (0.006)***	0.041 (0.006)***	0.039 (0.006)***	0.043 (0.006)***
Abs (negative sentiment)	0.029 (0.007)***	0.037 (0.007)***	0.032 (0.007)***	0.039 (0.007)***
Reviewer reputation × review sidedness		0.026 (0.005)***		0.027 (0.005)***
Information factuality × positive sentiment			0.016 (0.005)***	0.017 (0.005)***
Information factuality × Abs (negative sentiment)			−0.003 (0.005)	−0.004 (0.005)
Control variables				
Rating	0.141 (0.006)***	0.141 (0.006)***	0.141 (0.006)***	0.140 (0.006)***
Rating²	0.138 (0.003)***	0.137 (0.003)***	0.139 (0.003)***	0.138 (0.003)***
Review length	0.228 (0.007)***	0.228 (0.007)***	0.225 (0.007)***	0.224 (0.007)***
Readability	0.045 (0.005)***	0.045 (0.005)***	0.045 (0.005)***	0.046 (0.005)***
Available days	0.502 (0.005)***	0.502 (0.005)***	0.502 (0.005)***	0.502 (0.005)***
Hotel class	−0.040 (0.005)***	−0.040 (0.005)***	−0.040 (0.005)***	−0.040 (0.005)***
Hotel reputation	0.059 (0.005)***	0.059 (0.005)***	0.059 (0.005)***	0.059 (0.005)***
Hotel popularity	−0.087 (0.005)***	−0.087 (0.005)***	−0.087 (0.005)***	−0.087 (0.005)***
Log (theta)	0.046 (0.010)***	0.047 (0.010)***	0.047 (0.010)***	0.047 (0.010)***
Zero model				
(Intercept)	−14.317 (1.620)***	−14.322 (1.604)***	−14.314 (1.620)***	−14.317 (1.604)***
Rating	0.056 (0.082)	0.062 (0.082)	0.056 (0.082)	0.063 (0.082)
Rating²	0.073 (0.038)	0.075 (0.038)	0.073 (0.038)	0.075 (0.038)*
Review length	0.120 (0.070)	0.090 (0.072)	0.117 (0.070)	0.087 (0.072)
Readability	−0.050 (0.057)	−0.045 (0.056)	−0.047 (0.056)	−0.042 (0.055)
Available days	−2.163 (0.091)***	−2.165 (0.091)***	−2.163 (0.091)***	−2.164 (0.091)***
Hotel class	0.022 (0.057)	0.023 (0.057)	0.023 (0.057)	0.023 (0.057)
Hotel reputation	0.202 (0.077)**	0.201 (0.077)**	0.202 (0.077)**	0.201 (0.077)**
Hotel popularity	−0.301 (0.088)***	−0.299 (0.088)***	−0.301 (0.088)***	−0.299 (0.088)***
Reviewer reputation	−6.440 (0.641)***	−6.445 (0.635)***	−6.439 (0.641)***	−6.443 (0.635)***
Akaike Information Criterion (AIC)	326830.989	326804.329	326823.74	326795.845
Log-likelihood	−163389.494	−163375.164	−163383.87	−163368.922
Num. obs.	144982	144982	144982	144982

Note(s): ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

Table 6.
Statistical results of
zero-inflated negative
binomial regression

6. Discussion and implications

6.1 General discussion

By measuring online review sentiment by sentence and considering negative expressions and adverbs, this study offers a novel assessment of review content structures' (comprising *review sidedness*, *information factuality*, and *emotional intensity at the beginning of the review*)

Hypothesis	Result
H1: The degree of review sidedness is negatively associated with online review helpfulness	Supported
H2: Reviewer reputation positively moderates the effect of review sidedness on online review helpfulness	Supported
H3: Information factuality is positively associated with online review helpfulness	Supported
H4a: The interaction effect of positive sentiment and information factuality positively influences online review helpfulness	Supported
H4b: The interaction effect of negative sentiment and information factuality positively influences online review helpfulness	Not supported
H5: The emotional intensity at the beginning of a review is negatively associated with online review helpfulness	Supported

Table 7.
Hypothesis testing
results

effects on *online review helpfulness*. Moreover, we investigated the interaction effects of *review sidedness* and *reviewer reputation*, as well as *review sentiment* and *information factuality*.

We found *review sidedness* to negatively influence *online review helpfulness*. In other words, one-sided reviews with either positive or negative sentiment are considered more helpful than two-sided reviews. This tendency is reasonable; compared to reviews that contain equivocal opinions and sentiments, explicit reviews can more easily convey clear information and purchasing recommendations to readers. This finding contradicts the findings of a few previous studies that have stated that presenting multiple sides is more persuasive than emphasizing only one-sided opinions (Cheung *et al.*, 2012; Eisend, 2007; Jensen *et al.*, 2013). In the online reviews context, a well-supported decision-making process can save consumers' time (Kohli *et al.*, 2004). Readers may simply prefer one-sided reviews to two-sided reviews because one-sided reviews require less cognitive effort to base decisions on than two-sided reviews. Additionally, two-sided reviews may be perceived as too ambiguous to be meaningfully appreciated. Given the potential information overload caused by the rich availability of online reviews, one-sided reviews containing explicit recommendations about a service may effectively reduce the effort readers must expend to evaluate that service, thereby generating more helpful votes. Furthermore, our findings confirm our intuitive assumption that providing fact-based information enhances online reviews' perceived helpfulness.

Positive and negative sentiments' role in shaping online review helpfulness is less straightforward. Indeed, previous studies have reached conflicting conclusions about this role (Fan, 2021; Lee *et al.*, 2017; Salehan and Kim, 2016; Siering and Muntermann, 2013). For instance, Lee *et al.* (2017) demonstrated that negative reviews are considered more helpful than positive reviews. However, Siering and Muntermann (2013) claimed that a positive review sentiment positively affects online review helpfulness, while Salehan and Kim (2016) concluded that sentiment (positive or negative) insignificantly affects helpfulness. Our study may explain these contrasting results: aside from a review's valence, the effects of its embedded sentiments, combined with its level of factuality (objective facts) and other nonemotional information, influence online review helpfulness. Specifically, while information factuality improves online reviews' perceived diagnosticity (Filieri, 2015), reviews that combine both emotional comments and objective descriptions are considered more helpful than reviews that simply evaluate or narrate consumption experiences.

Moreover, our results indicate that how an online review begins (with either a highly emotional sentence or a factual description) can affect readers' perceptions of review helpfulness. When a review first states a fact, rather than an emotional opinion, it is more likely to be considered helpful. Because of the anonymous nature of online reviews, readers must rely on available cues to ascertain reviewers' credibility. Fact-based, emotion-free

descriptions can signal that a reviewer has firsthand experience with a product or service, allowing readers to attribute a review's content to the performance of the product or service.

In line with earlier research (Baek *et al.*, 2012; Cheung *et al.*, 2012; Filieri *et al.*, 2018c; Ghose and Ipeirotis, 2011), we found that online reviews written by reviewers with better reputations are perceived as more helpful. Specifically, we found that *reviewer reputation* moderates the effect of *review sidedness* on *online review helpfulness*. However, two-sided reviews written by experienced reviewers (i.e. reviewers with many helpfulness votes) are perceived as more helpful than similar messages by novice reviewers. This finding resonates with past studies that have concluded that such a reputation system can help customers identify whom to trust in their decision-making, in turn reducing their uncertainties regarding service quality (Liu and Park, 2015).

6.2 Theoretical contributions

This study contributes to the literature on online review helpfulness in two ways. First, drawing on attribution theory, our findings demonstrate that readers' evaluations of online reviews' helpfulness are determined by reviews' content structures. Moreover, we found that these structures are composed of *review sidedness*, *information factuality* and *emotional intensity at the beginning of the review*. Using attribution theory as a theoretical lens, our study offers a novel and useful perspective from which to understand the antecedents of *online review helpfulness* by simultaneously investigating reviews' emotional and factual content. Our findings also provide further evidence that information factuality is an important factor determining online review helpfulness or diagnosticity (Filieri *et al.*, 2018a). These findings agree with marketing studies that have stated that *informational appeal* is an important factor in advertisements, influencing product sales (e.g. Teichert *et al.*, 2018).

Second, given conflicting previous results on how *review sidedness* affects *online review helpfulness*, our work offers important evidence of a negative effect in this regard through our analysis of a large amount of secondary data and our use of NLP to detect review sentiment, rather than the more limited lexicon-based method. This result supports the view that consumers prefer one-sided reviews to two-sided reviews for purchase decision-making (März *et al.*, 2017; Pentina *et al.*, 2018). To the best of our knowledge, our study is the first to demonstrate how *reviewer reputation* moderates *review sidedness*'s impact on *online review helpfulness*.

6.3 Practical implications

Our findings provide guidance for online reviewers on how to produce helpful online reviews. Moreover, our findings help other customers as readers to evaluate online review helpfulness. For instance, our findings suggest that – to ensure that readers will find a review credible and helpful – novice reviewers should provide only one-sided reviews, whereas expert reviewers may also post two-sided reviews. Furthermore, we recommend that reviewers begin their reviews with objective, fact-based information, rather than emotional opinions. This approach may also enhance their perceived review trustworthiness and helpfulness, encouraging readers to attribute review content to services or products themselves, rather than reviewers' dispositional characteristics.

Our findings also suggest design guidelines for online review platforms. Specifically, we found that online review platforms might benefit from applying text mining techniques to discern their online reviews' sidedness magnitudes and levels of information factuality. By proactively engaging with customers and providing such additional information, these platforms can help consumers efficiently find helpful reviews and make purchase decisions, in turn improving online customer satisfaction.

6.4 Limitations and future research avenues

Some limitations of this study must be highlighted. First, our study only focused on reviews posted in English on a single online review platform. We assumed that at least some portion of our sample's reviews had been written by non-native English speakers who may have lacked the ability (or even the willingness) to express their emotions as well or as richly as they could have in their native languages. Furthermore, we did not account for any cultural differences between reviewers or readers. Certain cultural norms and values may have influenced how an online review (particularly its sentiments) is written and interpreted. Therefore, future studies should compare reviews written in different languages and posted on several online customer review websites while considering cultural differences. Second, our findings should only be generalized to other products or services – such as restaurants – with caution. Finally, information overload, which is a growing issue affecting consumers' appreciation of online customer reviews, was not considered in this study. Future studies should incorporate the effect of perceived information overload to confirm the validity of the findings of this study.

7. Conclusions

This research aimed to examine how reviews' content structures (review sidedness, information factuality and review sentiment at the beginning of a review) influence perceived online review helpfulness. Through the lens of attribution theory, we investigated the effects of emotional and factual content on online review helpfulness assessments using a large sample of online customer reviews from TripAdvisor. By computing review sentiment scores at the sentence level and considering adverbs and negative terms, we quantified each analyzed review's level of information factuality, degree of sidedness, and emotional intensity. As a result, we observed that two-sidedness negatively affects online review helpfulness, but reviewer reputation alleviates this impact. We also found that information factuality positively affects online review helpfulness, and this effect is strengthened when positive sentiment appears alongside fact-based information. Finally, we found that online reviews that begin with factual statements tend to be perceived as more helpful.

The current study contributes to the evolving body of research on online review helpfulness by confirming the importance of review content structure from an attribution theory perspective. Our study also contributes to the literature by introducing an approach to analyzing reviews' content structures and their effects on online review helpfulness by quantifying *review sidedness*, *information factuality* and *emotional intensity*.

Understanding the impact of emotional and factual content on perceived review helpfulness is also important for practitioners. This understanding can help professionals develop more effective online review platforms by prioritizing more helpful reviews, helping to reduce users' information overload and increase online customer satisfaction. Thus, this study advances the current understanding of online reviews' emotional and factual content, leading to a deeper comprehension of the review properties that readers consider helpful in decision-making.

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